Beyond Sedna: Probing the Distant Solar System

Thesis by

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To my parents and to the memory of my Uncle Robert “Bob” Riebling

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Abstract

This thesis presents studies in observational planetary astronomy probing the structure of the Kuiper belt and beyond. The discovery of Sedna on a highly eccentric orbit beyond Neptune challenges our understanding of the solar system and suggests the presence of a population of icy bodies residing past the Kuiper belt. With a perihelion of 76 AU, Sedna is well beyond the reach of the gas-giants and could not be scattered onto its highly eccentric orbit from interactions with Neptune alone. Sedna's aphelion at ∼1000 AU is too far from the edge of the solar system to feel the perturbing effects of passing stars or galactic tides in the present-day solar neighborhood. Sedna must have been emplaced in its orbit at an earlier time when massive unknown bodies were present in or near the solar system. The orbits of distant Sedna-like bodies are dynamically frozen and serve as the relics of their formation process.

We have performed two surveys to search for additional members of the Sedna population. In order to find the largest and brightest Sedna-like bodies we have searched ∼12,000 deg^2 within ±30 degrees of the ecliptic to a limiting R magnitude of 21.3 using the QUEST camera on the 1.2m Samuel Oschin Telescope. To search for the fainter, more common members of this distant class of solar system bodies, we have performed an deep survey using the Subaru Prime Focus Camera on the 8.2m Subaru telescope covering 43 deg^2 to a limiting R magnitude of 25.3. Searching over a two-night baseline, we were sensitive to motions out to distances of approximately 1000 AU.

We present the results of these surveys. We discuss the implications for a distant Sedna-like population beyond the Kuiper belt and discuss future prospects for detecting and studying these distant bodies, focusing in particular on the constraints we can place on the embedded stellar cluster environment the early Sun may have been born in, where the location and distribution of Sedna-like orbits sculpted by multiple stellar encounters is indicative of the birth cluster size. These surveys were specifically designed to find the select members of a distant Sedna population but were also sensitive to the dynamically excited off ecliptic populations of the Kuiper belt including the hot classicals, resonant, scattered disk, and detached Kuiper belt populations. We present our observed latitude distributions and implications for the plutino population.

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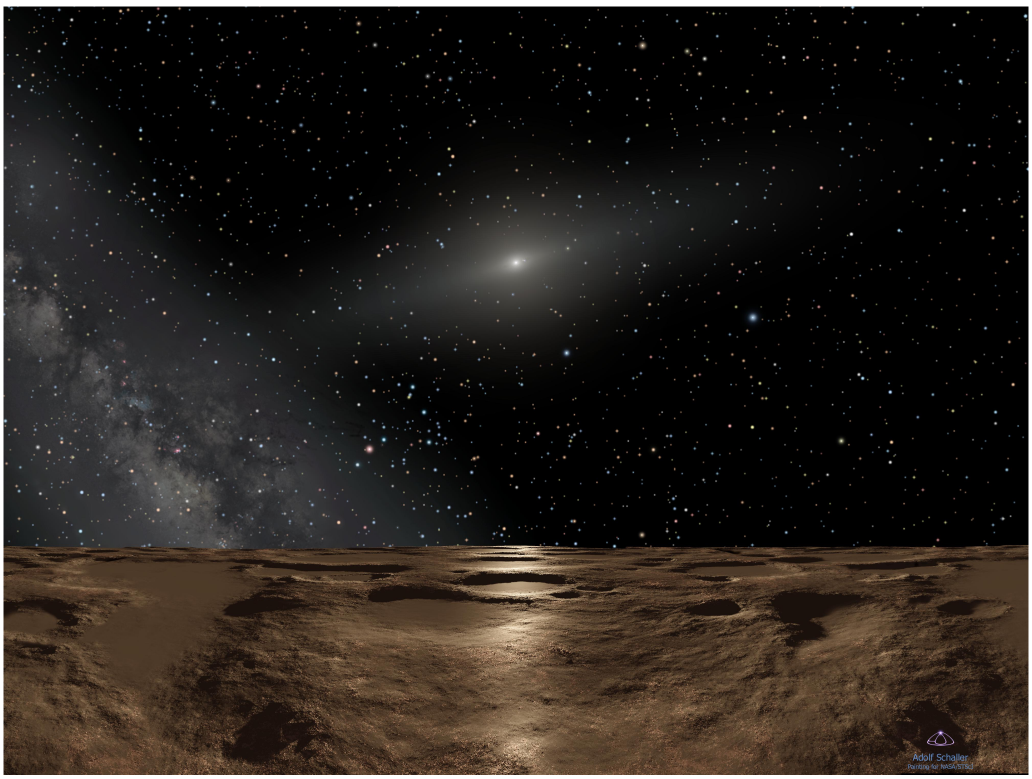
Introduction



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Artist's impression of noontime on Sedna. Illustration Credit: NASA, ESA, and Adolf Schaller

1.1 The Kuiper belt

The Kuiper belt contains icy planetesimals orbiting beyond Neptune. The Kuiper belt is the record of the accretion process and serves as a window into the dynamical history of the early solar system, including the migration of the giant planets (Malhotra, 1993; Morbidelli & Valsecchi, 1997; Levison & Morbidelli, 2003; Tsiganis et al., 2005; Gomes et al., 2005a; Levison et al., 2008). The existence of the Kuiper belt was first proposed over 40 years ago (Edgeworth, 1949; Kuiper, 1951). Edgeworth (1949) and Kuiper (1951) predicted that if the protoplanetary disk extended beyond Pluto's orbit, there would not have been enough mass in the region to produce a planet-sized body, but instead a number of small bodies would have formed orbiting in the region near Pluto. The notion of the Kuiper belt was later revived in the 1980s and 1990s, with the first computer-based numerical orbital simulations. Work by Fernandez (1980) suggested the Oort cloud could not be the source population of short period comets or Jupiter family comets (JFCs) suggesting that a repository of distant planetesimals beyond Neptune is supplying the short-period comets. Later Duncan et al. (1988),Quinn et al. (1990), and Ip & Fernandez (1991) found that the short period comets originate not from an isotropic inclination distribution like the Oort cloud but from a flattened distribution suggesting a disk of distant planetesimals. After Pluto, the next KBO was discovered by Jewitt and Luu in 1992 (Jewitt & Luu, 1993). Nearly two decades later, there are now over 1000 KBOs known including several nearly Pluto-sized or larger bodies. Approximately half the known KBOs have secure orbits. Current estimates place between 0.01 and a few times 0.1 $M_\oplus$ of material residing in the Kuiper belt (Gladman et al., 2001; Bernstein et al., 2004; Fuentes & Holman, 2008)

The orbital structure of the Kuiper belt can be divided into four dynamical sub-populations: classical belt, resonators, scattered disk, and detached. Additionally, a population of planetesimals with orbits crossing the outer planets is known as the Centaurs. The classical belt can be divided into two distinct classes: the cold and hot population. Cold classicals have low eccentricities with inclinations less than 5°. Cold classicals have extremely red colors and higher binary fraction when compared to the rest of the Kuiper belt as well (Tegler & Romanishin, 2000; Doressoundiram et al., 2002; Brown, 2001; Trujillo & Brown, 2002; Peixinho et al., 2008; Noll et al., 2008). The hot classicals have inclinations larger than 5°, slightly higher eccentricities with a more varied distribution of colors(Brown, 2001; Doressoundiram et al., 2002; Trujillo & Brown, 2002; Peixinho et al., 2008; Noll et al., 2008). The resonant KBOs are locked into mean motion resonances with Neptune, orbiting an integral number of times Neptune's period. Pluto's orbit is a prime example, locked in the 3:2 resonance with Neptune, where Pluto orbits twice for every time Neptune orbits three times; such that even though Pluto's orbit crosses Neptune's orbit, Pluto is protected from Neptune's gravitational effects. The two most populated mean motion resonances in the Kuiper belt are the 3:2 (dubbed plutinos after Pluto) and the 2:1 resonances. The scattered disk is comprised of those objects having been gravitationally scattered by Neptune. Through their interactions with Neptune, scattered disk KBOs are characterized by highly eccentric and inclined orbits with perihelia ranging from ∼33-40 AU. The scattered disk is theorized to be the source of JFCs (Duncan & Levison, 1997; Duncan et al., 2004; Volk & Malhotra, 2008). Precursors to the JFCs, the Centaurs are a transitory population on relatively short-lived chaotic orbits between Neptune and Jupiter that cross one or more of the giant planets. These short-lived planetesimals are thought to be recent escapees from the Kuiper belt. Detached KBOs have perihelia greater than 40 AU beyond the gravitational scattering effect of Neptune. Many of the detached KBOs are located in mean motional resonances with Neptune suggesting that the Kozai mechanism (the periodic exchange of eccentricity and inclination) may play a role. The Koazi mechanism can decrease the eccentricity of scattered disk objects, moving their perihelia to ∼40-50 AU (Gomes et al., 2005b; Allen et al., 2006; Gladman et al., 2008; Volk & Malhotra, 2009).

Beyond the Kuiper belt, sits Sedna currently at ∼88 AU. The discovery of Sedna (Brown et al., 2004) on a highly eccentric orbit far removed from the Kuiper belt was unexpected. Six years since its discovery, Sedna's origin still challenges our understanding of the solar system. Sedna is dynamically distinct from the rest of the Kuiper Belt. With a perihelion of 76 AU, Sedna is well beyond the reach of the gas-giants and, unlike typical Kuiper belt objects (KBOs), could not be scattered into its highly eccentric orbit from interactions with Neptune alone (Emel'yanenko et al., 2003; Gomes et al., 2005b). The orbits of many scattered KBOs extend well beyond Sedna's perihelion, but their perihelia remain coupled to Neptune below 50 AU. Sedna's aphelion at ∼1000 AU is too far from the edge of the solar system to feel the perturbing effects of passing stars or galactic tides in the present-day solar neighborhood (Duncan et al., 1987; Fernandez, 1997). Some other mechanism no longer active in the solar system today is required to emplace Sedna on its orbit.

1.2 Sedna's Origin

Sedna's unexpected discovery suggests the presence of a population of icy bodies residing past the Kuiper belt. The study of the Sedna population provides a new window into the history of the early solar system. Today, the Sedna region is isolated from the rest of solar system. The orbits of these distant planetoids are dynamically frozen in place providing a fossilized record of their formation. Sedna's origin remains one of the major unsolved questions about the evolution of the outer solar system. Several possible scenarios have been offered to explain Sedna's extreme orbit, each with their own great impact on the structure of the outer solar system:

Rogue planet: With the discovery of Pluto-sized objects in the Kuiper Belt, it is not unreasonable to assume that a few Mars-sized objects may have formed as well (Stern, 1991). Gravitational scattering by these Mars-sized bodies at ∼70 AU would produce an abundant number of Sedna-like planetoids with high inclinations and similar semimajor axes (Brown et al., 2004; Gladman & Chan, 2006; Lykawka & Mukai, 2008). A planet at ∼100 AU was not seen by Trujillo & Brown (2003), Brown (2008), Larsen et al. (2007), and Schwamb et al. (2010), but the possibility cannot be completely dismissed. Even if this planet were subsequently ejected from the solar system at an earlier time, the Sedna population would remain intact; all the planetoids found in this region would have perihelia close to the semimajor axis of the planet.

Secular resonances induced by a planetary or stellar-mass solar-companion: Matese et al. (2005); Gomes et al. (2006), Gomes & Soares (2010), and Matese & Whitmire (2010) find that secular resonances induced by a Earth-sized body, Jupiter-mass giant planet, or even a low-mass star could raise the perihelia of planetesimals onto Sedna-like orbits. The inclinations and orbital distribution of the produced Sedna population would indicate a range of possible masses and orbits for the stellar companion. From the IRAS (Moshir et al., 1993; Joint Iras Science, 1994) and 2MASS (Cutri et al., 2003) infrared survey observations, Matese & Whitmire (2010) rule out the existence of a 7 M_J (Jupiter mass) planet closer than 6000 AU, a 10 M_J planet closer than 25,000 AU, 2 M_J body closer than 2000 AU, and 5 M_J body closer than 10,000 AU.

Stellar fly-by: A chance close encounter with a passing star could scatter planetesimals onto high perihelia, eccentric orbits (Morbidelli & Levison, 2004; Kenyon & Bromley, 2004). A stellar encounter may produce a wide variety of orbits, but the dynamical origin of this collection of bodies would only be explainable by a unique fly-by configuration.

Interstellar capture: In this case, Sedna-like bodies would have formed in a physically and chemically different environment than our own solar system. A stellar encounter with a low-mass star would lead to tidal interactions between the stars' planetesimal disk and our own. The Sun may strip away planetesimals from the stellar intruder. These captured bodies would be deposited in Sedna-like orbits (Kenyon & Bromley, 2004; Morbidelli & Levison, 2004).

Cluster birth (multiple stellar encounters): Most stars are born in dense birth clusters (Lada et al., 1991; Carpenter, 2000; Porras et al., 2003; Lada & Lada, 2003; Allen et al., 2007), and it is likely that the Sun spent several million years in such an environment. In the early solar system, interactions with nearby solar neighbors would be frequent in the dense cluster environment (Adams & Laughlin, 2001; Laughlin & Adams, 1998; Proszkow & Adams, 2009; Adams, 2010). The abundance of daughter species of radioactive nuclei present in the solar system, may provide circumstantial evidence that the Sun was in relatively close proximity to a supernovae explosion (Chaussidon & Gounelle 2007; Brennecka et al. 2009 and references therein), and therefore in a much denser environment than the current local solar neighborhood. However, the orbital distribution of Sedna-like bodies would be the first direct evidence that our Sun was born in a cluster. Planetoids would be dispersed into orbits with a wide distribution of inclinations and perihelia (Brasser et al., 2006, 2007; Kaib & Quinn, 2008).The exact distribution of Sedna orbits would be indicative of the Sun's birth cluster size.

Deciphering Sedna's formation history provides a powerful tool for exploring the solar system's origin and subsequent evolution. Each of the proposed Sedna origin scenarios leaves a distinctive imprint on the members of this class of distant objects and has profound consequences for our understanding of the solar system. These planetesimals are the relics of the solar system's birth. The orbital distribution and number density of Sedna-like bodies will distinguish between the possible formation models discussed above. Finding just a handful of these bodies, we can begin to read this dynamical record. With the discovery of just a handful of Sedna-like objects, we will be able to significantly constrain the formation process responsible.

1.3 The Rest of the Story

From the wide-field survey in which Sedna was discovered, Brown (2008) estimated that between 40-120 Sedna-sized bodies may exist on Sedna's orbits. Sedna is the only body known to reside in this region. Sedna was discovered near the flux threshold and motion limit of the Palomar survey, which discovered it (Trujillo & Brown, 2003; Brown, 2008). None of the previous Kuiper Belt surveys were particularly sensitive to the extremely slow motions ($< 1''$ hr^{-1}) of this new population. The majority of surveys (Jewitt & Luu, 1995; Jewitt et al., 1996, 1998; Sheppard et al., 2000; Larsen et al., 2001; Trujillo et al., 2001; Trujillo & Brown, 2003; Elliot et al., 2005; Larsen et al., 2007; Brown, 2008; Kavelaars et al., 2009) searching for distant solar system bodies use images taken on a single night over a span of a few hours, probing out to distances of $\sim$100 AU and have been insensitive to bodies residing on Sedna-like orbits.

To date, only two wide-field surveys (Larsen et al., 2007; Brown, 2008) sensitive to motion beyond 100 AU have been unsuccessful in finding additional Sedna-like bodies. This work presents the first efforts to probe this region beyond Neptune. We focused on a two-pronged approach to search for additional Sedna-like bodies by increased sensitivity to both slower motions and fainter objects. In order to find the largest and brightest members of this population, we were engaged in a two-year observational campaign to survey the northern sky using the 1.2 m (48-inch) Samuel Oschin Telescope located at Palomar Observatory. We surveyed ~12,000 deg^2 within ±30° of the ecliptic to a depth of R magnitude ~21.3; making this survey the largest search for inner Oort cloud objects to date. To search for the fainter, more common members of this distant class of solar system bodies, we have performed a deep survey using the Subaru Prime Focus Camera on the 8.2 m Subaru telescope covering ~43 deg^2 to a limiting magnitude of ~25. We present the results of these surveys exploring the dynamical properties of the Kuiper belt and the Sedna region.

1.3.1 Wide-Field Survey

Chapter 2 (Schwamb et al., 2010) and Chapter 3 present the results of our search for additional Sedna-like bodies in the northern hemisphere with a wide-field survey covering ~12,000 deg^2 to a mean limiting magnitude of 21.3 in R with Palomar 48-inch telescope and the QUEST camera (Baltay et al., 2007). A total of 52 KBOs and Centaurs have been detected of which 25 are new discoveries from this survey. For 50 of our discovered objects have multiopposition orbits. No new Sedna-like bodies than with perihelia beyond 45 AU were found in the survey despite a sensitivity out to distances of ~1000 AU, but Sedna was detected in our survey.

Chapter 2 presents the work to constrain the number of objects specifically on Sedna's orbit. We model a population of bodies on Sedna's orbit with the same semi-major axis and eccentricity as Sedna and inclinations selected from an inclination distribution with the same form as the Kuiper belt such that Sedna's inclination of

$11.9°$ is the median inclination. We compare the expected number of detections from the theoretical population on Sedna's orbit to the Palomar survey results, a single detection of a Sedna-like body.

In Chapter 3, we discuss the implications for a distant Sedna-like population beyond the Kuiper belt and provide constraints on the cluster birth Sedna formation scenario (Brasser et al., 2006). Most stars are born in dense gas-rich embedded clusters (Lada et al., 1991; Carpenter, 2000; Porras et al., 2003; Lada & Lada, 2003; Allen et al., 2007), and it is likely that the Sun spent several million years in such an environment. Brasser et al. (2006) successfully produce objects on orbits similar to Sedna's in simulations of embedded cluster environments. If the mean density of the material the Sun encounters while residing in the embedded cluster was $\sim 10^3$ $M_\odot/pc^3$ (central cluster densities of 10^4 $M_\odot/pc^3$) or denser, Sedna's orbit is recreated and a distribution of Sedna-like bodies with semimajor axes less than 10,000 AU is formed. Brasser et al. (2006) find that the central density of the stellar cluster (directly correlated to the amount of material the Sun encounters in the cluster) determines the orbital distribution of Sedna-like bodies generated. The denser the cluster environment, the smaller semimajor axis at which the Sedna population begins. We compare the cluster-produced Sedna populations from Brasser et al. (2006) results for the 10^4, 10^5, and 10^6 $M_\odot/pc^3$ embedded cluster integrations to our observations. We determine if any of the three cluster environments can produce single detections consistent with our detection of Sedna. We estimate the size of the Sedna population for the viable cluster environments.

The Palomar survey was specifically designed to find the select brightest members of a distant Sedna population, but is also sensitive to the dynamically excited off ecliptic populations of the Kuiper belt including the scattered disk and detached Kuiper belt populations. In Chapter 3, we present the latitude distribution of bright KBOs and implications for the plutino population.

1.3.2 Deep Survey

The Palomar survey is sensitive to only the very brightest Sedna-like bodies. The largest and brightest bodies are relatively rare in the Sedna population. The majority of bodies residing in the Sedna region will be small, dim objects, undetectable in the Palomar survey. Chapter 4 presents the results of a narrow deep-sky survey best suited to find these common fainter members of the Sedna population using the Subaru Prime Focus Camera (Suprime-Cam) (Miyazaki et al., 2002) on the 8.2-m Subaru. With Suprime-Cam we were able to search for Sednas 100 times fainter than those detectable in the wide-field Palomar survey. We have surveyed $\sim$43 deg^2 within 40° of the ecliptic down to a limiting r′ magnitude of 25.2 out to distances of 1000 AU. Beyond 17 AU, 196 objects were found in the survey. No Sedna-like body with a perihelia greater than 72 AU was detected in the survey. We place constraints on the size of a distant Sedna population for the Brasser et al. (2006) cluster birth models and compare our results to those in Chapter 3 for the wide-field survey.

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Chapter 2

A Search for Distant Solar System Bodies in the Region of Sedna

http://www.astro.caltech.edu/palomar/images/48q2.jpg

This chapter has been published in its entirety under the same title by authors M. E. Schwamb, M. E. Brown, and D. L. Rabinowitz in *Astrophysical Journal*, 2009, V. 182, pp. 224–229. Reproduced by permission of the American Astronomical Society.

2.1 Abstract

We present the results of a wide-field survey for distant Sedna-like bodies in the outer solar system using the 1.2m Samuel Oschin Telescope at Palomar Observatory. We searched ∼12,000 deg^2 down to a mean limiting magnitude of 21.3 in R. A total number of 53 Kuiper belt objects and Centaurs have been detected; 25 of which were discovered in this survey. No additional Sedna-like bodies with perihelia beyond 70 AU were found despite a sensitivity to motions out to ∼1000 AU. We place constraints on the size and distribution of objects on Sedna orbits.

2.2 Introduction

The discovery of Sedna (Brown et al., 2004) suggests the presence of a population of icy bodies residing far outside the Kuiper belt. Sedna is dynamically distinct from the rest of the Kuiper Belt. With a perihelion of 76 AU, Sedna is well beyond the reach of the gas-giants and, unlike typical Kuiper belt objects (KBOs), could not be scattered into its highly eccentric orbit from interactions with Neptune alone (Emel'yanenko et al., 2003; Gomes et al., 2005). The orbits of many scattered KBOs extend well beyond Sedna's perihelion, but their perihelia remain coupled to Neptune below 50 AU. Sedna's aphelion at ∼1000 AU is too far from the edge of the solar system to feel the perturbing effects of passing stars or galactic tides in the present-day solar neighborhood (Duncan et al., 1987; Fernandez, 1997). Some other mechanism no longer active in the solar system today is required to emplace Sedna on its orbit.

Several formation mechanisms have been proposed to explain Sedna's origin, including interactions with planet-sized bodies (Lykawka & Mukai, 2008; Gladman & Chan, 2006; Gomes et al., 2006), stellar encounters (Morbidelli & Levison, 2004), multiple stellar fly-bys in a stellar birth cluster (Brasser et al., 2006, 2007; Kaib & Quinn, 2008), interstellar capture (Kenyon & Bromley, 2004; Morbidelli & Levison, 2004), and perturbations from a wide-binary solar companion (Matese et al., 2005). The study of the Sedna population provides a unique new window into the history of the early solar system. Each of the proposed scenarios leaves a distinctive imprint on the members of this class of distant objects and has profound consequences for our understanding of the solar system's origin and evolution. The orbits of these distant planetoids are likely dynamically frozen in place providing a fossilized record of their formation. Sedna is the only body known to reside in this region. To date, wide-field surveys (Brown, 2008; Larsen et al., 2007), have been unsuccessful in finding additional Sedna-like bodies.

2.3 Observations

From the wide-field survey in which Sedna was discovered, Brown (2008) estimated that between 40-120 Sedna-sized bodies may exist on similar Sedna-like orbits. In order to find additional members of this population, we have been engaged in an observational campaign to survey the northern sky for both fainter and more distant objects. From 2007 May 8 to 2008 September 27, we have surveyed 11,786 deg^2 within $\pm$ 30° of the ecliptic (see Figure 2.1) to a mean depth of R magnitude 21.3. In this Letter, we present the preliminary results of our survey and place constraints on the size of a distant Sedna population.

Observations were taken nightly using the robotic 1.2 m Samuel Oschin Telescope located at Palomar Observatory and the QUEST large-area CCD camera (Baltay et al., 2007). The QUEST camera has an effective field of view of 8.3 deg^2 with a pixel scale of 0.87″. The 161-megapixel camera is arranged in four columns or "fingers" along the east-west direction each equipped with 28 2400x640 CCDs in the north-south direction. The gap between chips in the north-south direction is ∼1.2′, and the spacing between adjacent fingers along the east-west direction is ∼35′. The R.A. chip gap is covered by adjacent pointings, but the declination gap remains mostly uncovered.

We observe over a two-night baseline to distinguish the extremely slow motions of distant Sednas from background stars. For each target field, a pair of 240s exposures is taken separated by ∼1 hour on each of the two nights. The second night of

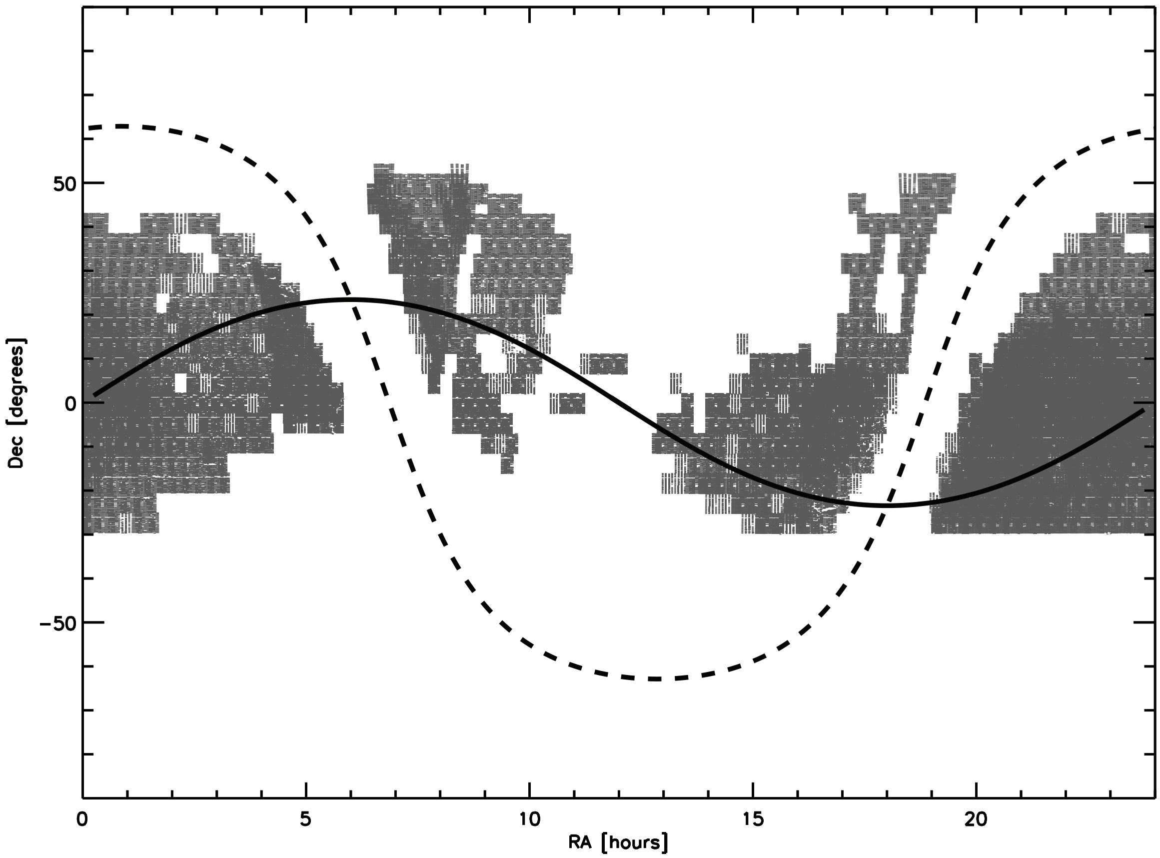

Figure 2.1 Sky coverage of the Palomar survey plotted on the J2000 sky. The observed fields are plotted to scale. The plane of the Milky Way is denoted as a dashed line, and the ecliptic is denoted as a solid line. Holes are due to galactic plane avoidance, bad weather, forest fires, and hardware malfunctions.

observations is typically the next day or at most four nights later. All exposures are taken through the broadband RG610 filter. Target fields are observed within 42° of opposition where the apparent movement of these objects is dominated by the Earth's parallax. If all opposition fields for a month's lunation have been completed, overlap pointings are then targeted to reduce holes in our sky coverage due to the camera's declination gap and defective CCDs.

Images are bias subtracted and flat field corrected. A flat field for each of the CCDs is constructed from a median of the night's science frames. Each CCD is searched separately for moving objects. SExtractor (Bertin & Arnouts, 1996) is used to generate a list of all sources in each image. Sources that have not moved within a 4″ radius between the two nights are removed as stationary background stars. Potential moving candidates are then identified from the remaining unmatched sources. The nightly images are searched for moving object pairs with motions less than 14.4 $''\mathrm{hr}^{-1}$, the velocity of bodies at distances of 10 AU or greater. Moving object pairs from the first night and pairs from the second night with consistent magnitudes and velocities are linked. Candidates with apparent prograde motion between the two nights, inconsistent with opposition, are rejected. Distant objects may move too slowly to show apparent motion over 1 hr baselines. We allow candidate objects to appear stationary on individual nights; we only require motion to be identified over the two-night baseline.

To further reduce the number of false positives, candidates are filtered via the orbit-fitting package described in Bernstein & Khushalani (2000). Those candidates with best-fit orbits producing a chi-squared less than 25 and a barycentric distance greater that 15 AU are screened by eye. To confirm there is a moving source present, the discovery images of these candidates are aligned and blinked. Recovery observations are performed within the first three months of discovery on all final moving object candidates to remove contamination from slow-moving asteroids near their stationary points and faint background stars at the limiting magnitude. One-year recovery observations are still ongoing for our new discoveries.

Observations are taken during a wide variety of photometric, seeing, and weather conditions. Each CCD frame is calibrated independently. For each image we derive a least squares best-fit magnitude zero offset to our instrumental magnitudes relative to the USNO A2.0 catalog (Monet, 1998) red magnitude. The photometric uncertainty of the USNO catalog is non-negligible. For magnitudes greater than 16, the uncertainty is 0.3 mag (Monet, 1998). We likely have several tenths of magnitude uncertainty in our discovery magnitudes. We have not fully calibrated the survey depth, but the average limiting magnitude based on the USNO catalog is 21.3 in R.

The original Palomar survey (Trujillo & Brown, 2003; Brown, 2008), which discovered Eris and Sedna, was sensitive to motions out to $1''\mathrm{hr}^{-1}$ ($\sim$150 AU) and a limiting magnitude of $\sim$20.5 in R. Our survey can detect motion out to $\sim$1000 AU ($\sim 0.2''\mathrm{hr}^{-1}$) and probes almost a full magnitude deeper than the previous Palomar survey. We are sensitive to Mars-sized bodies out to a distance of ∼300AU and to Jupiter-sized objects residing at ∼1000 AU.

2.4 Results and Analysis

A total number of 53 KBOs and Centaurs have been detected, of which 25 are new discoveries from this survey. The radial distribution of our detections is plotted in Figure 2.2. Of the objects found in our survey only two reside past 80 AU: Sedna and 2007 OR10 (discovered in this survey). All known objects past 80 AU within our magnitude limit were detected except for Eris. On both nights, Eris was located in the ∼1.2 arcmin declination gap between the CCDs and therefore was not positioned on any of our images. 2007 OR10 was detected moving at $1.4''\mathrm{hr}^{-1}$ at a barycentric distance of 85.369 ± 0.004. With an R magnitude of 21.4, this object is almost a full magnitude fainter than Sedna (R = 20.7).

From the discovery observations alone 2007 OR10 cannot be identified as a Sedna-like body on a high-perihelion orbit. Many scattered KBOs have aphelia well outside the planetary region past 50 AU. Both families of orbits provide reasonable fits to the short discovery arc. The two orbital solutions diverge sufficiently within a year after discovery, and a secure dynamical identification can only be made after these additional observations. Follow-up observations from the Palomar 60 inch telescope and the 0.9 m SMARTS telescope at Cerro Tololo between 2007 July and 2008 August confirm that 2007 OR10 is a scattered disk KBO close to aphelion. The best-fit orbit yields a semimajor axis of $a = 66.99 \pm 0.06$ AU, an eccentricity of $e = 0.503 \pm 0.001$, and an inclination of $i = 30.804 \pm 0.001°$.

No new Sedna-like bodies with perihelia beyond 70 AU were found in the survey despite a sensitivity out to distances of ∼1000 AU. An object of Sedna's size and albedo would have been detected up to a distance of ∼93 AU. To place constraints on the number of bodies in the Sedna region, we developed a survey simulator to compare the expected number of detections from a theoretical population to our survey results. The simulator draws synthetic objects from a model orbital and absolute magnitude

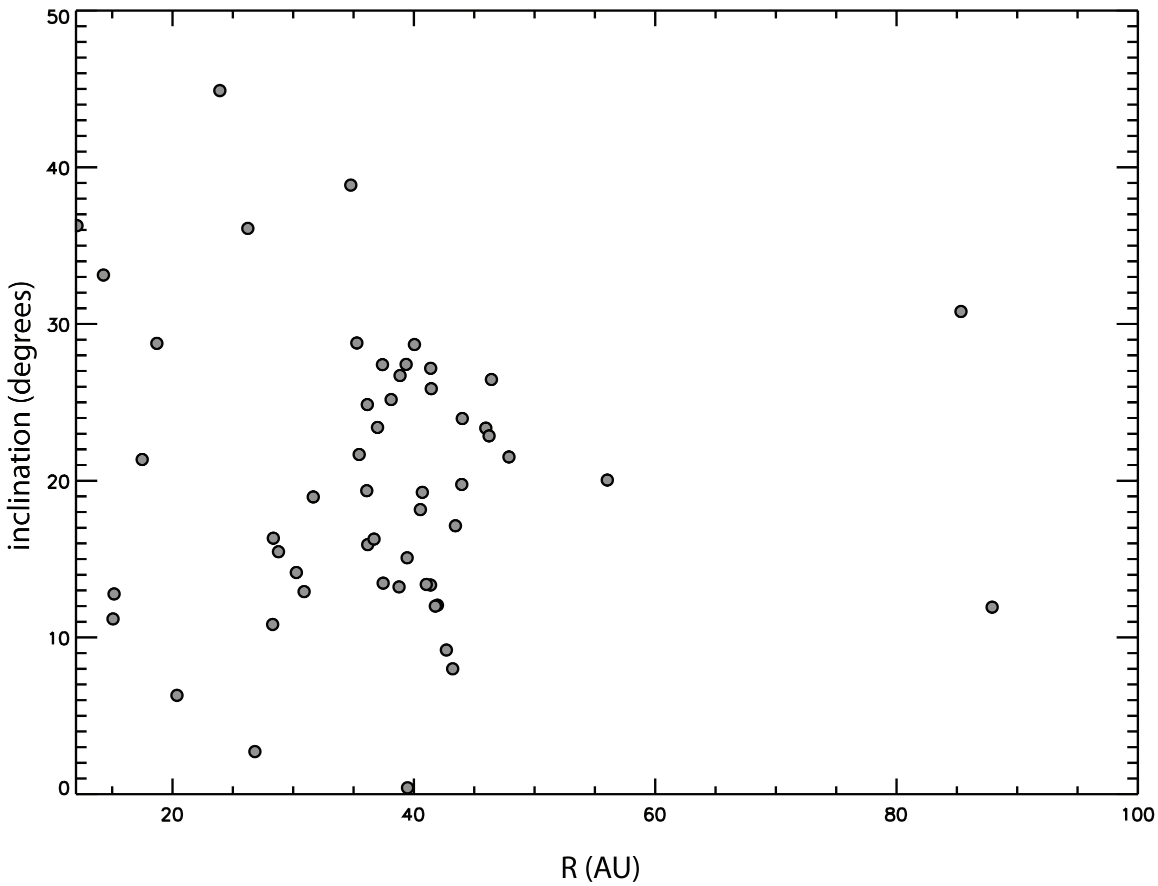

Figure 2.2 Inclination vs. barycentric distance for known objects and new discoveries found in the Palomar survey.

distribution and for every image computes the positions and brightnesses of these objects on the sky. Those synthetic objects that lie within our sky coverage with an apparent magnitude above both nights' limiting magnitudes are considered valid survey detections. Objects have multiple detection opportunities due to repeat sky coverage over subsequent years and overlapping fields. We do not count duplicate detections in our tallies.

We model a population of bodies on Sedna orbits with the same semimajor axis and eccentricity as Sedna ($a = 495$ AU $e = 0.846$) and randomize over all other orbital angles. Inclinations are selected from an inclination distribution adapted from Brown (2001) having a functional form of:

$$\mathrm{N}(i \leq i_{max}) = \int_0^{i_{max}} \exp\left(\frac{-i^2}{2\sigma^2}\right) \sin(i)\,\mathrm{d}i \tag{2.1}$$

where σ is chosen to be 10.25 to make Sedna's inclination of 11.9° the median inclination. Two million objects are drawn from our theoretical Sedna population. Approximately half of the synthetic Sednas are located within our sky coverage.

Due to the large uncertainties in the albedo distribution of such a distant population, we assign absolute magnitudes to our synthetic bodies instead of diameters. We assume a single power-law brightness distribution similar to the Kuiper belt where the number of objects brighter than a given absolute magnitude, H_{max}, is described by:

$$\mathrm{N}(H \leq H_{max)} = N_{H \leq 1.6} 10^{\alpha(H_{max}-1.6)} \tag{2.2}$$

The brightness distribution is scaled to $N_{H \leq 1.6}$, the number of bodies with an absolute magnitude brighter than or equal to Sedna (H=1.6). For these simulations, we use a value of $\alpha = 0.58$ as measured for a single-power law fit to the Kuiper belt by Fraser & Kavelaars (2009).

For each value of $N_{H \leq 1.6}$ between 1 and 250, we perform 100,000 survey simulations and tally the number of simulations in which, like the real survey, one object on a Sedna-like orbit is detected. Absolute magnitudes are randomly assigned to our simulated Sednas 100,000 times, for every value of $N_{H \leq 1.6}$, A single instance of the brightness distribution can be thought of as a separate survey. For each $N_{H \leq 1.6}$ tested, the number of "surveys" with one Sedna are tallied. We do not require that the object detected have Sedna's absolute magnitude (H=1.6). Bodies with H $\leq$ 3.2 at perihelion (76 AU) would be visible within our survey.

2.5 Discussion

Figure 2.3 plots the fraction of simulated surveys that produced a single Sedna detection as a function of $N_{H \leq 1.6}$. The best-fit value gives 40 bodies that are brighter than or equal to Sedna, with the largest body in the population having a H$\simeq$-1.0, which is approximately the absolute magnitude of Eris. At the 1σ confidence level we can rule out a population larger than 92 and smaller than 15 Sedna-sized or bigger objects on

Sedna-like orbits. For comparison, the total number of bodies Sedna-sized or larger in the Kuiper belt is ∼5-8 (Brown, 2008); there may be an order of magnitude more mass residing in the Sedna region than exists in the present Kuiper belt.

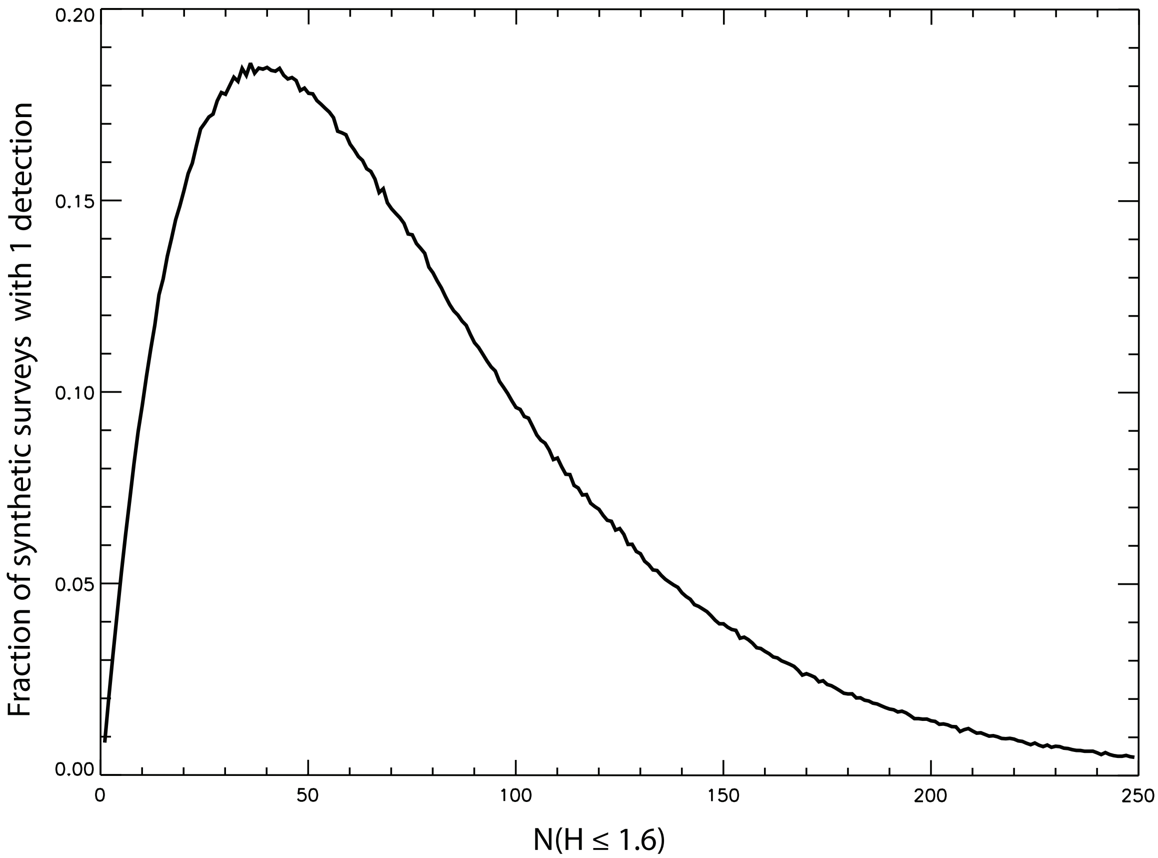

Figure 2.3 Fraction of synthetic surveys with one detectable Sedna-like body as a function of the number of bodies bigger and brighter than Sedna.

Due to the uncertainty in our limiting magnitude, we performed the simulations again adjusting the image limiting magnitudes by ±0.3 magnitudes. Our conclusion does not differ significantly with the best-fit value shifting by $\pm$ 14, still within our uncertainty. The Palomar survey is only sensitive to the very brightest objects in the distant Sedna population. Selecting a steeper or shallower power law for the brightness distribution does not affect our results greatly. Adjusting α by $\pm$ 0.2 only changed the best-fit value by ±10, well within our 1σ error bars.

We have limited our model population to bodies residing specifically on orbits similar to Sedna's. Any realistic Sedna population likely occupies a much larger region of orbital space, possibly including objects with sufficiently high perihelia that they would never or rarely become bright enough to see. Our results represent a lower limit on the size distribution of bodies in the regions beyond $\sim$100 AU.

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Chapter 3

Properties of the Distant Kuiper Belt: Results from the Palomar Distant Solar System Survey

http : //www.astro.caltech.edu/palomar/images/IMG$_3$063amed.jpg

This chapter has been submitted in its entirety under the same title by authors M. E. Schwamb, M. E. Brown, D. L. Rabinowitz, and D. Ragozzine to *Astrophysical Journal*. Reproduced by permission of the American Astronomical Society.

3.1 Abstract

We present the results of a wide-field survey using the 1.2-m Samuel Oschin Telescope at Palomar Observatory. This survey was designed to find the most distant members of the Kuiper belt and beyond. We searched ∼12,000 deg^2 down to a mean limiting magnitude of 21.3 in R. A total number of 52 KBOs and Centaurs have been detected, 25 of which were discovered in this survey. We discuss the implications for a distant Sedna-like population beyond the Kuiper belt, and we report our observed latitude distribution and implications for the plutino population.

3.2 Introduction

With the advent of wide-field CCD cameras in the past decade, there has been an explosion in observational programs searching for Kuiper belt objects (KBOs) (Jewitt & Luu, 1995; Jewitt et al., 1996, 1998; Sheppard et al., 2000; Larsen et al., 2001; Trujillo et al., 2001; Trujillo & Brown, 2003; Elliot et al., 2005; Larsen et al., 2007; Brown, 2008; Kavelaars et al., 2009). Now there are over 1000 KBOs known, with about half having secure orbits. The majority of these surveys search for distant solar system bodies using images taken on a single night over a span of a few hours, probing out to distances of ∼100 AU. Most of these surveys have focused on observing within 10° of the ecliptic with the majority only imaging within just a few degrees.

The discovery of Sedna (Brown et al., 2004) on a highly eccentric orbit far outside the Kuiper belt challenges our understanding of the solar system. With a perihelion of 76 AU, Sedna is well beyond the reach of the gas-giants and could not be scattered into its highly eccentric orbit from interactions with Neptune alone (Emel'yanenko et al., 2003; Gomes et al., 2005). Sedna's aphelion at 1000 AU is too far from the edge of the solar system to feel the perturbing effects of passing stars or galactic tides in the present-day solar neighborhood (Duncan et al., 1987; Fernandez, 1997). Sedna is dynamically distinct from the rest of the Kuiper belt, and its unexpected discovery alludes to a population of icy bodies residing past the Kuiper belt with perihelia greater than ∼45 and semimajor axes greater than ∼220 AU, beyond which Neptune is unable to raise the perihelia of scattered disk KBOs through resonant perturbations (Gomes et al., 2005).

Sedna is the only body known to reside in this region. Sedna was found near perihelion at a distance of ∼88 AU, at the motion limit and brightness limit of its discovery survey (Brown et al. 2008). With one night imaging, previous KBOs surveys were likely insensitive to the objects in the Sedna region. To date, surveys (Larsen et al., 2007; Brown, 2008; Parker & Kavelaars, 2010a) have been unsuccessful in finding additional Sedna-like bodies. In order to find the largest and brightest members of the Sedna population, we have been engaged in an observational campaign to survey the northern sky. We present the results of our search for distant solar system bodies covering ∼12,000 deg^2 within 30° of the ecliptic. Rather than searching over a single night, we use a two-night baseline to distinguish the extremely slow motions of these distant bodies from background stars. We are sensitive to motions out to a distance of ∼1000 AU (∼0.2 $''hr^{-1}$).

In this paper, we discuss the implications for a distant Sedna-like population beyond the Kuiper belt and provide constraints on the cluster birth Sedna formation scenario (Brasser et al., 2006). The survey was specifically designed to find the select brightest members of a distant Sedna population but was also sensitive to the dynamically excited off ecliptic populations of the Kuiper belt including the hot classicals, resonant, scattered disk, and detached Kuiper belt populations. We present our observed latitude distribution and implications for the plutino population.

3.3 Observations

Observations were taken nightly using the robotic 1.2 m Samuel Oschin Telescope located at Palomar Observatory and the QUEST large-area CCD camera. The QUEST camera has an effective field of view of 8.3 deg^2 with a pixel scale of 0.87″ (Baltay et al., 2007). The 161-megapixel camera is arranged in four columns or "fingers" along the east-west direction each equipped with 28 2400x600 CCDs in the north-south direction (see Figure 3.1). The gap between CCDs in the north-south direction is $\sim 1.2'$ and the spacing between adjacent fingers along the east-west direction is $\sim 25'$. The four fingers are labeled (A-D) and the CCDs are numbered sequentially (1-28) from North to South. We will refer to the CCDs by finger and position along the finger (i.e.,C14, D28).

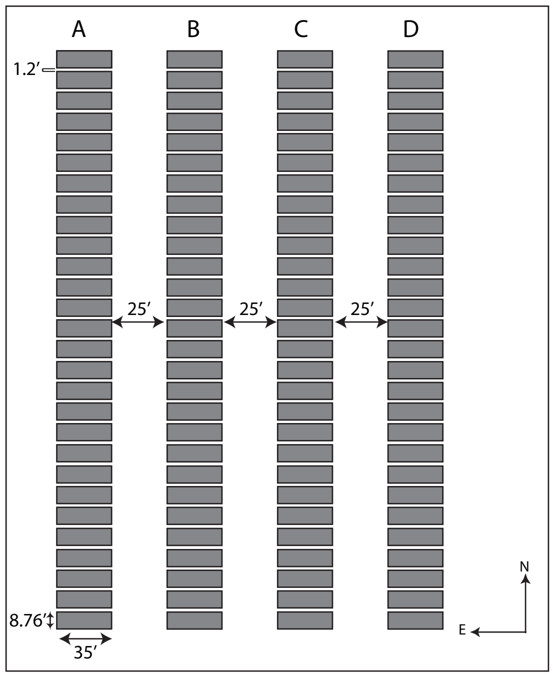

Figure 3.1 Scale drawing of the focal plane of the QUEST camera, depicting the layout of the 112 CCDs. The gap between CCDs in the north-south direction is $\sim 1.2'$ and the spacing between adjacent fingers along the east-west direction is $\sim 25'$.

Observations were taken from 2007 May 8 - 2008 September 27. We have surveyed in total 11,786 deg^2 within $\pm 30°$ of the ecliptic to a mean depth of R magnitude 21.3. Our sky coverage is shown in Figure 4.1. Field centers are compiled in Table **??**. A forest fire on Palomar Mountain prevented observations in 2007 September and camera malfunctions ceased operations from 2008 February -2008 May leading to gaps in longitudinal coverage. After 2008 May normal observations resumed until the QUEST camera ceased operations on the Oschin telescope at the end of 2008 September.

Target fields were observed over a two-night baseline in order to search for solar system objects out to distances of ∼1000 AU (moving at speeds as low as 0.2 $''\mathrm{hr}^{-1}$). All exposures were taken through the broadband red RG610 filter (IIIaF filter from the POSS-II survey) with a wavelength range of λ=610−690nm (Reid et al., 1991). For each field, a pair of 240s exposures was taken separated by ∼1 hour on each of the two nights. The second night of observations was typically the next day or at most four nights later. Observations were in varying photometric conditions and lunations. To check the photometric quality of each nightly pair of observations, magnitudes of the detected sources from both images were histogram binned with a bin size of 0.2 mag, and the peak value of the histogram was selected as an indicator of image depth. If the median value of the five CCDs best CCDs (B11,C19,D09,D12,D13) was less than 20.4 mag (19.0 mag for crowded fields with greater than 4000 detected sources) than the observation was rejected as poor quality, and the target field was rescheduled for new observations the next night. If a target field cannot be successfully imaged within four nights of the first pair of observations, the field was reset and scheduled for another two nights of observations.

All target fields were observed within 42° of opposition, and to avoid high star densities, fields less than 15° from the galactic plane were avoided. The camera RA CCD gap was covered by adjacent pointings, but the ∼1.2′ declination gap remains mostly uncovered in our survey observations. When all opposition fields within ±30° of the ecliptic for a month's lunation were completed, overlap pointings were then targeted to reduce holes in our sky coverage due to the camera's declination gap and defective CCDs. From the beginning of the survey to 2007 November 12, instead of performing overlapping coverage, fields with ecliptic latitudes greater than 30° were instead targeted once all available opposition fields within 30° of the ecliptic were completed.

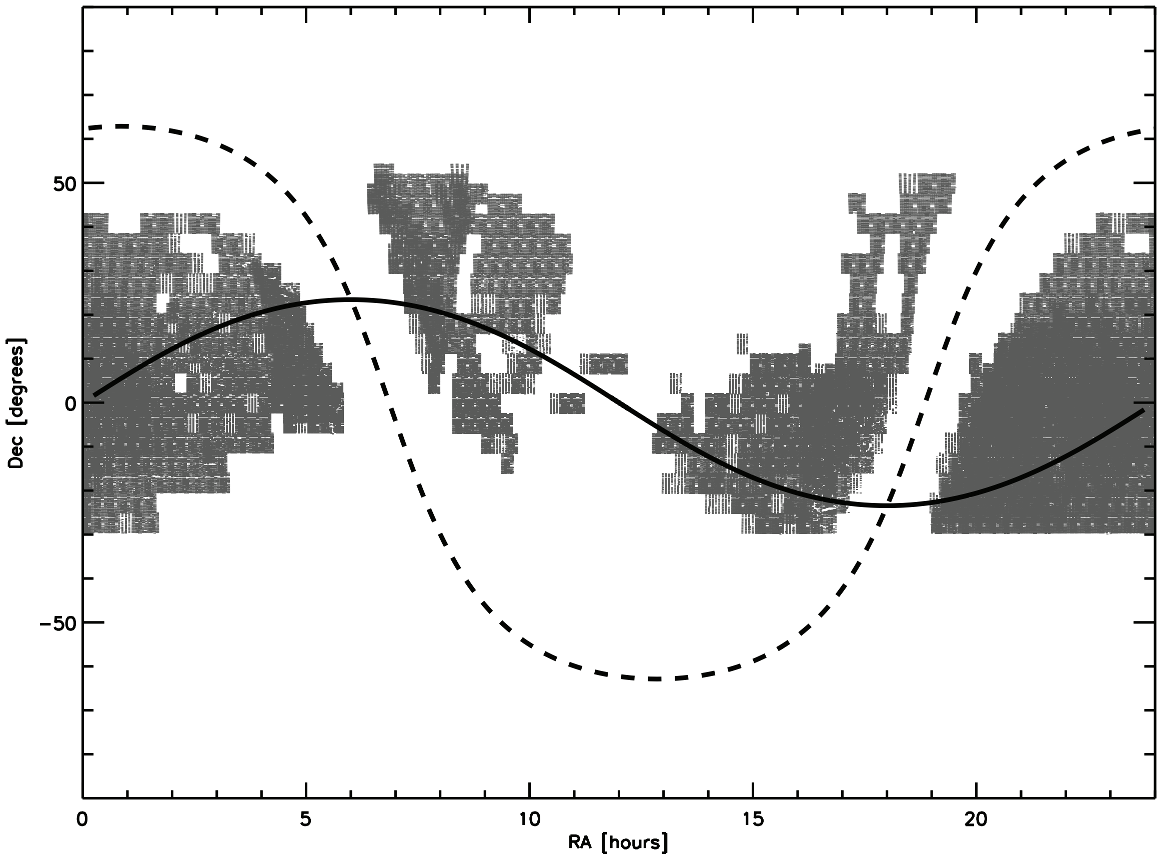

Figure 3.2 Sky coverage of the Palomar survey plotted on the J2000 sky. The observed fields are plotted to scale. The plane of the Milky Way is denoted as a dashed line, and the ecliptic is denoted as a solid line. Holes are due to galactic plane avoidance, bad weather, forest fires, and hardware malfunctions.

3.4 Data Analysis and Object Detection

3.4.1 Moving Object Detection

Observations were processed nightly though an automated reduction pipeline using the Interactive Data Language (IDL) Software package. Each CCD on the detector was reduced and searched for moving objects independently from the other CCDs on the mosaic. All images were bias-subtracted and flat-field corrected. A row-by-row median of the overscan region was used for the bias subtraction. A master flat-field image for each CCD was constructed from a 3-σ clipped median of the night's science images. Some of the camera CCDs had a significant fraction of hot or defective pixels.

These pixels were identified as those where the flat field image value deviated by more than 0.7% from the value of the 3x3 median boxcar filtered flat field image. To mask the effects of these hot pixels, those regions of the science image were replaced by the median value of a 3x3 pixel box centered on the bad pixel. If hot/bad pixels constituted more than 20% of the image than a 3x3 median boxcar smoothed image was substituted for analysis.

SExtractor (Bertin & Arnouts, 1996) was run on each image to compile a list of sources. SExtractor was tuned such that source detection constituted 4 or more contiguous pixels (DETECT_MINAREA parameter) above the detection threshold (DETECT_THRESH parameter) of 1.2 σ above the sky background. Chips C14, C04, and D26 had significant image defects and higher SExtractor detection thresholds were used for these three CCDs (DETECT_MINAREA =5 and DETECT_THRESH =2.3) SExtractor performed circular-aperture photometry using a 5-pixel radius aperture. Each source was characterized by its position, flux, and shape. The best of the four images was selected as the master template whose astrometric solution was found by matching image stars to the USNO A2.0 catalog (Monet, 1998). The other three images were then aligned relative to the stars in the template image. Even if the absolute astrometry failed, the relative astronomy between the images was still sufficient to search for distant solar system bodies. The median absolute astrometric error for the entire survey was $0.4''$. The median relative astrometric error between survey images was $0.076''$.

Once astrometric solutions had been found, the images were searched for moving objects. Because our observations were taken at or near opposition, slow-moving solar system objects were identified by their retrograde motion due to the parallax caused by the Earth's orbital motion. Distant planetesimals may move too slowly to show apparent motion over the nightly one-hour baselines and appear stationary on individual nights. To ensure the detection of objects out to distances of $\sim$1000 AU, we only required motion to be identified over the two-night baseline. The detection catalogs from all four images were compared to identify and eliminate the stationary sources in each image. Sources on one image that had a counterpart within a $4''$

radius on either of the second night's observations were removed as background stars. To further cull the object lists of stars that were above the SExtractor thresholds on one night but below the detection limit on the other, we generated SExtractor source catalogs with more sensitive detection parameters (DETECT_MINAREA = 3 and DETECT_THRESH = 1.1), and compared these deep catalogs to our detection lists. Image sources from one night that appeared on the other night's deep detection catalogs were deemed stationary and rejected as well. Saturated stars and extended sources whose peak flux was more than 3 pixels from the source center measured by SExtractor were also removed from the object catalogs.

Potential moving candidates were identified from the remaining unmatched sources. The nightly images were searched for moving object pairs with motions less than 14.4 $''\mathrm{hr}^{-1}$, the velocity of bodies at distances of 10 AU. Moving object pairs from the first night and pairs from the second night separated by more than 4.38$''$ with retrograde motion consistent with opposition were linked. Candidates with average nightly magnitudes differing by more than one magnitude were eliminated. Remaining candidates whose nightly motions differ by less than twice the first nights on sky velocity were kept to create the list of moving object candidates. Candidates were filtered via the orbit-fitting package described in Bernstein & Khushalani (2000). Those candidates with successful orbit fits which produced a χ^2 less than 25 and barycentric distance between 15 and 1000 AU were identified as moving objects and added to the final list of candidates to be screened by eye. 100x100 pixel subimages for each of the final moving object candidates were created from the discovery images. These snapshots were aligned and blinked by eye. A total of 39,110 candidates (~200 a night) were visually inspected. Typical false positives included diffraction spikes, faint background stars, blended sources, and CCD imperfections. t) were visually inspected. Typical false positives included diffraction spikes, faint background stars, blended sources, and CCD imperfections.

3.4.2 Recovery Observations

At discovery, heliocentric distance and inclination can be identified from the parallax effect due to the Earth's motion, but other orbital parameters remain unconstrained. With only a two-night discovery arc, a distant Sedna-like body cannot be distinguished from a typical scattered disk Kuiper belt object near aphelion. Even with follow-up observations a month after discovery, both families of orbits provide reasonable astrometric fits to the observations. The two orbital solutions diverge sufficiently a year after discovery, and a secure dynamical identification can only be made after these additional observations.

Recovery observations of new discoveries were taken at the Palomar 60-inch telescope, the Palomar 200-inch telescope, the 0.9-m telescope operated by the SMARTS consortium at Cerro Tololo Inter-American Observatory , the 42-inch John S. Hall Telescope located at Lowell Observatory, the 2.66-m Nordic Optical Telescope located at el Roque de los Muchachos Observatory, and then 8.2-m Subaru Telescope on Mauna Kea. Of our detected KBOs, 96% have multi-opposition observations. All but two discoveries classified as KBOs by the Minor Planet Center (2007 JF45 and 2007 PS45) were recovered during the survey. The two unrecovered objects were discovered during reprocessing of the data with more sensitive SExtractor source detection parameters and were discovered after they were no longer observable. Observations taken near 40° from opposition, contained contamination from asteroids near their stationary points that appeared to be moving at rates similar to distant KBOs. Some were identified with subsequent observations that confirmed these objects were on orbits with semimajor axes less than 5 AU. All other objects not successfully recovered have either been linked with other asteroid observations or have been classified on orbits well short of the Kuiper belt by the Minor Planet Center (MPC) database[1].

[1] `http://www.cfa.harvard.edu/iau/Ephemerides/Distant/index.html`

3.4.3 Calibration and Efficiency

3.4.3.1 Limiting Magnitude

The survey observations were taken during a wide variety of photometric, seeing, and weather conditions. Each CCD frame was independently photometrically calibrated. A photometric zero point offset to our instrumental magnitudes was derived relative to the USNO A2.0 catalog (Monet, 1998) red magnitude. The photometric uncertainty of the USNO catalog is non-negligible. For magnitudes greater than 17, the uncertainty is 0.3 mag (Monet, 1998). We likely have several tenths of magnitude uncertainty in our discovery magnitudes. We have not precisely calibrated the survey depth with calibration observations. Limiting magnitudes were computed based on the USNO catalog. We found that the faintest magnitude with a 5σ (10σ for C2 A19, C14, C04, D26; CCDs with larger numbers of hot pixels), uncertainty as reported by SExtractor represented an accurate measure of the source detection limit of our images, and we used these values in the work presented in this paper. The limiting magnitude for each nightly pair of field observations was taken as the depth of the shallower of the two images.The mean limiting magnitude of the survey based on the USNO catalog is 21.3 in R.

3.4.3.2 Survey Efficiency

Because our survey has covered a wide swath of sky detecting multiple previously known KBOs, we have an alternative method of determining the limiting magnitude of our survey. About half of our detections are previous known KBOs in the MPC database. The absolute magnitudes recorded in the MPC are based upon the apparent magnitudes measured from the discovery or follow-up observations, like our survey, which are often taken in non-standard filters and observed without precise photometric calibrations. Romanishin & Tegler (2005) find the absolute magnitudes recorded in the MPC are systematically 0.3 mag brighter than those magnitudes accurately measured for their sample of 90 KBOs and Centaurs. We can still use the known population of bright KBOs to estimate a crude efficiency for the survey. We obtained the positions and visual apparent magnitudes computed by JPL Horizons[2] for known KBOs. As of 2010 January 20, there were 64 previously known multi-opposition KBOs with visual magnitudes brighter than 22nd magnitude (excluding discoveries found in this survey and objects with $a < 30$) located on our images. We only considered KBOs positioned on the same CCD for all 4 field observations, not accounting for masked regions of the CCDs. Masked bad pixel regions account for ∼8% of the QUEST camera's observable area. For every object not detected in the survey, we examined the images to determine if a moving source was visible. No known KBO was missed during the visual inspection of moving object candidates. The majority of the missed KBOs were not found because the KBO's psf overlapped with a neighboring star and was missed by SExtractor, the KBO was on a bad or masked off region of the CCD, image quality was bad due to poor telescope tracking, or the KBO was too faint to be detected and no visible moving source was identifiable.

Figure 4.3 plots the efficiency for sources located on all 4 field images binned in 0.5 mag bins. The survey efficiency function is defined as

$$\varepsilon = \frac{\varepsilon_{max}}{2}\left(1 - \tanh\left(\frac{m - m^*}{g}\right)\right) \tag{3.1}$$

where ε is the efficiency with which KBOs of magnitude m are detected in our survey, ε_{max} is the maximum efficiency, m^* is the magnitude at which $\frac{\varepsilon_{max}}{2}$, and g is the half width. We fit for the efficiency by computing the cumulative distribution for all known KBOs scaling for the probability of detection and compare to the observed cumulative distribution. To find the optimal parameters, we minimize the χ^2 between the observed and calculated cumulative distributions. We find ε_{max}=0.66, m^*=21.5, g=0.05. The efficiency drops by 50% at 21.5 V mag, consistent with our median image limiting magnitude. We estimate the uncertainty in our survey efficiency using the number of known KBOs found with magnitudes less than or equal to 21st magnitude, well before the drop off in the best-fit efficiency function. We found 13 of 19 known KBOs brighter than or equal to 21st magnitude, giving an efficiency of 68%, consistent

[2] http://ssd.jpl.nasa.gov/horizons.cgi

with our best-fit efficiency function, and assuming Poisson counting statistics, the one-σ confidence level ranges from 51-89%.

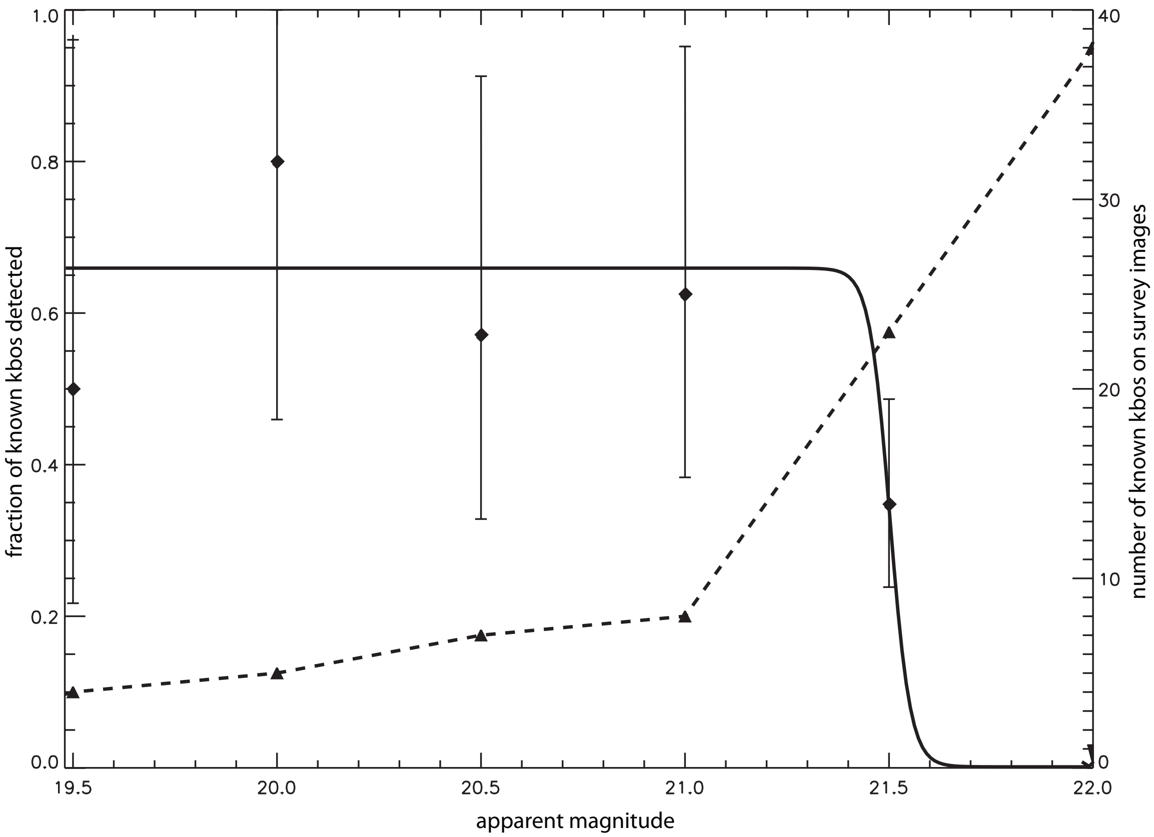

Figure 3.3 Survey efficiency based on the known KBO population. Black diamonds plot the binned detection efficiency in 0.5 mag bins with one-σ Poissonian error bars plotted. Solid line is best-fit efficiency function. Dashed line with triangles is the number of known KBOs whose positions were located on the survey images binned in 0.5 mag bins.

3.4.3.3 Geometric Losses

The gap between the QUEST camera's CCDs in the North-South direction is $\sim$1.2$'$. Along the East-West direction the separation between CCDs is $\sim$25$'$. At the distances our survey is sensitive to, a KBO located in the declination gap would remain in the gap between CCDs over the two-night baseline. This was the case for Eris, and Eris was not detected in our survey. For some areas of the sky we do have overlap pointings to try and cover the declination gap but only after all opposition target fields were observed. The losses due to the CCD gaps is accounted for in our sky coverage estimates, but we do not include the effects of bad pixels. Masked bad pixel regions account for ∼8% of the QUEST camera's observable area. Likely the loss due to bad pixels is smaller than 8%; a KBO positioned on a bad pixel may not necessarily be lost, Sextractor interpolates values for masked pixels from neighboring good pixels before source detection.

KBOs that moved off the edge of the CCD into the CCD gaps were missed by our automated detection pipeline. Non-functioning CCDs and longitudinal losses are accounted for in our latitudinal sky coverage estimates, but to measure our geometric losses from those KBOs moving off the CCDs or lost in the CCD gaps, we generated $\sim 10^6$ random circular orbits assuming a uniform inclination distribution (0-180°) for a range of semimajor axes. Neglecting the effect of masked CCD regions, we calculated the fraction of simulated KBOs positioned on all four survey images as a function of ecliptic latitude. Figure 3.4 compares our survey sky coverage to the fractional coverage of the simulated circular orbits at 30, 50, and 100 AU. The greatest losses occur at the ecliptic, and we find this effect is at most ∼10%. Closer orbits are moving at faster on-sky velocities and are more likely to move off the CCD over the two night-base line than objects at further distances, but we find the difference in losses by objects at 30 and at 100 AU is small, and that all objects in the Kuiper belt have similar geometric losses in our survey.

3.4.3.4 Pipeline Detection Efficiency of Sedna-like Bodies

Any comparison of the Sedna population requires that we also understand whether these bodies would be detected in our survey. Many of the mechanisms proposed for the formation of Sedna (Kenyon & Bromley, 2004; Morbidelli & Levison, 2004; Brasser et al., 2006, 2007; Kaib & Quinn, 2008) produce many highly eccentric and even retrograde orbits. To test whether Sedna-like orbits would pass through our orbit-fitting filter, we created artificial orbits with a uniform semimajor axis ranging from 100-1100 AU and uniform eccentricity and inclination distribution including retrograde orbits. For those 781,763 artificial orbits whose positions land on our

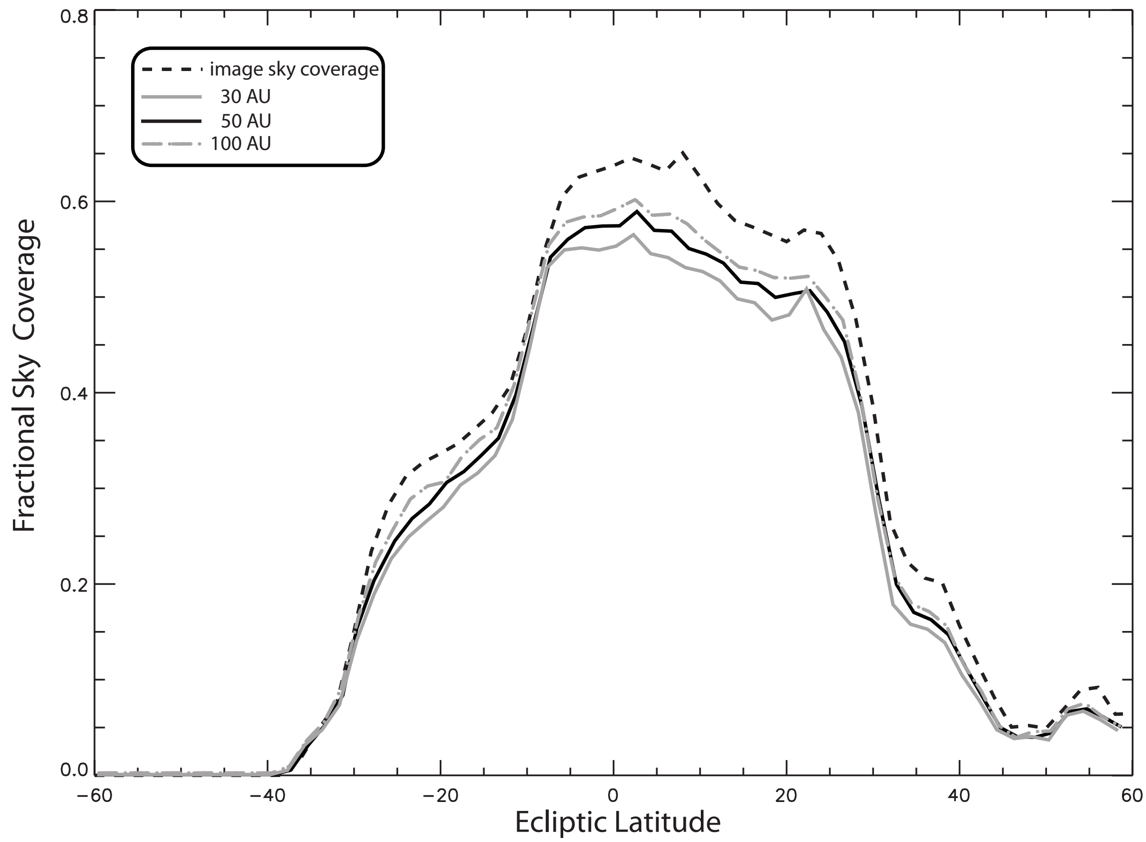

Figure 3.4 Effect of geometric losses on the sky coverage of the survey as a function of latitude binned in 2° bins. Main effects are due to KBOs that are not located on all field observations and move off the CCD or objects positioned in the gaps between the CCDs.

images, have barycentric distances less than 1000 AU and have perihelia greater than 50 AU, we add absolute and relative positional offsets characteristic of the survey's astrometric errors. All four images of a field observation have the same absolute astrometric error but random relative positional errors. We add normally distributed random absolute and relative astrometric errors using the three-sigma clipped median and standard deviation of the survey astrometric uncertainties. As shown in Fig 3.5, the efficiency is the fraction of synthetic orbits fit with the Bernstein & Khushalani (2000) software that pass our selection criteria in each semimajor axis bin compared to the number of objects in the 100 AU bin. 5% of the synthetic population would not have made it through to visual inspection with the majority of failures due to the best-fit orbit placing the object on an asteroid-like orbit. We are confident that

Sedna-like bodies present in our images detected by SExtractor would be identified by our automated detection scheme.

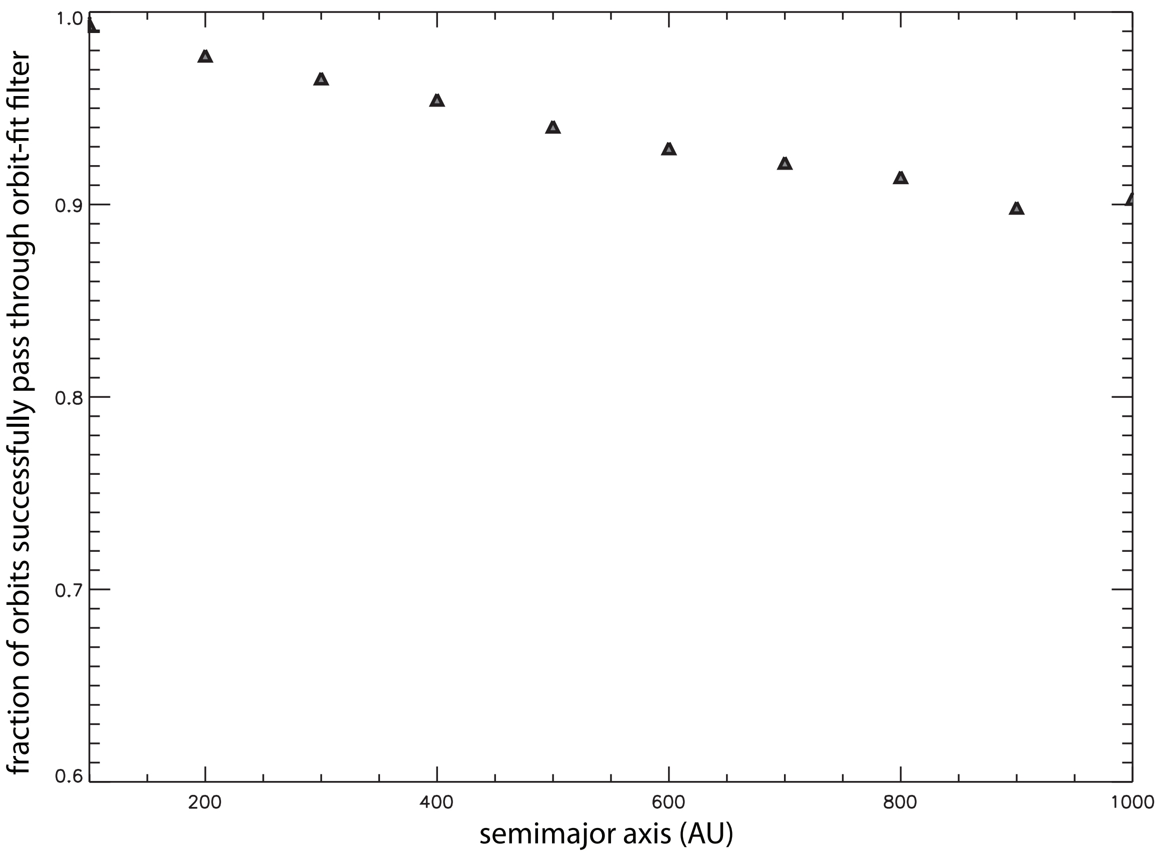

Figure 3.5 Efficiency of our orbit-fit detection filter. Fraction of synthetic orbits with barycentric distances between 15-1000 AU that successfully are identified as outer solar system bodies found on all four survey images versus semimajor axis binned in 100 AU bins

3.5 Detections

A total of 52 KBOs and Centaurs have been detected of which 25 are new discoveries from this survey. 50 of our discovered objects have multiopposition orbits. Table 3.1 lists the orbital information for objects detected in the survey. The orbital and radial distribution is plotted in Figure 3.5 and Figure 3.7 respectively. With the detection of no cold classical belt objects; our overall survey probes the orbital properties of the hot classical, scattered disk, detached, and resonant populations. The survey was specifically designed to probe the Sedna region, but except for Sedna, no additional objects with perihelion greater than 45 AU were detected despite sensitivity out to distances of 1000 AU.

We do detect several Centaurs with semi-major axes less than 30 AU in our survey, but to constrain the number of false detections by inner solar system objects we placed a minimum distance threshold in our moving object detection scheme. Candidates with barycentric distances less than 15 AU as calculated from initial orbits fit by the Bernstein & Khushalani (2000) method were ignored. Our survey is limited to detecting only the most distant of the Centaurs, and we therefore will not address the Centaur population in this paper.

designation	a (AU)	e	i (deg)	R (AU)	oppositions	night 1 avg mag	night 2 avg mag	H	MMR
(26181) 1996 GQ21	93.01	0.588	13.4	40.87	11	21.0	20.6	5.2	11:2
(26308) 1998 SM165	47.99	0.375	13.5	36.99	12	21.4	21.4	5.8	2:1 Kozai
(19521) 1998 WH24	45.74	0.103	12.0	41.84	11	21.9	21.9	4.8	
(40314) 1999 KR16	48.83	0.306	24.8	36.27	6	20.6	20.7	5.8	
(38628) 2000 EB173	39.44	0.277	15.5	28.93	7	19.3	19.4	4.7	3:2 Kozai
(47932) 2000 GN171	39.36	0.281	10.8	28.34	9	20.3	20.4	6.0	3:2
(20000) 2000 WR106	42.85	0.056	17.2	43.39	13	19.9	19.7	3.6	
(82075) 2000 YW134	57.61	0.287	19.8	43.81	6	21.0	21.1	4.9	8:3
(83982) 2002 GO9	19.45	0.277	12.8	15.00	6	21.1	21.1	9.1	
(50000) 2002 LM60	43.47	0.039	8.0	43.27	16	19.3	19.4	2.5	
(55636) 2002 TX300	43.46	0.126	25.8	41.29	12	19.8	19.7	3.3	
(55638) 2002 VE95	39.37	0.290	16.3	28.24	10	20.1	20.0	5.3	3:2
(119979) 2002 WC19	47.80	0.260	9.2	42.95	7	21.4	21.4	5.0	2:1
(174567) 2003 MW12	45.87	0.144	21.5	47.95	12	20.6	20.5	3.6	
(120178) 2003 OP32	43.45	0.108	27.1	41.36	6	19.9	19.9	4.1	
(120181) 2003 UR292	32.49	0.176	2.7	26.87	6	21.4	21.5	7.0	
2003 UZ117	44.29	0.133	27.4	39.46	6	22.0	21.7	5.3	
(90377) 2003 VB12	510.00	0.850	11.9	88.31	8	21.1	21.0	1.6	
(136204) 2003 WL7	20.17	0.259	11.2	15.21	6	20.6	20.6	8.7	
(175113) 2004 PF115	39.18	0.062	13.4	41.34	6	20.5	20.3	4.7	
2004 PG115	92.08	0.605	16.3	36.65	5	20.8	20.9	5.0	
(120347) 2004 SB60	42.27	0.105	23.9	43.89	10	20.4	20.5	4.2	
2005 CB79	43.15	0.140	28.7	40.16	6	20.4	20.3	5.0	
(145451) 2005 RM43	91.37	0.616	28.8	35.19	7	19.9	19.9	4.4	
(145452) 2005 RN43	41.77	0.028	19.2	40.72	13	20.0	20.0	3.9	
(145480) 2005 TB190	76.58	0.397	26.4	46.45	7	20.9	20.8	4.7	
2006 SX368	22.28	0.463	36.3	12.44	4	20.3	20.3	9.5	
2007 JF43	39.41	0.185	15.1	39.45	4	20.9	20.8	5.2	3:2
2007 JF45	44.69	0.147	10.6	38.12	1d	21.5	21.4	6.0	
2007 JJ43	48.22	0.166	12.0	41.96	3	20.8	20.7	4.9	
2007 JK43	46.35	0.492	44.9	23.93	3	20.8	21.1	7.6	
2007 NC7	34.39	0.507	6.3	20.37	3	21.4	21.6	8.6	

Continued on next page...

designation	a (AU)	e	i (deg)	R (AU)	oppositions	night 1 avg mag	night 2 avg mag	H	MMR
2007 OC10	50.09	0.292	21.7	35.48	3	20.8	20.8	5.7	
(225088) 2007 OR10	67.34	0.500	30.7	85.37	7	21.5	21.4	1.9	
2007 PS45	43.75	0.090	18.9	39.80	1d	21.5	21.1	5.6	
2007 RG283	19.98	0.233	28.8	18.70	3	21.5	21.0	8.8	
2007 RH283	15.96	0.339	21.4	17.48	8	21.4	21.2	8.4	
2007 RT15	39.61	0.234	12.9	30.90	3	21.6	21.3	6.9	3:2
2007 RW10	30.40	0.303	36.0	26.24	7	21.3	21.1	6.5	
(229762) 2007 UK126	73.52	0.488	23.4	45.96	9	20.4	20.3	3.4	
2007 XV50	46.02	0.073	22.9	46.19	3	21.2	21.3	5.0	
2008 AP129	41.66	0.138	27.4	37.39	5	20.6	20.7	5.3	
2008 CS190	42.08	0.153	16.0	36.17	2	21.6	21.6	6.4	5:3
2008 CT190	52.47	0.339	38.9	34.77	2	21.0	21.4	5.5	7:3
2008 LP17	88.04	0.660	14.1	30.26	2	21.0	20.9	6.6	
2008 NW4	45.58	0.203	23.1	36.92	2	21.2	21.0	6.0	
2008 OG19	67.37	0.428	13.1	38.74	2	21.6	21.3	4.9	
2008 QB43	43.36	0.219	26.3	38.79	3	21.6	21.4	5.6	
2008 QY40	63.09	0.418	25.1	38.11	2	20.9	20.9	5.3	
2008 SO266	39.64	0.247	18.8	31.58	2	21.5	21.4	6.9	3:2
2008 SP266	41.21	0.124	19.5	36.18	2	21.2	21.2	5.7	
2008 ST291	106.00	0.607	20.7	56.68	2	21.8	21.3	4.4	

Table 3.1: Orbital elements reported by the Minor Planet Center of Centaurs and KBOs detected in the Palomar survey: semimajor axis (a) , eccentricity (e) , inclination (i), barycentric distance (R), oppositions observed (in years excepted where days noted by d), nightly discovery magnitudes, absolute magnitude (H), and mean motion resonance (MMR) if applicable.

3.6 Sedna Population

With a perihelion of 76 AU and an aphelion of ∼1000 AU Sedna is dynamically distinct from the rest of the Kuiper Belt. Its extreme orbit suggests the presence of a population of icy bodies residing past the Kuiper belt. The study of this Sedna population provides a unique new window into the history of the early solar system. Some other mechanism no longer active in the solar system today is required to emplace Sedna on its highly eccentric orbit. Several possible scenarios have been offered to explain Sedna's extreme orbit, including interactions with planet-sized bodies (Gladman & Chan, 2006; Gomes et al., 2006; Lykawka & Mukai, 2008; Gomes & Soares, 2010), stellar encounters (Morbidelli & Levison, 2004), multiple stellar fly-bys in a stellar

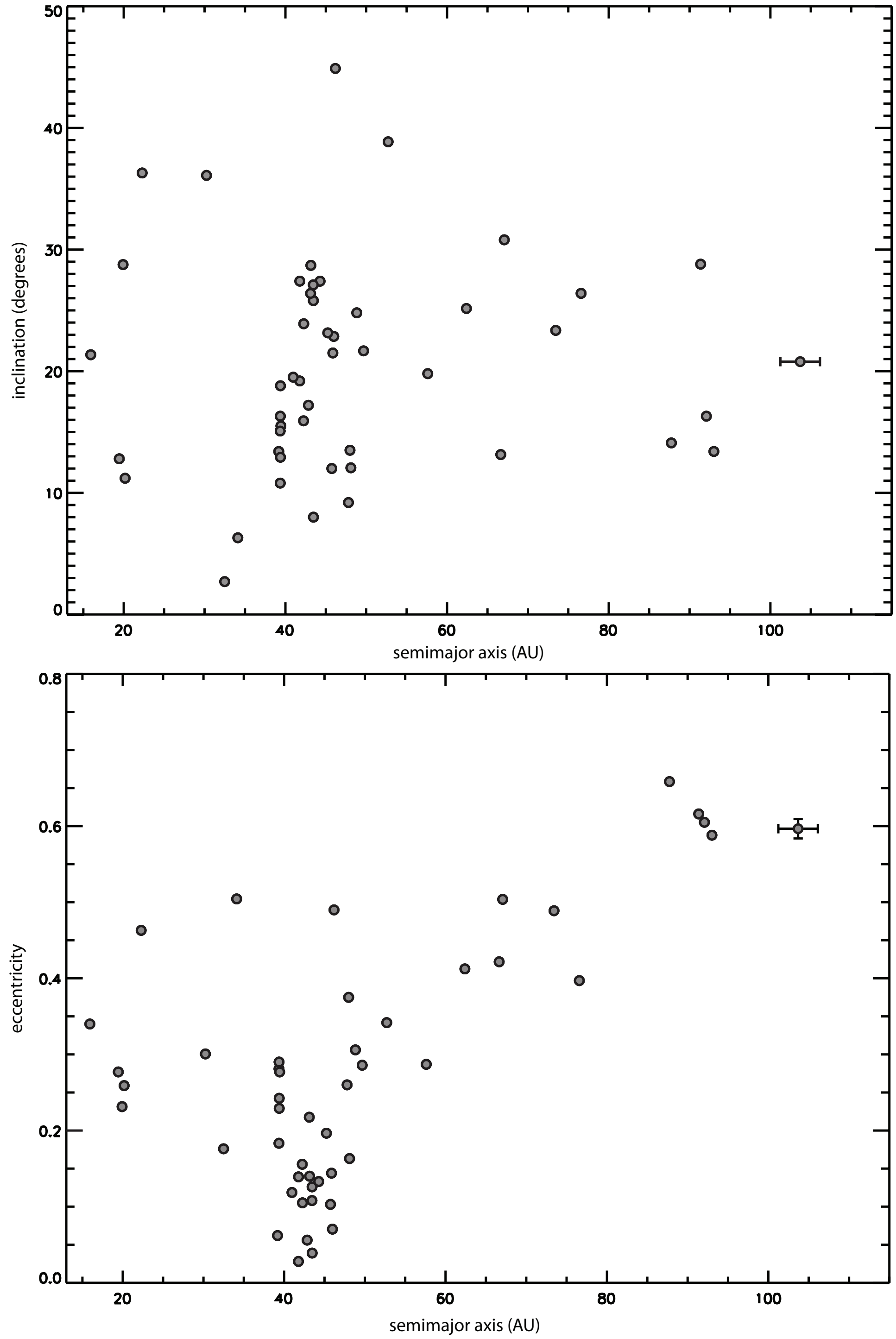

Figure 3.6 Eccentricity vs. Semimajor axis and Inclination vs. Semimajor axis of multiopposition objects found in the Palomar survey. Sedna has been excluded for better resolution. One-σ errors from Bernstein & Khushalani (2000) orbit fit are plotted.

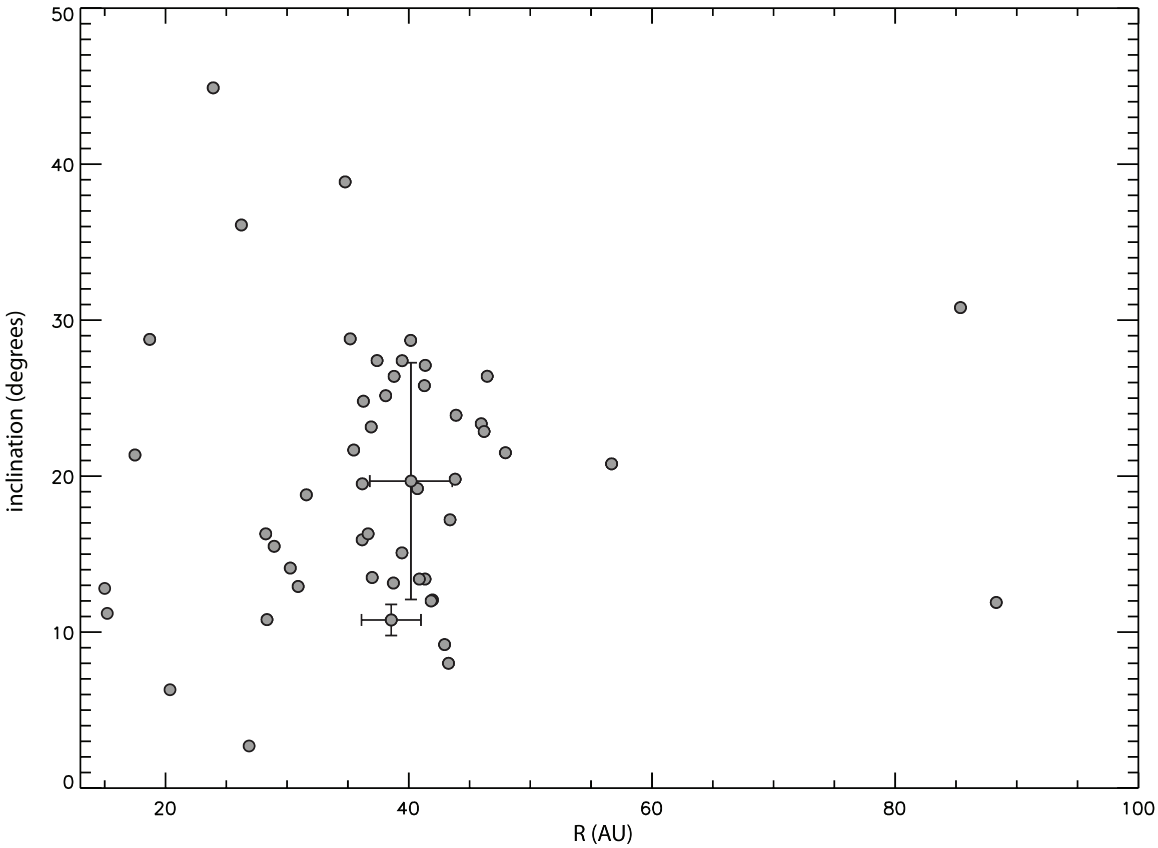

Figure 3.7 Inclination vs. barycentric distance for objects detected in the Palomar survey. One-σ errors from Bernstein & Khushalani (2000) orbit fit are plotted.

birth cluster (Morbidelli & Levison, 2004; Brasser et al., 2006, 2007; Kaib & Quinn, 2008), interstellar capture (Kenyon & Bromley, 2004; Morbidelli & Levison, 2004), and perturbations from a wide-binary solar companion (Matese et al., 2005). Each of the various Sedna formation models leave a distinctive imprint on the members of this class of distant objects and has profound consequences for our understanding of the solar system. These planetesimals in the Sedna region are dynamically frozen and the relics of their formation process. The orbital distribution and number density of Sedna-like bodies will distinguish between the formation scenarios.

In Schwamb et al. (2010), before recovery observations were complete, we compared the expected number of detections from a theoretical population on orbits with the same semi-major axis and eccentricity as Sedna to our survey results, the redetection of Sedna. Our best-fit value gives 40 bodies residing on Sedna's orbit that are brighter than or equal to Sedna. At the one-σ confidence level we ruled out a population larger than 92 and smaller than 15 Sedna-sized or bigger objects on orbits similar to Sedna's. Our previous work had been limited to examining a model population of bodies residing specifically on Sedna's orbit. Any realistic Sedna population likely occupies a much larger region of orbital space, possibly including objects with sufficiently high perihelia that they would never or rarely become bright enough to see. With secure orbital classifications for survey objects, we can now test more sophisticated orbital distributions.

3.6.1 Constraints on a Cluster Birth

No new Sedna-like bodies with perihelia beyond 45 AU were found in the survey despite a sensitivity out to distances of ~1000 AU. Although, we cannot differentiate between the Sedna origin scenarios with a single detection, we can place constraints on the cluster birth model where the location and distribution of Sedna-like orbits is indicative of the Suns birth cluster size. Most stars are born in dense gas-rich embedded clusters (Lada et al., 1991; Carpenter, 2000; Porras et al., 2003; Lada & Lada, 2003; Allen et al., 2007), and it is likely that the Sun spent several million years in such an environment. The presence of short-lived radioactive nuclides in primitive meteorites, may provide circumstantial evidence that the Sun was in relatively close proximity to a supernovae early on in the solar system's formation, (Chaussidon & Gounelle 2007;Brennecka et al. 2009 and references therein) and therefore in a much denser environment than the present-day solar neighborhood. In the dense stellar nursery, encounters between nearby solar neighbors and the Sun would occur at a much higher frequency than in the present solar environment (Adams & Laughlin, 2001; Laughlin & Adams, 1998; Proszkow & Adams, 2009; Adams, 2010). Close flybys of passing stars would perturb objects in the Sun's planetesimal disk onto highly eccentric Sedna-like orbits (Morbidelli & Levison, 2004; Brasser et al., 2006, 2007; Kaib & Quinn, 2008).

Brasser et al. (2006) successfully produce objects on orbits similar to Sedna's in simulations of embedded cluster environments. The gravitational effects of both stars and gas in the cluster are included in their integrations. If the mean density of the material the Sun encounters while residing in the embedded cluster was $\sim 10^3$ $M_\odot/pc^3$ (central cluster densities of 10^4 $M_\odot/pc^3$) or denser, Sedna's orbit is recreated and a distribution of Sedna-like bodies with semimajor axes less than 10,000 AU is formed. Brasser et al. (2006) find that the central density of the stellar cluster (directly correlated to the amount of material the Sun encounters in the cluster) determines the orbital distribution of Sedna-like bodies generated. The denser the cluster environment, the smaller semimajor axis at which the Sedna population begins. For this paper, we focus specifically on the Brasser et al. (2006) results for the 10^4,10^5, and 10^6 $M_\odot/pc^3$ embedded cluster integrations (10^3 $M_\odot/pc^3$ did not produce Sedna). We refer the reader to their paper for details of the orbital integrations and the review of embedded clusters by Lada & Lada (2003). Figure 3.8 shows the orbital distributions from the embedded cluster numerical simulations used in this work.

Our survey observations probe the Sedna population today after 4.5 Gyrs of evolution. The distribution of orbits presented by Brasser et al. (2006) is what remains after 3 Myr when the integrations end and the Sun is expected to have left the birth cluster. Once the Sun exits the cluster, the Galaxy becomes the dominant gravitational potential. The gravitational perturbations from galactic tides over the age of the solar system have not been accounted for in the Brasser et al. (2006) integrations. Sedna's orbit is protected from the effects of passing stars and galactic tides in the current solar environment, but objects with higher semimajor axes than Sedna may be perturbed onto comet-like orbits (Duncan et al., 1987; Fernandez, 1997). Kaib & Quinn (2009) examined the production of long period comets in the Sedna region and find that the production efficiency drops significantly for bodies with a $<$ 3000 AU compared to those with larger semimajor axes. Therefore we expect that objects emplaced onto Sedna-like orbits with semimajor axes less than 3000 AU should remain to the present day, and we do not include any orbits from the cluster simulations with a $\geq$ 3000 AU in comparisons to our observations.

The Nice model (Tsiganis et al., 2005; Gomes et al., 2005a) predicts that the giant planets were in a more compact configuration than in the present-day solar system. The orbits of the giant planets went unstable approximately 1 Gyr after the formation of the solar system causing the migration of the giant planets and scattering of planetesimal disk. Jupiter migrates inward, and the remaining giant planets move outward with Neptune migrating outward to 30 AU. The oldest embedded clusters are $\sim$5 Myrs old (Leisawitz et al., 1989; Lada & Lada, 2003), Neptune migrates well after the Sun has left the birth cluster and the emplacement of the Sedna population. Brasser (2008) confirms this scenario can create a Sedna population and generate an Oort cloud population within the current estimates of the mass of the Oort cloud. Neptune's orbit became eccentric during migration and was later circularized via scattering of planetoids in the Kuiper belt region. Current estimates have Neptune's eccentricity as high as $\sim$0.3 corresponding to an aphelion of $\sim$39 AU at the end of migration (Levison et al., 2008). The sculpting of the Sedna population due to Neptune's migration outward has not been accounted for in the Brasser et al. (2006) simulation results. The cluster models do create orbits with perihelia in the range of 30-50 AU, which may not exist in the current solar system due to Neptune ejecting these Sednas or scattering them onto KBO-like orbits during its eccentric phase. We chose a conservative minimum perihelia threshold of 50 AU (which would require Neptune to have an eccentricity of $\sim$0.7 to reach 50 AU at aphelion) to compare the cluster distributions to our survey results.

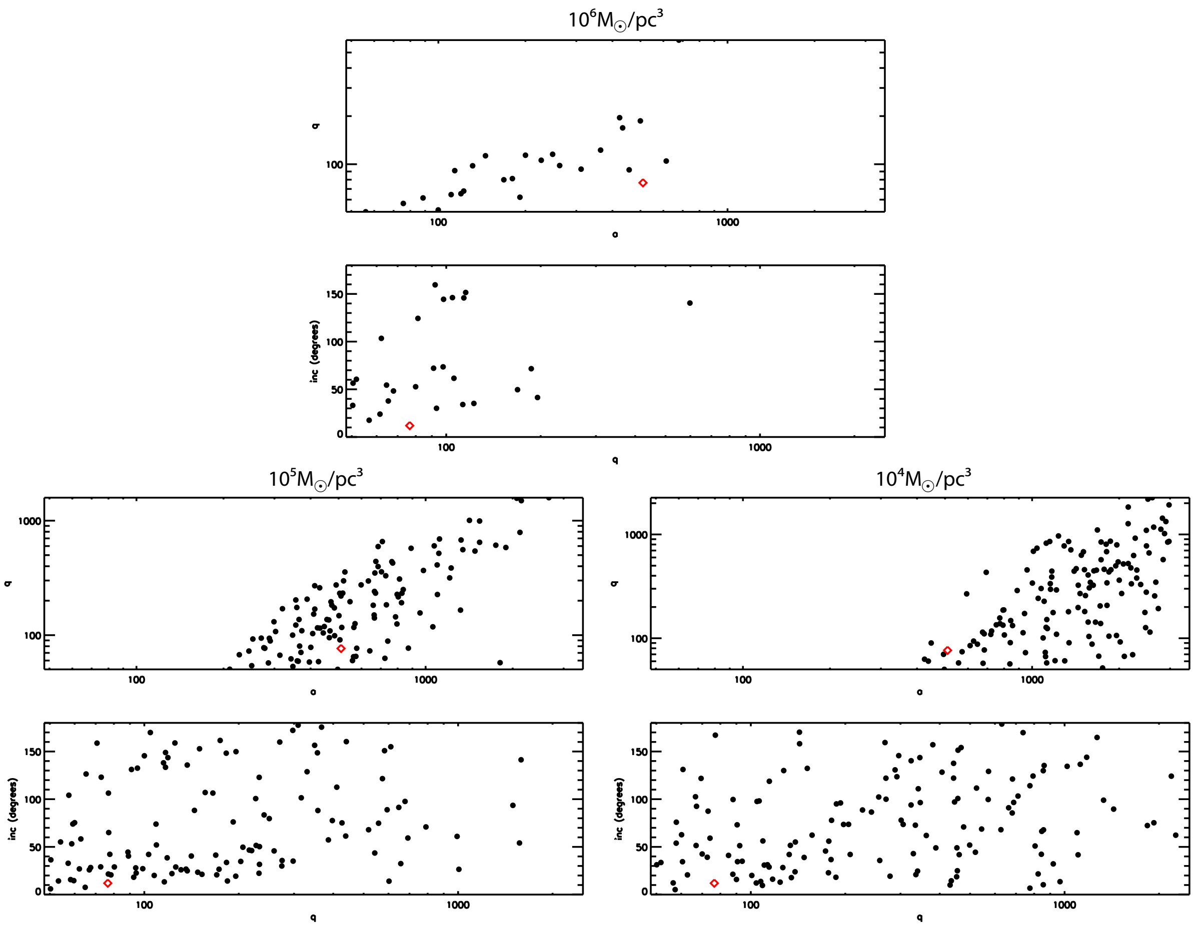

Figure 3.8 Plot of perihelion (q) vs. semimajor axis (a) and plot of inclination (i) vs. semimajor axis (a) for Sedna-like bodies produced at the end of the Brasser et al. (2006) embedded cluster simulations used in this work. We limit the population to orbits $q > 50$ and $a < 3{,}000$ AU. The red diamond denotes Sedna's orbit.

3.6.2 Survey Simulator

We developed a survey simulator to compare the expected number of detections from the theoretical cluster Sedna populations to our survey results. The simulator draws synthetic objects from a model orbital and absolute magnitude distribution and for every image computes the positions and brightnesses of these objects on the sky. For all three cluster environments, we model a population of 3,000,000 bodies on cluster-created orbits randomly drawing the semimajor axis, eccentricity, and inclination for each particle from those produced in the cluster numerical integrations. Brasser et al. (2006) obtain a value of ∼2 Gyr for the precession frequency of Sedna and other Sedna-like objects, therefore we assume that the orbits have been randomized due to planetary effects, and randomize over all other orbital angles. The positions of the artificial objects are computed for the survey period; those synthetic cluster objects that land on our images are identified neglecting the effects of masked regions of the CCDs. For each of the three cluster environments, approximately a third of the synthetic cluster-created orbits are located on our images.

A brightness distribution is then applied to the synthetic population. Due to the large uncertainties in the albedo distribution of such a distant population, we assign absolute magnitudes to our synthetic bodies instead of diameters. We assume a single power-law brightness distribution similar to the Kuiper belt where the number of objects brighter than a given absolute magnitude, H_{max}, is described by:

$$\mathrm{N}(H \leq H_{max}) = N_{H\leq 1.6} 10^{\alpha(H_{max}-1.6)} \tag{3.2}$$

The brightness distribution is scaled to $N_{H\leq 1.6}$, the number of bodies with an absolute magnitude brighter than or equal to Sedna (H=1.6). A typical value of α measured for the asteroid belt is 0.3 (Jedicke & Metcalfe, 1998). The best-fit single power law for the hot (inclinations > 5) and cold (inclinations < 5) Kuiper belt populations are

α=0.35 and α=0.82 respectively, measured by Fraser et al. (2010), but it is unclear if the Sedna population should have an α value similar to the Kuiper belt. The Sedna population may have very different surface characteristics than typical KBOs. Barucci et al. (2005) find methane and a tentative detection of nitrogen on Sedna's surface. Schaller & Brown (2007) model of volatile loss on KBO surfaces predicts that moderate-sized Sedna-like bodies on high perihelia orbits should retain methane and nitrogen ices on their surfaces. Most KBOs on the other hand, are either too small or too hot to hold on to their primordial abundance of volatiles. Distant Sednas never sublimate a significant amount of ices to renew their surfaces in a frost/thaw cycle. Instead the surfaces of the Sedna population would be subject to constant photoprocessing of methane by solar irradiation steadily darkening their surfaces. Sedna is one of the reddest KBOs with a V-R=0.78 with thermal measurements constraining Sedna's V albedo to be between 0.16 and 0.30 (Brown, 2008; Stansberry et al., 2008). We choose to explore the extremes of the brightness distribution and model the likely range of power-law distributions for α ranging from 0.2-0.8 including the best-fit value for the hot and cold KBOs measured by Fraser et al. (2010).

For a given value of α and $N_{H\leq1.6}$ absolute magnitudes are randomly assigned to our simulated Sednas. A single instance of the brightness distribution can be thought of as a separate survey. Those synthetic objects that lie within our sky coverage with an apparent magnitude above both nights' limiting magnitudes (as determined in Section 3.4.3.1) are deemed valid survey detections. We assume a 100% efficiency out to the limiting magnitude where then the efficiency immediately drops to zero. We require that the object must be located on all 4 field images to be considered "discovered" in the simulated survey, and we do not require the object have Sedna's perihelia of 76 AU. Bodies with H $\leq$ 4.3 residing at 50 AU would be visible within our survey, and an object of Sedna's size and albedo would have been detected up to a distance of $\sim$93 AU. Objects have multiple detection opportunities due to repeat sky coverage over subsequent years and overlapping fields. We do not count duplicate detections in our tallies.

3.6.3 Could Sedna Have Been Formed in a Cluster Environment?

e did not find any distant objects with perihelia greater than 45 AU with the exception of Sedna. To determine whether the orbital distributions produced in the various cluster environments are consistent with our redetection of Sedna, we must compare the orbital distributions of single detections produced by the survey simulator to Sedna. We employ our 3,000,000 synthetic Sedna population for each cluster environment to generate single detections. For each given value of α, absolute magnitudes are randomly assigned to our simulated Sednas for the range of possible values of $N_{H\leq1.6}$ to create 10,000 single detections.

Each simulated detection is characterized by a semimajor axis, eccentricity, and inclination (a,e,i). We test a,e,i because these three parameters are directly effected by the impulses from the stellar encounters and gravitational effects from the embedded gas and stars, and these are the most independent set of orbital parameters. We choose to exclude the H distribution in our analysis because of the uncertainty of our limiting magnitudes. To determine whether Sedna and the cluster produced single detections could be drawn from the same parent population for varying slopes and scaling of the brightness distribution, we employ a variant of a 3-dimensional Kolmogorov-Smirnov (KS) test adapted from Peacock (1983) and Press et al. (1992) which simultaneously compares the a,e,i orbital distributions to Sedna. The fraction of data points in each of the 8 quadrants in a, e, i space, where the origin is defined by Sedna's orbital parameters (a=519 AU , e=0.853, i=11.9 deg), is computed. In order to determine if Sedna's orbit is extreme compared to the cluster produced detections, the D statistic in this case is defined as the difference of the maximum and minimum fraction calculated. The significance of the computed D statistic is found by performing our 3-D KS test again, selecting each of the 10,000 simulated single detections as the new origin, counting the fraction where the computed D statistic was higher than the D statistic for Sedna's orbit. We reject the cluster-produced population if the 3-D KS test does reject at a 95% or greater significance the null hypothesis, that the simulated survey single detections and our sole detection of Sedna are drawn from the same distribution.

We performed the 3-D KS test for all ranges of $N_{H\leq1.6}$ that produced single detections and possible values for α (0.2-0.82) for all three cluster environments. The orbital distribution of single detections produced at smaller $N_{H\leq1.6}$, is different from those at large $N_{H\leq1.6}$, and the entire range of possible values $N_{H\leq1.6}$ must be tested. At small values of $N_{H\leq1.6}$ there are fewer bright H objects available to fill detectable orbits, biasing the single detections to slightly lower perihelia orbits than for larger values of $N_{H\leq1.6}$ where there is an ample supply of bright bodies to fill detectable orbits. We find that the 3-D KS test confidence levels calculated for the 10^6 and 10^5 $M_\odot/pc^3$cluster distribution for varying values of α are independent of $N_{H\leq1.6}$. For the 10^4 cluster and any value of α, $N_{H\leq1.6}$=1 has the highest probability of rejection and then decreases to a flat value as $N_{H\leq1.6}$ increases. For the 10^4 cluster, $N_{H\leq1.6}$=1 represents an upper limit on the rejection confidence level of the orbital distribution. Therefore we report the confidence level calculated for each cluster distribution and brightness distribution for values of $N_{H\leq1.6}$=1 in Table 3.2. For the two densest cluster environments 10^6 and 10^5 $M_\odot/pc^3$ producing Sedna as the sole detection is an extremely low probability event. The bulk of the 10^6 and 10^5 $M_\odot/pc^3$ cluster-created single detections had orbits with semimajor axes less than Sedna's. The simulations produce many more objects with lower perihelia than Sedna that should have been found but were not detected in our survey. We can rule out 10^6 and the 10^5 $M_\odot/pc^3$

cluster central density ($M_\odot/pc^3$)	α				
	0.2	0.35	0.4	0.6	0.82
10^4	60	54	48	40	47
10^5	99	98	99	98	97
10^6	100	100	100	100	100

Table 3.2 3D KS test results for the Brasser et al. (2006) cluster produced single detections compared to Sedna's orbit. We report the confidence level at which we can reject the two distributions as drawn from the same parent population.

cluster population at confidence levels greater than 95% for all ranges of α and possible values of $N_{H\leq1.6}$. Therefore we reject the 10^6 and 10^5 $M_\odot/pc^3$ clusters as the source of the Sedna population. We cannot reject the 10^4 $M_\odot/pc^3$ cluster environments to a confidence level greater than 60% for all combinations of α and $N_{H\leq1.6}$ tested; we are unable to rule this population out with statistical significance. The 10^4 $M_\odot/pc^3$ orbital distribution is consistent with our redetection of Sedna. These results assumed that every object that lands on a CCD brighter than the image limiting magnitude would be detected. Our detection efficiency is not 100%, but including a flat detection efficiency curve that drops to zero at the image limiting magnitude does not change the results presented. Including a detection efficiency produces the same types of orbits for single detections, just the absolute number of single detections decreases. Since we are only looking at single detections, the 3D KS test results are the same for any efficiency value.

If Sedna's orbit is the result of multiple stellar encounters when the nascent Sun resided in an embedded cluster, our work rules out central densities for the cluster greater than or equal to 10^5 $M_\odot/pc^3$ for the environment of the early solar system, and Brasser et al. (2006) requires central densities higher than 10^3 $M_\odot/pc^3$ to reproduce Sedna's orbit. In terms of the mean density of the material the Sun would have interacted with in the cluster environment, the Sun would have had to have encountered a mean density greater than 10^3 and less than $\sim 10^4$ $M_\odot/pc^3$ to be consistent with our survey observations. Gutermuth et al. (2005) map the volume density of three young embedded cluster regions (GGD 12-15, IRAS 20050+2720, NGC 7129). The peak densities of these regions were on the order of $\sim 10^5$ $M_\odot/pc^3$. For GGD 12-15 and IRAS 20050+2720, 72% and 91% of the member stars reside in locations with densities upwards of 10^4 $M_\odot/pc^3$, and are unlikely to produce the observed Sedna population. For NGC 7129, less than 24% of the stars in the core of the cluster experience densities greater than 10^4 $M_\odot/pc^3$. Lada & Lada (1995) estimate the central stellar density of the 0.1 pc central regions of IC 348, NGC 2024, and Trapezium clusters to range from $\sim 10^3 - 10^4$ $M_\odot/pc^3$3 at the minimum central density required to form Sedna's orbit. These environments and NGC 7129 could produce the observed Sedna population.

3.6.4 Population Estimate

Now that we have found the 10^4 $M_\odot/pc^3$ cluster population is the only cluster environment capable of emplacing Sedna on its orbit, we can place constraints on the size of the produced population. To estimate the size of the Sedna population, we use the value of α measured by Fraser et al. (2010) for the hot and cold populations of the Kuiper belt (α==0.35 and 0.82 respectively) as limits for our brightness distribution. For each given value of α, absolute magnitudes are randomly assigned to our survey simulator created 3,000,000 Sednas 50,000 times, for every value of $N_{H\leq 1.6}$. A single instance of the brightness distribution can be thought of as a separate survey. For each $N_{H\leq 1.6}$ tested, the number of synthetic "surveys" in which, like the real survey, one object on a Sedna-like body is detected are tallied. Valid detections are only those in which the object is located on the same CCD and in all 4 field observations. We do not require that the object have Sedna's absolute magnitude (H=1.6), only that the apparent magnitude of the object is above the SExtractor calculated limiting magnitudes of all 4 frames the object is "discovered on.

The best-fit values for the number of objects brighter than or equal to Sedna with 95% errors are 393 $^{+1286}_{-264}$ and 74^{+279}_{-47} for the hot and cold brightness distributions respectively. The lower and upper 95% confidence levels limits reported are one-sided statistics found by computing the interval over which the integrated probability distribution 0.95 respectively of the total area. The survey simulator assumes all simulated Sednas that land on our images and are above the image limiting magnitude would be detected in the survey. The effect of a less than 100% survey detection efficiency is non-negligible. The reported size estimates represent a lower-bound on the size of the Sedna population. Assuming a uniform detection efficiency which drops to zero at the image limiting magnitude, the best-fit value and 95% limits for $N_{H\leq1.6}$ is scaled by the inverse of the survey efficiency. For our nominal detection efficiency of 0.66, the best-fit values for the number of objects brighter than or equal to Sedna are 595^{+1949}_{-400} and 112^{+423}_{-71} respectively for the hot and cold brightness distributions. Figure 3.6.4 plots the fraction of simulated surveys that produced a single Sedna detection as a function of $N_{H\leq1.6}$ the 10^4 $M_\odot/pc^3$ cluster environment for our nominal survey detection efficiency.

For the 10^4 $M_\odot/pc^3$ cluster environment, the range is quite large but there could be on the order of hundreds to thousands of planetoids brighter than Sedna present beyond the Kuiper belt. For comparison, the total number of Sedna-sized or larger bodies in the Kuiper belt is ∼5-8 (Brown, 2008); there may be an order of magnitude or two more mass residing in the Sedna region than exists in the present Kuiper belt. The expected number of objects with H≤1.6 varies significantly with the slope of the brightness distribution. Choosing a steeper power law for the brightness distribution decreases the likelihood of detecting only one Sedna because of the larger number of bright objects populating detectable orbits and decreases the best-fit number of objects brighter than Sedna. Selecting a smaller value of α, a shallower brightness distribution, increases the likelihood of detecting only one object on Sednas orbit by

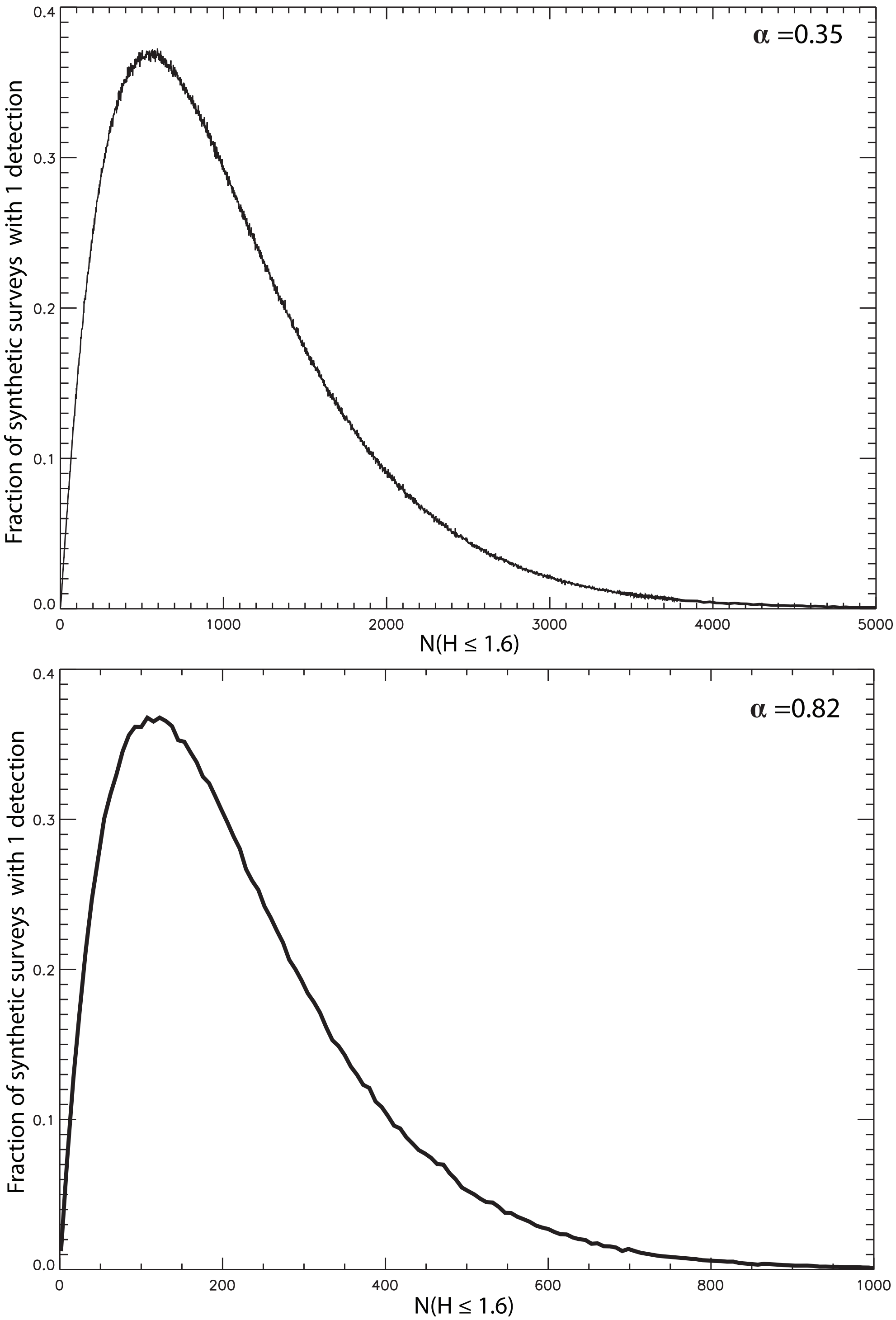

Figure 3.9 Results of the 10^4 $M_\odot/pc^3$ cluster analysis for the α=0.35 (hot) and α=0.82 (cold) Kuiper belt population size distributions- Fraction of synthetic surveys with one detectable Sedna-like body as a function of the number of bodies bigger and brighter than Sedna assuming our nominal 66% detection efficiency.

decreasing the number of synthetic surveys with multiple detections.

We excluded orbits with semimajor axes greater than 3000 AU from our analysis. If we had included higher semimajor axis orbits, the best-fit number of Sedna-like bodies brighter than or equal to Sedna would increase due to the larger population of orbits being included, but our overall conclusions would not change. Those orbits that are contributing most to being Sedna detections are those with semimajor axes much smaller than 3000 AU. The 10^4 $M_{\odot}/pc^3$ cluster results are the most sensitive to this cut. We examined the single detections produced in the best-fit simulations for the range of α parameters. Orbits with semimajor axes less than 1000 AU contribute ~80-90% of the Sedna single Sedna detections. The number is even greater from the 10^6 and 10^5 $M_{\odot}/pc^3$clusters. We make a conservative perihelia cut at 50 AU to compare the cluster produced Sedna-like orbits to our observed Sedna population. Our simulations were rerun, including orbits with perihelia greater than 45 AU and our conclusions remain the same. The 10^6 and 10^5 $M_{\odot}/pc^3$ cluster will be ruled out with a higher confidence level because of the increase in low perihelia orbits that should have been detected in our survey. For this analysis we used the SEXtractor computed limiting magnitudes to determine whether our simulated Sedna population was observable on our images.

3.6.5 Comparison to Occultation Surveys

Wang et al. (2009) place upper limits on the number of small bodies in the Sedna region due to the lack of occultations from distant solar system bodies in the TAOS survey. We can estimate whether our upper limits for the Sedna population are consistent with Wang et al. (2009)'s reported upper limits on the number density of objects larger than 1 km. We find the fraction of our 10^4 $M_{\odot}/pc^3$ cluster survey simulator created 3,000,000 Sednas that are within 3° of the ecliptic (TAOS's ecliptic latitude range) and at 100 and 1000 AU. Assuming no break in the size distribution, we extrapolate the number of bodies larger than 1 km. The albedo distribution is uncertain, Sednas V albedo is measured to be between 0.16 and 0.30 (Brown, 2008; Stansberry et al., 2008), but to give an extreme upper limit we chose an albedo for 0.04 and assume no break in the size-distribution in order to estimate the fraction of bodies that would be observable by TAOS. TAOS is sensitive to bodies brighter than H=19.1.

Within 3° of the ecliptic, 0.05% of the 10^4 $M_\odot/pc^3$ cluster produced Seda population are located between 50-150 AU and 0.07% reside at 900-1100 AU. For the flat size distribution value (α=.35), we expect there to be no more than 780 Sednas/deg^2 on the ecliptic at 100 AU and 10^4 Sednas/deg^2 at 1000 AU assuming a 66% detection efficiency. Our 95% confidence level estimates for a flat size distribution are well below TAOS's ecliptic number density of 1 km or larger bodies at 100 ($\sim10^7$ Sednas/deg^2) and 1000 AU ($\sim10^9$ Sednas/deg^2) even without a break in the size distribution. The TAOS observations do not rule out a large Sedna population with thousands of Sedna-sized or larger bodies residing far from the Sun for a flat brightness distribution. For the steep (cold population) size distribution, $\alpha = .82$, and a 66% magnitude detection efficiency, at 100 AU we expect no more than 2.8x10^{10} objects/deg^2, approximately two orders of magnitude larger than TAOS's 3-σ upper limit. We find that even our 95% lower limit at 100 AU is an order of magnitude larger than the TAOS limit. Our expected number density at 1000 AU at our 95% upper confidence level, on the other hand, is 3.70x10^{11} objects/deg^2 below TAOS's limit of $\sim10^{12}$ objects/deg^2.

The occultation results do not necessarily rule out a steep size distribution for the Sedna population. In the Kuiper belt at small sizes (~50-150 km) the distribution is observed to break to a shallower slope (Bernstein et al., 2004; Fuentes et al., 2009; Fraser & Kavelaars, 2009). Brasser et al. (2006)'s model did not include gas in the solar nebula and therefore did not include the effects of gas dynamics in their simulations. Sedna is ~1500 km in size and would not be effected by gas drag, but smaller sized objects would be. Brasser et al. (2007) investigated the effect of gas drag on the size distribution of objects deposited into the Sedna region. They find a size sorting effect in the cluster-produced Sedna population. Bodies smaller than ∼20-60 km would be circularized onto orbits beyond Jupiter and Saturn and not available to be scattered into the Sedna region. Far fewer small-sized objects would be deposited into the Sedna region. Our survey is sensitive to objects much larger than those that would be effected by gas drag or the break in the brightness distribution. The combination of a broken power-law size distribution and a size-sorting effect could reconcile the observations, causing very few small objects that TAOS would have been able to detect to be present in the Sedna region.

3.6.6 Open Cluster Environments

The majority of stars are birthed in embedded clusters, but 4-7% of stars form in smaller loose conglomerations with little or no gas known as open clusters (Lada, 2004). Open clusters, like the Pleiades, have ages of a few tens to hundreds of Myrs (Lada, 2004). Although embedded clusters are more prevalent, it is postulated that ∼5% of the embedded clusters may dissipate into loosely bound open clusters (Lada & Lada, 2003). Kaib & Quinn (2008) are able to produce objects on Sedna-like orbits in various open cluster environments. Interactions between the planetesimals disks of the cluster members are not included in their simulations. Their numerical integrations produce similar wedge-like orbital distributions to the Brasser et al. (2006) embedded clusters models, but Kaib & Quinn (2008) find no relationship between the size of the birth cluster and the orbital distribution of Sednas. The open cluster integrations are nondeterministic with Sednas orbit being produced in only 5 of their 16 cluster simulations of varying cluster size. For those integrations that do produce Sedna and other Sedna-like orbits, distributions similar to the 10^4 and 10^6 $M_\odot/pc^3$ Brasser et al. (2006) results are generated. This is not unsurprising since the dominant dynamics sculpting the Sedna region, stellar encounters, is the same in both environments. Our analysis above of the embedded cluster distributions also applies to Kaib & Quinn (2008) open cluster orbital distributions. Those distributions where Sedna is at the end of a distribution Sedna-like orbits with many lower semimajor axes and lower perihelia orbits similar to the 10^5 and 10^6 $M_\odot/pc^3$3 embedded clusters, are inconsistent with our observations.

3.6.7 Implications for the Kuiper Belt

Using the discovery of 2008 KV42, with an orbit essentially perpendicular to the ecliptic, Gladman et al. (2009) posit a metastable parent population with inclinations greater than ∼50 AU with a in the hundreds of AU and q = 3545 AU. Such a population is produced in the 10^5 and 10^6 $M_\odot/pc^3$ cluster environments but not present in the 10^4 $M_\odot/pc^3$ embedded cluster (Brasser et al., 2006). Gladman et al. (2009) suggest 2008 KV42 may have been a high inclination counterpart to Sedna placed on a lower perihelia and semimajor axis that later diffused to its current orbit. Although for our analysis we removed such objects with perihelia less than 50 AU from our distribution, adding those objects would only rule out the 10^5 and 10^6 $M_\odot/pc^3$ cluster environments to even higher confidence because many more low a and low q objects single detections would be produced than detections with similar orbits to Sedna. With this region devoid of particles in the 10^4 $M_\odot/pc^3$ cluster integrations, this suggests that 2008 KV42 and Sedna are likely formed from two independent source populations.

3.7 Latitude Distribution

Figure 3.10 plots the folded latitude distribution of all objects with a>30 debiased for latitudinal coverage. We assume Poisson detection statistics (as computed by Kraft et al. (1991)), with error bars representing the Poissonian 68% confidence limit on the detected number of objects in each latitude bin corrected for sky coverage. A noticeable spike occurs at $\sim 12°$ from the ecliptic. Brown (2008) also finds these prominent peaks in the latitudinal distribution $\sim\pm$ 11° ecliptic latitude. Brown finds that this peaked distribution cannot be generated by a simple inclination distribution of objects in random orbits. Brown (2008) suggests that resonant orbits are likely able to explain these high latitude concentrations. Resonators trapped in the Kozai resonance (such as Pluto) have their perihelia near their maximum excursion off the ecliptic (Morbidelli, 1997) and the highest detection probability out of the ecliptic plane. The plutinos come to perihelia away from Neptune(Malhotra, 1996, 1995) and are preferentially biased towards detection at certain longitudes. Without dynamical classification Brown (2008) could not verify the plutinos as the source of these peaked latitude distributions.

With secure orbits for our detections we can address this issue. In order to classify which of the survey KBOs reside in mean motion resonances with Neptune, each KBO had 13 clones integrated for 10 MYrs. One clone represents the best-fit orbit, and the rest are taken from a self-consistent spread of orbits covering the 3-σ uncertainty of the KBOs best-fit orbital solution computed from the covariance matrix of orbital elements obtained from AstDys[3] on 2009 December 1. These objects were integrated using the n-body code SyMBA (Levison & Duncan, 1994) using the integrator `swift_rmvs3` based on the mapping by Wisdom & Holman (1991). The KBO clones were treated as massless particles. The four giant planets were included and their initial conditions were taken from JPL HORIZONS. The mass, position,

[3] `http://hamilton.dm.unipi.it/astdys/`

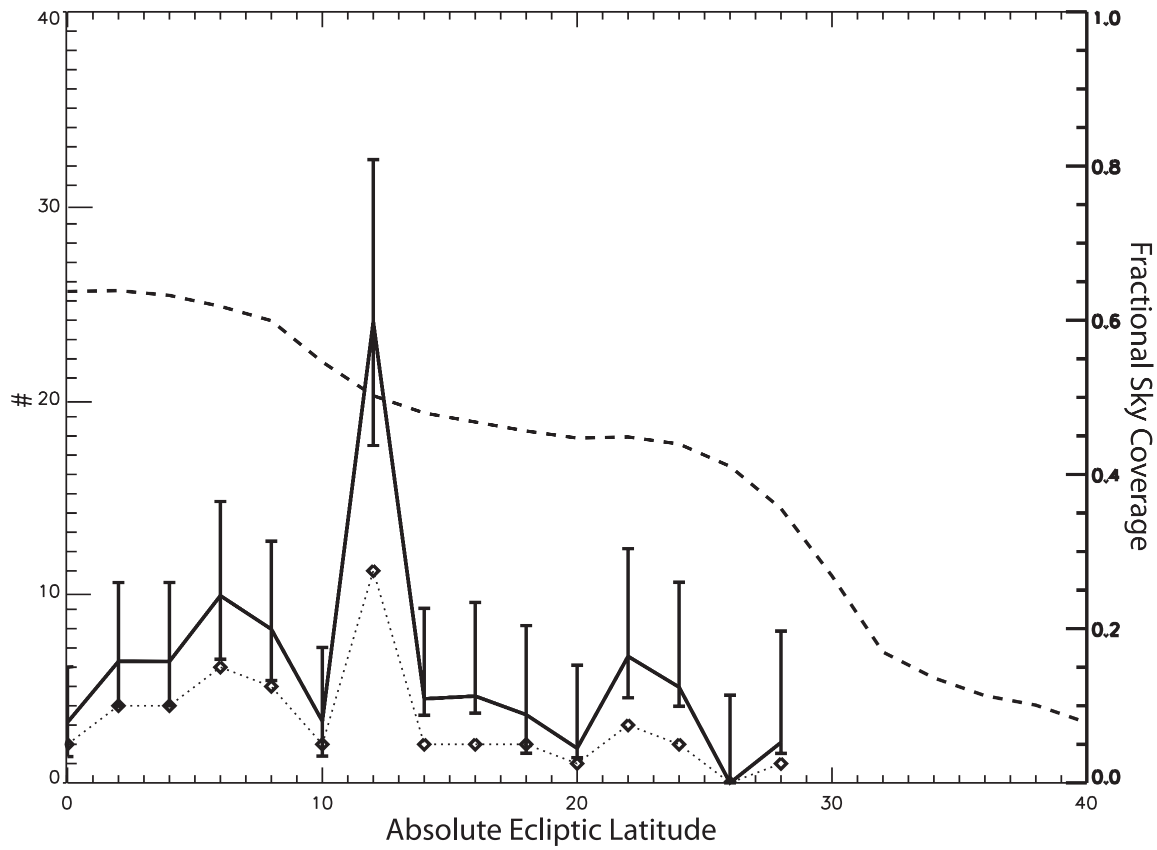

Figure 3.10 The folded latitudinal distribution of objects with semimajor axis > 30 AU found in this work. The lower dashed line with diamonds shows the number of actual KBO detections in 2° bins. The dashed line shows the fractional ecliptic latitude completeness. The solid line shows the expected number of KBOs brighter than 21.3 corrected for sky coverage with one-σ Poisson error bars computed for the unfolded distribution added in quadrature.

and velocity of the terrestrial planets were combined with the Sun. The integration proceeded backwards in time with 40-day time steps from epoch JD 2455200. After 10 MYrs, the clones were examined for one or more librating resonant angles and as well as librating arguments of perihelion in order to identify Kozai resonators. We identified objects (listed in Table 3.1) as resonant if all the clones lie in the resonance at the end of the integrations.

The latitudinal distribution of detected plutinos found in the survey is plotted in Figure 3.7. Six plutinos were detected in our survey, only two reside at ecliptic latitudes less than 10°. The remaining four plutinos compose the majority of the

12° latitude spike. Of these four plutinos (Huya, 2007 RT15, 2002 VE95 and 2008 SO2006), two objects are Kozai resonators, Huya and 2007 RT15; the other three have perihelia off the ecliptic having possibly experienced temporary Kozai interactions. The remaining non-plutino distribution still exhibited a peak in the distribution at 12° including two members of the Haumea collisonal family. At least 7% of our detections are fragments of the Huamea collisional family (Brown et al., 2007; Ragozzine & Brown, 2007; Schaller & Brown, 2008; Snodgrass et al., 2010). The identifier of the Haumea family is the characteristic deep near-infrared pure water ice absorption features on their surfaces (Brown et al., 2007; Schaller & Brown, 2008). The water ice-rich bodies are thought to all have anomalously high albedos, like family member 2002 TX300 (Elliot et al., 2010), extremely biasing our survey toward detection of Haumea family members. Any clustering in the Haumea family members will severely bias our latitude distribution. Removing the spectroscopicly confirmed family members from our survey, the non-plutino distribution is not peaked as shown in Figure 3.7.

Brown (2008) and this work are the only two wide-field surveys to probe significantly beyond the ecliptic. In order to test whether the plutino population observed by ecliptic surveys is representative of the entire plutino population, we compare our observed plutino latitude distribution to the CFEPS plutino model. The CFEPS survey (Kavelaars et al., 2009; Gladmanet al., 2010) orbital and brightness distribution is based on the sample of plutinos detected in observations covering ecliptic latitudes less than 2°. None of their detections are Kozai librators, thus only representing the non-Kozai plutino population. CFEPS is sensitive to an absolute magnitude range of $H_{g'}\sim$ 6-10.5, fainter than the sources we are able to detect in our survey. In order to compare their model to our observed latitude distribution, we must extend the distribution to larger objects where the CFEPS survey does not measure directly and where the slope of their measured brightness distribution may not be applicable to the larger bodies that we detect. The H distribution is measured in g′ and we observe

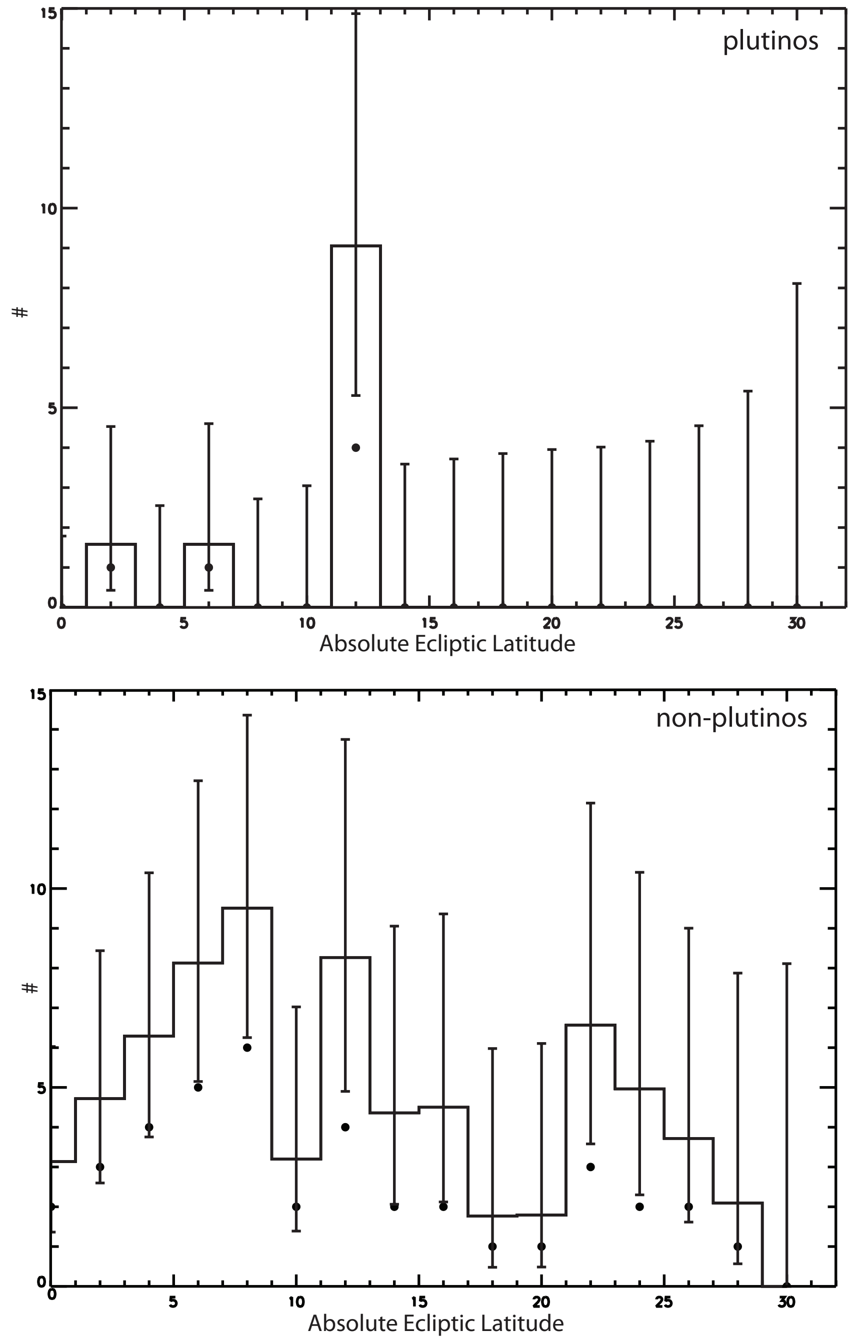

Figure 3.11 The folded latitudinal distribution 2° bins of survey of multi-opposition plutinos (top) and non-plutinos excluding confirmed Haumea family members (bottom) brighter than 21.3 corrected for sky coverage with one-σ Poisson error bars computed for the unfolded distribution added in quadrature. Filled circles shows the number of actual KBO detections in 2° bins

in a broadband R filter. Fraser et al. (2008) find an average KBO value of $< g'$-R $>= 0.95$, and we apply this as our constant offset to the g′ magnitudes. We create a latitude distribution by shuffling the absolute distribution of the 10^5 model plutinos with H_g>10.5 $\sim 10^5$ times. We tally the latitudes of all plutinos for all runs with magnitudes brighter than R=22 that lie within our survey sky coverage in a folded latitude histogram binned in 2° latitude bins. To estimate the expected number of plutinos in the 12° bin, we scale CFEPS model latitude distribution to the value of our folded latitude distribution at 2°, the lowest latitude binned plutino detection in our survey. Assuming Poisson errors and using the quadrature of the fractional errors. $6.7\ ^{+15.6}_{-6.3}$ (68% confidence level) times as many plutinos reside in 11-13° from the ecliptic than are predicted by the non-Kozai plutino CFEPS model. Although the range is quite high, our latitude distribution suggests that the plutino population in particular the Kozai population has been underestimated and may be much larger than previous KBO surveys have reported.

3.8 Number of Bright Objects

Our survey probes the bright-end of the KBO size distribution. Assuming a uniform latitude distribution we can crudely estimate the number of large observable KBOs. Using our nominal survey efficiency function from Section 3.4.3.2 and the effective area covered we compute the expected number of bright KBOs (a>30) as a function of magnitude. We neglect the effects of masked CCD regions and other geometric effects. Our sky coverage drops significantly above latitudes of ±30° and therefore we only focus on detections and sky covered within ±30° of the ecliptic. Figure 3.12 plots the cumulative number of expected bright KBOs as a function of magnitude compared to known multiopposition KBOs.

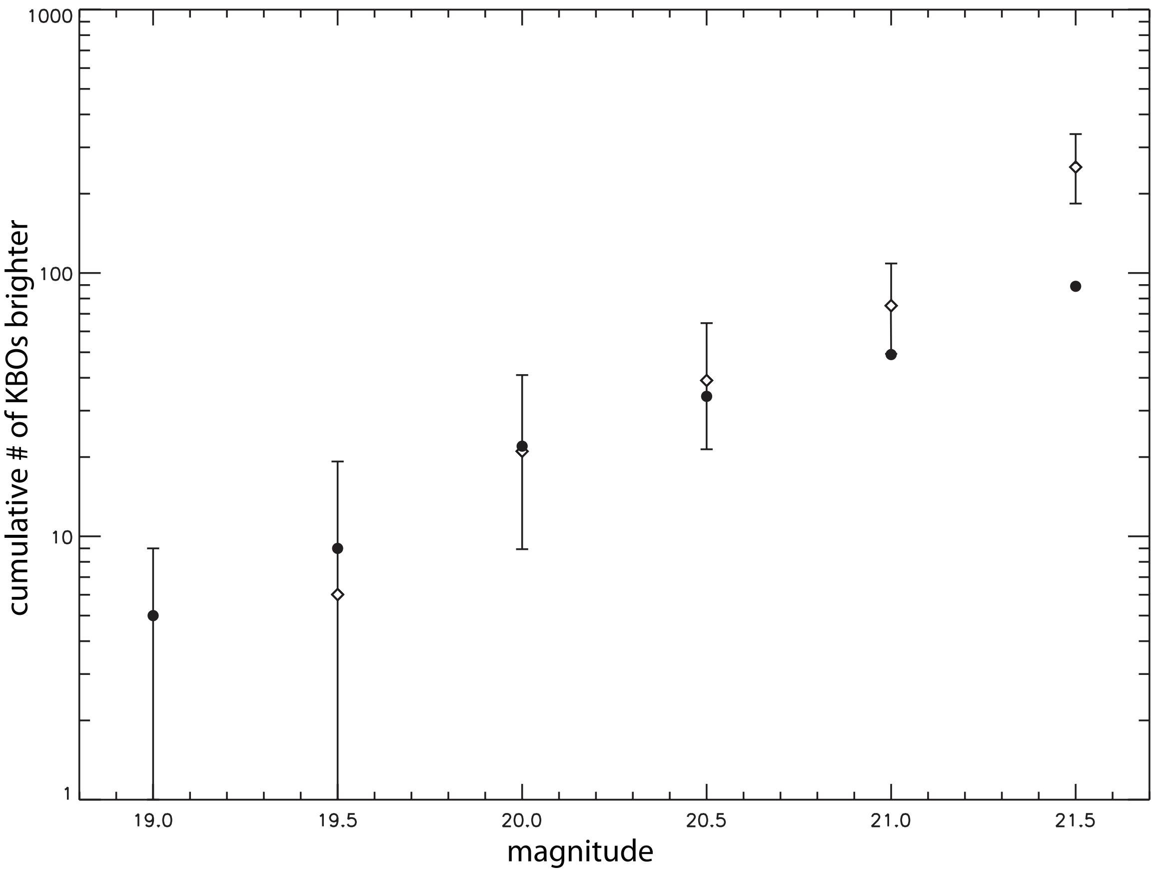

Figure 3.12 Cumulative number of expected KBOs within ± 30° of the ecliptic assuming a flat latitude distribution (open diamonds) with 2-σ Poisson error bars. Cumulative number of known multiopposition KBOs (a≥ 30)within ±30° ecliptic latitude (filled circles).

3.9 Conclusions

Surveying ~12000 deg^2 within ±30° of the ecliptic to ~21.5 in R magnitude, we have searched for additional members of the Sedna population. Based on the 52 KBOs and Centaurs detected in our survey we conclude:

- We detected only one object on a Sedna-like orbit, Sedna, despite a sensitivity to motions of bodies out to ~1000 AU. With one detection, we cannot differentiate between the various proposed formation mechanisms proposed to emplace Sedna on its orbit.

- For the embedded cluster Sedna formation model, we reject the 10^5 and 10^6 $M_\odot/pc^3$ cluster environment-produced populations as consistent with our redetection of Sedna. We find the 10^4 $M_\odot/pc^3$ cluster environment consistent with our observations, with a best-fit population of $N_{H\leq 1.6}= 595^{+1949}_{-400}$ for the hot population and and 112^{+423}_{-71} for the cold population size distributions assuming our nominal detection efficiency of 66%.

- The plutino population has a peaked distribution at $\sim\pm 12^\circ$ ecliptic latitude, likely due to Kozai resonators and current estimates of the size of the plutino population from on-ecliptic surveys insensitive to these high latitude plutinos likely underestimate the size of the true population

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Chapter 4

A Deep Survey in the Region of Sedna

http : //www.naoj.org/photo/dome$_t$ele2$_3$00.jpg

4.1 Abstract

The distant solar system object Sedna exists in a region far beyond the Kuiper belt and must have been emplaced in its orbit at an earlier time when massive unknown bodies were present in or near the solar system. The orbits of these distant Sedna-like bodies are dynamically frozen and serve as a fossilized record of their formation. We have performed a deep sky survey to search for Sedna-like bodies. With Suprime-Cam on the Subaru telescope we have surveyed 43 deg^2 within 40° of the ecliptic down to a limiting r′ magnitude of ∼25.2. Using a two-night baseline, our survey is sensitive to motion out to distances of 1000 AU. We present the results of this survey. We discuss the implications for a distant Sedna-like population beyond the Kuiper belt and future prospects for detecting and studying these distant bodies, focusing in particular on the constraints we can place on the embedded stellar cluster environment the early Sun may have been born in.

4.2 Introduction

The discovery of Sedna (Brown et al., 2004) on an eccentric orbit far outside the Kuiper belt challenges our understanding of the solar system. Sedna is dynamically distinct from the rest of the Kuiper Belt. With a perihelion of 76 AU, Sedna is well beyond the reach of the gas-giants and, unlike typical Kuiper belt objects (KBOs), could not be scattered onto its highly eccentric orbit from interactions with Neptune alone (Emel'yanenko et al., 2003; Gomes et al., 2005). The orbits of many scattered KBOs extend well beyond Sedna's perihelion, but their perihelia remain coupled to Neptune below 50 AU. Sednas aphelion at ∼1000 AU is too far from the edge of the solar system to feel the perturbing effects of passing stars or galactic tides in the present-day solar neighborhood (Duncan et al., 1987; Fernandez, 1997). Some other mechanism no longer active in the solar system today is required to emplace Sedna on its orbit.

Several possible scenarios have been offered to explain Sedna's extreme orbit, including interactions with planet-sized bodies (Gladman & Chan, 2006; Gomes et al., 2006; Lykawka & Mukai, 2008; Gomes & Soares, 2010), stellar encounters (Morbidelli & Levison, 2004), multiple stellar fly-bys in a stellar birth cluster (Morbidelli & Levison, 2004; Brasser et al., 2006, 2007; Kaib & Quinn, 2008), interstellar capture (Kenyon & Bromley, 2004; Morbidelli & Levison, 2004), and perturbations from a wide-binary solar companion (Matese et al., 2005). Each proposed scenario creates a population of icy bodies beyond the Kuiper belt and leaves a distinctive imprint on the orbits of these distant objects. The orbits of these distant planetoids are likely dynamically frozen in place providing a fossilized record of their formation.

To date, wide-field surveys (Larsen et al. 2007; Brown 2008; Schwamb et al. 2010) have been unsuccessful in finding additional Sedna-like bodies. The Palomar Distant Solar System survey (Schwamb et al. 2010), searched ∼12,000 deg^2 down to a limiting R magnitude of ∼21.3, within ±30° of the ecliptic, but did not find any additional Sedna-like bodies with perihelia greater than 45 AU even though it was sensitive to motions out to 1000 AU. Such surveys (Larsen et al. 2007; Brown 2008; Schwamb et al. 2010) are sensitive to only the very brightest members of this distant population. The majority of bodies residing in the Sedna region will be small, dim objects. A narrow deep sky survey is best suited to find these common fainter members of the Sedna population.

Recent pencil-beam surveys have taken observations on a single night spanning a few hours and therefore have not been sensitive to motions beyond ∼200-300 AU (Parker & Kavelaars, 2010b). The Subaru Prime Focus Camera (Suprime-Cam) (Miyazaki et al., 2002) on the 8.2 m Subaru telescope located on Mauna Kea is the ideal instrument to search for the faintest, most distant solar system bodies. There is a trade-off between search area and survey depth, but with Suprime-Cam's relatively large field-of-view (0.25 deg^2) and small overhead, we can probe a sufficiently large enough area to find Sednas 100 times fainter than those detectable in the Schwamb et al. (2010) Palomar survey. With Suprime-Cam, we have surveyed 43 deg^2 within 40° of the ecliptic down to a limiting r′ magnitude of ∼25.2 to search for additional members of the distant Sedna population. Using a two night baseline, our survey is sensitive to motion out to distances of 1000 AU.

Parker & Kavelaars (2010a) reexamined previous published Kuiper belt pencil-beam surveys covering only a few square degrees of sky on the ecliptic, including Bernstein et al. (2004)'s Hubble Space Telescope (HST) survey sensitive to objects brighter than 28.5 in R, to constrain the properties of a Sedna population. Assuming an isotropic latitude distribution and an assumed radial distribution, finding that these deep surveys provide strong upper limits for steep sloped size distributions. With our large sky coverage compared to previous surveys, we can place new constraints and limits on the numbers of smaller fainter members of a distant Sedna population. We present the results of this survey, and discuss the implications for a distant Sedna-like population beyond the Kuiper belt including future prospects for detecting these distant bodies using our Subaru observations and including the Bernstein et al. (2004) observations in our analysis. We focus on the constraints we can place on the embedded stellar cluster environment the early Sun may have been born in, where the location and distribution of Sedna-like orbits sculpted by multiple stellar encounters is indicative of the birth cluster's size (Brasser et al., 2006). This work expands on Schwamb et al. (2010), which used the results of their wide-field survey to constrain the size and distribution of Sedna-like orbits produced in Brasser et al. (2006) modeled embedded cluster environment for the H $\lesssim$ 4 Sedna population. We also present the results of this survey including the latitude distribution of the hot (i>5) KBO population.

4.3 Observations

Observations were taken on UT 2007 November 14 and 15 and on UT 2008 September 30 and October 1 with Suprime-Cam on the Subaru 8.2 m telescope. Located at prime focus, Suprime-Cam has a field of view of $34'$x$27'$ with a pixel scale of $0.2''$. The camera is equipped with 10 CCDs arranged in a 5x2 pattern with the long axis along the east-west direction. The November 2007 observations used MIT Lincoln Laboratory 2400x4800 pixel CCDs. The spacing between the chips in the north-south direction was $\sim 4''$ and $\sim 17''$ along the east-west direction. Suprime-Cam was upgraded in mid 2008. The CCDs and the front-end electronics were replaced, and the 2008 September data was taken with fully-depleted-type Hamamatsu Photonics K.K 2048x4096 pixel CCDs. The pixel scale and camera orientation remained the same after the upgrade. The spacing between the CCDs changed; the RA and declination chip gaps were $16''$ each. The November 2007 nights were mainly photometric with a few scattered cirrus with a median seeing of $0.68''$ FWHM. The two September nights were photometric with a median seeing of $0.59''$ FWHM. Calibration on all four nights was performed with Landolt (1992) standards taken on each night.

In order to distinguish the extremely slow motions of distant solar system objects from background stars, we searched for motion over two nights. Each target field was observed twice on both nights with observations separated by approximately 1.5 hours or more. The first night's fields were repeated on the second night to search for objects moving at speeds as low as 0.1 $''\mathrm{hr}^{-1}$ ($\sim$1500 AU). Each exposure consists of a 120 second integration, and all observations were taken in a single filter, the SDSS r' filter. Target fields were observed within $40°$ of the ecliptic and near opposition ($104°$-$75°$ from the Earth's motion vector) where the apparent movement of distant solar system objects was dominated by the Earth's parallax. Field centers are compiled in Table B.1 in Appendix B. Our sky coverage is shown in Figure 4.1 and latitudinal coverage is plotted in Figure 4.2.

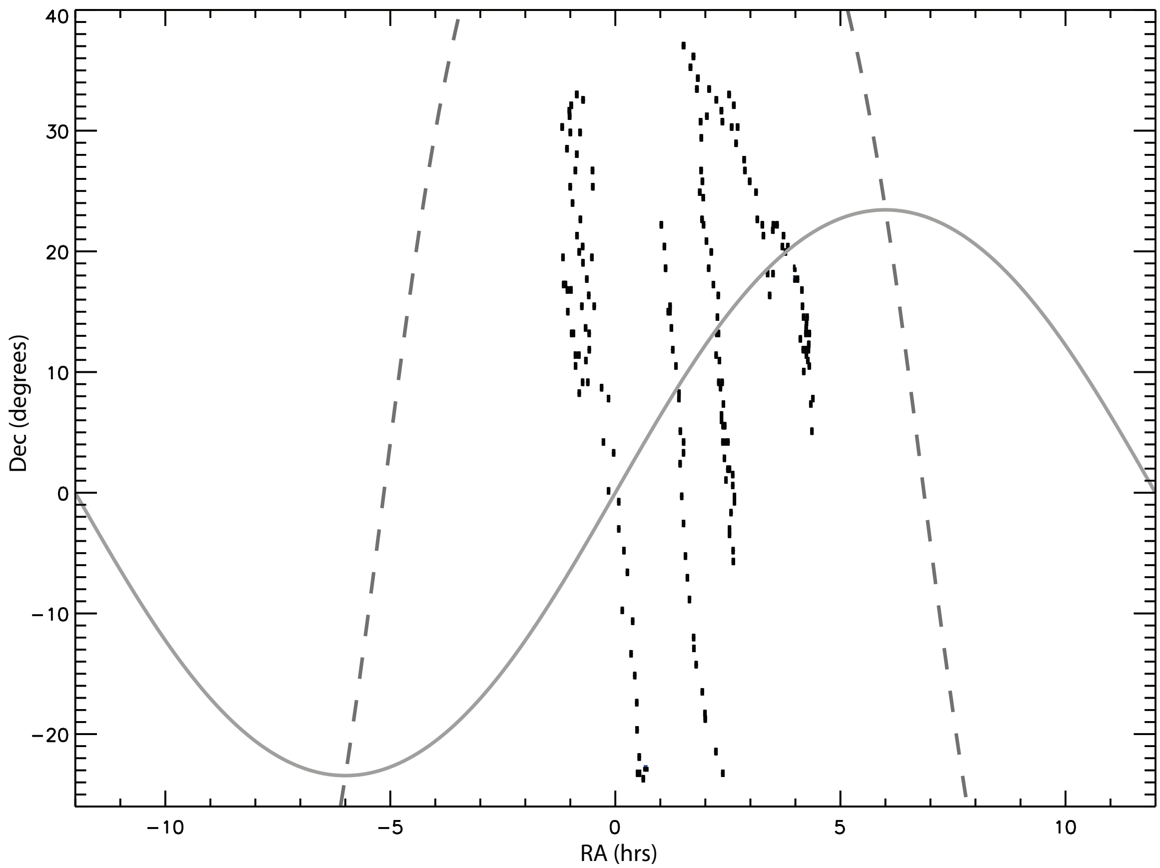

Figure 4.1 Sky coverage of the survey plotted on the J2000 sky. The observed fields are plotted to scale. The plane of the Milky Way is denoted as a dashed line, and the ecliptic is denoted as a solid line.

4.4 Data Analysis and Moving Object Detection

For each run, our images were bias subtracted and flat-field corrected. A row-by-row median of the overscan region was used for the bias subtraction. Images were flat-fielded from a master skyflat assembled from a 3-σ clipped median of both nights' science exposures. SExtractor (Bertin & Arnouts, 1996) generated a list of all sources on each CCD image. SExtractor was tuned such that a source detection constituted 3 or more contiguous pixels (DETECT_MINAREA parameter) above the detection thresh-

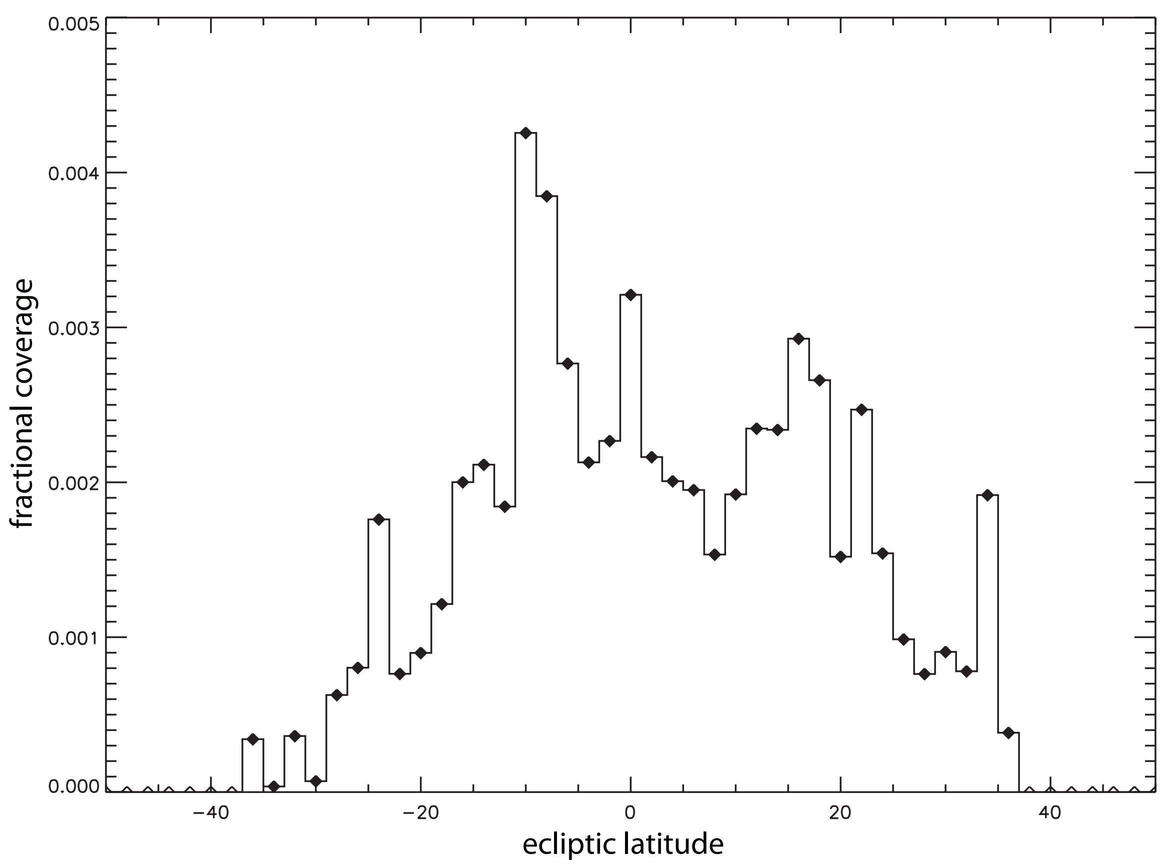

Figure 4.2 Latitudinal coverage of the Subaru survey binned in 2° bins.

old (DETECT_THRESH parameter) of 1.3-σ above the sky background. SExtractor performed circular-aperture photometry using a 5-pixel radius aperture. Instrumental magnitudes were used during the search process, later more accurate aperture photometry with zeropoint and airmass corrections were applied to all the detections and used to obtain the detection thresholds for each image.

Linear astrometric solutions were solved for each CCD independently in the mosaic using SCAMP (Bertin, 2006). The best of the four field images was selected as the master template whose absolute astrometric solution was found by matching image stars to the USNO B1.0 catalog (Monet et al., 2003). To further reduce the positional errors and ensure detection of slow moving solar system bodies, relative astrometry was performed between the master template and the three additional field observations. The median relative astrometric error between survey images was $0.03''$. The median absolute astrometric error for our images relative to the USNO B1.0 catalog was $0.65''$.

Distant objects may move too slowly to show apparent motion between field images taken over the course of one night. To ensure detection of these distant solar system bodies, we only required motion to be identified over the two-night baseline. The detection catalogs from all four field observations were compared to identify and eliminate the stationary sources in each image. First, saturated sources and extended sources whose peak flux was more than 3 pixels from the measured source center were removed from the SExtractor generated catalogs. From the remaining detections, sources that have not moved further than $0.5''$ between the two nights (corresponding to on-sky motions of less than $0.02''\mathrm{hr}^{-1}$) were removed as stationary background stars. To further cull the object lists of stars that were above the SExtractor thresholds on one night but below the detection limit on the other, we generated SExtractor source catalogs with more sensitive detection parameters (DETECT_MINAREA = 3 and DETECT_THRESH = 1), and compared these deep catalogs to our detection lists. Image sources from one night that appeared on the other night's deep detection catalogs were deemed stationary and rejected as well.

Moving solar system bodies were identified from the remaining unmatched sources. All 10 CCDs were searched together in order to ensure the detection of KBOs that had moved from one CCD to another between observations. We first required that any moving object be detected on all four field observations. Exploiting the opposition effect, slow-moving solar system objects were identified by their retrograde motion. The nightly field observations were searched for moving object pairs with motions less than 10 $''\mathrm{hr}^{-1}$, the velocity of bodies at 15 AU. The moving objects pairs from each night were compared, and those candidates with consistent nightly motions in ecliptic latitude and longitude (less than 0.5 $''\mathrm{hr}^{-1}$ difference in each direction) and with less than 0.5 $''\mathrm{hr}^{-1}$ differences in ecliptic latitude and longitude motions between the first and second field observation and the first and third observation were considered to be moving objects. The list of candidates was further filtered via the Bernstein & Khushalani (2000) orbit fitting program. Submitted candidates with best-fit orbits producing a χ^2 less than 200 and at a barycentric distance greater that 15 AU but less than 1000 AU were then screened visually to confirm the presence of a moving source. Discovery images were aligned and blinked for 1986 candidate detections.

The images were then re-searched for triplet detections missed in our initial search where the KBO was found on only three but not all four observations due to changes in limiting magnitude or moving off into the CCD chip gaps. For each night, non-stationary sources with fluxes greater than 900 counts on each image with retrograde motions less than 10 $''\mathrm{hr}^{-1}$ and magnitudes differing by less than 0.7 mag were linked as moving object pairs. For moving objects pairs with on sky separations greater than 1 arcsecond, we confirmed that the deeper more sensitive SExtractor catalogs did not have a source present in the other image from the same night. Pairs from each night were linked with transient sources from either of the two images on the other night. If the standard deviation in magnitude was less than 0.5 mag and the differences in ecliptic motions between the first and second detection and the first and third detection were less than 0.5 $''\mathrm{hr}^{-1}$, the candidate KBO was passed through to the orbit-fitting filter. Objects at distances greater than 25 AU and less than 1000 AU with a χ^2 less than 5 were then visually examined for motion. 3474 triplet detections were screened by eye.

4.5 Calibration

Photometric calibrations were obtained from Landolt (1992) standard stars imaged several times positioned on one of the cameras centermost CCDs. The Suprime-Cam CCDs were upgraded between the two observing runs in mid 2008. The photometric calibration accounted for these changes. During the 2007 November observing run, one of the two shutter blades was non-functioning, and we have accounted for the non-uniform exposure time across the CCDs. The zeropoint and airmass correction was measured from several Landolt stars observed at different airmasses imaged at the beginning and end of each night. The Landolt standards were located on the same CCD for all exposures. Landolt (1992) photometric magnitudes were converted to the Subaru r′ filter from the transformations reported in Fukugita et al. (1996).

Limiting magnitudes were calculated for each CCD individually. We have not calibrated the survey depth by implanting synthetic moving objects into the survey images. Instead we calculate a minimum magnitude threshold for which above SExtractor detects a source and below it does not. We find that the faintest magnitude with a 5-σ uncertainty as reported by SExtractor represents an accurate measure of the source detection limit of our images. The median r′ limiting magnitude of the combined 2007 November and 2008 September observing runs is 25.2.

4.6 Detection Efficiency of Sedna-like Bodies

The Bernstein & Khushalani (2000)'s software package was designed specifically for fitting the orbits of Kuiper belt objects, but not necessarily for distant highly eccentric orbits like Sedna. The cluster-produced Sedna populations (Brasser et al., 2006) have highly eccentric and even retrograde orbits. All candidate detections were filtered via the Bernstein & Khushalani (2000) software package. For potential moving objects found on all four field observations, only those with orbital solutions with a χ^2 less than 200 and at a barycentric distance between 15 and 1000 AU went on to be visually examined. For triplet detections, orbits with a χ^2 less than 5 located beyond 25 AU and less than 1000 AU were visually screened by eye. To determine what fraction of Sedna-like orbits would not pass our orbit-fitting criteria, we created artificial orbits with a uniform eccentricity and inclination distribution, including retrograde orbits. We choose a range of semimajor axes from 100-1000 AU in 100 AU increments. For every semimajor axis value tested, 10^4 artificial Sedna-like objects with perihelia greater than 50 AU and barycentric distances less than 1000 AU are positioned within the sky covered by the camera mosaic (including sources that move from one chip to another). We add normally distributed random absolute and relative astrometric errors using the 3-σ clipped median and standard deviation of the survey astrometric uncertainties. All generated "observations" for each synthetic orbit have the same absolute astrometric error but random relative positional errors. In order to examine our survey efficiency for the triplet search, one of the four calculated positions is randomly removed and the orbit refit. As shown in Fig 4.3, the efficiency is the fraction of synthetic orbits fit with the Bernstein & Khushalani (2000) software that pass our selection criteria in each semimajor axis bin compared to the number of objects in the bin for both triplet and quadruplet detections. 4% of the synthetic population would not have made it through to visual inspection in the quadruplet search. For triplet detections, 80% of the orbits passed the χ^2 filter. We are confident that additional Sedna-like bodies present in our images detected by SExtractor would be identified by our automated detection scheme.

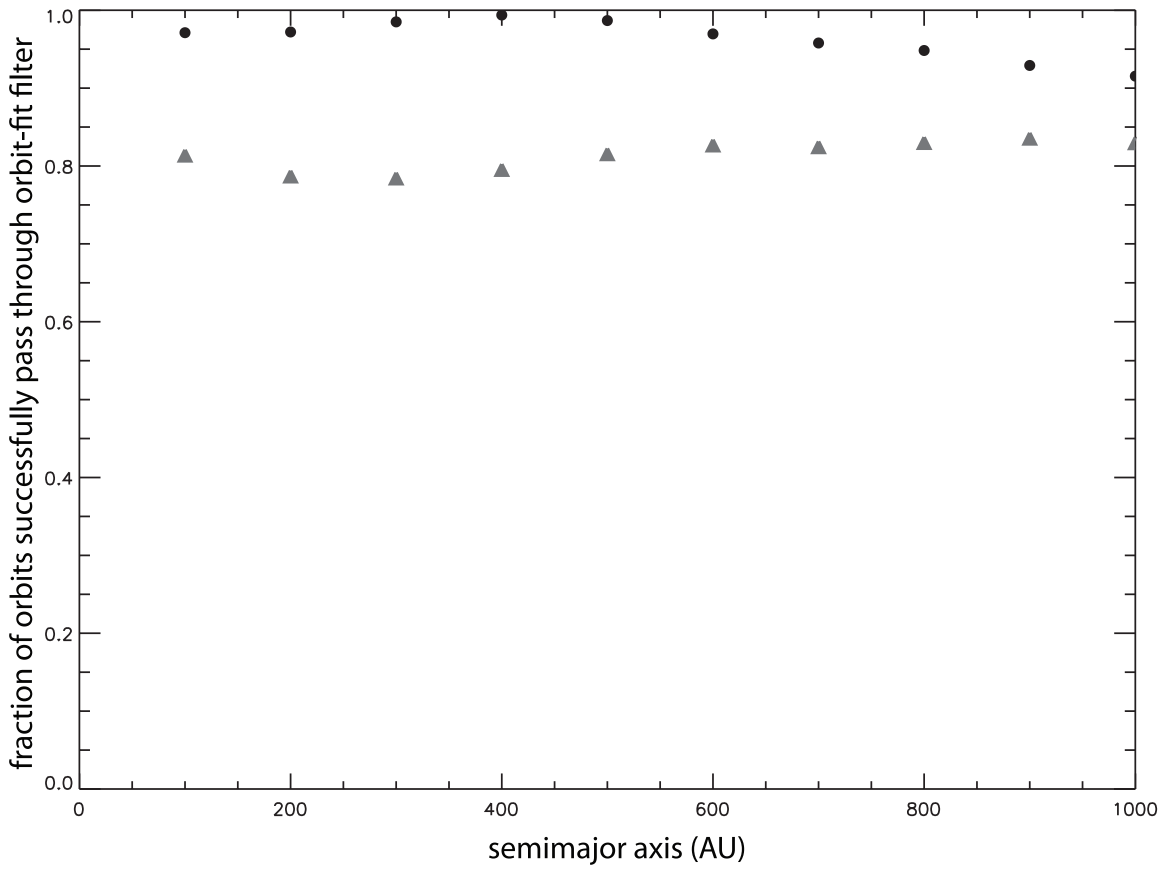

Figure 4.3 Efficiency of our orbit-fit detection filter for quadruplet (circles) and triplet (grey triangles) detections Fraction of orbits with barycentric distances between 10-1000 AU (25-1000 AU for triplet detections) that successfully are identified as outer solar system bodies versus semimajor axis.

4.7 Detections and Identifying Sedna-like Orbits

202 objects beyond 17 AU were detected in our survey. Of these 166 were detected on all four field observations and an additional 36 objects were found in our triplet detection search. Figure 4.4 plots the ecliptic latitudes and barycentric distances

of detections. Table 4.1 lists the discovery circumstances of all detections. Three known multiopposition KBOs were serendipitously located within our sky coverage (2006 WS195, 2004 TV357, and 2003 SP317), and all three KBOs were found by the detection pipeline. 11 objects (8-22 objects within the 1-σ error bars) were found at distances greater than 50 AU. The discovery observations alone are insufficient to disentangle which of the distant bodies we discover are Sedna-like bodies on detached orbits rather than typical Kuiper belt objects scattered by Neptune. Only heliocentric distance and inclination can be identified at discovery. Other orbital parameters remain unconstrained. Both families of orbits provide reasonable fits to the short discovery arc. The two orbital solutions diverge sufficiently within a year after discovery, and a secure dynamical identification can only be made after additional one year recovery observations.

Our most distant object detected, 20080930_002, is located at 72 AU. We targeted objects past 50 AU for follow-up observations in order to obtain secure dynamical classifications, but of these objects, only two (20080930_002 and 20080930_044) discovered in the 2008 September run were successfully recovered with Keck LRIS observations a month later on 2008 October 31 (UT) and a year later with Gemini GMOS observations on 2009 September 16 (UT) for 20080930_002 and 2009 September 27 (UT) for 20080930_044. We were also able to recover 20080930_002 on LRIS on 2009 November 11 (UT) as well. With a secure orbit, 20080930_002 is not on a Sedna-like orbit but instead a scattered disk KBO at aphelion. The Bernstein & Khushalani (2000) best fit orbit yields a semimajor axis of a =56.0 ± 0.2 AU, an eccentricity of e = 0.31 ± 0.01, and an inclination of i = 20.72 ± 0.01°. Follow-up observations confirm that 20080930_044 is near perihelia but has a lower semimajor axis more consistent with a detached KBO rather than a member of the Sedna population. The best-fit orbit yields a semimajor axis of a = 53.7 ± 2.9 AU, an eccentricity of e =0.16 ± 0.15, and an inclination of i=35.6 ± 0.01°. With its high inclination, 20080930_044 could be a resonant KBO trapped in a Kozai resonance. At zero inclination, 20080930_044 would have a perihelion of 22 AU well within the planetary region.

No Sedna-like bodies with perihelia greater than 65 AU were detected in the survey. For the remaining 9 (6-20 within the 1-σ error bars) objects, we are unable to rule them out as being on Sedna-like orbits near perihelia and must include them in our population estimates. Without additional Sedna-like bodies with secure orbits, we are unable to differentiate between the various Sedna formation models, but we can test the the cluster birth model, where the location and distribution of Sedna-like orbits sculpted by multiple stellar encounters is indicative of the birth cluster size (Brasser et al., 2006).

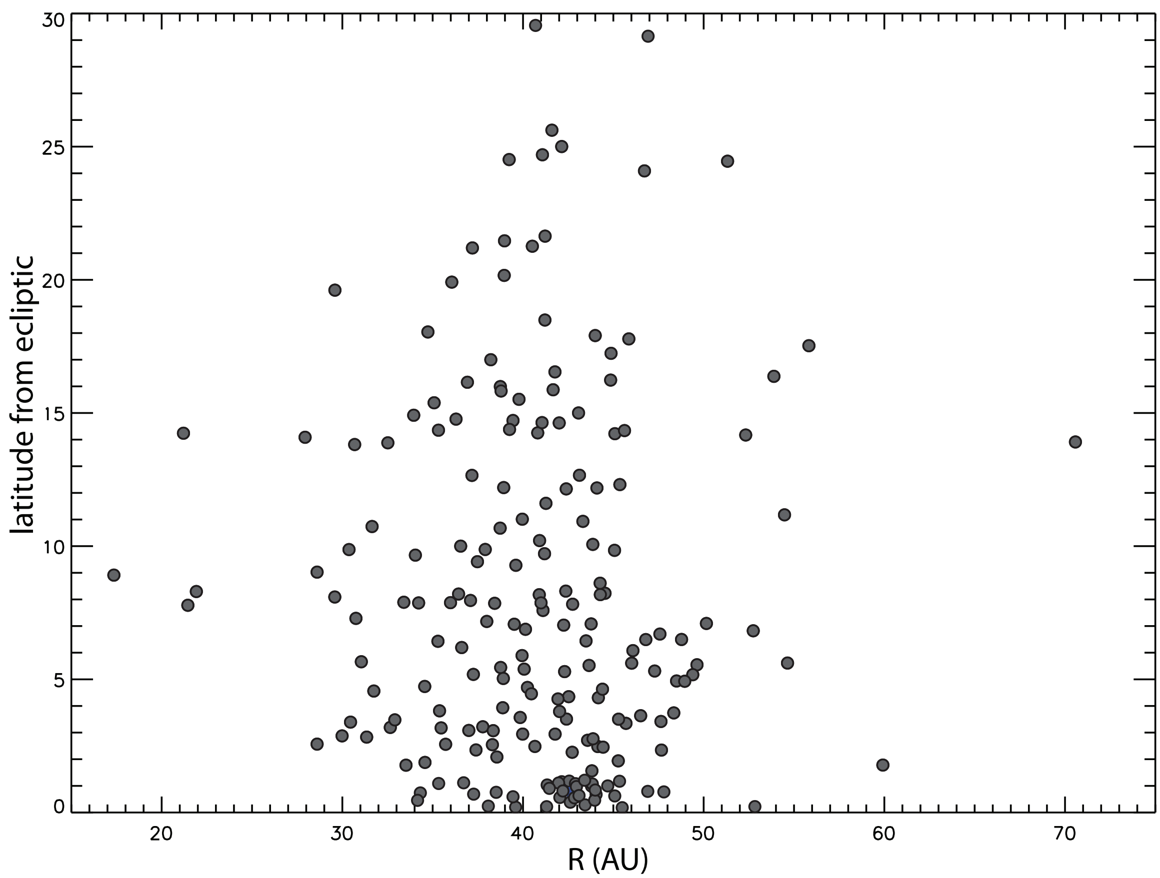

Figure 4.4 Absolute ecliptic latitude vs. barycentric distance for objects detected in the Subaru survey.

designation	ecliptic latitude (deg)	R (AU)	i (deg)	night 1 avg r′ mag	night 2 avg r′ mag	discovery circumstance
20071115_000	21.64	41.22 ± 3.10	41.33 ±11.23	24.9 ± 0.10	24.9± 0.10	Q
20071115_001	7.87	34.22 ± 2.54	16.64 ± 4.42	25.6 ± 0.12	25.5± 0.12	Q
20071115_002	6.82	52.74 ± 2.70	9.55 ± 1.75	26.1 ± 0.14	25.5± 0.14	Q
20071115_003	6.70	47.58 ± 2.62	8.70 ± 1.33	24.7 ± 0.05	24.5± 0.05	Q
20071115_004	2.57	28.60 ± 2.74	24.82 ±10.99	25.1 ± 0.10	25.1± 0.10	Q
20071115_005	0.97	42.96 ± 2.54	2.08 ± 1.36	25.6 ± 0.14	25.8± 0.14	Q
20071115_006	0.77	47.80 ± 2.62	2.80 ± 1.80	25.7 ± 0.10	25.3± 0.10	Q
20071115_007	0.76	38.52 ± 2.54	8.49 ± 3.46	23.7 ± 0.04	23.9± 0.04	Q
20071115_008	-0.24	38.08 ± 2.73	19.59 ± 7.98	24.1 ± 0.04	24.3± 0.04	Q
20071115_009	-0.22	41.31 ± 2.54	0.47 ± 1.11	26.2 ± 0.15	25.8± 0.15	Q
20071115_010	-0.18	45.49 ± 2.60	0.91 ± 1.45	25.4 ± 0.09	25.2± 0.09	Q
20071115_011	-0.56	42.04 ± 2.57	8.63 ± 3.36	24.7 ± 0.05	24.6± 0.05	Q
20071115_012	-0.29	43.43 ± 2.57	3.82 ± 1.95	24.6 ± 0.04	24.0± 0.04	Q
20071115_013	-0.68	44.05 ± 2.57	3.21 ± 1.79	25.3 ± 0.09	25.2± 0.09	Q
20071115_014	-2.71	43.58 ± 2.58	4.70 ± 1.80	25.6 ± 0.10	25.4± 0.10	Q
20071115_015	-4.94	48.50 ± 4.62	43.96 ±25.13	26.0 ± 0.13	25.7± 0.13	Q
20071115_016	-4.69	40.24 ± 2.53	4.83 ± 0.51	25.2 ± 0.11	25.2± 0.11	Q
20071115_017	-6.43	35.29 ± 2.50	13.28 ± 3.46	25.4 ± 0.09	25.0± 0.09	Q
20071115_018	-8.20	36.43 ± 2.51	9.83 ± 1.96	25.7 ± 0.09	25.4± 0.09	Q
20071115_019	-8.18	40.90 ± 2.93	27.91 ± 9.65	26.0 ± 0.16	25.5± 0.16	Q
20071115_020	-11.01	39.96 ± 2.53	10.85 ± 0.18	24.7 ± 0.05	24.5± 0.05	Q
20071115_021	-10.74	31.64 ± 2.46	10.86 ± 0.80	24.9 ± 0.06	24.8± 0.06	Q
20071115_022	-12.18	44.09 ± 2.81	19.93 ± 6.25	25.4 ± 0.09	25.3± 0.09	Q
20071115_023	-13.88	32.52 ± 2.43	18.15 ± 2.28	25.8 ± 0.12	25.5± 0.12	Q
20071115_024	-13.82	30.68 ± 2.88	26.91 ±11.01	25.0 ± 0.07	24.8± 0.07	Q
20071115_025	19.61	29.59 ± 2.40	26.09 ± 3.96	25.0 ± 0.05	24.8± 0.05	Q
20071115_026	16.54	41.77 ± 2.46	17.05 ± 1.06	25.9 ± 0.08	24.9± 0.08	Q
20071115_027	15.83	38.79 ± 2.49	19.38 ± 3.41	26.1 ± 0.10	25.6± 0.10	Q
20071115_028	15.87	41.67 ± 2.52	22.48 ± 3.78	25.8 ± 0.09	25.4± 0.09	Q
20071115_029	14.35	35.32 ± 2.37	18.83 ± 2.87	26.1 ± 0.11	26.2± 0.11	Q
20071115_030	14.24	21.21 ± 2.28	17.23 ± 3.57	26.1 ± 0.37	26.8± 0.37	Q
20071115_031	14.22	45.09 ± 2.67	22.59 ± 5.98	25.9 ± 0.18	26.2± 0.18	Q
20071115_032	12.66	43.12 ± 2.61	21.03 ± 5.79	26.2 ± 0.40	26.8± 0.40	Q
20071115_033	12.66	37.17 ± 2.44	19.95 ± 4.35	24.4 ± 0.04	24.6± 0.04	Q
20071115_034	9.66	34.04 ± 2.29	10.41 ± 0.74	24.3 ± 0.04	24.4± 0.04	Q
20071115_035	8.31	42.37 ± 3.14	34.82 ±14.42	25.5 ± 0.09	25.4± 0.09	Q
20071115_036	8.23	44.54 ± 3.15	34.38 ±14.03	25.6 ± 0.11	25.7± 0.11	Q
20071115_037	7.17	37.99 ± 2.51	20.09 ± 6.86	26.4 ± 0.14	26.1± 0.14	Q
20071115_038	6.88	40.14 ± 2.60	21.59 ± 7.84	25.8 ± 0.12	25.8± 0.12	Q
20071115_039	4.56	31.74 ± 2.25	4.66 ± 0.34	24.9 ± 0.05	24.8± 0.05	Q
20071115_040	4.93	48.95 ± 2.90	26.95 ±10.24	26.1 ± 0.14	25.9± 0.14	Q
20071115_041	5.03	38.91 ± 2.63	23.26 ± 8.85	23.6 ± 0.04	24.4± 0.04	Q
20071115_042	3.82	35.38 ± 2.40	15.61 ± 5.74	26.0 ± 0.15	25.9± 0.15	Q
2004 TV357	3.08	36.14 ± 0.00	9.80 ± 0.00	23.3 ± 0.01	23.2± 0.01	Q
20071115_044	3.19	32.65 ± 2.26	5.42 ± 1.58	25.0 ± 0.06	24.8± 0.06	Q
20071115_045	2.83	31.35 ± 2.29	10.17 ± 3.81	26.0 ± 0.17	26.0± 0.17	Q
20071115_046	2.88	29.98 ± 2.24	7.49 ± 2.60	25.6 ± 0.09	25.3± 0.09	Q
20071115_047	2.55	38.30 ± 2.62	22.42 ± 8.96	26.2 ± 0.31	26.5± 0.31	Q
20071115_048	-0.39	42.62 ± 2.40	5.36 ± 2.31	26.3 ± 0.21	26.5± 0.21	Q
20071115_049	-0.55	42.85 ± 2.39	3.48 ± 1.78	24.9 ± 0.07	25.0± 0.07	Q
20071115_050	-0.46	43.97 ± 2.40	2.31 ± 1.55	26.5 ± 0.21	26.2± 0.21	Q

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designation	ecliptic latitude (deg)	R (AU)	i (deg)	night 1 avg r′ mag	night 2 avg r′ mag	discovery circumstance
20071115_051	-0.81	42.21 ± 2.38	1.59 ± 1.19	25.3 ± 0.10	25.4± 0.10	Q
20071115_052	-0.64	43.10 ± 2.39	0.63 ± 0.19	24.4 ± 0.03	24.1± 0.03	Q
20071115_053	-1.07	43.84 ± 2.40	1.96 ± 1.25	24.3 ± 0.04	24.0± 0.04	Q
20071115_054	-0.79	46.91 ± 2.45	3.92 ± 1.98	25.4 ± 0.06	24.8± 0.06	Q
20071115_055	-2.48	44.14 ± 2.40	2.43 ± 0.10	25.3 ± 0.09	25.3± 0.09	Q
20071115_056	-2.35	37.40 ± 2.39	12.27 ± 4.58	25.1 ± 0.06	24.9± 0.06	Q
20071115_057	-2.34	47.66 ± 2.53	12.26 ± 4.50	24.8 ± 0.05	24.8± 0.05	Q
20071115_058	-2.08	38.55 ± 2.35	6.09 ± 2.26	24.7 ± 0.06	24.8± 0.06	Q
20071115_059	-4.46	40.46 ± 3.92	38.69 ±20.86	26.0 ± 0.24	26.4± 0.24	Q
20071115_060	-4.35	42.53 ± 2.57	4.32 ± 0.27	26.4 ± 0.22	26.0± 0.22	Q
20071115_061	-4.31	44.17 ± 2.60	4.22 ± 0.07	26.2 ± 0.12	25.8± 0.12	Q
20071115_062	-4.26	41.94 ± 2.57	4.71 ± 0.85	25.9 ± 0.15	26.0± 0.15	Q
20071115_063	-7.03	42.25 ± 2.57	8.51 ± 0.96	24.6 ± 0.04	24.6± 0.04	Q
20071115_064	-7.10	50.15 ± 2.69	7.73 ± 1.14	25.2 ± 0.12	25.4± 0.12	Q
20071115_065	-8.18	44.28 ± 2.77	17.38 ± 6.23	26.0 ± 0.17	26.2± 0.17	Q
20071115_066	-8.30	21.92 ± 3.28	30.09 ±18.28	25.8 ± 0.26	26.6± 0.26	Q
20071115_067	-9.87	30.37 ± 2.42	9.84 ± 0.56	26.6 ± 0.16	26.0± 0.16	Q
20071115_068	-9.84	45.07 ± 2.67	12.52 ± 2.77	25.7 ± 0.12	25.7± 0.12	Q
20071115_069	-14.91	33.95 ± 2.46	15.68 ± 1.58	26.2 ± 0.21	26.5± 0.21	Q
20071115_070	-14.77	36.29 ± 3.02	28.48 ±11.20	25.8 ± 0.10	25.5± 0.10	Q
20071115_071	-15.51	39.78 ± 2.62	18.54 ± 3.44	24.5 ± 0.04	24.6± 0.04	Q
20071115_072	-15.38	35.08 ± 2.65	27.94 ± 6.69	25.1 ± 0.07	25.0± 0.07	Q
2006 WS195	-17.00	38.37 ± 0.00	32.70 ± 0.00	24.5 ± 0.04	24.6± 0.04	Q
20071115_074	-19.91	36.06 ± 2.58	20.99 ± 2.21	25.5 ± 0.11	25.4± 0.11	Q
20071115_075	2.94	39.98 ± 3.33	36.96 ±17.67	24.8 ± 0.08	24.9± 0.08	Q
20071115_076	2.94	41.78 ± 2.39	4.85 ± 1.55	25.9 ± 0.27	26.3± 0.27	Q
20071115_077	1.21	43.41 ± 2.40	1.24 ± 0.40	25.0 ± 0.11	25.1± 0.11	Q
20071115_078	0.20	39.59 ± 2.99	31.18 ±13.71	24.5 ± 0.04	24.5± 0.04	Q
20071115_079	-1.88	34.57 ± 2.49	18.40 ± 7.23	26.0 ± 0.14	25.8± 0.14	Q
20071115_080	-2.77	43.88 ± 2.43	2.77 ± 0.28	25.7 ± 0.12	25.4± 0.12	Q
20071115_081	-3.93	38.88 ± 2.73	25.14 ± 9.85	24.1 ± 0.05	24.2± 0.05	Q
20071115_082	-5.29	42.30 ± 3.04	32.04 ±13.11	25.1 ± 0.10	25.0± 0.10	Q
20071115_083	-6.49	46.80 ± 2.49	6.86 ± 0.60	25.5 ± 0.13	25.3± 0.13	Q
20071115_084	-6.44	43.49 ± 2.78	23.13 ± 8.95	25.7 ± 0.28	26.3± 0.28	Q
20071115_085	-6.50	48.77 ± 2.74	18.70 ± 6.72	25.0 ± 0.11	25.2± 0.11	Q
20071115_086	-7.96	37.09 ± 2.59	19.55 ± 7.19	26.7 ± 0.26	26.4± 0.26	Q
20071115_087	-8.09	29.58 ± 2.40	17.93 ± 5.47	25.9 ± 0.16	25.5± 0.16	Q
20071115_088	-9.02	28.60 ± 2.24	8.77 ± 0.08	24.2 ± 0.04	24.0± 0.04	Q
20071115_089	-9.72	41.19 ± 2.73	23.42 ± 8.48	25.1 ± 0.12	25.1± 0.12	Q
20071115_090	-10.68	38.73 ± 2.42	15.15 ± 2.68	25.0 ± 0.11	25.0± 0.11	Q
20071115_091	-10.93	43.31 ± 3.17	32.92 ±13.70	23.2 ± 0.02	23.3± 0.02	Q
20071115_092	-9.28	39.60 ± 2.97	32.66 ±12.48	24.3 ± 0.08	24.6± 0.08	Q
20071115_093	-7.87	41.00 ± 2.43	8.55 ± 0.98	24.3 ± 0.07	24.3± 0.07	Q
20071115_094	-7.78	21.45 ± 2.54	23.53 ± 9.96	24.2 ± 0.11	24.4± 0.11	Q
20071115_095	-7.89	33.40 ± 2.65	25.69 ± 9.46	23.8 ± 0.04	23.5± 0.04	Q
20071115_096	-7.82	42.75 ± 2.45	9.69 ± 1.30	24.1 ± 0.07	24.0± 0.07	Q
20071115_097	-7.29	30.75 ± 2.36	14.91 ± 4.26	22.2 ± 0.02	22.6± 0.02	Q
20071115_098	16.38	53.89 ± 2.70	16.09 ± 0.01	25.8 ± 0.14	25.7± 0.14	T
20071115_099	11.61	41.27 ± 2.57	12.19 ± 1.23	26.5 ± 0.39	26.6± 0.39	T
20071115_100	0.91	41.46 ± 2.54	1.84 ± 1.52	25.5 ± 0.20	25.3± 0.20	T
20071115_101	0.84	44.00 ± 2.59	5.82 ± 2.69	25.1 ± 0.18	25.7± 0.18	T

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designation	ecliptic latitude (deg)	R (AU)	i (deg)	night 1 avg r′ mag	night 2 avg r′ mag	discovery circumstance
20071115_102	-0.46	34.16 ± 2.44	1.87 ± 1.23	24.3 ± 0.07	24.6± 0.07	T
20071115_103	-0.62	45.08 ± 2.58	2.53 ± 1.87	25.7 ± 0.49	26.9± 0.49	T
20071115_104	-2.48	40.66 ± 2.59	11.65 ± 4.14	26.1 ± 0.29	26.2± 0.29	T
20071115_105	-9.42	37.48 ± 3.50	33.39 ±16.81	25.5 ± 0.10	25.4± 0.10	T
20071115_106	17.78	45.86 ± 2.53	21.49 ± 2.22	26.0 ± 0.32	26.4± 0.32	T
20071115_107	17.53	55.82 ± 2.72	17.69 ± 0.85	26.4 ± 0.24	26.3± 0.24	T
20071115_108	-2.45	44.43 ± 2.42	2.50 ± 0.51	25.6 ± 0.40	26.6± 0.40	T
20071115_109	-2.26	42.72 ± 2.39	4.63 ± 1.87	25.5 ± 0.09	25.7± 0.09	T
20071115_110	-4.63	44.40 ± 2.62	8.88 ± 2.38	23.9 ± 0.04	23.8± 0.04	T
20071115_111	-8.61	44.27 ± 3.57	39.22 ±16.39	26.8 ± 0.20	26.3± 0.20	T
20071115_112	-10.00	36.55 ± 2.47	9.74 ± 0.07	25.6 ± 0.06	24.8± 0.06	T
20071115_113	-10.21	40.92 ± 2.53	12.78 ± 1.47	25.8 ± 0.11	25.5± 0.11	T
20071115_114	-15.00	43.07 ± 2.55	14.84 ± 0.45	25.2 ± 0.07	25.1± 0.07	T
20071115_115	-17.24	44.87 ± 3.15	27.88 ± 9.44	25.6 ± 0.12	25.6± 0.12	T
20071115_116	3.07	38.35 ± 2.59	21.70 ± 8.51	25.4 ± 0.11	25.1± 0.11	T
20071115_117	1.56	43.81 ± 2.50	12.62 ± 4.87	25.6 ± 0.21	25.8± 0.21	T
20071115_118	0.69	37.27 ± 2.32	1.16 ± 1.06	24.7 ± 0.07	24.6± 0.07	T
20071115_119	0.22	52.83 ± 2.55	2.35 ± 2.28	25.2 ± 0.13	25.3± 0.13	T
20071115_120	-1.94	45.27 ± 2.46	2.68 ± 1.26	25.0 ± 0.14	25.6± 0.14	T
20071115_121	-2.56	35.72 ± 2.32	2.56 ± 0.29	26.2 ± 0.14	25.4± 0.14	T
20071115_122	-7.88	35.99 ± 2.45	16.05 ± 4.43	25.3 ± 0.12	24.4± 0.12	T
20071115_123	-7.07	39.52 ± 2.65	20.46 ± 7.75	24.7 ± 0.07	24.1± 0.07	T
20080930_000	24.52	39.23 ± 2.50	25.31 ± 0.45	24.9 ± 0.14	25.0± 0.14	Q
20080930_001	14.72	39.45 ± 2.96	25.59 ± 8.90	25.5 ± 0.25	25.6± 0.25	Q
20080930_002*	13.91	71.96 ± 0.02	20.72 ± 0.01	24.7 ± 0.11	24.8± 0.11	Q
20080930_003	20.17	38.96 ± 2.58	27.86 ± 4.54	25.5 ± 0.16	25.2± 0.16	Q
20080930_004	21.46	38.98 ± 2.56	28.31 ± 4.06	24.4 ± 0.09	24.6± 0.09	Q
20080930_005	29.15	46.92 ± 2.58	28.76 ± 0.44	25.5 ± 0.32	25.3± 0.32	Q
20080930_006	-24.09	46.72 ± 3.26	35.29 ±10.02	24.5 ± 0.07	24.3± 0.07	Q
20080930_007	-24.45	51.32 ± 3.03	31.46 ± 6.42	24.7 ± 0.08	24.4± 0.08	Q
20080930_008	-24.69	41.08 ± 2.66	28.78 ± 4.17	24.7 ± 0.10	24.8± 0.10	Q
20080930_009	-16.15	36.92 ± 2.47	21.14 ± 3.07	24.5 ± 0.09	24.4± 0.09	Q
20080930_010	-16.24	44.85 ± 2.62	23.46 ± 4.16	24.7 ± 0.12	25.1± 0.12	Q
20080930_011	-14.17	52.33 ± 2.62	15.92 ± 1.27	24.8 ± 0.09	24.7± 0.09	Q
20080930_012	-14.38	39.25 ± 2.47	18.07 ± 2.27	24.4 ± 0.08	24.7± 0.08	Q
20080930_013	-7.59	41.11 ± 2.51	14.96 ± 4.03	24.8 ± 0.08	24.5± 0.08	Q
20080930_014	-7.85	38.43 ± 2.47	14.15 ± 3.58	24.6 ± 0.09	24.7± 0.09	Q
20080930_015	-5.52	43.66 ± 2.77	23.45 ± 8.48	24.5 ± 0.09	24.7± 0.09	Q
20080930_016	-5.44	38.76 ± 2.42	6.19 ± 0.96	24.0 ± 0.05	24.0± 0.05	Q
20080930_017	-3.22	37.77 ± 2.42	5.93 ± 1.98	25.0 ± 0.11	24.3± 0.11	Q
20080930_018	-3.18	35.47 ± 2.42	9.57 ± 3.25	25.2 ± 0.15	25.3± 0.15	Q
20080930_019	-3.42	47.64 ± 2.55	4.51 ± 1.19	25.1 ± 0.17	25.3± 0.17	Q
20080930_020	-3.35	45.70 ± 2.52	4.95 ± 1.38	25.3 ± 0.20	25.5± 0.20	Q
20080930_021	-1.03	41.34 ± 2.50	10.03 ± 3.92	23.3 ± 0.03	23.5± 0.03	Q
20080930_022	-1.15	42.14 ± 2.46	1.29 ± 0.63	23.4 ± 0.05	24.1± 0.05	Q
20080930_023	-1.11	36.71 ± 2.45	11.01 ± 4.34	25.7 ± 0.19	25.4± 0.19	Q
20080930_024	1.18	42.56 ± 2.76	21.16 ± 8.29	26.0 ± 0.25	25.7± 0.25	Q
2003 SP317	0.99	44.12 ± 0.00	5.10 ± 0.00	23.8 ± 0.05	23.9± 0.05	Q
20080930_026	1.09	35.33 ± 2.60	18.34 ± 7.52	24.4 ± 0.05	23.7± 0.05	Q
20080930_027	1.11	41.97 ± 2.51	7.58 ± 2.93	25.2 ± 0.12	25.0± 0.12	Q
20080930_028	1.00	44.69 ± 2.63	13.93 ± 5.25	25.1 ± 0.10	24.8± 0.10	Q

Continued on next page...

designation	ecliptic latitude (deg)	R (AU)	i (deg)	night 1 avg r′ mag	night 2 avg r′ mag	discovery circumstance
20080930_029	5.55	49.63 ± 2.84	21.61 ± 7.41	25.6 ± 0.20	25.6± 0.20	Q
20080930_030	5.61	54.64 ± 3.37	31.06 ±13.02	24.8 ± 0.10	24.8± 0.10	Q
20080930_031	5.38	40.06 ± 2.53	13.62 ± 4.14	25.6 ± 0.37	25.9± 0.37	Q
20080930_032	5.31	47.29 ± 2.75	17.53 ± 6.50	23.1 ± 0.02	23.2± 0.02	Q
20080930_033	9.88	37.91 ± 2.40	10.88 ± 0.79	24.4 ± 0.05	24.0± 0.05	Q
20080930_034	10.07	43.86 ± 2.50	11.02 ± 0.82	24.4 ± 0.06	24.3± 0.06	Q
20080930_035	12.20	38.93 ± 2.78	22.74 ± 7.76	25.0 ± 0.12	25.0± 0.12	Q
20080930_036	12.15	42.39 ± 3.17	30.17 ±12.32	24.8 ± 0.20	25.6± 0.20	Q
20080930_037	14.25	40.81 ± 2.74	22.21 ± 6.34	25.1 ± 0.18	25.3± 0.18	Q
20080930_038	29.55	40.69 ± 2.54	30.40 ± 1.75	25.0 ± 0.26	25.7± 0.26	Q
20080930_039	-21.20	37.20 ± 2.40	21.06 ± 0.23	25.2 ± 0.13	25.0± 0.13	Q
20080930_040	-21.26	40.52 ± 2.48	21.41 ± 0.87	24.5 ± 0.16	25.2± 0.16	Q
20080930_041	-18.04	34.73 ± 2.52	21.51 ± 3.66	24.3 ± 0.07	24.2± 0.07	Q
20080930_042	-15.99	38.75 ± 2.45	18.67 ± 1.67	25.1 ± 0.13	25.1± 0.13	Q
20080930_043	-14.09	27.94 ± 2.86	28.79 ±11.91	-0.1 ± 0.20	25.5± 0.20	Q
20080930_044*	-11.18	54.85 ± 0.03	35.60 ± 0.01	25.3 ± 0.30	25.8± 0.30	Q
20080930_045	-8.91	17.35 ± 2.33	9.51 ± 0.75	25.0 ± 0.14	25.0± 0.14	Q
20080930_046	-6.08	46.08 ± 2.55	6.05 ± 0.27	24.6 ± 0.13	25.0± 0.13	Q
20080930_047	-6.19	36.61 ± 2.42	6.38 ± 0.35	24.3 ± 0.06	24.2± 0.06	Q
20080930_048	-3.57	39.84 ± 3.11	31.17 ±13.29	23.7 ± 0.05	24.0± 0.05	Q
20080930_049	-3.51	42.41 ± 2.53	5.41 ± 1.72	24.6 ± 0.08	24.5± 0.08	Q
20080930_050	-3.74	48.34 ± 2.60	4.23 ± 0.82	25.0 ± 0.15	25.1± 0.15	Q
20080930_051	-1.08	42.90 ± 2.53	2.52 ± 1.37	25.7 ± 0.16	25.2± 0.16	Q
20080930_052	-0.76	42.66 ± 2.90	23.91 ± 9.83	25.0 ± 0.08	24.5± 0.08	Q
20080930_053	3.79	42.02 ± 2.51	5.96 ± 1.49	24.5 ± 0.13	24.7± 0.13	Q
20080930_054	3.63	46.51 ± 2.83	20.20 ± 7.95	24.7 ± 0.19	25.3± 0.19	Q
20080930_055	3.50	45.29 ± 2.56	3.43 ± 0.05	24.2 ± 0.06	24.1± 0.06	Q
20080930_056	3.39	30.45 ± 2.37	4.64 ± 1.27	22.8 ± 0.02	22.9± 0.02	Q
20080930_057	7.08	43.77 ± 2.54	7.55 ± 0.58	24.8 ± 0.19	25.0± 0.19	Q
20080930_058	1.78	59.92 ± 2.78	2.18 ± 1.32	25.5 ± 0.35	25.8± 0.35	Q
20080930_059	1.78	33.52 ± 2.42	5.63 ± 2.30	25.4 ± 0.28	25.8± 0.28	Q
20080930_060	14.64	41.05 ± 2.50	14.30 ± 0.06	24.9 ± 0.16	25.2± 0.16	Q
20080930_061	14.63	42.00 ± 2.51	15.42 ± 0.59	24.4 ± 0.06	24.1± 0.06	Q
20080930_062	12.31	45.36 ± 2.57	12.09 ± 0.17	24.4 ± 0.05	23.9± 0.05	Q
20080930_063	5.19	37.25 ± 2.48	10.16 ± 2.66	25.4 ± 0.19	25.3± 0.19	Q
20080930_064	-4.73	34.56 ± 2.43	6.27 ± 1.54	23.3 ± 0.04	23.5± 0.04	Q
20080930_065	-5.17	49.40 ± 2.64	7.88 ± 1.81	25.2 ± 0.13	24.7± 0.13	Q
20080930_066	-5.61	46.02 ± 2.56	5.55 ± 0.22	25.5 ± 0.16	24.9± 0.16	Q
20080930_067	-5.89	39.95 ± 2.58	15.76 ± 4.85	25.7 ± 0.24	25.6± 0.24	Q
20080930_068	17.91	44.00 ± 2.60	17.55 ± 0.11	25.2 ± 0.54	26.1± 0.54	T
20080930_069	18.49	41.21 ± 2.47	20.15 ± 1.16	25.6 ± 0.10	24.7± 0.10	T
20080930_070	-25.00	42.14 ± 2.50	27.86 ± 1.91	25.1 ± 0.14	24.9± 0.14	T
20080930_071	-25.62	41.60 ± 2.52	28.98 ± 2.13	24.6 ± 0.12	24.7± 0.12	T
20080930_072	-0.74	34.32 ± 2.46	9.12 ± 3.64	25.1 ± 0.19	25.2± 0.19	T
20080930_073	-1.17	45.34 ± 2.57	2.64 ± 1.84	24.9 ± 0.13	25.0± 0.13	T
20080930_074	-0.59	39.45 ± 2.55	10.99 ± 4.35	24.5 ± 0.11	24.5± 0.11	T
20080930_075	3.48	32.91 ± 2.42	9.20 ± 3.03	25.5 ± 0.16	24.3± 0.16	T
20080930_076	14.34	45.62 ± 2.80	21.21 ± 5.70	24.7 ± 0.11	24.8± 0.11	T
20080930_077	-5.66	31.05 ± 2.39	7.90 ± 2.11	24.7 ± 0.09	24.7± 0.09	T

Table 4.1: Orbital elements reported by Bernstein (2004) orbit fit for Centaurs and KBOs detected in the Subaru survey: ecliptic latitude (deg), barycentric distance (R), inclination (i), nightly discovery magnitudes, discovery circumstance Q = quadruplet detection T = triplet detection. * recovered.

4.8 Constraints on a Cluster Birth

Most stars are born in dense gas-rich embedded clusters (Lada et al., 1991; Carpenter, 2000; Porras et al., 2003; Lada & Lada, 2003; Allen et al., 2007). The presence of short-lived radioactive nuclides in primitive meteorites, may provide circumstantial evidence that the Sun was in relatively close proximity to a supernovae and likely spent several million years in a cluster environment (Chaussidon & Gounelle 2007;Brennecka et al. 2009 and references therein). In the dense stellar nursery, close stellar fly-bys would perturb objects in the Suns planetesimal disk onto highly eccentric Sedna-like orbits (Morbidelli & Levison, 2004; Brasser et al., 2006, 2007; Kaib & Quinn, 2008). Brasser et al. (2006) find that the central density of the stellar cluster (directly correlated to the amount of material the Sun encounters in the cluster) determines the orbital distribution of Sedna-like bodies generated. The denser the cluster environment, the smaller semimajor axis at which the Sedna population begins. Brasser et al. (2006) find that for clusters with central densities of 10^4, 10^5, and 10^6 $M_\odot/pc^3$, Sedna's orbit is recreated and a distribution of Sedna-like bodies with semimajor axes less than 10,000 AU is formed. We refer the reader to Brasser et al. (2006) for details of the orbital integrations and the review of embedded clusters by Lada & Lada (2003).

Schwamb et al. (2010) compare the Brasser et al. (2006) orbital distributions of Sedna-like orbits with perihelia greater than 50 AU and semimajor axes less than 3000 AU to the results of their wide-field survey covering ∼12,000 deg^2 to a depth of 21.3 in R. Schwamb et al. (2010) rule out the densest 10^5 and 10^6 $M_\odot/pc^3$ cluster environments as the source of the Sedna population. They find the 10^4 $M_\odot/pc^3$ cluster environment consistent with their redetection of Sedna. The produced distribution of orbits has Sedna's orbit at inner edge of the population, with the bulk of the Sedna-like orbits with semimajor axes and perihelia greater than Sedna's. For 10^4 $M_\odot/pc^3$ cluster Schwamb et al. (2010) report a best-fit population with 95% confidence level limits of $N_{H\leq1.6}$= 595^{+1949}_{-400} assuming a shallow brightness distribution slope of α=0.35 and 112^{+423}_{-71} for a steeper slope of α=0.82. Schwamb et al. (2010) was sensitive to bodies with H $\leq$ 4.3 residing at 50 AU. Going four magnitudes fainter, our survey probes the faint end of the size distribution, providing an additional lever to further constrain the size of the Sedna population.

4.8.1 Constraining the Size of the Sedna Population

We calculate the expected number of detections from the theoretical 10^4 $M_\odot/pc^3$ cluster Sedna population and compare to our survey results. We use the same criteria, perihelia greater than 50 AU and semimajor axes less than 3000 AU, used by Schwamb el al (2010) to compare the Brasser et al. (2006) generated orbital distribution to the present-day observed Sedna population. We randomly draw orbits from the cluster-produced orbital distribution obtaining the semimajor axis, inclination, and eccentricity for each synthetic Sedna. Brasser et al. (2006) obtain a value of ~2 Gyr for the precession frequency of Sedna and other Sedna-like objects, therefore we assume that the orbits have been randomized due to planetary effects, and randomize over all other orbital angles. Due to the large number of particles required ($10^6 - 10^{11}$) in each simulation, the on-sky positions of the simulated objects are calculated, and each synthetic Sedna is characterized by barycentric distance, ecliptic latitude, inclination, and apparent magnitude only.

With only one known object residing in the Sedna region, the surface characteristics of this distant population remains virtually unknown. It is uncertain if the Sedna population would have a size distribution similar to the Kuiper belt. Sedna-like bodies may have very different surface compositions and properties than objects residing in the Kuiper belt. Only the largest KBOs have been observed to contain volatile ices, such as methane, nitrogen, and carbon monoxide, on their surfaces (Brown 2008 and references within). Schaller & Brown (2007)'s model of volatile loss on KBO surfaces predicts moderate-sized Sedna-like bodies on high perihelia orbits should retain volatile ices on their surfaces, and near-infrared spectroscopic observations of Sedna detect the presence of methane and tentatively nitrogen ices (Barucci et al., 2005). Distant Sednas never sublimate a significant amount of ices to renew their surfaces like Pluto and possibly Eris and Makemake (Stern & Trafton 2008 and references within). Instead these bodies would be subject to constant bombardment from solar irradiation likely darkening their surfaces.

We choose to assign absolute magnitudes to our synthetic bodies instead of diameters, due to the large uncertainties in the surface properties of such a distant population. We assume a single power-law brightness distribution similar to the asteroid belt and Kuiper belt where the number of objects brighter than a given absolute magnitude, H_{max}, is described by:

$$\mathrm{N}(H \leq H_{max)} = N_{H\leq 1.6} 10^{\alpha(H_{max}-1.6)} \tag{4.1}$$

The brightness distribution is scaled to $N_{H\leq 1.6}$, the number of bodies with an absolute magnitude brighter than or equal to Sedna (H=1.6). We choose to probe the possible range of power-law distributions and to allow for direct comparison to Schwamb et al. (2010)'s results by using α= 0.35 and 0.82, the best-fit value for the hot (i>5°) and cold (i<5°) KBOs measured by Fraser et al. (2010). These two values serve as representative values for a shallow and steep brightness distribution respectively.

For a given value of α and $N_{H\leq 1.6}$, we generate a large population of Sednas with absolute magnitudes brighter than H=8.5, the smallest object the survey could detect at 50 AU. An object of Sedna's size and albedo would be detected in our survey out to a distance of 229 AU. Absolute magnitudes are randomly assigned to our simulated Sednas. Objects at distances less than or equal to 1000 AU and apparent magnitudes less than or equal to the survey limiting magnitude (25.2) are considered detections.

We ignore geometric losses and do not have a measured detection efficiency for the survey, and therefore assume a 100% of objects with magnitudes brighter than the limiting magnitude would be found by the detection pipeline. Our observations cover a wide range in ecliptic latitude (Figure 4.2) and the cluster-produced population does not have an isotropic latitude distribution (Figure 4.5). We tally the latitudes of all the detections in a latitude histogram binned in 2° bins and scale the detection count by the observed fractional sky coverage for each latitude bin. The expected number of Sednas is then just the detection count summed for all latitudes. For each value of α and $N_{H \leq 1.6}$, we generate 100 instances of the brightness distribution each which can be considered a synthetic "survey". The median number of detections from the synthetic surveys is the expectation value we report.

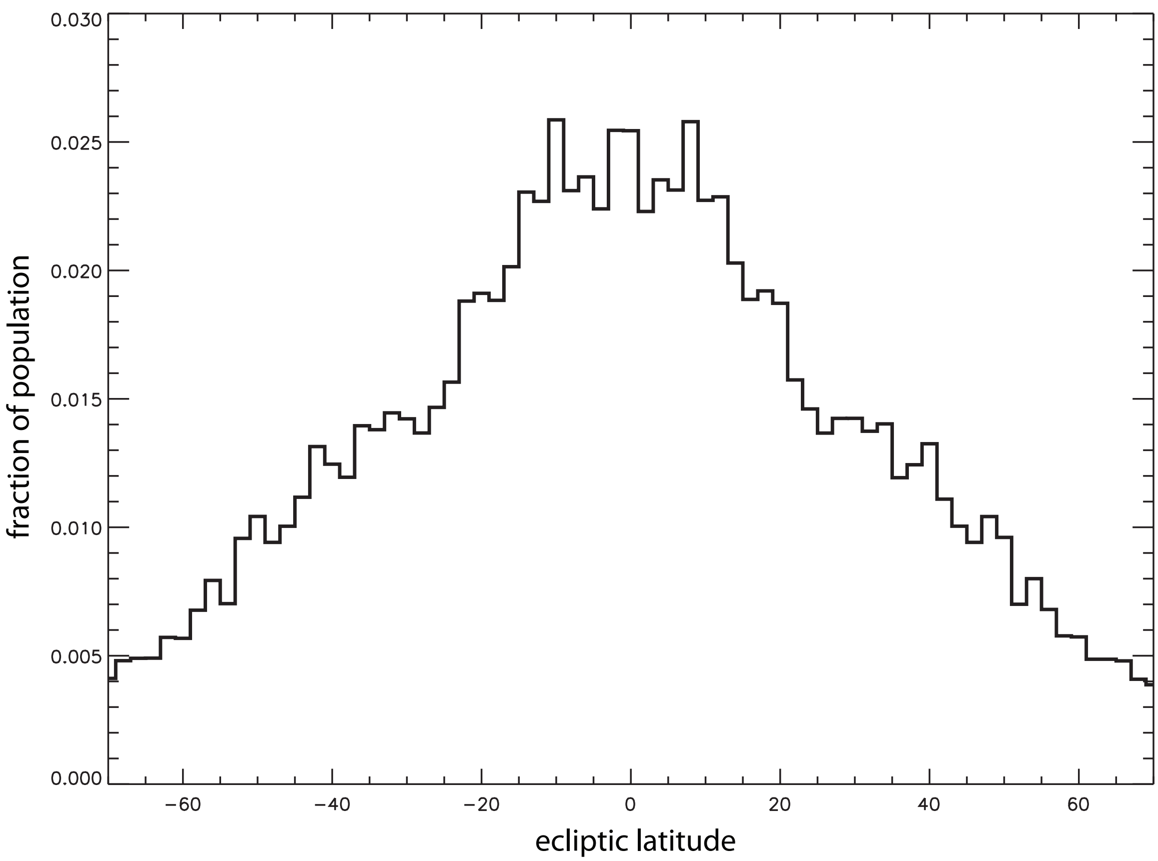

Figure 4.5 Latitude distribution of Sedna-like bodies from the 10^4 $M_{\odot}/pc^3$ Brasser et al. (2006) cluster model binned in 2° latitude bins.

4.8.2 Subaru Constraints

We did not detect any Sedna-like bodies with perihelia beyond 65 AU in the survey despite a sensitivity out to distances of ∼1000 AU. No more than 20 bodies, within the 1-σ error bars, are potentially on Sedna-like orbits with perihelia greater than 50 AU. Although these objects are likely on scattered disk orbits, we are unable to rule them out as being on Sedna-like orbits near perihelia and must include them in our comparison to the Brasser et al. (2006) cluster-produced Sedna populations. Schwamb et al. (2010) report a 2-σ upper limit of 2544 bodies brighter than or equal to Sedna for α=0.35. For this flat size distribution, our observations would have detected no Sednas. With the expected value of 0.56, we can only confirm that a null detection is consistent with our observations. For Schwamb et al. (2010)'s upper limit of $N_{H\leq 1.6}$ = 535 for an α=0.82, 25.3 Sedna-like bodies would be present on our images, slightly more than our 1-σ upper limits of 20 objects found beyond 50 AU reducing the estimate to 444 bodies larger than or equal to Sedna. We can use the fact that we did not detect any high-perihelia objects beyond 65 AU to further constrain the steep size distribution. For $N_{H\leq 1.6}$ =444, we would expect there to be 6.3 objects located at distances greater than 65 AU present in our Subaru images, inconsistent with our observations. At the 95% level, no more than 3 objects could be present beyond 65 AU and be consistent with our null detection. Using the value of 4 detections beyond 65 AU as the $N_{H\leq 1.6}$ two-σ limit, we further constrain the steep size distribution to have less than 292 objects bigger than or brighter than Sedna. We have not characterized our detection efficiency, if the limiting magnitude shifted by ±0.2 mag, the values reported and size estimates would vary by a factor of ∼±1.2 for a slope of α=0.35. No detections would still be expected for such a shallow size-distribution. For a value of α=0.82, our reported values would change by a factor of ∼±1.5, still requiring at the 95% upper confidence level over 100 objects that are larger than or equal to Sedna present in the Sedna region.

4.8.2.1 Size Distribution Effects: Broken Power-law and Gas Drag Induced Size Sorting in the Sedna Region

We present results for a single power-law for the brightness distribution of Sedna-like bodies. The luminosity function of the combined Kuiper belt is not a single power-law. At small sizes H $\simeq$ 10 the distribution breaks to a shallower slope (Bernstein et al., 2004; Fuentes et al., 2009; Fraser & Kavelaars, 2009). Without additional confirmed Sednas we cannot constrain the shape of the size distribution. The smallest Sedna-like body our survey would be sensitive to is H $\simeq$ 8.2 at 50 AU. It is unclear if the Sedna population would also exhibit a break in the size distribution, but if it occurs at sizes less than H $\simeq$xw 8.2, then the Sedna population is smaller than our reported estimates. Our results then represent an extreme upper limit for the Brasser et al. (2006) orbital distribution.

In the Brasser et al. (2006) embedded cluster scenario, Sedna originally formed in the Jupiter/Saturn region before planetary migration when the giant planets were in a much more compact configuration. When the Sun was still in its birth cluster, Sedna is scattered out to the outer solar system, and stellar encounters and tidal torques from cluster stars and embedded gas perturb Sedna onto its highly eccentric and high perihelion orbit. Brasser et al. (2006) model did not include gas in the solar nebula and therefore did not include the effects of gas dynamics in their simulations. Sedna is ~1500 km in size and would not be effected by gas drag, but smaller-sized objects would be. Brasser et al. (2007) investigate the effect of gas drag on the size distribution of objects deposited into the Sedna region. They find a size sorting effect in the cluster-produced Sedna population. Bodies smaller than ~20-60 km would be circularized onto orbits beyond Jupiter and Saturn and not available to be scattered into the Sedna region. Far fewer objects would be deposited into the Sedna region. The expected albedo of distant Sednas is unknown. Thermal measurements constrain Sednas V albedo to be between 0.16 and 0.30 (Brown, 2008; Stansberry et al., 2008).

Assuming a V albedo like Sedna, the smallest sizes we are sensitive to is ∼60-83 km, at the edge of the transition size. Our survey is unable to determine if there is a deficit of small bodies that would be affected by gas drag in the Sedna region.

4.8.3 HST Limits

Bernstein et al. (2004) conducted a faint KBO search using ACS on HST down to a limiting magnitude of 28.5 in R. The observations covered 0.019 deg^2 at 1.48° ecliptic latitude. Although the primary goal of the survey was to search for KBOs, the survey was sensitive to distant Sedna-like bodies out to extreme distances beyond 1000 AU on prograde orbits with inclinations less than 45°. An object at 1000 AU would have moved several ACS pixels over the duration of the survey observations, but only 4 objects were detected in the survey with the most distant body located at 42 AU. Sedna could have detected in the ACS images out to a distance of nearly of 500 AU. No Sedna-like bodies with perihelia greater than 45 AU were found in their observations. We apply the same analysis for our Subaru observations to Bernstein et al. (2004) observations to calculate the expected number of Sedna-like bodies for orbits with inclinations less than 45°. Bernstein et al. (2004) were sensitive to bodies as small as H=11.5 at 50 AU and claim they are sensitive to motions out to infinity; we adopt a conservative distance limit of 1000 AU. We include the detection efficiency reported by Bernstein et al. (2004); for each simulated Sedna we calculate a uniform random number, if the value is less than or equal to the detection efficiency at the objects given apparent magnitude then it is considered a valid detection. The HST observations probe down to sizes that would be effected by gas drag or by a broken power-law and serve as an extreme upper limit on the size of the Sedna population.

Schwamb et al. (2010) report a 95% confidence level upper limit for α =0.35 of $N_{H\leq 1.6}$= 2544. We would expect 0.003 detections of Sedna-like bodies in the Bernstein et al. (2004) observations consistent with their nondetection of bodies on

Sedna-like orbits. For a shallow brightness distribution, the nondetection of an object on a Sedna-like high-perihelia orbit in the HST survey, like the Subaru survey, is consistent with the single detection of Sedna in the Schwamb et al. (2010) wide-field survey, assuming a single power-law extrapolation. For the Schwamb et al. (2010) two-σ upper limit for α=0.82, 6 distant Sednas would have been detected in the HST images. Assuming a 95% confidence level as no more than 3 detections, the upper limit decreases to 334 bodies bigger than and brighter than Sedna, larger than the Subaru observational 95% confidence level.

4.8.4 Combined Results

A 10^4 $M_\odot/pc^3$ cluster-produced Sedna population cannot be ruled out by our observations or due to the nondetection by Bernstein et al. (2004). We summarize our results in Table 4.2. Both the HST and Subaru surveys are consistent with a flat size distribution (α=0.35) with Schwamb et al. (2010)'s 2-σ upper limit of 2544 objects bigger than or brighter than Sedna. For α=0.82, the nondetection of a Sedna located beyond 65 AU in the Subaru data provides a more stringent constraint, reducing Schwamb et al. (2010)'s 95% confidence level upper limit to 292 bodies with absolute magnitudes brighter than or equal to Sedna. The total number of Sedna-sized or larger bodies in the Kuiper belt is $\sim$5-8 (Brown, 2008). There may be on the order of hundreds or thousands of planetoids brighter than Sedna present beyond the Kuiper belt. An order of magnitude or two more mass may reside in the Sedna region than exists in the present-day Kuiper belt.

4.9 Finding the Next Sedna

We explore the requirements for a survey undertaken to further constrain the Sedna population and explore the depth and sky coverage required in order to find an ad-

Survey	α	
	0.35	0.82
Palomar	195-2544	41-535
Subaru	0->2544	0-292
HST	0->2544	0-334
combined	195-2544	41-292

Table 4.2 Population 95% confidence level size estimates of $N_{H\leq 1.6}$ for Brasser et al. (2006)'s cluster-produced Sedna population.

ditional body on a detached Sedna-like high perihelion orbit. New observational campaigns searching for the additional Sednas will need to cover a large portion of sky with a high recovery rate for new discoveries. For our two canonical values of α we examine the likelihood of finding additional Sedna-like bodies. The Large Synoptic Survey Telescopes (LSST) is proposed to cover down to a limiting magnitude of 24.7 in R covering a total of approximately 30,000 deg^2 (LSST Science Collaborations, 2009). Assuming LSST will cover all sky south of 20° ecliptic latitude, extrapolating the brightness distribution, we would expect 13 or more Sedna-like bodies to be found over the course of the survey, for α=0.35. Extrapolating the power-law for the steep size distribution (α=.82) to LSST's limiting magnitude, over 350 Sednas could be in LSST's sky coverage. LSST provides the best prospect of detecting a handful of Sedna-like bodies and testing the Brasser et al. (2006) cluster scenario for Sedna's formation. Even with a nondetection LSST will have sufficient sky coverage and depth to place a powerful constraint on the luminosity function and orbital distribution of the Sedna region.

4.10 Latitude Distribution of the Hot Population

Although this survey was specifically designed to probe the Sedna region, we detected ~200 KBOs. Most pencil-beam surveys cover only several square degrees within a few degrees of the ecliptic. We observe over a wide range of ecliptic latitudes (as high as 40°). With our relatively large sky coverage and latitudinal coverage, our survey is particularly sensitive to the distribution of hot (i >5°) KBOs including the hot classical, scattered disk, detached, and resonant populations. Of the ∼200 KBOs discovered, 157 KBOs found beyond 25 AU have best-fit inclinations greater than 5°. Figure 4.7 plots the latitude distribution of all objects within 30° of the ecliptic with barycentric distances greater than 25 AU and inclinations greater than 5° debiased for sky coverage. We assume Poisson detection statistics (as computed by Kraft et al. (1991)), with error bars representing the Poissonian 68% confidence limit on the detected number of objects in each latitude bin corrected for sky coverage. We can now compare the spatial distribution of the largest and brightest Kuiper belt objects measured by Schwamb et al. (2010) to that of that faint and small KBOs found in our Subaru survey.

We bin both latitude distributions in two degree bins corrected for each survey's fractional sky coverage assuming Poissonian 68% uncertainity. In order to compare the Palomar distribution directly to our sample, we only include objects with inclinations greater than 5° and distances greater than 25 AU, and we normalize each distribution to the value at 0° ecliptic latitude (plotted in Figure 4.7). The two distributions are both relatively flat and consistent with each other within the 1-σ error bars except for the spikes in the Schwamb et al. (2010) distribution around ± 12°. Schwamb et al. (2010) attribute this peaks at ∼±12° to Kozai plutinos that are preferentially detected at perihelion near their maximum excursion off the ecliptic. Though likely a characteristic of the entire Plutino population and independent of size, our survey does not detect this enhancement in the spatial distribution. The number of plutinos a survey detects is extremely dependent on the longitude of the observations. The Schwamb et al. (2010) survey spans a large range of longitudes including those where the plutinos preferentially come to perihelia where they are brightest and most likely to be detected in flux limited surveys. The longitudinal distribution of the plutinos, particularly the off-ecliptic population, has not been accurately measured. We can use the reported plutino detections in the Minor Planet Center (MPC) database[1] as a guide. Only 20% of the observed plutinos have been discovered at the longitudes the Subaru observations cover. Our observations span longitudes before and after the peak detections of plutinos in the MPC, and therefore likely miss the plutino population that Schwamb et al. (2010) detect. We find there is no size dependence on the latitude distribution of i>5° KBOs, which is what would be expected for excitation and scattering by Neptune.

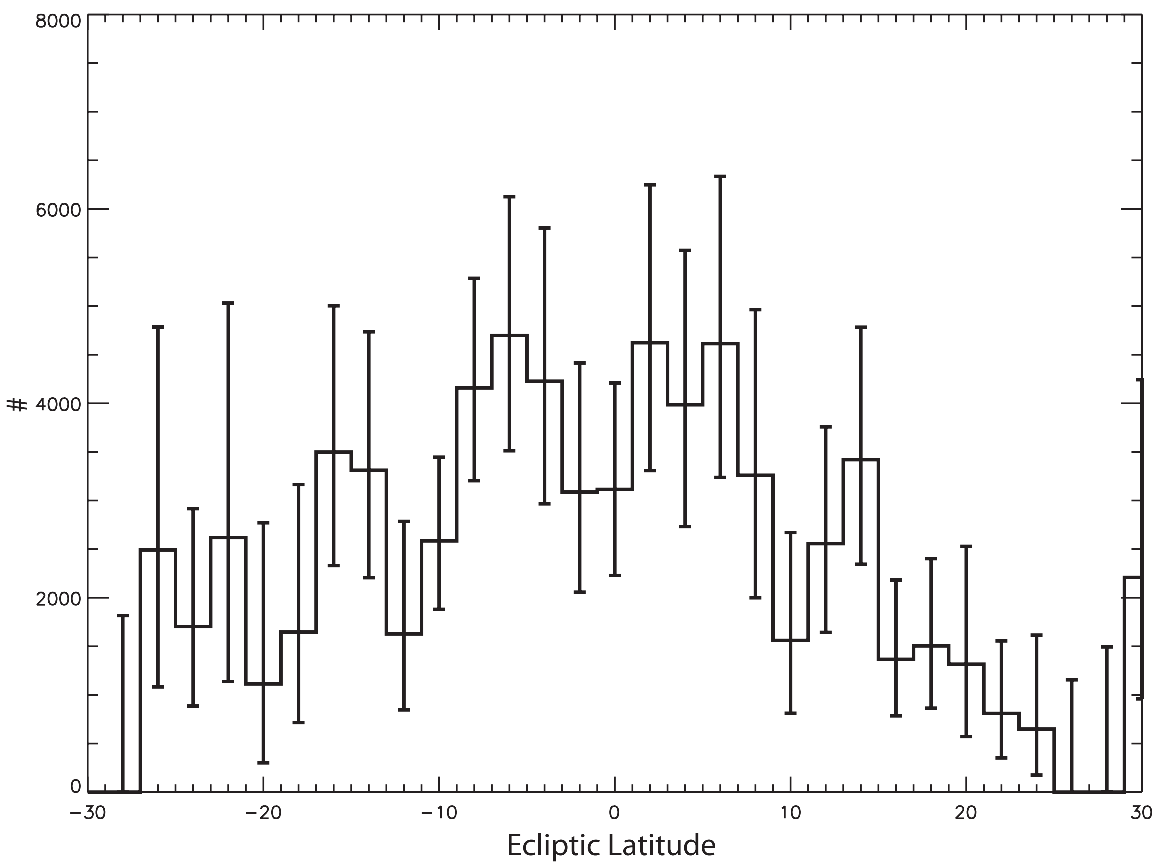

Figure 4.6 The latitudinal distribution binned in 2° bins for KBOs and Centaurs found in this work at distances greater than 25 AU and best-fit inclinations greater than 5° corrected for sky coverage with one-σ Poisson error bars.

[1] http://www.cfa.harvard.edu/iau/Ephemerides/Distant/index.html

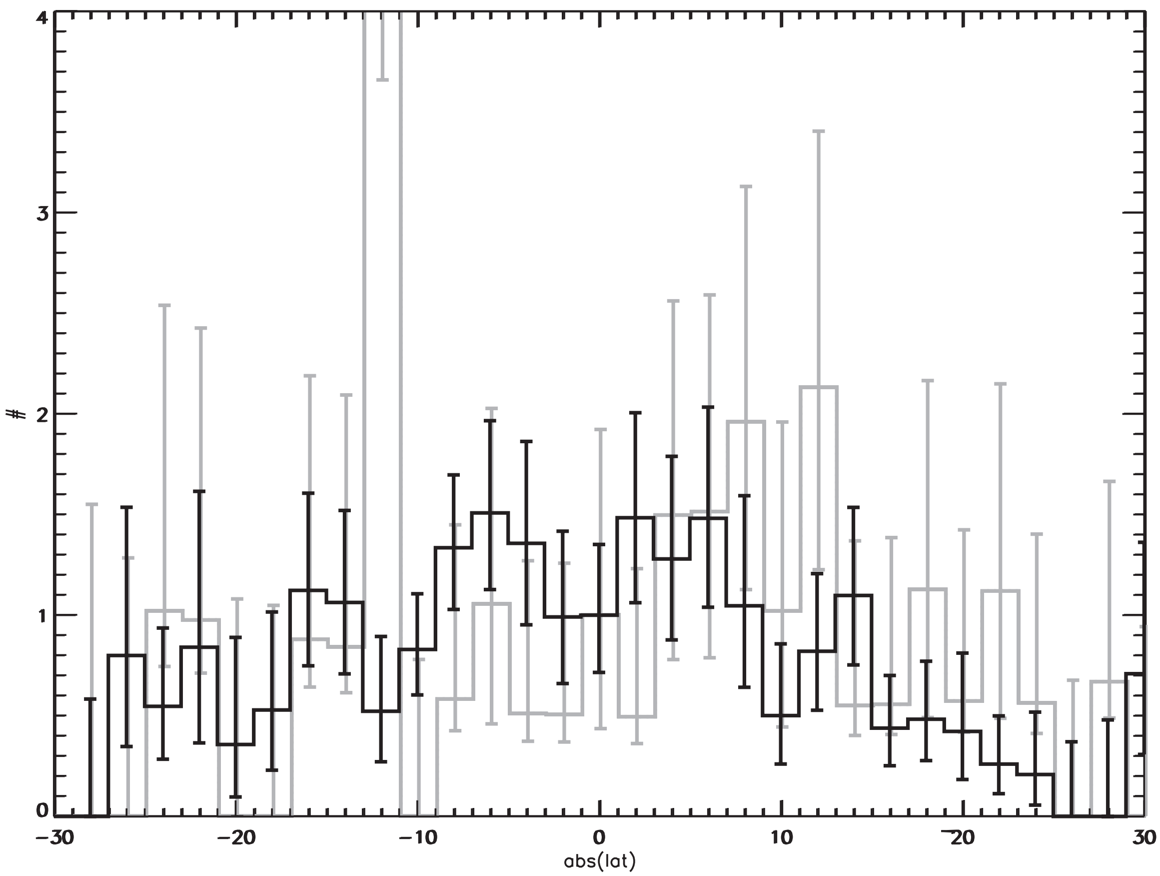

Figure 4.7 Latitudinal distribution binned in 2° bins normalized to the value in the 0° bin for KBOs and Centaurs found in the Subaru survey (black) and Schwamb et al. (2010) Palomar survey (grey) at distances greater than 25 AU and best-fit inclinations greater than 5° corrected for sky coverage with one-σ Poisson error bars .

4.11 Conclusions

Surveying 43 deg^2 within ±40° of the ecliptic to 25.2 in r′ magnitude, we have searched for additional members of the Sedna population with the Subaru telescopes. Based on the 202 KBOs and Centaurs detected in our survey and the results of the Bernstein et al. (2004) HST survey we conclude:

- We did not detect any objects on Sedna-like orbit with perihelia beyond 65 AU, Sedna, despite a sensitivity to motions of bodies out to 1000 AU. Without the additional detection of a Sedna-like with a secure orbit we cannot differentiate between the various proposed formation mechanisms proposed to emplace Sedna on its orbit.

- For the embedded cluster Sedna formation model, we find the 10^4 $M_\odot/pc^3$ cluster environment-produced population, the Schwamb et al. (2010) 2-σ limits ($195 \leqslant N_{H \leq 1.6} \leqslant 2544$) for α=0.35 is consistent with our Subaru observations and with a with the nondetection of Sedna-like bodies in the HST ACS observations.

- For a steep single power-law size distribution of α=0.82 we place more stringent limits on the number of Sedna-like bodies, decreasing the 95% confidence level upper limit to 292 objects bigger and brighter than Sedna for the 10^4 $M_\odot/pc^3$ cluster environment-produced population.

- An order of magnitude or two more mass may be present in the Sedna region than exists in the present Kuiper belt

- There is no size dependence in the latitude distribution of excited ($i > 5°$) KBOs

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Appendix A

Palomar target fields and observation limiting magnitudes

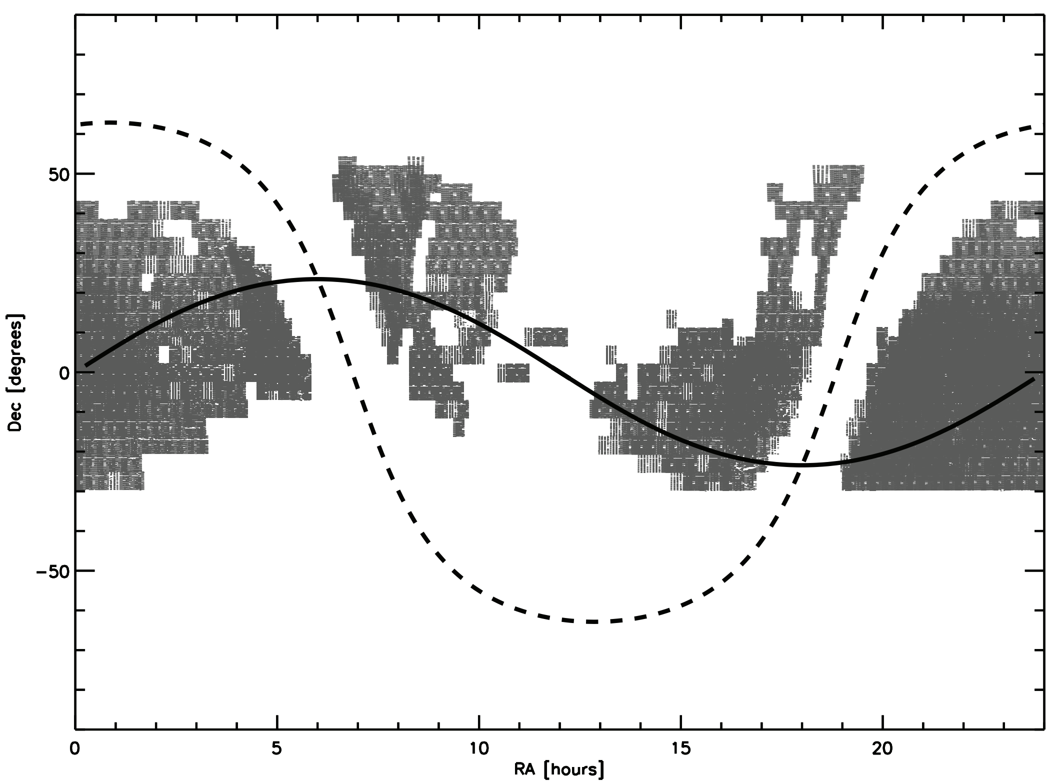

Table A.1: Summary of Paloma survey field positions and image depths

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1	13 53 27.599	-18 15 59.80	54228.327	54228.333	20.9	54229.189	54229.237	21.4
2	13 55 33.959	-18 15 59.80	54228.330	54228.336	21.1	54229.192	54229.240	21.5
3	13 22 04.440	-13 43 28.20	54228.313	54228.320	20.6	54229.163	54229.209	20.9
4	13 38 45.960	-13 43 28.60	54228.260	54228.266	21.4	54229.169	54229.216	21.3
5	13 40 49.440	-13 43 27.50	54228.263	54228.269	21.4	54229.172	54229.219	21.4
6	13 55 27.841	-13 43 27.80	54228.205	54228.211	21.2	54229.176	54229.222	21.3
7	12 51 16.560	-09 10 55.60	54228.273	54228.279	21.0	54229.183	54229.230	21.4
8	12 53 18.240	-09 10 55.90	54228.276	54228.283	21.1	54229.186	54229.233	21.4
9	13 07 40.440	-09 10 55.90	54228.219	54228.226	21.3	54229.196	54229.243	21.5
10	13 09 42.121	-09 10 56.30	54228.222	54228.229	21.3	54229.199	54229.247	21.6
11	13 24 04.321	-09 10 56.30	54228.164	54228.172	21.0	54229.202	54229.250	21.5
12	13 26 05.641	-09 10 55.90	54228.167	54228.175	21.0	54229.206	54229.253	21.4
13	13 40 27.841	-09 10 55.90	54228.178	54228.185	21.2	54229.256	54229.302	21.5
14	13 42 29.522	-09 10 55.90	54228.182	54228.188	21.2	54229.260	54229.306	21.5
15	13 56 51.718	-09 10 55.90	54228.232	54228.239	21.2	54229.263	54229.310	21.4
16	13 58 53.399	-09 10 55.90	54228.236	54228.242	21.3	54229.266	54229.313	21.4
17	14 13 15.599	-09 10 56.30	54228.286	54228.293	21.4	54229.270	54229.317	21.3
18	14 15 16.919	-09 10 55.90	54228.289	54228.296	21.3	54229.273	54229.320	21.3
19	12 58 04.441	-04 38 23.60	54228.191	54228.198	21.3	54229.276	54229.324	21.3
20	13 00 05.040	-04 38 24.40	54228.195	54228.201	21.3	54229.279	54229.327	21.4
21	13 14 16.439	-04 38 24.40	54228.245	54228.252	21.4	54229.283	54229.330	21.3
22	13 16 16.681	-04 38 24.40	54228.249	54228.255	21.4	54229.286	54229.333	21.4
23	13 30 28.080	-04 38 24.40	54228.299	54228.307	21.2	54229.289	54229.337	21.4
24	13 32 28.679	-04 38 24.40	54228.304	54228.310	21.3	54229.293	54229.340	21.3
25	14 02 51.720	-04 38 24.40	54228.340	54228.348	21.1	54229.296	54229.343	21.5
26	14 04 51.962	-04 38 24.40	54228.343	54228.351	21.1	54229.299	54229.347	21.5
27	13 30 28.080	-00 05 52.10	54228.354	54228.361	21.3	54230.165	54230.209	21.7
28	13 32 28.319	-00 05 52.40	54228.357	54228.364	20.9	54230.168	54230.212	21.4
29	14 02 51.720	-00 05 52.80	54228.380	54228.387	20.9	54230.172	54230.215	21.4
30	14 04 51.601	-00 05 52.40	54228.384	54228.391	20.8	54230.175	54230.218	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
31	13 16 16.681	+04 26 39.50	54228.370	54228.377	21.0	54230.181	54230.226	21.7
32	16 05 01.678	-27 21 18.70	54230.322	54230.368	21.3	54231.316	54231.360	21.1
33	16 07 16.679	-27 21 19.10	54230.325	54230.371	21.2	54231.320	54231.363	21.2
34	14 55 50.882	-22 48 46.40	54230.261	54230.307	21.4	54231.252	54231.299	21.4
35	14 58 00.840	-22 48 46.80	54230.264	54230.311	21.4	54231.255	54231.302	21.4
36	15 13 26.400	-22 48 46.80	54230.267	54230.315	21.4	54231.265	54231.310	21.4
37	15 15 36.718	-22 48 46.80	54230.271	54230.318	21.4	54231.269	54231.313	21.4
38	14 44 26.880	-18 16 15.20	54230.254	54230.301	21.4	54231.218	54231.259	21.4
39	14 46 33.240	-18 16 14.90	54230.257	54230.304	21.5	54231.221	54231.262	21.4
40	15 01 26.761	-18 16 14.90	54230.274	54230.328	21.3	54231.232	54231.279	21.3
41	15 03 33.121	-18 16 14.90	54230.277	54230.331	21.3	54231.236	54231.282	21.2
42	15 18 26.639	-18 16 15.20	54230.281	54230.335	21.6	54231.245	54231.292	21.4
43	15 20 32.639	-18 16 14.90	54230.284	54230.338	21.5	54231.249	54231.295	21.4
44	15 35 26.160	-18 16 15.20	54230.294	54230.348	21.4	54231.272	54231.323	21.4
45	16 26 25.437	-18 16 14.20	54230.374	54230.416	21.4	54231.305	54231.347	21.5
46	16 28 31.800	-18 16 14.50	54230.378	54230.419	21.5	54231.336	54231.350	21.6
47	14 45 33.120	-13 43 43.70	54230.202	54230.244	21.3	54231.204	54231.340	21.3
48	14 47 36.600	-13 43 43.30	54230.205	54230.247	21.3	54231.208	54231.343	21.3
49	15 02 14.641	-13 43 43.00	54230.287	54230.341	21.1	54231.211	54231.353	21.1
50	15 04 18.120	-13 43 43.30	54230.291	54230.345	21.1	54231.214	54231.357	21.1
51	14 19 03.361	-00 06 07.60	54230.185	54230.230	21.3	54231.165	54231.226	21.5
52	14 21 03.239	-00 06 07.60	54230.188	54230.233	21.5	54231.168	54231.229	21.6
53	16 09 01.798	-13 43 41.50	54230.381	54230.423	21.2	54232.256	54232.302	21.4
54	16 11 05.277	-13 43 43.30	54230.384	54230.426	21.3	54232.259	54232.305	21.4
55	16 25 43.682	-13 43 42.60	54230.388	54230.429	21.4	54232.269	54232.316	21.3
56	16 27 47.162	-13 43 43.30	54230.391	54230.433	21.3	54232.272	54232.320	21.6
57	15 02 26.880	+08 58 52.30	54231.178	54231.391	21.3	54232.166	54232.211	21.2
58	15 48 38.161	-22 48 47.20	54232.289	54232.336	21.7	54233.288	54233.336	21.1
59	15 50 48.119	-22 48 46.40	54232.292	54232.340	21.6	54233.291	54233.339	21.2
60	16 06 13.679	-22 48 47.90	54232.310	54232.356	21.6	54233.301	54233.342	21.1
61	16 09 25.919	-18 16 15.20	54232.276	54232.330	21.5	54233.281	54233.356	21.0

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
62	16 11 32.283	-18 16 15.20	54232.279	54232.333	21.5	54233.285	54233.359	21.1
63	15 52 19.920	-13 43 44.00	54232.242	54232.295	21.5	54233.241	54233.295	21.6
64	15 54 23.400	-13 43 43.30	54232.245	54232.299	21.5	54233.245	54233.298	21.5
65	15 35 14.281	-09 11 12.10	54232.221	54232.363	21.1	54233.214	54233.255	21.3
66	15 37 15.962	-09 11 11.80	54232.226	54232.366	21.3	54233.217	54233.258	21.4
67	15 51 38.162	-09 11 11.80	54232.236	54232.376	21.3	54233.228	54233.316	21.2
68	15 53 39.482	-09 11 11.80	54232.239	54232.380	21.3	54233.231	54233.319	21.2
69	16 40 49.443	-09 11 11.80	54232.400	54232.441	21.7	54233.261	54233.362	21.6
70	16 42 50.760	-09 11 11.80	54232.403	54232.444	21.7	54233.265	54233.366	21.6
71	15 07 38.641	-04 38 40.60	54232.185	54232.229	21.1	54233.180	54233.268	21.3
72	16 28 37.561	-04 38 39.50	54232.415	54232.455	21.5	54233.369	54233.410	21.4
73	16 30 37.800	-04 38 40.20	54232.418	54232.458	21.6	54233.372	54233.413	21.3
74	14 53 27.239	+04 26 23.30	54232.182	54232.218	21.2	54233.170	54233.224	21.3
75	15 20 52.081	+08 58 55.20	54232.396	54232.438	21.2	54233.177	54233.386	20.8
76	15 18 50.400	+08 58 55.60	54232.393	54232.434	21.2	54234.166	54234.209	21.2
77	15 35 14.281	+08 58 54.80	54233.187	54233.389	21.3	54234.169	54234.213	21.2
78	15 37 15.962	+08 58 54.10	54233.190	54233.392	21.6	54234.172	54234.216	21.3
79	15 51 38.162	+08 58 54.10	54233.207	54233.397	21.5	54234.183	54234.226	21.3
80	15 53 39.839	+08 58 54.10	54233.210	54233.400	21.5	54234.186	54234.230	21.3
81	16 08 02.039	+08 58 54.50	54233.403	54233.445	21.4	54234.196	54234.240	21.2
82	16 10 03.362	+08 58 54.10	54233.406	54233.448	21.4	54234.199	54234.244	21.1
83	14 52 14.880	-27 21 16.60	54234.260	54234.307	21.4	54235.255	54235.302	21.4
84	15 10 26.760	-27 21 16.90	54234.267	54234.315	21.4	54235.268	54235.313	21.7
85	15 12 41.761	-27 21 16.90	54234.270	54234.318	21.5	54235.272	54235.317	21.7
86	15 28 38.639	-27 21 16.90	54234.280	54234.322	21.4	54235.282	54235.324	21.6
87	15 30 53.641	-27 21 16.60	54234.284	54234.325	21.4	54235.285	54235.327	21.7
88	16 08 02.039	-09 11 08.90	54234.287	54234.335	21.5	54235.235	54235.288	21.5
89	16 10 03.362	-09 11 09.60	54234.290	54234.338	21.5	54235.238	54235.292	21.5
90	16 24 25.562	-09 11 09.60	54234.355	54234.396	21.5	54235.241	54235.295	21.5
91	16 26 27.243	-09 11 10.00	54234.358	54234.400	21.6	54235.245	54235.298	21.6
92	15 23 50.640	-04 38 38.40	54234.189	54234.234	21.2	54235.187	54235.248	21.3

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
93	15 25 50.882	-04 38 38.00	54234.193	54234.237	21.3	54235.191	54235.251	21.3
94	15 40 02.281	-04 38 38.00	54234.202	54234.247	21.4	54235.200	54235.275	21.4
95	15 42 02.880	-04 38 37.70	54234.206	54234.250	21.4	54235.204	54235.278	21.4
96	15 56 13.919	-04 38 38.40	54234.300	54234.348	21.7	54235.220	54235.309	21.7
97	15 58 14.521	-04 38 37.70	54234.304	54234.351	21.8	54235.224	54235.320	21.6
98	16 12 25.917	-04 38 37.30	54234.361	54234.404	21.5	54235.228	54235.330	21.5
99	16 14 26.162	-04 38 38.00	54234.365	54234.407	21.5	54235.231	54235.334	21.5
100	16 28 37.561	-00 06 06.10	54234.375	54234.417	21.5	54235.337	54235.383	21.7
101	15 07 38.641	+04 26 25.40	54234.176	54234.219	21.2	54235.168	54235.343	21.3
102	15 09 39.240	+04 26 25.80	54234.179	54234.222	21.4	54235.171	54235.347	21.2
103	15 23 50.640	+04 26 25.80	54234.294	54234.341	21.3	54235.174	54235.350	21.0
104	15 25 50.882	+04 26 25.80	54234.297	54234.345	21.2	54235.177	54235.354	21.1
105	15 40 02.281	+04 26 26.50	54234.368	54234.411	21.5	54235.181	54235.357	21.4
106	15 42 02.880	+04 26 25.80	54234.371	54234.414	21.6	54235.184	54235.360	21.4
107	15 56 13.919	-00 06 06.50	54235.390	54235.432	21.5	54236.197	54236.241	21.4
108	15 58 14.160	-00 06 06.80	54235.393	54235.435	21.6	54236.200	54236.244	21.6
109	16 12 25.917	-00 06 07.20	54235.397	54235.438	21.5	54236.207	54236.251	21.4
110	16 14 25.798	-00 06 06.80	54235.401	54235.442	21.4	54236.210	54236.254	21.3
111	16 44 49.199	-00 06 06.50	54235.404	54235.445	21.7	54236.234	54236.281	21.7
112	16 46 49.438	-00 06 06.80	54235.407	54235.448	21.7	54236.238	54236.284	21.8
113	16 12 25.917	+04 26 25.10	54235.411	54235.452	21.6	54236.204	54236.248	21.6
114	15 46 50.159	-27 21 28.10	54236.288	54236.333	22.0	54237.284	54237.326	21.4
115	16 25 28.562	-27 21 28.40	54236.316	54236.359	22.3	54237.319	54237.362	21.9
116	14 38 14.999	-22 48 56.50	54236.258	54236.301	21.5	54237.231	54237.273	21.4
117	14 40 25.321	-22 48 56.20	54236.261	54236.305	21.7	54237.234	54237.277	21.4
118	15 07 38.641	-00 06 06.80	54235.194	54235.363	21.5	54237.169	54237.212	21.4
119	16 28 37.561	+04 26 13.90	54236.274	54236.320	21.8	54237.205	54237.252	21.1
120	16 30 37.800	+04 26 14.30	54236.277	54236.323	21.8	54237.208	54237.255	21.2
121	16 44 49.199	+04 26 15.00	54236.295	54236.340	21.8	54237.216	54237.258	21.1
122	16 46 49.801	+04 26 13.90	54236.298	54236.343	21.7	54237.220	54237.261	21.1
123	14 10 27.481	-18 16 24.20	54237.179	54237.223	21.3	54238.175	54238.216	21.0

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
124	14 12 33.841	-18 16 24.20	54237.182	54237.227	21.4	54238.178	54238.219	21.1
125	14 27 27.002	-18 16 25.00	54237.192	54237.265	21.3	54238.185	54238.227	21.1
126	14 29 33.719	-18 16 24.60	54237.195	54237.268	21.3	54238.188	54238.231	21.1
127	16 43 25.318	-18 16 24.20	54237.293	54237.339	21.7	54238.281	54238.326	21.6
128	16 45 31.318	-18 16 23.90	54237.296	54237.342	21.7	54238.285	54238.329	21.7
129	13 04 34.679	-18 16 19.60	54242.172	54242.215	21.4	54244.175	54244.222	20.8
130	13 21 34.560	-18 16 19.60	54242.178	54242.221	21.3	54244.181	54244.228	20.9
131	13 36 28.078	-18 16 19.90	54242.188	54242.239	21.0	54244.191	54244.233	20.9
132	13 38 34.081	-18 16 19.60	54242.191	54242.243	21.2	54244.188	54244.195	21.0
133	14 14 12.841	-13 43 47.60	54242.205	54242.256	21.0	54244.208	54244.253	21.0
134	17 30 04.683	-09 10 53.00	54245.333	54245.379	22.6	54246.261	54246.304	21.8
135	17 32 06.363	-09 10 52.70	54245.336	54245.383	22.7	54246.265	54246.308	21.9
136	17 01 05.163	-04 38 21.10	54245.346	54245.393	21.8	54246.224	54246.272	21.0
137	17 17 17.157	-04 38 20.80	54245.353	54245.399	22.4	54246.237	54246.278	21.8
138	17 19 17.403	-04 38 21.50	54245.356	54245.404	22.2	54246.240	54246.281	21.9
139	17 33 28.802	-04 38 20.80	54245.359	54245.407	22.3	54246.248	54246.291	21.9
140	17 35 29.398	-04 38 20.80	54245.363	54245.410	22.5	54246.251	54246.295	21.8
141	17 49 40.440	-04 38 20.40	54245.366	54245.413	22.4	54246.285	54246.326	22.1
142	17 51 41.042	-04 38 21.50	54245.369	54245.417	22.3	54246.288	54246.329	22.1
143	17 01 05.163	-00 05 49.60	54245.373	54245.420	21.9	54246.230	54246.298	21.5
144	17 03 05.401	-00 05 49.20	54245.376	54245.423	21.9	54246.234	54246.301	21.4
145	17 19 17.039	-00 05 49.20	54245.430	54245.458	22.0	54246.243	54246.363	21.4
146	17 17 16.800	-00 05 49.60	54246.318	54246.360	21.7	54248.220	54248.261	21.4
147	17 33 28.802	-00 05 49.20	54246.367	54246.413	21.7	54248.229	54248.271	21.4
148	17 49 40.440	-00 05 49.20	54246.373	54246.420	21.9	54248.243	54248.288	21.5
149	17 51 40.678	-00 05 49.60	54246.376	54246.424	21.8	54248.248	54248.291	21.4
150	18 05 52.441	-00 05 49.20	54246.380	54246.427	21.4	54248.258	54248.301	21.3
151	17 01 05.163	+04 26 41.60	54246.203	54246.343	21.0	54248.199	54248.251	20.9
152	17 19 17.403	+04 26 42.40	54246.390	54246.437	21.3	54248.212	54248.268	20.9
153	16 57 17.643	+08 59 28.30	54258.189	54258.231	21.4	54259.220	54259.266	21.6
154	16 59 18.959	+08 59 29.00	54258.193	54258.235	21.4	54259.186	54259.270	21.4

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
155	16 59 11.399	+13 32 02.40	54258.196	54258.238	21.5	54259.190	54259.236	21.4
156	17 01 14.879	+13 32 01.30	54258.199	54258.241	21.5	54259.193	54259.239	21.4
157	17 15 53.277	+13 32 00.60	54258.202	54258.245	21.4	54259.310	54259.353	21.2
158	17 17 56.763	+13 32 01.00	54258.206	54258.248	21.6	54259.313	54259.356	21.5
159	17 00 29.519	+18 04 34.00	54258.209	54258.251	21.5	54259.196	54259.243	21.4
160	17 02 35.882	+18 04 32.50	54258.212	54258.255	21.4	54259.199	54259.246	21.3
161	17 17 29.043	+18 04 32.50	54258.215	54258.258	21.6	54259.202	54259.249	21.5
162	17 19 35.400	+18 04 32.90	54258.219	54258.261	21.8	54259.206	54259.252	21.8
163	17 18 51.482	+22 37 04.80	54258.225	54258.370	21.4	54259.209	54259.256	21.5
164	17 35 29.041	-00 05 17.20	54259.216	54259.263	21.5	54260.204	54260.250	21.5
165	17 13 41.159	+08 59 45.20	54259.226	54259.273	21.3	54260.184	54260.231	21.4
166	17 15 42.840	+08 59 45.20	54259.229	54259.276	21.5	54260.187	54260.234	21.5
167	17 30 05.040	+08 59 45.60	54259.283	54259.327	21.6	54260.190	54260.237	21.3
168	17 32 06.720	+08 59 45.20	54259.286	54259.330	21.5	54260.194	54260.240	21.3
169	18 02 52.437	+08 59 44.90	54259.303	54259.347	21.6	54260.207	54260.254	21.5
170	18 04 54.118	+08 59 45.20	54259.306	54259.350	21.7	54260.210	54260.257	21.5
171	17 32 34.797	+13 32 17.20	54259.316	54259.360	21.5	54260.224	54260.270	21.5
172	17 34 38.277	+13 32 17.20	54259.320	54259.363	21.5	54260.227	54260.274	21.6
173	17 49 16.682	+13 32 16.80	54259.373	54259.415	21.4	54260.281	54260.328	21.6
174	18 08 02.039	+13 32 17.20	54259.383	54259.425	21.3	54260.291	54260.338	21.6
175	18 24 43.559	+13 32 17.20	54259.370	54259.412	21.6	54260.298	54260.345	21.6
176	17 36 35.281	+18 04 48.70	54259.390	54259.432	21.1	54260.304	54260.351	21.0
177	17 16 41.157	+22 37 05.90	54258.222	54258.265	21.2	54260.308	54260.354	21.2
178	17 34 17.039	+22 37 04.40	54258.373	54258.419	21.2	54260.311	54260.358	21.5
179	17 36 27.000	+22 37 04.10	54258.376	54258.422	21.2	54260.314	54260.361	21.5
180	17 17 53.158	+27 09 36.40	54258.380	54258.426	21.0	54260.317	54260.364	21.3
181	17 20 08.160	+27 09 36.00	54258.383	54258.429	21.1	54260.321	54260.368	21.3
182	17 36 05.041	+27 09 36.40	54258.386	54258.432	21.1	54260.371	54260.413	21.2
183	17 38 20.043	+27 09 36.00	54258.390	54258.436	21.1	54260.374	54260.416	21.3
184	17 08 50.640	+31 42 07.60	54258.396	54258.442	20.9	54260.381	54260.423	21.3
185	17 25 29.283	+31 42 07.90	54258.399	54258.462	21.0	54260.384	54260.426	21.3

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
186	17 27 50.403	+31 42 08.30	54258.403	54258.459	21.0	54260.388	54260.429	21.4
187	17 44 28.682	+31 42 07.90	54258.406	54258.456	21.0	54260.391	54260.433	21.4
188	17 45 46.802	+36 14 41.30	54258.413	54258.452	21.3	54260.397	54260.439	21.5
189	17 48 15.838	+36 14 39.50	54258.416	54258.449	21.2	54260.401	54260.443	21.7
190	17 51 20.161	+13 32 18.20	54260.284	54260.331	21.5	54264.184	54264.187	21.3
191	18 05 58.559	+13 32 18.20	54260.288	54260.335	21.6	54264.190	54264.193	21.4
192	18 22 40.080	+13 32 18.20	54260.294	54260.341	21.5	54264.197	54264.200	21.3
193	17 34 28.918	+18 04 49.80	54260.301	54260.348	21.4	54264.204	54264.207	21.3
194	17 06 29.163	+31 42 25.60	54260.377	54260.420	21.2	54264.210	54264.213	21.6
195	17 46 49.801	+31 42 25.20	54260.394	54260.436	21.2	54264.217	54264.220	21.5
196	17 29 04.917	+40 47 29.00	54260.404	54260.449	21.3	54264.223	54264.230	21.6
197	17 31 43.677	+40 47 29.00	54260.407	54260.446	21.2	54264.227	54264.233	21.8
198	16 43 40.438	-22 48 05.80	54264.240	54264.247	21.4	54266.295	54266.303	21.4
199	16 59 06.002	-22 48 05.80	54264.250	54264.257	21.0	54266.271	54266.317	21.1
200	17 01 15.957	-22 48 05.80	54264.254	54264.260	21.0	54266.274	54266.321	21.0
201	17 46 29.278	-09 10 30.40	54264.362	54264.367	19.6	54266.278	54266.336	19.7
202	17 35 29.762	+04 27 05.40	54264.371	54264.376	21.7	54266.281	54266.410	21.4
203	18 05 52.798	+04 27 04.70	54264.389	54264.398	21.6	54266.288	54266.348	21.5
204	16 41 30.120	-22 48 05.80	54264.237	54264.244	21.3	54267.237	54267.279	21.4
205	15 21 00.001	-13 43 41.20	54234.277	54234.331	21.2	54267.197	54267.255	21.3
206	17 17 17.521	+04 27 01.40	54266.356	54266.402	21.5	54267.186	54267.230	21.4
207	17 33 29.523	+04 27 01.80	54266.360	54266.406	21.4	54267.190	54267.234	21.3
208	17 00 29.519	-18 15 10.80	54267.213	54267.272	21.2	54268.211	54268.252	21.2
209	17 02 35.518	-18 15 10.80	54267.217	54267.275	21.2	54268.214	54268.256	21.3
210	17 17 29.043	-18 15 11.20	54267.292	54267.336	20.7	54268.224	54268.265	20.7
211	19 16 27.479	-18 15 11.20	54267.309	54267.351	21.1	54268.305	54268.351	21.1
212	19 18 33.842	-18 15 10.40	54267.313	54267.354	21.1	54268.308	54268.355	21.1
213	19 33 27.003	-18 15 11.20	54267.323	54267.364	21.4	54268.318	54268.365	21.2
214	19 35 33.360	-18 15 10.80	54267.326	54267.367	21.4	54268.322	54268.368	21.3
215	19 50 26.878	-18 15 10.80	54267.394	54267.436	21.4	54268.331	54268.378	21.3
216	19 52 33.241	-18 15 11.20	54267.397	54267.441	21.5	54268.335	54268.381	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
217	20 07 26.759	-18 15 10.80	54267.387	54267.429	21.6	54268.345	54268.391	21.5
218	20 09 33.122	-18 15 10.80	54267.390	54267.432	21.7	54268.348	54268.395	21.6
219	20 24 26.283	-18 15 11.20	54267.381	54267.422	21.6	54268.398	54268.440	21.8
220	20 26 32.640	-18 15 11.20	54267.384	54267.425	21.7	54268.401	54268.445	21.7
221	15 19 00.841	-13 42 39.20	54267.193	54267.251	21.3	54268.188	54268.231	21.4
222	15 35 42.719	-13 42 38.50	54267.204	54267.260	21.4	54268.191	54268.235	21.4
223	15 37 46.201	-13 42 39.20	54267.207	54267.264	21.2	54268.195	54268.238	21.3
224	19 46 09.118	-13 42 38.50	54267.316	54267.358	21.6	54268.311	54268.358	21.6
225	19 48 12.597	-13 42 39.20	54267.319	54267.361	21.7	54268.315	54268.361	21.7
226	20 02 50.638	-13 42 38.90	54267.329	54267.371	21.6	54268.325	54268.371	21.5
227	20 04 54.118	-13 42 39.60	54267.333	54267.374	21.8	54268.328	54268.375	21.6
228	20 19 32.523	-13 42 38.50	54267.400	54267.465	21.6	54268.338	54268.384	21.5
229	20 21 36.002	-13 42 38.90	54267.404	54267.460	21.5	54268.341	54268.388	21.4
230	19 29 26.883	-13 42 25.20	54268.431	54268.461	21.4	54269.291	54269.333	21.2
231	19 31 30.363	-13 42 25.60	54268.436	54268.466	21.4	54269.295	54269.336	21.2
232	15 04 28.200	-09 11 11.80	54232.199	54232.266	21.2	54269.197	54269.248	21.4
233	20 30 13.678	-22 47 47.40	54275.368	54275.410	20.9	54276.361	54276.410	20.9
234	20 32 23.639	-22 47 47.00	54275.372	54275.413	21.5	54276.364	54276.413	21.0
235	19 24 50.398	-09 10 12.00	54275.260	54275.305	20.6	54276.254	54276.296	20.9
236	20 01 14.522	-04 37 40.10	54275.405	54275.447	22.2	54276.276	54276.320	21.6
237	19 45 02.163	-00 05 08.50	54275.250	54275.295	21.4	54276.247	54276.293	21.3
238	19 59 39.483	+08 59 55.70	54275.470	54275.479	21.5	54276.280	54276.477	21.1
239	19 04 24.963	-22 47 47.00	54275.315	54275.358	20.8	54277.315	54277.357	20.9
240	19 57 11.161	-22 47 35.20	54276.368	54276.417	21.2	54277.336	54277.378	21.5
241	20 12 36.718	-22 47 35.20	54276.379	54276.424	21.3	54277.348	54277.390	21.5
242	20 14 46.679	-22 47 35.20	54276.382	54276.428	21.2	54277.352	54277.393	21.4
243	19 12 44.642	-13 42 43.60	54275.274	54275.318	20.6	54277.259	54277.301	21.0
244	19 41 14.279	-09 10 10.60	54275.375	54275.416	21.8	54277.263	54277.305	21.3
245	20 16 02.279	-09 09 59.80	54276.398	54276.446	21.3	54277.291	54277.333	21.3
246	19 45 01.799	-04 37 28.60	54276.437	54276.468	21.6	54277.252	54277.295	21.5
247	20 15 25.921	-04 37 40.10	54275.390	54275.433	21.9	54277.275	54277.318	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
248	20 17 26.159	-04 37 40.10	54275.394	54275.438	21.1	54277.278	54277.322	21.4
249	19 43 02.281	-00 05 08.50	54275.246	54275.291	21.3	54277.241	54277.284	21.4
250	17 48 30.237	+08 59 45.20	54259.300	54259.343	21.6	54287.196	54287.240	21.5
251	17 46 27.122	+09 00 05.00	54287.192	54287.236	21.6	54288.185	54288.232	21.9
252	18 19 14.519	+09 00 04.30	54287.202	54287.246	21.4	54288.192	54288.239	21.7
253	18 21 16.199	+09 00 04.30	54287.206	54287.250	21.4	54288.195	54288.242	21.6
254	17 51 27.000	+18 05 09.20	54287.199	54287.243	21.5	54288.189	54288.235	21.7
255	18 25 26.399	+18 05 09.20	54287.209	54287.253	21.7	54288.199	54288.245	22.0
256	18 27 32.763	+18 05 08.50	54287.212	54287.256	21.8	54288.202	54288.249	22.1
257	18 27 02.523	+22 37 40.10	54287.216	54287.260	21.7	54288.206	54288.252	22.0
258	18 29 12.477	+22 37 39.70	54287.219	54287.263	21.7	54288.209	54288.255	21.9
259	18 30 38.521	+27 10 11.30	54287.222	54287.266	21.5	54288.212	54288.259	21.7
260	18 32 53.522	+27 10 12.00	54287.226	54287.270	21.6	54288.215	54288.262	21.8
261	18 22 26.402	+31 42 43.60	54287.279	54287.328	21.4	54288.219	54288.265	21.8
262	18 24 47.521	+31 42 43.20	54287.283	54287.332	21.5	54288.222	54288.268	21.8
263	18 41 26.158	+31 42 43.90	54287.273	54287.319	21.3	54288.225	54288.272	21.8
264	18 43 47.277	+31 42 43.60	54287.276	54287.324	21.4	54288.229	54288.275	21.8
265	18 25 56.282	+36 15 15.11	54287.293	54287.346	21.4	54288.278	54288.320	21.7
266	18 28 25.318	+36 15 15.81	54287.296	54287.350	21.4	54288.282	54288.325	21.7
267	18 46 02.279	+36 15 14.80	54287.286	54287.337	21.4	54288.285	54288.329	21.6
268	18 48 31.322	+36 15 15.50	54287.289	54287.341	21.3	54288.288	54288.333	21.6
269	18 33 14.403	+40 47 47.01	54287.306	54287.363	21.8	54288.291	54288.338	22.0
270	18 35 53.162	+40 47 47.40	54287.309	54287.368	21.8	54288.295	54288.342	22.0
271	18 54 38.162	+40 47 47.40	54287.299	54287.354	21.8	54288.298	54288.347	22.1
272	18 57 16.558	+40 47 46.70	54287.302	54287.359	21.6	54288.301	54288.351	21.9
273	18 27 26.281	+45 20 18.60	54287.390	54287.436	21.3	54288.305	54288.356	21.7
274	18 30 17.640	+45 20 19.00	54287.395	54287.440	21.4	54288.309	54288.360	21.8
275	18 50 31.918	+45 20 18.21	54287.381	54287.427	21.2	54288.314	54288.364	21.6
276	18 53 22.920	+45 20 17.90	54287.386	54287.431	21.2	54288.317	54288.369	21.5
277	19 13 37.918	+45 20 19.00	54287.313	54287.372	21.2	54288.373	54288.418	21.5
278	19 16 28.921	+45 20 18.60	54287.316	54287.377	21.5	54288.377	54288.423	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
279	16 43 44.400	-27 20 00.60	54268.245	54268.288	21.2	54289.191	54289.217	21.2
280	17 01 15.600	-13 43 05.50	54266.201	54266.244	22.0	54289.204	54289.250	22.1
281	19 25 13.442	-27 20 02.00	54289.306	54289.338	21.3	54290.296	54290.322	21.3
282	20 38 00.240	-27 20 02.00	54289.367	54289.398	21.4	54290.345	54290.373	21.2
283	20 40 15.241	-27 20 01.30	54289.370	54289.403	21.3	54290.348	54290.377	21.1
284	19 19 49.442	-22 47 29.00	54289.288	54289.331	21.0	54290.276	54290.299	20.6
285	19 37 25.317	-22 47 29.80	54289.295	54289.344	21.3	54290.306	54290.335	21.2
286	19 39 35.278	-22 47 29.80	54289.298	54289.347	21.4	54290.309	54290.338	21.2
287	19 55 00.842	-22 47 29.40	54289.319	54289.361	21.3	54290.312	54290.341	21.5
288	20 47 48.118	-22 47 29.80	54289.351	54289.407	21.1	54290.351	54290.380	21.2
289	20 41 24.359	-18 14 58.20	54289.380	54289.423	21.5	54290.316	54290.358	21.1
290	20 43 30.358	-18 14 57.80	54289.384	54289.427	21.6	54290.319	54290.361	21.3
291	16 42 27.723	-13 42 25.60	54289.195	54289.237	22.1	54290.186	54290.233	21.9
292	16 44 31.202	-13 42 26.30	54289.198	54289.241	22.1	54290.189	54290.237	21.6
293	16 59 09.600	-13 42 25.90	54289.201	54289.246	22.0	54290.193	54290.241	22.1
294	19 57 37.082	-09 09 54.70	54289.390	54289.436	21.5	54290.246	54290.289	21.1
295	19 59 38.398	-09 09 54.40	54289.394	54289.440	21.6	54290.249	54290.292	21.5
296	19 07 01.923	-27 19 52.30	54291.286	54291.308	20.2	54292.277	54292.302	21.2
297	19 09 16.918	-27 19 52.70	54291.289	54291.311	20.3	54292.280	54292.306	21.2
298	20 01 37.202	-27 20 00.20	54290.364	54290.412	21.1	54292.316	54292.338	21.7
299	20 03 52.203	-27 19 59.50	54290.369	54290.408	21.2	54292.319	54292.342	21.6
300	20 22 03.722	-27 20 00.20	54290.417	54290.425	21.2	54292.332	54292.386	21.5
301	19 21 59.403	-22 47 29.40	54289.292	54289.334	21.1	54292.283	54292.309	21.4
302	20 49 58.437	-22 47 29.00	54289.354	54289.412	21.2	54292.335	54292.356	21.6
303	17 17 57.120	-13 43 02.30	54264.293	54264.300	22.0	54292.199	54292.246	21.8
304	17 34 38.998	-13 43 02.30	54264.340	54264.349	21.7	54292.223	54292.268	21.8
305	20 14 00.962	-09 09 52.90	54290.403	54290.430	21.3	54292.261	54292.313	21.5
306	19 43 01.197	-04 37 12.40	54291.368	54291.418	21.4	54292.210	54292.257	21.2
307	19 59 13.198	-04 37 20.30	54290.387	54290.434	22.1	54292.227	54292.273	22.0
308	19 59 13.198	+04 27 41.80	54290.210	54290.262	21.3	54292.203	54292.250	21.3
309	20 01 13.801	+04 27 42.10	54290.213	54290.266	21.3	54292.206	54292.254	21.2

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
310	16 41 27.957	-27 19 52.30	54292.186	54292.213	21.1	54293.185	54293.206	21.1
311	19 43 25.318	-27 19 52.00	54292.345	54292.366	21.5	54293.296	54293.322	21.4
312	19 45 40.320	-27 19 51.60	54292.348	54292.370	21.4	54293.299	54293.326	21.4
313	20 19 48.721	-27 19 51.60	54292.359	54292.382	21.5	54293.329	54293.351	21.4
314	20 58 24.240	-18 14 48.50	54292.375	54292.417	21.5	54293.309	54293.354	21.4
315	21 00 30.597	-18 14 48.50	54292.378	54292.422	21.5	54293.312	54293.357	21.4
316	17 15 51.478	-13 42 16.90	54292.196	54292.243	21.0	54293.188	54293.209	22.1
317	17 32 32.998	-13 42 16.20	54292.220	54292.264	21.7	54293.192	54293.212	21.8
318	21 09 35.999	-13 42 16.60	54292.408	54292.446	21.7	54293.302	54293.344	21.4
319	21 11 39.479	-13 42 16.90	54292.413	54292.451	21.9	54293.306	54293.347	21.5
320	21 26 17.877	-13 42 16.90	54292.402	54292.429	21.9	54293.316	54293.361	21.7
321	21 28 21.363	-13 42 16.60	54292.405	54292.433	21.8	54293.319	54293.364	21.7
322	21 42 59.762	-13 42 15.80	54292.391	54292.437	21.7	54293.333	54293.374	21.5
323	21 45 02.877	-13 42 16.20	54292.394	54292.442	21.6	54293.336	54293.377	21.5
324	17 15 42.840	-09 10 22.40	54259.213	54259.259	21.9	54293.232	54293.255	22.5
325	19 59 13.198	-00 04 41.50	54292.232	54292.289	21.6	54293.216	54293.259	21.5
326	20 01 13.080	-00 04 41.50	54292.236	54292.292	21.6	54293.219	54293.263	21.5
327	19 57 37.082	+09 00 15.10	54290.391	54290.439	21.3	54293.195	54293.238	21.2
328	21 15 23.758	-18 14 37.00	54293.384	54293.427	21.6	54294.322	54294.359	21.4
329	21 17 30.121	-18 14 37.00	54293.388	54293.431	21.6	54294.325	54294.362	21.6
330	21 32 23.639	-18 14 36.60	54293.391	54293.436	21.6	54294.335	54294.372	21.4
331	21 34 29.639	-18 14 36.60	54293.394	54293.440	21.5	54294.338	54294.375	21.4
332	20 36 12.237	-13 42 05.00	54293.276	54293.367	21.4	54294.273	54294.305	21.3
333	20 38 15.717	-13 42 05.00	54293.279	54293.371	21.3	54294.276	54294.308	21.3
334	20 52 54.122	-13 42 04.30	54293.398	54293.445	21.5	54294.296	54294.328	21.5
335	20 54 57.601	-13 42 04.70	54293.402	54293.449	21.6	54294.300	54294.331	21.6
336	16 57 15.480	-09 09 33.10	54293.199	54293.223	22.1	54294.189	54294.212	21.9
337	16 59 17.160	-09 09 33.10	54293.202	54293.226	22.1	54294.192	54294.215	21.9
338	17 13 39.360	-09 09 33.10	54293.229	54293.250	22.4	54294.195	54294.219	22.3
339	20 30 24.479	-09 09 33.80	54293.409	54293.468	21.4	54294.252	54294.286	21.2
340	17 51 41.042	+04 26 42.70	54246.403	54246.453	21.8	54294.209	54294.234	21.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
341	16 43 40.438	-22 48 05.80	54264.240	54264.247	21.4	54266.295	54266.303	21.4
342	20 46 48.360	-09 09 27.40	54294.266	54294.311	21.2	54295.259	54295.301	21.6
343	20 48 50.040	-09 09 27.40	54294.270	54294.315	21.3	54295.263	54295.304	21.4
344	21 03 12.240	-09 09 26.60	54294.365	54294.405	22.1	54295.271	54295.314	21.8
345	21 05 13.921	-09 09 27.40	54294.368	54294.409	22.0	54295.274	54295.317	21.8
346	21 19 35.757	-09 09 27.40	54294.352	54294.389	21.8	54295.284	54295.327	21.7
347	21 21 37.437	-09 09 27.70	54294.355	54294.393	21.9	54295.287	54295.330	21.9
348	21 35 59.637	-09 09 28.10	54294.345	54294.379	21.5	54295.307	54295.352	21.4
349	21 38 01.318	-09 09 27.40	54294.349	54294.382	21.6	54295.311	54295.355	21.6
350	16 44 51.719	-04 36 55.10	54294.199	54294.222	22.0	54266.204	54266.248	21.9
351	16 46 52.321	-04 36 55.40	54294.202	54294.226	21.9	54266.208	54266.251	21.8
352	20 31 36.481	-04 36 55.80	54294.246	54294.279	21.4	54295.236	54295.277	21.5
353	20 33 37.083	-04 36 55.80	54294.249	54294.283	21.4	54295.239	54295.281	21.6
354	20 47 48.482	-04 36 55.80	54294.396	54294.430	21.7	54295.247	54295.291	21.4
355	20 49 48.721	-04 36 56.20	54294.400	54294.434	21.9	54295.250	54295.294	21.3
356	17 35 29.762	+04 27 05.40	54264.371	54264.376	21.7	54266.281	54266.410	21.4
357	17 49 38.998	+04 28 07.70	54294.205	54294.231	21.9	54266.284	54266.344	21.8
358	21 05 24.722	-22 47 06.40	54295.345	54295.388	21.1	54297.328	54297.372	21.2
359	21 07 34.683	-22 47 06.40	54295.349	54295.391	21.3	54297.331	54297.375	21.5
360	21 49 23.878	-18 14 34.80	54295.431	54295.464	21.6	54297.335	54297.378	21.5
361	21 51 30.241	-18 14 34.10	54295.435	54295.468	21.7	54297.338	54297.381	21.6
362	22 06 23.759	-18 14 34.40	54295.446	54295.477	21.4	54297.358	54297.402	21.3
363	22 08 30.123	-18 14 34.40	54295.451	54295.473	21.0	54297.361	54297.405	21.2
364	21 59 41.639	-13 42 01.80	54295.368	54295.411	21.0	54297.322	54297.365	21.5
365	22 01 45.482	-13 42 02.50	54295.372	54295.414	21.4	54297.325	54297.368	21.3
366	20 32 25.802	-09 09 33.10	54293.414	54293.463	21.4	54297.244	54297.287	21.4
367	21 52 23.882	-09 09 30.60	54295.418	54295.459	21.5	54297.304	54297.345	21.5
368	21 54 25.562	-09 09 31.00	54295.421	54295.455	21.6	54297.307	54297.348	21.5
369	22 08 47.763	-09 09 31.00	54295.377	54295.424	21.5	54297.310	54297.352	21.5
370	22 10 49.079	-09 09 31.00	54295.381	54295.427	21.1	54297.313	54297.355	21.5
371	21 25 10.558	-22 47 06.40	54295.365	54295.407	21.3	54298.367	54298.410	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
372	22 23 23.277	-18 14 28.30	54297.425	54297.458	21.6	54298.353	54298.397	21.7
373	22 25 29.283	-18 14 28.30	54297.428	54297.463	21.6	54298.356	54298.400	21.7
374	21 20 12.122	-04 36 52.90	54297.269	54297.416	21.7	54298.261	54298.304	21.6
375	21 22 12.360	-04 36 52.90	54297.272	54297.420	21.7	54298.264	54298.308	21.6
376	21 36 23.759	-04 36 52.60	54297.280	54297.408	21.6	54298.274	54298.318	21.5
377	21 38 24.362	-04 36 52.90	54297.284	54297.411	21.5	54298.278	54298.321	21.5
378	21 52 35.761	-04 36 53.30	54297.290	54297.395	21.6	54298.288	54298.331	21.7
379	21 54 35.999	-04 36 52.60	54297.294	54297.398	21.7	54298.291	54298.334	21.8
380	22 08 47.399	-04 36 52.90	54297.297	54297.388	21.7	54298.298	54298.340	22.0
381	22 10 47.637	-04 36 52.90	54297.300	54297.391	21.8	54298.301	54298.343	21.9
382	21 36 23.759	-00 04 21.00	54297.449	54297.480	21.6	54298.268	54298.311	21.6
383	21 38 23.641	-00 04 21.00	54297.454	54297.476	21.7	54298.271	54298.314	21.6
384	21 52 35.761	-00 04 21.00	54297.440	54297.485	21.7	54298.281	54298.324	21.8
385	21 54 35.642	-00 04 21.00	54297.445	54297.472	21.7	54298.284	54298.327	21.9
386	21 50 47.038	-27 19 35.00	54298.370	54298.415	21.6	54299.375	54299.417	21.5
387	21 53 02.039	-27 19 35.00	54298.374	54298.418	21.7	54299.378	54299.422	21.6
388	22 08 58.557	-27 19 35.00	54298.384	54298.430	21.5	54299.381	54299.426	21.6
389	22 11 13.922	-27 19 34.70	54298.387	54298.435	21.5	54299.385	54299.429	21.5
390	21 40 35.037	-22 47 03.10	54298.377	54298.422	21.8	54299.349	54299.395	21.5
391	21 42 45.363	-22 47 02.80	54298.380	54298.426	21.7	54299.352	54299.398	21.6
392	22 15 46.802	-22 47 03.50	54298.404	54298.448	21.6	54299.388	54299.434	21.5
393	22 17 56.763	-22 47 03.10	54298.407	54298.452	21.4	54299.391	54299.438	21.3
394	22 16 22.803	-13 41 59.30	54298.390	54298.439	21.8	54299.327	54299.368	21.5
395	22 18 26.282	-13 42 00.00	54298.394	54298.443	21.7	54299.330	54299.372	21.4
396	21 03 59.763	-00 04 24.20	54298.475	54298.488	21.6	54299.236	54299.279	21.5
397	21 06 00.722	-04 36 52.90	54297.436	54297.467	21.8	54303.260	54303.308	21.7
398	21 22 11.639	-00 04 24.60	54298.470	54298.484	21.9	54303.267	54303.314	21.8
399	20 56 12.480	-27 19 22.10	54303.318	54303.338	21.5	54305.314	54305.340	21.5
400	20 58 27.481	-27 19 21.70	54303.321	54303.341	21.5	54305.317	54305.344	21.5
401	21 14 23.999	-27 19 22.10	54303.332	54303.359	21.4	54305.354	54305.375	21.6
402	21 16 39.001	-27 19 21.40	54303.335	54303.362	21.4	54305.357	54305.379	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
403	22 33 23.041	-22 46 50.20	54303.465	54303.485	21.3	54305.368	54305.390	21.6
404	22 35 33.002	-22 46 49.80	54303.470	54303.489	21.1	54305.371	54305.393	21.4
405	21 04 00.120	-04 36 42.80	54303.257	54303.304	21.4	54305.279	54305.320	21.7
406	20 31 36.838	-00 04 10.20	54303.366	54303.416	21.9	54305.199	54305.245	21.3
407	20 33 36.719	-00 04 11.30	54303.370	54303.421	21.8	54305.202	54305.249	21.2
408	20 47 48.482	-00 04 11.30	54303.291	54303.345	21.8	54305.212	54305.259	21.0
409	20 49 48.357	-00 04 11.30	54303.295	54303.348	21.7	54305.216	54305.262	20.9
410	21 20 12.122	-00 04 10.90	54303.264	54303.311	21.8	54305.282	54305.324	21.7
411	20 31 36.838	+04 28 20.60	54303.408	54303.474	21.6	54305.192	54305.239	21.2
412	20 47 48.482	+04 28 21.40	54303.390	54303.443	21.6	54305.206	54305.252	21.0
413	21 04 00.120	+04 28 21.00	54303.381	54303.434	21.8	54305.219	54305.265	21.3
414	21 06 00.722	+04 28 21.40	54303.385	54303.438	21.7	54305.222	54305.268	21.3
415	21 20 12.122	+04 28 20.60	54303.374	54303.425	21.9	54305.225	54305.272	21.3
416	21 22 12.360	+04 28 20.60	54303.378	54303.430	21.8	54305.229	54305.275	21.3
417	21 36 23.759	+04 28 21.00	54303.298	54303.352	21.7	54305.285	54305.327	21.4
418	21 38 23.998	+04 28 20.60	54303.301	54303.355	21.4	54305.288	54305.330	21.4
419	21 52 35.397	+04 28 21.00	54303.278	54303.325	21.3	54305.292	54305.334	21.4
420	21 54 35.999	+04 28 20.60	54303.281	54303.328	21.4	54305.295	54305.337	21.4
421	21 35 59.637	+09 00 52.20	54303.399	54303.452	21.7	54305.298	54305.347	21.6
422	21 38 01.318	+09 00 52.20	54303.403	54303.456	21.5	54305.302	54305.351	21.4
423	22 27 10.797	-27 19 21.00	54305.384	54305.427	21.5	54306.378	54306.419	21.5
424	22 29 26.162	-27 19 21.00	54305.387	54305.431	21.4	54306.381	54306.422	21.5
425	21 03 12.240	+09 01 09.10	54306.311	54306.357	21.5	54307.277	54307.321	20.9
426	21 05 13.557	+09 01 09.50	54306.315	54306.361	21.5	54307.281	54307.324	20.8
427	21 19 36.121	+09 01 09.10	54306.302	54306.351	21.6	54307.284	54307.327	20.9
428	20 54 57.601	+13 33 41.80	54306.463	54306.492	21.6	54307.291	54307.334	21.0
429	21 45 03.241	+13 33 41.00	54306.331	54306.374	22.1	54307.310	54307.354	20.8
430	17 50 26.878	+40 48 51.80	54306.271	54306.318	21.6	54307.184	54307.233	21.3
431	17 53 05.637	+40 48 51.80	54306.276	54306.323	21.6	54307.187	54307.237	21.1
432	18 11 50.637	+40 48 51.80	54306.293	54306.342	21.6	54307.190	54307.242	21.0
433	18 14 29.403	+40 48 51.80	54306.297	54306.346	21.7	54307.193	54307.246	21.3

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
434	17 18 09.363	+45 21 23.00	54306.235	54306.284	21.5	54307.177	54307.224	21.4
435	17 21 00.358	+45 21 24.10	54306.240	54306.288	21.5	54307.180	54307.229	21.2
436	21 32 35.161	-27 18 51.50	54317.306	54317.349	21.0	54318.306	54318.352	21.3
437	21 22 59.162	-22 46 20.30	54317.297	54317.340	21.1	54318.285	54318.327	21.4
438	21 58 10.919	-22 46 19.20	54317.312	54317.356	20.8	54318.309	54318.357	21.3
439	22 00 20.881	-22 46 19.60	54317.315	54317.359	20.8	54318.312	54318.360	21.3
440	20 15 24.479	-00 03 41.00	54317.201	54317.251	21.5	54318.190	54318.234	21.6
441	20 15 24.479	+04 28 51.20	54317.208	54317.257	21.8	54318.197	54318.240	21.9
442	20 17 24.717	+04 28 50.90	54317.211	54317.260	21.7	54318.200	54318.243	21.8
443	20 30 24.122	+09 01 24.20	54317.215	54317.264	21.6	54318.203	54318.247	21.6
444	20 32 25.438	+09 01 22.40	54317.218	54317.267	21.5	54318.206	54318.250	21.6
445	20 46 48.002	+09 01 22.80	54317.234	54317.280	21.4	54318.217	54318.261	21.5
446	20 48 49.319	+09 01 22.80	54317.237	54317.283	21.5	54318.220	54318.264	21.4
447	20 36 11.880	+13 33 55.40	54317.240	54317.287	21.8	54318.224	54318.268	21.9
448	20 38 15.360	+13 33 54.70	54317.243	54317.290	21.8	54318.227	54318.271	21.9
449	20 52 53.758	+13 33 54.70	54317.301	54317.344	21.5	54318.281	54318.323	21.3
450	21 09 35.642	+13 33 54.40	54317.319	54317.363	21.6	54318.292	54318.334	22.0
451	21 11 39.122	+13 33 54.40	54317.322	54317.368	21.5	54318.295	54318.339	21.8
452	20 58 23.519	+18 06 28.10	54317.326	54317.372	21.4	54318.299	54318.343	21.9
453	21 00 29.883	+18 06 25.90	54317.329	54317.377	21.5	54318.302	54318.348	21.9
454	21 05 23.637	+22 38 59.60	54317.332	54317.381	21.4	54318.364	54318.409	21.5
455	21 07 33.598	+22 38 57.80	54317.336	54317.386	21.5	54318.368	54318.413	21.6
456	19 17 31.199	+49 54 09.40	54317.222	54317.271	22.0	54318.210	54318.254	22.0
457	19 20 37.679	+49 54 08.60	54317.225	54317.275	22.0	54318.213	54318.257	22.0
458	22 45 23.037	-27 18 43.20	54319.354	54319.381	21.0	54320.379	54320.400	21.1
459	22 47 38.038	-27 18 43.20	54319.358	54319.384	21.1	54320.382	54320.404	21.5
460	22 25 11.643	-09 08 36.20	54319.263	54319.306	20.9	54320.261	54320.289	21.4
461	22 41 35.160	-09 08 35.50	54319.321	54319.368	21.3	54320.276	54320.299	21.5
462	22 43 36.840	-09 08 35.50	54319.324	54319.371	21.1	54320.279	54320.303	21.3
463	22 57 59.041	-09 08 35.90	54319.361	54319.408	21.4	54320.336	54320.372	21.6
464	23 00 00.357	-09 08 36.20	54319.364	54319.412	21.5	54320.339	54320.375	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
465	22 57 23.040	-04 36 04.30	54319.347	54319.395	21.5	54320.270	54320.293	21.6
466	22 59 23.278	-04 36 04.30	54319.351	54319.398	21.5	54320.273	54320.296	21.4
467	23 13 34.677	-04 36 04.00	54319.292	54319.334	21.1	54320.283	54320.329	21.4
468	23 15 35.280	-04 36 04.30	54319.295	54319.338	21.1	54320.286	54320.332	21.4
469	23 29 46.679	-04 36 04.00	54319.327	54319.374	21.4	54320.306	54320.349	21.6
470	23 31 46.918	-04 36 04.70	54319.331	54319.377	21.4	54320.309	54320.352	21.6
471	23 45 58.317	-04 36 04.30	54319.401	54319.443	21.3	54320.313	54320.355	21.5
472	23 47 58.562	-04 36 04.30	54319.404	54319.448	21.2	54320.316	54320.359	21.6
473	22 10 47.637	-00 03 32.40	54319.236	54319.281	21.0	54320.235	54320.468	21.6
474	23 29 46.322	-00 03 31.70	54319.417	54319.466	21.4	54320.319	54320.362	21.8
475	23 45 58.317	-00 03 32.40	54319.341	54319.388	21.4	54320.322	54320.365	21.7
476	23 47 58.198	-00 03 32.80	54319.344	54319.391	21.5	54320.326	54320.368	21.7
477	21 52 23.882	+09 01 30.70	54319.223	54319.245	21.1	54320.195	54320.225	21.3
478	21 54 25.562	+09 01 30.70	54319.226	54319.249	21.1	54320.199	54320.228	21.2
479	21 26 18.241	+13 34 02.60	54319.426	54319.457	21.2	54320.183	54320.213	21.7
480	21 28 21.720	+13 34 02.60	54319.431	54319.461	21.2	54320.186	54320.216	21.6
481	21 43 00.119	+13 34 02.60	54319.422	54319.452	21.7	54320.190	54320.219	21.9
482	23 14 22.200	-09 08 30.10	54320.386	54320.431	21.4	54321.296	54321.338	21.2
483	22 41 10.681	-04 35 57.80	54320.447	54320.473	21.7	54321.260	54321.306	21.5
484	22 43 10.919	-04 35 58.20	54320.451	54320.477	21.7	54321.263	54321.309	21.3
485	22 08 47.042	-00 03 26.30	54320.422	54320.464	21.8	54321.223	54321.266	21.5
486	21 34 51.241	-27 18 46.80	54321.314	54321.341	21.5	54322.302	54322.329	21.7
487	22 33 05.401	-13 41 11.80	54321.283	54321.325	21.4	54322.276	54322.323	21.4
488	22 35 08.881	-13 41 11.40	54321.286	54321.328	21.5	54322.279	54322.326	21.6
489	22 49 47.279	-13 41 11.40	54321.290	54321.331	21.2	54322.289	54322.333	21.4
490	22 51 50.758	-13 41 11.40	54321.293	54321.334	21.4	54322.292	54322.336	21.6
491	23 06 28.799	-13 41 11.80	54321.409	54321.454	21.2	54322.306	54322.353	21.7
492	23 30 46.802	-09 08 40.20	54321.352	54321.395	21.2	54322.309	54322.356	21.5
493	23 32 48.118	-09 08 40.20	54321.355	54321.399	21.3	54322.313	54322.359	21.4
494	23 47 10.318	-09 08 40.20	54321.382	54321.427	21.5	54322.340	54322.387	21.9
495	23 49 11.999	-09 08 40.20	54321.385	54321.430	21.5	54322.343	54322.390	21.8

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
496	00 00 34.560	-04 36 07.90	54321.318	54321.365	21.3	54322.346	54322.393	21.7
497	00 02 34.800	-04 36 07.90	54321.321	54321.368	21.3	54322.349	54322.397	21.8
498	22 24 59.757	-04 36 07.90	54321.253	54321.300	21.5	54322.241	54322.282	21.5
499	22 27 00.003	-04 36 07.90	54321.256	54321.303	21.5	54322.244	54322.286	21.6
500	20 17 25.438	-00 03 36.00	54321.220	54321.246	21.6	54322.168	54322.211	21.4
501	22 57 23.040	-00 03 35.60	54321.375	54321.418	21.7	54322.252	54322.296	21.6
502	22 59 23.278	-00 03 36.40	54321.379	54321.422	21.6	54322.256	54322.299	21.5
503	23 13 34.677	-00 03 36.00	54321.345	54321.389	21.8	54322.269	54322.316	21.7
504	23 15 34.923	-00 03 36.40	54321.348	54321.392	21.8	54322.272	54322.319	21.7
505	20 33 37.797	+04 28 55.90	54321.227	54321.250	21.8	54322.172	54322.214	21.4
506	20 49 49.442	+04 28 55.60	54321.232	54321.270	21.6	54322.175	54322.217	21.3
507	23 45 58.317	+04 28 56.30	54321.358	54321.402	21.7	54322.363	54322.407	22.0
508	23 47 58.919	+04 28 55.60	54321.361	54321.405	21.7	54322.366	54322.411	22.1
509	00 00 34.560	-09 08 40.60	54322.404	54322.446	21.8	54323.318	54323.361	21.1
510	21 06 00.722	-00 03 36.40	54321.235	54321.273	21.6	54323.175	54323.216	21.3
511	22 41 11.402	-00 03 37.80	54322.263	54322.370	21.8	54323.239	54323.281	21.3
512	22 43 11.283	-00 03 37.80	54322.266	54322.373	21.9	54323.242	54323.284	21.4
513	23 29 46.679	+04 28 54.50	54322.380	54322.423	22.1	54323.263	54323.305	21.4
514	23 31 46.918	+04 28 53.80	54322.383	54322.427	22.1	54323.267	54323.308	21.4
515	21 21 38.158	+09 01 27.50	54321.241	54321.278	21.6	54323.171	54323.213	21.3
516	22 40 22.801	-18 13 39.70	54323.298	54323.340	21.2	54324.310	54324.352	21.4
517	22 42 29.158	-18 13 39.40	54323.301	54323.343	21.3	54324.313	54324.355	21.5
518	22 57 22.683	-18 13 38.30	54323.350	54323.395	21.4	54324.317	54324.358	21.4
519	22 59 29.039	-18 13 39.40	54323.354	54323.398	21.5	54324.320	54324.361	21.5
520	23 14 22.200	-18 13 40.10	54323.364	54323.413	21.7	54324.323	54324.365	21.7
521	23 16 28.557	-18 13 39.00	54323.367	54323.417	21.8	54324.327	54324.368	21.8
522	23 23 10.320	-13 41 06.70	54323.372	54323.422	21.6	54324.330	54324.372	21.6
523	23 25 13.799	-13 41 07.40	54323.375	54323.426	21.6	54324.333	54324.375	21.6
524	22 24 59.043	-00 03 32.40	54323.386	54323.439	22.0	54324.224	54324.267	21.6
525	22 26 58.918	-00 03 32.00	54323.390	54323.444	21.8	54324.227	54324.270	21.5
526	22 43 11.283	+04 28 59.20	54323.490	54323.503	21.3	54324.230	54324.293	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
527	22 57 22.683	+04 29 00.20	54323.404	54323.448	21.9	54324.238	54324.284	21.4
528	22 59 22.921	+04 28 59.50	54323.408	54323.452	21.8	54324.241	54324.287	21.5
529	23 13 34.320	+04 28 59.90	54323.379	54323.430	21.8	54324.254	54324.297	21.4
530	23 15 34.559	+04 28 59.50	54323.382	54323.435	21.7	54324.257	54324.300	21.4
531	23 30 46.081	+09 01 31.80	54323.476	54323.494	21.7	54324.260	54324.303	21.4
532	23 32 47.761	+09 01 31.40	54323.481	54323.498	21.6	54324.263	54324.307	21.5
533	23 31 22.439	-18 13 45.80	54324.338	54324.382	21.5	54325.331	54325.358	21.3
534	23 33 28.802	-18 13 45.10	54324.342	54324.385	21.6	54325.335	54325.361	21.3
535	00 00 34.200	-13 41 13.60	54324.405	54324.450	21.6	54325.345	54325.371	21.3
536	00 02 37.680	-13 41 13.60	54324.408	54324.454	21.7	54325.348	54325.374	21.4
537	00 17 16.080	-13 41 13.20	54324.422	54324.483	21.8	54325.365	54325.397	21.4
538	00 19 19.560	-13 41 13.60	54324.425	54324.479	21.7	54325.368	54325.400	21.4
539	23 39 52.197	-13 41 13.20	54324.345	54324.388	21.5	54325.313	54325.338	21.3
540	23 41 55.677	-13 41 13.20	54324.348	54324.392	21.6	54325.316	54325.341	21.1
541	23 56 34.082	-13 41 12.50	54324.399	54324.441	21.7	54325.325	54325.351	21.4
542	23 58 37.561	-13 41 13.60	54324.402	54324.445	21.7	54325.328	54325.354	21.3
543	22 24 59.400	+04 28 53.40	54324.216	54324.277	21.5	54325.211	54325.236	21.6
544	22 27 00.003	+04 28 53.40	54324.219	54324.280	21.5	54325.214	54325.239	21.5
545	22 41 11.038	+04 28 53.40	54324.247	54324.290	21.9	54325.223	54325.249	21.9
546	23 14 22.557	+09 01 25.30	54324.412	54324.459	21.7	54325.243	54325.268	21.4
547	23 16 24.238	+09 01 25.30	54324.416	54324.463	21.9	54325.246	54325.272	21.6
548	22 08 47.399	+04 28 51.60	54325.201	54325.226	21.6	54327.195	54327.240	21.2
549	22 41 34.803	+09 01 22.80	54325.262	54325.290	21.8	54327.210	54327.253	20.8
550	22 43 36.483	+09 01 23.20	54325.265	54325.293	21.7	54327.213	54327.256	21.2
551	22 57 58.677	+09 01 23.20	54325.255	54325.283	21.8	54327.220	54327.266	21.3
552	23 00 00.357	+09 01 22.80	54325.258	54325.286	21.8	54327.223	54327.270	21.2
553	23 23 10.320	+13 33 55.40	54325.277	54325.302	21.8	54327.233	54327.279	21.0
554	23 25 13.799	+13 33 55.10	54325.280	54325.305	21.8	54327.236	54327.283	20.9
555	00 00 33.840	-22 46 12.40	54328.402	54328.436	21.5	54329.395	54329.436	21.3
556	22 50 58.923	-22 46 19.60	54325.388	54325.421	21.4	54329.314	54329.340	21.3
557	22 53 08.878	-22 46 19.20	54325.392	54325.425	21.2	54329.317	54329.344	21.3

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
558	23 08 34.442	-22 46 19.20	54325.403	54325.431	21.3	54329.327	54329.354	21.1
559	23 10 44.760	-22 46 19.60	54325.408	54325.436	21.3	54329.331	54329.357	21.2
560	23 26 10.317	-22 46 19.20	54325.412	54325.440	21.2	54329.347	54329.374	21.1
561	23 28 20.278	-22 46 19.20	54325.416	54325.444	21.2	54329.350	54329.377	21.0
562	00 00 34.200	-18 13 47.30	54325.459	54325.486	21.7	54329.367	54329.409	21.6
563	00 02 40.560	-18 13 47.60	54325.463	54325.491	21.6	54329.370	54329.413	21.4
564	00 17 33.720	-18 13 40.40	54328.407	54328.442	21.3	54329.399	54329.441	21.1
565	00 19 40.080	-18 13 40.40	54328.410	54328.447	21.0	54329.402	54329.445	21.0
566	23 48 21.963	-18 13 46.90	54325.449	54325.477	21.6	54329.334	54329.360	21.3
567	23 50 28.320	-18 13 47.30	54325.453	54325.482	21.6	54329.337	54329.363	21.4
568	22 10 48.001	+04 28 51.20	54325.205	54325.230	21.7	54329.192	54329.213	21.5
569	22 08 47.042	+09 01 29.60	54327.273	54327.327	21.0	54329.181	54329.204	21.2
570	22 25 10.922	+09 01 30.40	54327.247	54327.293	21.2	54329.216	54329.238	21.3
571	22 27 12.239	+09 01 30.00	54327.250	54327.296	21.3	54329.219	54329.242	21.6
572	21 59 41.282	+13 34 01.20	54327.181	54327.226	21.3	54329.175	54329.198	21.5
573	22 01 44.762	+13 34 01.20	54327.184	54327.230	21.3	54329.178	54329.201	21.5
574	22 33 04.680	+13 34 01.60	54327.299	54327.374	20.9	54329.222	54329.245	21.7
575	22 35 08.160	+13 34 01.60	54327.303	54327.378	20.9	54329.226	54329.248	21.8
576	22 49 46.558	+13 34 01.20	54328.268	54328.300	21.7	54329.296	54329.386	21.6
577	22 51 50.037	+13 34 01.60	54328.271	54328.303	22.0	54329.300	54329.390	21.8
578	23 06 28.078	+13 34 01.60	54327.260	54327.306	21.8	54329.229	54329.252	21.8
579	23 08 31.922	+13 34 01.60	54327.263	54327.309	21.9	54329.232	54329.255	21.9
580	23 43 45.842	-22 46 13.40	54328.395	54328.427	21.3	54330.352	54330.374	21.2
581	23 45 55.797	-22 46 12.70	54328.399	54328.432	21.5	54330.355	54330.377	21.4
582	22 42 28.801	+18 06 33.10	54327.444	54327.483	20.9	54330.232	54330.259	21.7
583	00 00 33.840	-27 18 43.90	54330.396	54330.419	21.3	54331.379	54331.406	20.8
584	00 02 48.840	-27 18 43.90	54330.399	54330.422	21.2	54331.382	54331.409	20.9
585	00 18 45.720	-27 18 44.60	54330.429	54330.449	21.6	54331.392	54331.414	21.1
586	23 39 57.601	-27 18 44.30	54330.381	54330.402	21.1	54331.359	54331.386	21.3
587	23 42 12.603	-27 18 44.30	54330.384	54330.406	21.1	54331.363	54331.389	21.2
588	23 58 09.478	-27 18 43.90	54330.389	54330.413	21.0	54331.373	54331.399	20.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
589	00 00 24.480	-27 18 43.90	54330.393	54330.416	21.3	54331.376	54331.402	21.3
590	22 16 22.803	+13 34 01.60	54330.216	54330.242	21.7	54331.175	54331.201	21.6
591	22 18 26.282	+13 34 01.60	54330.219	54330.246	21.6	54331.178	54331.205	21.5
592	21 49 23.521	+18 06 33.10	54330.179	54330.202	21.8	54331.162	54331.188	21.9
593	21 51 29.877	+18 06 33.50	54330.182	54330.206	21.8	54331.165	54331.191	21.9
594	22 06 23.038	+18 06 33.10	54330.275	54330.298	21.9	54331.168	54331.195	21.6
595	22 08 29.402	+18 06 33.10	54330.279	54330.302	21.8	54331.172	54331.198	21.7
596	22 23 22.920	+18 06 33.10	54330.269	54330.292	21.9	54331.181	54331.208	21.7
597	22 25 29.283	+18 06 33.10	54330.272	54330.295	21.8	54331.185	54331.211	21.7
598	22 40 22.437	+18 06 33.50	54330.229	54330.256	21.8	54331.215	54331.238	21.9
599	22 57 22.319	+18 06 33.80	54330.222	54330.249	21.8	54331.218	54331.241	21.9
600	22 59 28.682	+18 06 33.50	54330.226	54330.252	21.6	54331.221	54331.244	21.7
601	23 14 22.200	+18 06 33.10	54330.209	54330.236	21.7	54331.224	54331.248	22.0
602	23 16 28.557	+18 06 33.50	54330.213	54330.239	21.8	54331.228	54331.251	22.2
603	23 08 34.078	+22 39 04.70	54330.262	54330.285	22.0	54331.231	54331.254	22.1
604	23 10 44.403	+22 39 05.00	54330.265	54330.288	22.0	54331.234	54331.257	22.1
605	00 21 00.720	-27 18 44.30	54330.432	54330.454	21.7	54332.386	54332.408	21.8
606	23 21 46.082	-27 18 44.60	54330.345	54330.367	21.2	54332.340	54332.361	21.2
607	23 24 01.077	-27 18 43.90	54330.349	54330.371	21.3	54332.343	54332.365	21.4
608	00 36 57.600	-27 18 43.90	54332.431	54332.451	21.6	54333.390	54333.413	21.6
609	00 39 12.600	-27 18 43.90	54332.434	54332.456	21.5	54333.393	54333.416	21.5
610	23 03 34.199	-27 18 44.60	54330.334	54330.359	21.4	54333.330	54333.351	21.5
611	23 05 49.200	-27 18 44.30	54330.338	54330.362	21.4	54333.333	54333.354	21.4
612	00 18 09.720	-22 46 12.70	54332.371	54332.413	21.5	54333.365	54333.406	21.5
613	00 20 19.680	-22 46 12.40	54332.375	54332.416	21.5	54333.368	54333.410	21.5
614	00 35 45.600	-22 46 12.70	54332.379	54332.421	21.4	54333.376	54333.420	21.4
615	00 37 55.920	-22 46 12.40	54332.383	54332.424	21.3	54333.379	54333.423	21.4
616	21 22 59.883	+22 39 04.70	54332.160	54332.206	21.9	54333.164	54333.208	21.9
617	21 25 09.837	+22 39 05.00	54332.163	54332.209	21.8	54333.167	54333.211	21.8
618	21 42 45.720	+22 39 04.70	54332.172	54332.178	21.7	54333.170	54333.214	21.6
619	21 58 11.283	+22 39 06.10	54332.213	54332.258	21.4	54333.174	54333.218	21.5

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
620	22 00 21.238	+22 39 05.00	54332.217	54332.261	20.9	54333.177	54333.221	21.6
621	22 15 46.802	+22 39 05.00	54332.195	54332.236	21.5	54333.180	54333.224	21.5
622	22 17 57.120	+22 39 04.70	54332.198	54332.240	21.7	54333.184	54333.227	21.7
623	22 33 22.677	+22 39 04.70	54332.188	54332.230	21.3	54333.187	54333.231	21.4
624	22 50 58.559	+22 39 05.00	54332.182	54332.223	21.4	54333.190	54333.234	21.5
625	22 53 08.521	+22 39 05.00	54332.185	54332.227	21.4	54333.193	54333.237	21.6
626	23 03 34.199	+27 11 36.60	54332.251	54332.293	21.8	54333.201	54333.245	21.5
627	23 05 49.200	+27 11 36.60	54332.254	54332.297	21.7	54333.204	54333.248	21.7
628	21 15 23.758	+18 06 33.50	54333.251	54333.295	21.8	54334.171	54334.199	21.6
629	21 17 30.121	+18 06 33.50	54333.255	54333.298	22.2	54334.174	54334.202	21.8
630	21 32 23.639	+18 06 33.10	54333.258	54333.302	21.9	54334.179	54334.206	21.7
631	21 34 30.003	+18 06 33.10	54333.261	54333.305	21.9	54334.182	54334.209	21.6
632	21 40 35.401	+22 39 05.80	54333.270	54333.311	21.9	54334.212	54334.235	21.8
633	22 27 10.797	+27 11 37.00	54333.282	54333.323	21.7	54334.223	54334.252	21.6
634	22 29 25.798	+27 11 36.60	54333.285	54333.326	21.6	54334.227	54334.255	21.6
635	22 45 22.680	+27 11 37.00	54333.275	54333.316	21.7	54334.245	54334.269	21.7
636	22 47 37.681	+27 11 36.60	54333.278	54333.320	21.7	54334.249	54334.272	21.7
637	21 32 35.518	+27 11 37.00	54334.215	54334.239	22.0	54335.409	54335.453	21.9
638	21 34 50.520	+27 11 37.00	54334.219	54334.242	21.9	54335.414	54335.458	21.6
639	21 50 47.401	+27 11 37.00	54334.295	54334.324	21.8	54335.418	54335.462	21.6
640	21 53 02.403	+27 11 37.00	54334.298	54334.328	21.8	54335.422	54335.467	21.6
641	22 08 58.921	+27 11 37.00	54334.263	54334.286	21.7	54335.427	54335.471	21.5
642	22 11 13.922	+27 11 37.00	54334.266	54334.289	21.9	54335.431	54335.475	21.7
643	21 51 23.402	+31 44 08.50	54334.372	54334.411	22.1	54335.436	54335.493	21.2
644	21 53 44.522	+31 44 08.90	54334.377	54334.416	22.1	54335.440	54335.480	21.5
645	22 10 23.158	+31 44 08.20	54334.364	54334.395	21.9	54335.445	54335.488	21.5
646	22 12 44.278	+31 44 08.50	54334.368	54334.400	21.9	54335.449	54335.484	21.6
647	22 29 22.921	+31 44 08.90	54334.314	54334.337	21.9	54336.200	54336.245	21.3
648	22 31 44.041	+31 44 08.50	54334.317	54334.341	22.0	54336.204	54336.248	21.4
649	22 48 22.320	+31 44 08.20	54334.279	54334.303	22.1	54336.207	54336.251	21.6
650	22 50 43.803	+31 44 08.90	54334.282	54334.306	22.2	54336.210	54336.255	21.6

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
651	22 06 59.039	+36 16 40.10	54334.441	54334.473	22.1	54336.214	54336.258	21.9
652	22 27 04.679	+36 16 40.40	54334.432	54334.458	21.8	54336.220	54336.265	21.6
653	22 29 33.722	+36 16 40.10	54334.436	54334.462	21.8	54336.224	54336.268	21.6
654	18 27 08.277	+49 54 16.20	54334.161	54334.188	21.7	54336.187	54336.231	21.6
655	18 52 19.920	+49 54 15.80	54334.164	54334.192	21.9	54336.191	54336.236	21.6
656	18 55 26.399	+49 54 16.20	54334.167	54334.195	21.8	54336.196	54336.240	21.6
657	00 02 44.160	-22 45 53.60	54346.323	54346.365	21.0	54347.316	54347.359	21.2
658	23 08 31.922	-13 40 49.80	54346.239	54346.280	21.0	54347.232	54347.278	21.3
659	22 27 12.603	-09 08 18.60	54346.193	54346.235	21.1	54347.218	54347.240	21.0
660	23 16 23.881	-09 08 18.60	54346.225	54346.267	21.2	54347.221	54347.264	21.3
661	22 10 48.722	+09 01 48.70	54346.211	54346.256	21.4	54347.225	54347.246	21.7
662	22 35 33.002	+22 39 24.10	54346.218	54346.261	21.5	54347.228	54347.249	21.7
663	00 34 33.600	-18 12 15.80	54347.309	54347.352	20.9	54348.311	54348.353	21.0
664	00 36 39.960	-18 12 14.80	54347.313	54347.355	21.0	54348.315	54348.356	21.1
665	00 33 57.600	-13 39 43.60	54347.294	54347.337	21.3	54348.293	54348.338	21.2
666	00 33 21.600	-09 07 11.60	54347.285	54347.326	21.2	54348.273	54348.318	21.0
667	00 35 23.280	-09 07 11.60	54347.288	54347.330	21.3	54348.276	54348.321	21.2
668	00 49 45.840	-09 07 12.00	54347.463	54347.514	20.9	54348.325	54348.367	21.3
669	00 51 47.160	-09 07 11.60	54347.467	54347.511	21.0	54348.328	54348.370	21.5
670	01 05 21.840	-04 34 40.10	54347.400	54347.443	21.4	54348.331	54348.373	21.5
671	01 07 22.080	-04 34 40.40	54347.396	54347.440	21.3	54348.334	54348.377	21.4
672	00 00 33.480	-00 02 08.20	54347.271	54347.320	21.5	54348.234	54348.280	21.2
673	00 02 33.720	-00 02 08.20	54347.274	54347.323	21.7	54348.238	54348.283	21.4
674	00 49 09.840	-00 02 08.20	54347.383	54347.427	21.5	54348.259	54348.303	21.1
675	00 51 09.720	-00 02 08.20	54347.386	54347.430	21.4	54348.263	54348.306	21.1
676	00 32 57.840	+04 30 24.10	54347.369	54347.417	21.6	54348.243	54348.286	21.2
677	00 34 58.080	+04 30 23.80	54347.372	54347.420	21.6	54348.246	54348.290	21.2
678	00 33 21.600	+09 02 55.70	54347.390	54347.433	21.9	54348.345	54348.390	21.9
679	00 35 23.280	+09 02 55.00	54347.393	54347.436	21.9	54348.348	54348.393	21.9
680	00 17 15.720	+13 35 27.20	54347.403	54347.447	21.5	54348.221	54348.266	21.3
681	00 19 19.200	+13 35 27.20	54347.406	54347.450	21.5	54348.224	54348.270	21.3

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
682	23 39 51.483	+13 35 27.60	54347.302	54347.345	21.9	54348.189	54348.214	21.6
683	23 41 55.320	+13 35 27.20	54347.306	54347.348	21.9	54348.193	54348.218	21.6
684	23 56 33.361	+13 35 27.20	54347.457	54347.489	21.5	54348.201	54348.227	21.2
685	23 58 36.840	+13 35 27.20	54347.460	54347.492	21.5	54348.204	54348.231	21.3
686	00 17 33.720	+18 07 59.20	54347.470	54347.495	21.5	54348.208	54348.249	21.3
687	00 19 40.080	+18 07 59.20	54347.474	54347.499	21.5	54348.211	54348.253	21.4
688	23 31 21.718	+18 07 59.20	54347.333	54347.376	21.8	54348.171	54348.196	21.2
689	00 16 46.200	-04 35 36.60	54348.383	54348.424	21.6	54352.239	54352.286	21.4
690	00 18 46.800	-04 35 36.60	54348.386	54348.427	21.7	54352.242	54352.289	21.6
691	00 34 57.720	-00 02 08.20	54347.379	54347.423	21.6	54352.356	54352.403	21.7
692	00 00 34.200	+04 29 26.50	54348.407	54348.450	21.5	54352.204	54352.245	21.4
693	00 02 34.800	+04 29 26.90	54348.410	54348.454	21.6	54352.207	54352.249	21.5
694	23 47 10.318	+09 01 58.10	54348.438	54348.468	22.0	54352.186	54352.219	21.7
695	23 49 11.999	+09 01 58.80	54348.441	54348.471	21.8	54352.190	54352.222	21.6
696	00 16 58.800	-09 07 55.20	54352.252	54352.299	21.0	54353.247	54353.290	20.9
697	00 19 00.120	-09 07 54.80	54352.255	54352.302	21.1	54353.250	54353.293	21.0
698	00 16 46.920	-00 02 52.10	54352.225	54352.272	21.6	54353.223	54353.267	21.5
699	00 18 46.800	-00 02 51.70	54352.229	54352.275	21.5	54353.226	54353.270	21.5
700	00 32 58.920	-00 02 51.70	54352.352	54352.399	21.6	54353.236	54353.280	21.3
701	00 16 46.920	+04 29 39.80	54352.232	54352.279	21.5	54353.215	54353.260	21.4
702	00 18 47.160	+04 29 40.20	54352.235	54352.282	21.4	54353.218	54353.263	21.4
703	00 49 10.920	+04 29 39.80	54352.266	54352.313	21.4	54353.240	54353.284	21.3
704	00 51 11.160	+04 29 40.20	54352.269	54352.316	21.4	54353.243	54353.287	21.3
705	01 05 22.920	+04 29 39.80	54352.326	54352.373	21.4	54353.254	54353.297	21.2
706	01 07 23.160	+04 29 39.80	54352.329	54352.376	21.5	54353.257	54353.300	21.3
707	01 21 34.560	+04 29 40.20	54352.386	54352.428	21.8	54353.304	54353.350	21.5
708	01 23 35.160	+04 29 40.20	54352.389	54352.431	21.8	54353.307	54353.354	21.6
709	01 37 46.560	+04 29 39.50	54352.419	54352.461	21.8	54353.310	54353.357	21.6
710	00 49 46.920	+09 02 12.10	54352.359	54352.406	21.7	54353.230	54353.273	21.3
711	00 51 48.240	+09 02 11.40	54352.363	54352.409	21.8	54353.233	54353.277	21.3
712	01 06 10.800	+09 02 11.80	54352.319	54352.366	21.6	54353.314	54353.360	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
713	01 08 12.120	+09 02 11.80	54352.323	54352.369	21.6	54353.317	54353.363	21.5
714	01 22 34.680	+09 02 12.10	54352.259	54352.306	21.4	54353.320	54353.367	21.6
715	01 24 36.360	+09 02 11.40	54352.262	54352.309	21.4	54353.324	54353.370	21.6
716	01 38 58.920	+09 02 11.80	54352.292	54352.339	21.8	54353.327	54353.373	21.8
717	01 41 00.240	+09 02 11.40	54352.296	54352.343	21.9	54353.330	54353.377	22.0
718	01 55 22.800	+09 02 12.10	54352.333	54352.379	21.6	54353.333	54353.380	21.5
719	01 24 04.680	+13 34 43.30	54352.413	54352.455	21.9	54353.337	54353.383	21.7
720	01 26 08.160	+13 34 43.30	54352.416	54352.458	21.9	54353.340	54353.387	21.8
721	01 40 46.560	+13 34 44.40	54352.346	54352.393	22.1	54353.343	54353.390	21.8
722	01 42 50.400	+13 34 43.00	54352.349	54352.396	21.7	54353.347	54353.393	21.7
723	23 26 11.038	+22 39 46.40	54352.172	54352.212	21.5	54353.147	54353.178	21.0
724	23 28 20.999	+22 39 47.20	54352.175	54352.215	21.5	54353.150	54353.181	20.7
725	01 05 22.560	-00 02 49.90	54353.413	54353.455	21.2	54354.297	54354.340	21.1
726	01 07 22.800	-00 02 49.60	54353.416	54353.458	21.4	54354.300	54354.343	21.2
727	23 31 46.918	-00 02 49.90	54353.211	54353.401	21.4	54354.188	54354.219	21.1
728	01 53 58.560	+04 29 42.00	54353.420	54353.462	21.4	54354.330	54354.373	21.4
729	01 07 22.800	+13 34 45.80	54353.406	54353.448	21.7	54354.367	54354.410	21.9
730	01 09 26.280	+13 34 45.50	54353.410	54353.452	21.8	54354.370	54354.413	22.0
731	23 33 29.159	+18 07 17.80	54353.442	54353.484	21.5	54354.168	54354.202	21.3
732	01 06 10.800	-09 07 48.40	54354.279	54354.323	20.9	54355.281	54355.316	21.1
733	01 08 12.480	-09 07 48.40	54354.283	54354.327	21.2	54355.284	54355.319	21.3
734	01 22 34.680	-09 07 48.70	54354.384	54354.426	21.6	54355.288	54355.323	21.2
735	01 24 36.360	-09 07 48.00	54354.387	54354.429	21.6	54355.291	54355.326	21.2
736	01 38 58.920	-09 07 48.70	54354.390	54354.432	21.2	54355.309	54355.343	21.0
737	01 41 00.240	-09 07 48.00	54354.393	54354.436	21.2	54355.313	54355.346	21.0
738	01 55 22.800	-09 07 48.40	54354.397	54354.439	21.0	54355.329	54355.363	21.1
739	01 57 24.480	-09 07 48.00	54354.400	54354.442	21.1	54355.333	54355.366	21.1
740	02 11 46.680	-09 07 48.40	54354.404	54354.446	21.4	54355.336	54355.369	21.3
741	02 13 48.360	-09 07 48.40	54354.407	54354.449	21.4	54355.339	54355.372	21.4
742	01 21 34.920	-00 02 44.50	54354.303	54354.347	21.7	54355.264	54355.296	21.3
743	01 23 34.800	-00 02 44.90	54354.307	54354.350	21.3	54355.267	54355.299	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
744	01 37 46.920	-00 02 44.90	54354.310	54354.353	21.3	54355.349	54355.383	21.6
745	01 39 46.800	-00 02 44.90	54354.313	54354.357	21.4	54355.352	54355.386	21.7
746	01 53 58.920	-00 02 44.90	54354.316	54354.360	21.5	54355.356	54355.389	21.8
747	01 55 58.800	-00 02 44.90	54354.320	54354.363	21.4	54355.359	54355.393	21.7
748	00 00 34.920	+13 34 50.20	54354.193	54354.236	21.0	54355.217	54355.249	21.2
749	00 02 38.400	+13 34 50.90	54354.196	54354.239	21.3	54355.220	54355.252	21.4
750	00 33 59.040	+13 34 50.50	54354.229	54354.273	21.5	54355.225	54355.256	21.5
751	00 36 02.520	+13 34 50.50	54354.232	54354.276	21.4	54355.229	54355.259	21.5
752	00 50 40.920	+13 34 50.50	54354.333	54354.377	21.8	54355.271	54355.302	21.6
753	00 52 44.400	+13 34 50.50	54354.337	54354.380	21.9	54355.274	54355.306	21.8
754	00 34 35.040	+18 07 22.10	54354.206	54354.253	21.7	54355.403	54355.436	22.1
755	00 36 41.040	+18 07 22.40	54354.209	54354.256	21.4	54355.406	54355.440	22.0
756	00 51 34.920	+18 07 22.10	54354.212	54354.259	21.5	54355.416	54355.450	21.8
757	00 53 41.280	+18 07 22.40	54354.215	54354.263	21.3	54355.420	54355.453	21.9
758	01 08 34.800	+18 07 22.40	54354.222	54354.266	21.3	54355.423	54355.456	21.8
759	01 10 41.160	+18 07 22.10	54354.226	54354.269	21.2	54355.426	54355.460	21.9
760	01 25 34.680	+18 07 22.80	54354.246	54354.290	21.5	54355.443	54355.473	22.0
761	01 27 41.040	+18 07 22.40	54354.249	54354.293	21.3	54355.446	54355.476	22.0
762	00 02 36.600	-09 07 43.00	54355.243	54355.277	21.1	54356.245	54356.288	21.2
763	00 00 34.920	+09 02 23.30	54355.206	54355.236	21.6	54356.186	54356.229	21.8
764	00 02 36.600	+09 02 23.60	54355.209	54355.239	21.6	54356.189	54356.232	21.9
765	00 16 58.800	+09 02 24.00	54355.463	54355.493	21.1	54356.272	54356.315	22.0
766	00 19 00.480	+09 02 23.60	54355.466	54355.497	21.6	54356.275	54356.318	22.0
767	00 02 41.280	+18 07 27.10	54355.400	54355.433	21.8	54356.172	54356.215	21.6
768	23 48 22.677	+18 07 27.10	54355.376	54355.410	21.9	54356.162	54356.204	21.7
769	23 50 29.041	+18 07 27.50	54355.379	54355.413	22.1	54356.165	54356.208	21.8
770	00 32 58.560	-04 35 22.60	54356.249	54356.293	21.5	54357.242	54357.285	21.5
771	00 34 59.160	-04 35 22.60	54356.252	54356.297	21.4	54357.245	54357.288	21.5
772	00 49 10.560	-04 35 22.20	54356.262	54356.304	21.4	54357.249	54357.292	21.4
773	00 51 11.160	-04 35 22.60	54356.265	54356.307	21.5	54357.252	54357.295	21.5
774	01 21 34.560	-04 35 22.90	54356.322	54356.364	21.7	54357.343	54357.390	21.9

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
775	01 23 35.160	-04 35 22.60	54356.325	54356.367	21.5	54357.346	54357.393	21.7
776	01 37 46.560	-04 35 22.90	54356.328	54356.370	21.6	54357.356	54357.404	21.8
777	01 39 47.160	-04 35 22.60	54356.331	54356.374	21.6	54357.360	54357.407	21.8
778	01 53 58.560	-04 35 22.60	54356.335	54356.377	21.6	54357.370	54357.414	21.6
779	01 55 58.800	-04 35 22.60	54356.338	54356.380	21.8	54357.373	54357.418	21.8
780	02 10 10.560	-04 35 22.60	54356.341	54356.384	21.9	54357.383	54357.427	22.0
781	02 12 11.160	-04 35 22.90	54356.345	54356.387	22.0	54357.386	54357.431	22.0
782	00 00 34.920	+18 07 26.80	54355.396	54355.430	21.9	54357.166	54357.208	21.5
783	00 00 34.560	+22 39 48.60	54356.348	54356.390	22.2	54357.173	54357.215	22.0
784	00 02 44.880	+22 39 47.90	54356.352	54356.394	22.1	54357.176	54357.218	21.8
785	00 18 10.440	+22 39 48.20	54356.424	54356.465	22.1	54357.190	54357.235	21.8
786	00 20 20.760	+22 39 47.90	54356.427	54356.468	22.0	54357.193	54357.238	21.7
787	00 35 46.680	+22 39 48.20	54356.357	54356.404	22.3	54357.222	54357.263	22.0
788	00 37 56.640	+22 39 47.90	54356.360	54356.407	22.3	54357.225	54357.267	22.0
789	00 53 22.560	+22 39 47.90	54356.397	54356.439	21.9	54357.228	54357.270	21.6
790	00 55 32.880	+22 39 48.20	54356.400	54356.442	21.8	54357.232	54357.273	21.5
791	01 10 58.800	+22 39 48.20	54356.410	54356.452	22.1	54357.257	54357.300	21.9
792	01 13 08.760	+22 39 47.90	54356.414	54356.455	22.0	54357.260	54357.303	21.8
793	01 28 34.680	+22 39 47.90	54356.417	54356.458	21.9	54357.397	54357.441	21.9
794	01 30 44.640	+22 39 47.90	54356.420	54356.461	22.4	54357.400	54357.445	22.2
795	23 43 46.563	+22 39 47.90	54356.175	54356.218	21.7	54357.158	54357.202	21.6
796	23 45 56.882	+22 39 47.50	54356.179	54356.221	21.7	54357.161	54357.205	21.4
797	00 50 40.200	-13 40 24.20	54357.278	54357.326	21.0	54358.291	54358.334	21.0
798	00 52 43.320	-13 40 24.60	54357.282	54357.329	21.2	54358.295	54358.337	21.2
799	01 07 22.080	-13 40 24.20	54357.308	54357.350	21.4	54358.365	54358.406	21.4
800	01 09 25.560	-13 40 24.20	54357.312	54357.353	21.6	54358.368	54358.409	21.5
801	01 24 03.960	-13 40 23.90	54357.318	54357.363	21.3	54358.371	54358.413	21.3
802	01 26 07.440	-13 40 24.60	54357.321	54357.366	21.1	54358.375	54358.416	21.1
803	01 40 45.840	-13 40 23.90	54357.334	54357.376	21.4	54358.378	54358.420	21.1
804	01 42 49.320	-13 40 24.20	54357.337	54357.380	21.5	54358.381	54358.423	21.4
805	01 57 27.720	-13 40 24.60	54357.421	54357.463	21.5	54358.386	54358.433	21.5

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
806	01 59 31.200	-13 40 24.60	54357.424	54357.466	21.5	54358.389	54358.436	21.5
807	02 14 09.960	-13 40 25.00	54357.434	54357.477	21.4	54358.426	54358.468	21.3
808	02 16 13.440	-13 40 24.20	54357.438	54357.480	21.2	54358.429	54358.471	21.1
809	01 03 20.880	+36 17 24.70	54357.411	54357.452	22.1	54358.183	54358.225	21.8
810	00 53 22.920	-22 45 22.70	54358.348	54358.393	21.3	54359.320	54359.366	21.1
811	00 55 32.880	-22 45 22.00	54358.351	54358.396	21.6	54359.324	54359.369	21.5
812	01 10 58.800	-22 45 22.70	54358.354	54358.400	21.2	54359.330	54359.373	21.3
813	01 13 09.120	-22 45 22.70	54358.358	54358.403	21.6	54359.333	54359.376	21.5
814	00 00 34.920	+27 12 26.30	54358.235	54358.281	21.8	54359.146	54359.190	21.3
815	00 02 49.920	+27 12 26.30	54358.238	54358.285	21.6	54359.150	54359.193	21.1
816	00 18 46.800	+27 12 27.00	54358.254	54358.300	21.6	54359.159	54359.203	21.4
817	00 21 01.800	+27 12 26.60	54358.257	54358.303	21.9	54359.163	54359.206	21.5
818	00 36 59.040	+27 12 27.40	54358.265	54358.341	21.8	54359.220	54359.263	21.7
819	00 39 14.040	+27 12 26.60	54358.268	54358.344	21.7	54359.223	54359.266	21.7
820	00 55 10.920	+27 12 27.00	54358.440	54358.482	21.8	54359.226	54359.269	21.7
821	00 57 25.920	+27 12 26.60	54358.443	54358.485	22.0	54359.229	54359.272	21.8
822	01 13 22.800	+27 12 26.60	54358.448	54358.511	22.0	54359.233	54359.276	21.6
823	01 15 37.800	+27 12 26.60	54358.451	54358.488	21.9	54359.236	54359.279	21.6
824	23 21 47.160	+27 12 27.00	54358.157	54358.198	21.6	54359.133	54359.176	21.3
825	23 24 02.162	+27 12 27.00	54358.160	54358.202	21.7	54359.136	54359.179	21.4
826	23 39 59.043	+27 12 26.60	54358.163	54358.205	21.6	54359.140	54359.183	21.3
827	23 42 14.038	+27 12 27.00	54358.167	54358.208	21.9	54359.143	54359.186	21.5
828	23 58 10.562	+27 12 26.30	54358.229	54358.275	21.7	54359.153	54359.196	21.4
829	00 00 25.560	+27 12 26.30	54358.232	54358.278	21.8	54359.156	54359.199	21.4
830	00 00 34.920	+31 44 58.90	54358.455	54358.507	21.9	54359.166	54359.209	21.8
831	00 40 46.920	+36 17 30.50	54358.170	54358.211	21.7	54359.170	54359.213	21.4
832	00 43 15.960	+36 17 30.50	54358.173	54358.215	21.7	54359.173	54359.216	21.5
833	01 00 52.920	+36 17 30.50	54358.180	54358.222	21.6	54359.240	54359.282	21.6
834	00 19 34.680	+31 45 01.40	54359.313	54359.359	22.0	54360.163	54360.211	21.4
835	00 21 55.800	+31 45 02.20	54359.316	54359.362	21.8	54360.167	54360.214	21.4
836	00 38 34.440	+31 45 01.80	54359.402	54359.444	21.5	54360.172	54360.218	21.0

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
837	00 40 55.920	+31 45 01.80	54359.405	54359.448	21.5	54360.176	54360.221	21.0
838	00 57 34.560	+31 45 01.80	54359.409	54359.451	22.0	54360.229	54360.270	21.8
839	00 59 55.680	+31 45 01.80	54359.412	54359.454	21.7	54360.232	54360.273	21.9
840	01 16 34.680	+31 45 02.20	54359.415	54359.458	21.6	54360.238	54360.288	21.5
841	23 07 23.161	+31 45 10.10	54360.150	54360.198	21.7	54361.412	54361.454	21.8
842	23 09 44.280	+31 45 10.10	54360.154	54360.201	21.7	54361.415	54361.457	21.8
843	23 47 43.799	+31 45 10.40	54360.267	54360.310	21.7	54361.479	54361.504	21.2
844	00 00 34.560	+36 17 42.41	54360.279	54360.321	21.6	54361.301	54361.344	21.9
845	00 03 03.600	+36 17 41.99	54360.282	54360.324	21.8	54361.304	54361.348	21.9
846	00 20 40.560	+36 17 41.99	54360.429	54360.470	21.6	54361.307	54361.351	21.8
847	00 23 09.600	+36 17 41.60	54360.432	54360.474	21.6	54361.311	54361.354	21.7
848	22 47 11.403	+36 17 41.60	54360.143	54360.189	21.6	54361.397	54361.439	21.6
849	22 49 40.440	+36 17 41.60	54360.147	54360.192	21.5	54361.401	54361.443	21.6
850	23 26 22.917	+31 45 10.10	54360.157	54360.204	21.7	54363.152	54363.195	21.9
851	23 28 44.043	+31 45 09.40	54360.160	54360.207	21.8	54363.156	54363.198	22.0
852	23 45 22.680	+31 45 09.70	54360.263	54360.307	21.6	54363.170	54363.215	21.7
853	23 07 16.679	+36 19 00.81	54361.418	54361.460	21.7	54363.146	54363.188	21.7
854	23 09 45.722	+36 19 00.11	54361.422	54361.463	21.9	54363.149	54363.191	21.9
855	00 55 10.560	-27 16 31.40	54375.293	54375.335	20.8	54376.299	54376.322	21.2
856	01 13 22.440	-27 16 31.40	54375.309	54375.351	20.9	54376.304	54376.326	21.1
857	01 15 37.440	-27 16 31.10	54375.313	54375.354	21.0	54376.307	54376.329	21.1
858	01 31 34.320	-27 16 31.10	54375.322	54375.365	20.8	54376.314	54376.335	20.9
859	01 33 49.320	-27 16 30.70	54375.325	54375.368	20.9	54376.317	54376.338	21.1
860	22 49 59.158	+40 51 25.61	54375.377	54375.418	21.6	54376.136	54376.183	22.0
861	22 52 37.917	+40 51 25.61	54375.380	54375.421	21.6	54376.139	54376.186	22.0
862	00 51 34.920	-18 12 12.20	54376.253	54376.280	20.9	54377.241	54377.286	20.8
863	01 27 41.400	-18 12 11.50	54376.348	54376.368	21.0	54377.308	54377.351	20.8
864	01 42 34.920	-18 12 12.20	54376.357	54376.378	21.3	54377.318	54377.366	20.9
865	01 44 41.280	-18 12 11.90	54376.360	54376.381	21.3	54377.322	54377.370	20.9
866	01 59 34.800	-18 12 12.20	54376.386	54376.413	21.1	54377.329	54377.373	20.8
867	02 18 41.400	-18 12 11.50	54376.401	54376.422	21.2	54377.358	54377.401	21.0

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
868	02 33 34.920	-18 12 12.20	54376.438	54376.461	21.6	54377.381	54377.423	21.4
869	02 35 41.280	-18 12 11.90	54376.442	54376.465	21.6	54377.384	54377.426	21.6
870	02 50 35.160	-18 12 11.90	54376.455	54376.476	21.2	54377.391	54377.432	21.0
871	02 52 41.520	-18 12 11.90	54376.458	54376.479	20.9	54377.394	54377.435	20.8
872	03 07 35.040	-18 12 11.50	54376.468	54376.488	21.2	54377.404	54377.452	21.3
873	03 09 41.400	-18 12 11.50	54376.471	54376.492	21.2	54377.408	54377.455	21.2
874	02 28 10.920	-09 07 08.00	54376.406	54376.448	21.3	54377.412	54377.458	21.2
875	02 30 12.600	-09 07 08.80	54376.409	54376.451	21.2	54377.416	54377.461	21.1
876	00 00 34.920	+40 50 40.91	54376.169	54376.219	21.6	54377.154	54377.195	21.6
877	00 03 13.680	+40 50 40.91	54376.172	54376.222	21.7	54377.157	54377.199	21.7
878	00 21 59.040	+40 50 41.30	54376.430	54376.495	21.2	54377.208	54377.259	21.5
879	00 24 37.800	+40 50 41.30	54376.433	54376.483	21.4	54377.211	54377.263	21.5
880	23 14 02.397	+40 50 41.30	54376.146	54376.195	21.8	54377.136	54377.177	21.8
881	23 32 47.040	+40 50 41.30	54376.154	54376.202	21.8	54377.139	54377.181	21.8
882	23 35 25.800	+40 50 41.30	54376.157	54376.206	21.9	54377.142	54377.184	21.8
883	23 54 10.800	+40 50 40.91	54376.163	54376.213	21.9	54377.147	54377.189	21.9
884	23 56 49.559	+40 50 40.91	54376.166	54376.216	21.7	54377.150	54377.192	21.8
885	01 08 34.800	-18 12 11.90	54376.268	54376.291	21.0	54378.259	54378.281	21.0
886	01 10 41.160	-18 12 11.90	54376.271	54376.294	21.1	54378.263	54378.284	21.1
887	02 28 10.920	+09 02 54.20	54377.230	54377.275	21.0	54378.226	54378.267	21.1
888	02 26 11.040	+27 13 01.20	54377.202	54377.244	21.2	54378.195	54378.238	21.2
889	02 44 22.920	+27 13 00.80	54377.215	54377.256	21.4	54378.209	54378.252	21.4
890	01 47 34.800	+40 50 36.59	54377.233	54377.278	21.3	54378.176	54378.199	21.2
891	01 50 13.560	+40 50 36.20	54377.237	54377.282	21.2	54378.180	54378.202	21.1
892	02 08 58.920	+40 50 37.01	54377.248	54377.289	21.3	54378.170	54378.213	21.0
893	01 28 35.040	-22 44 34.80	54385.282	54385.326	21.0	54387.268	54387.312	20.9
894	01 30 45.000	-22 44 34.80	54385.286	54385.330	21.2	54387.271	54387.315	21.2
895	02 30 52.920	-13 39 31.30	54385.302	54385.350	21.2	54387.261	54387.305	21.1
896	02 32 56.400	-13 39 31.30	54385.306	54385.353	21.3	54387.265	54387.309	21.1
897	02 26 22.920	-04 34 28.20	54385.236	54385.279	21.6	54387.231	54387.275	21.3
898	02 42 34.920	-04 34 28.20	54385.247	54385.292	21.6	54387.241	54387.285	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
899	02 44 35.520	-04 34 27.80	54385.250	54385.295	21.4	54387.244	54387.288	21.3
900	02 58 47.280	-04 34 28.60	54385.340	54385.382	22.1	54387.329	54387.375	21.9
901	03 00 47.520	-04 34 27.80	54385.343	54385.386	22.1	54387.333	54387.378	22.0
902	03 14 59.280	-04 34 28.20	54385.480	54385.531	21.2	54387.343	54387.389	21.5
903	04 03 35.281	-04 34 27.80	54385.493	54385.521	21.0	54387.351	54387.396	21.7
904	04 05 35.880	-04 34 27.80	54385.497	54385.518	21.0	54387.354	54387.399	21.8
905	02 10 10.920	-00 01 56.60	54385.215	54385.257	21.7	54387.234	54387.278	21.5
906	02 12 11.160	-00 01 55.90	54385.218	54385.260	21.8	54387.238	54387.282	21.7
907	04 03 35.281	-00 01 55.90	54385.474	54385.507	21.1	54387.357	54387.403	22.1
908	04 05 35.521	-00 01 56.30	54385.477	54385.511	20.8	54387.361	54387.406	22.3
909	02 26 22.920	+04 30 36.00	54385.333	54385.375	21.3	54387.254	54387.299	21.2
910	02 28 23.520	+04 30 35.60	54385.336	54385.379	21.3	54387.258	54387.302	21.4
911	03 31 11.280	+04 30 36.00	54385.404	54385.446	21.7	54387.409	54387.456	21.7
912	03 33 11.520	+04 30 36.00	54385.408	54385.449	21.7	54387.413	54387.459	21.6
913	03 47 23.280	+04 30 36.00	54385.422	54385.463	21.9	54387.416	54387.463	21.8
914	03 49 23.880	+04 30 35.60	54385.425	54385.466	22.0	54387.420	54387.466	21.9
915	03 50 11.400	+09 03 07.20	54385.393	54385.436	21.7	54387.423	54387.469	21.7
916	03 52 12.720	+09 03 07.20	54385.396	54385.439	21.8	54387.426	54387.473	21.6
917	01 42 34.920	+18 08 11.00	54385.267	54385.311	22.0	54387.248	54387.292	21.8
918	01 44 41.280	+18 08 10.70	54385.270	54385.315	22.0	54387.251	54387.295	21.7
919	01 31 35.040	+27 13 14.20	54385.319	54385.362	21.9	54387.322	54387.368	21.7
920	01 33 50.040	+27 13 14.50	54385.322	54385.365	22.0	54387.326	54387.371	21.8
921	01 49 46.920	+27 13 14.20	54385.418	54385.459	21.7	54387.347	54387.393	21.6
922	02 10 14.160	+27 13 14.90	54385.399	54385.442	21.6	54387.433	54387.479	21.5
923	01 35 35.160	+31 45 46.80	54385.369	54385.411	21.5	54387.336	54387.382	21.4
924	01 37 56.280	+31 45 46.40	54385.372	54385.415	21.6	54387.340	54387.385	21.6
925	02 32 35.160	+31 45 46.10	54385.429	54385.470	21.3	54387.436	54387.483	21.7
926	02 16 35.040	-18 12 03.60	54385.299	54385.347	21.2	54388.268	54388.310	21.2
927	03 06 20.520	-13 39 44.60	54377.315	54377.361	21.1	54388.292	54388.334	21.4
928	03 00 58.320	+09 03 53.60	54387.509	54387.525	21.8	54388.368	54388.411	22.3
929	03 02 59.640	+09 03 53.60	54387.506	54387.538	21.1	54388.372	54388.414	22.2

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
930	02 47 34.440	+13 36 25.60	54387.452	54387.497	21.7	54388.387	54388.435	22.0
931	02 49 37.560	+13 36 25.20	54387.449	54387.494	21.8	54388.390	54388.438	21.9
932	03 04 16.320	+13 36 25.60	54387.446	54387.491	21.8	54388.397	54388.441	22.1
933	03 06 19.800	+13 36 25.20	54387.443	54387.488	21.9	54388.401	54388.445	22.1
934	01 25 34.680	-18 11 49.90	54388.233	54388.275	20.9	54389.239	54389.259	21.0
935	02 49 38.280	-13 39 17.60	54388.282	54388.325	21.1	54389.276	54389.322	21.1
936	03 04 17.040	-13 39 18.00	54388.286	54388.295	21.4	54389.306	54389.347	21.5
937	02 44 34.800	-09 06 46.80	54388.263	54388.304	21.2	54389.310	54389.353	21.4
938	02 46 36.480	-09 06 46.40	54388.300	54388.345	21.4	54389.313	54389.356	21.4
939	03 00 59.040	-09 06 46.40	54388.316	54388.322	21.5	54389.339	54389.382	21.5
940	03 03 00.360	-09 06 46.40	54388.319	54388.365	21.5	54389.342	54389.386	21.3
941	02 07 58.800	+27 13 28.20	54388.481	54388.521	21.6	54389.170	54389.214	21.4
942	02 47 34.800	-13 39 20.50	54389.271	54389.318	21.3	54391.317	54391.358	21.3
943	03 19 24.600	-09 06 46.10	54388.338	54388.380	21.7	54391.324	54391.365	21.4
944	03 33 47.160	-09 06 46.40	54388.341	54388.351	21.6	54391.331	54391.372	21.4
945	03 35 48.480	-09 06 46.80	54388.348	54388.394	21.5	54391.334	54391.375	21.2
946	01 39 47.160	+04 30 46.40	54389.197	54389.218	21.3	54391.320	54391.361	21.5
947	03 14 58.920	+04 30 48.60	54388.475	54388.508	22.0	54391.341	54391.382	21.8
948	03 16 59.520	+04 30 49.00	54388.478	54388.511	22.0	54391.344	54391.386	21.8
949	03 17 22.920	+09 03 20.20	54388.448	54388.492	22.3	54391.348	54391.389	22.2
950	03 19 24.600	+09 03 20.50	54388.451	54388.495	22.4	54391.351	54391.392	22.1
951	03 33 47.160	+09 03 20.50	54388.454	54388.498	22.2	54391.396	54391.437	22.0
952	03 35 48.480	+09 03 20.50	54388.458	54388.502	22.2	54391.399	54391.440	22.0
953	02 14 10.680	+13 35 50.60	54389.181	54389.223	21.5	54391.327	54391.368	21.9
954	03 20 58.920	+13 35 52.40	54388.425	54388.468	22.2	54391.402	54391.444	22.0
955	03 23 02.400	+13 35 52.40	54388.428	54388.471	22.2	54391.406	54391.447	22.0
956	03 07 35.040	+18 08 25.10	54388.418	54388.461	22.0	54391.409	54391.450	21.8
957	00 02 56.040	+31 45 56.90	54389.137	54389.157	22.0	54391.107	54391.299	21.8
958	02 13 34.680	+31 45 59.40	54388.488	54388.515	21.9	54391.413	54391.454	21.6
959	02 15 56.160	+31 46 00.50	54388.485	54388.518	21.9	54391.416	54391.457	21.8
960	00 53 40.920	-18 11 52.10	54389.209	54389.232	21.0	54392.200	54392.244	20.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
961	02 01 41.160	-18 11 52.10	54389.256	54389.298	21.0	54392.247	54392.293	20.9
962	02 13 48.360	+09 03 20.90	54388.331	54388.377	21.6	54392.240	54392.290	21.6
963	01 57 28.800	+13 35 56.00	54391.419	54391.463	21.5	54392.167	54392.209	21.4
964	01 59 32.280	+13 35 56.00	54391.423	54391.466	21.5	54392.170	54392.212	21.4
965	02 32 55.680	+13 36 25.60	54387.502	54387.522	21.8	54392.278	54392.320	22.1
966	02 35 41.280	+18 08 24.40	54388.421	54388.465	21.9	54392.370	54392.416	21.9
967	02 52 41.520	+18 08 11.00	54385.389	54385.432	21.9	54392.430	54392.471	21.8
968	01 18 56.160	+31 45 57.60	54389.149	54389.173	21.4	54392.107	54392.150	21.3
969	01 20 58.920	+36 18 35.61	54391.426	54391.469	21.4	54392.110	54392.153	21.4
970	01 23 27.960	+36 18 35.30	54391.429	54391.473	21.3	54392.113	54392.156	21.2
971	01 41 04.920	+36 18 31.99	54388.358	54388.404	21.9	54392.117	54392.160	21.4
972	01 43 33.960	+36 18 31.29	54388.361	54388.408	21.8	54392.120	54392.163	21.2
973	03 50 11.040	-09 06 42.10	54392.344	54392.363	21.6	54393.356	54393.397	21.5
974	03 52 12.720	-09 06 42.10	54392.360	54392.402	21.6	54393.359	54393.401	21.5
975	04 06 35.280	-09 06 42.10	54392.389	54392.436	21.3	54393.380	54393.423	21.2
976	04 08 36.599	-09 06 42.50	54392.385	54392.433	21.5	54393.384	54393.426	21.3
977	03 31 10.920	-04 34 10.60	54392.341	54392.382	21.7	54393.342	54393.387	21.7
978	03 33 11.520	-04 34 10.20	54392.355	54392.399	21.3	54393.345	54393.390	21.4
979	03 47 22.920	-04 34 10.60	54392.379	54392.423	21.6	54393.370	54393.416	21.5
980	03 49 23.520	-04 34 10.20	54392.375	54392.420	21.4	54393.373	54393.419	21.7
981	01 55 59.160	+04 30 53.30	54392.225	54392.267	21.4	54393.188	54393.230	21.2
982	01 57 24.120	+09 03 25.20	54392.233	54392.283	21.6	54393.203	54393.245	21.4
983	02 11 46.680	+09 03 24.50	54392.237	54392.286	21.6	54393.222	54393.264	21.5
984	02 30 52.920	+13 35 56.80	54392.275	54392.316	22.1	54393.296	54393.339	21.9
985	01 59 34.800	+18 08 28.70	54392.257	54392.298	21.7	54393.281	54393.324	21.5
986	02 16 34.680	+18 08 28.00	54392.260	54392.302	22.0	54393.287	54393.330	21.8
987	02 18 41.040	+18 08 28.30	54392.264	54392.305	22.0	54393.291	54393.334	21.6
988	02 33 34.920	+18 08 28.70	54392.367	54392.413	22.0	54393.366	54393.413	22.0
989	02 50 34.800	+18 08 28.70	54392.426	54392.468	21.4	54393.394	54393.436	21.7
990	03 24 34.920	+18 08 28.70	54392.392	54392.440	22.1	54393.406	54393.450	22.1
991	03 26 41.280	+18 08 28.30	54392.395	54392.443	22.1	54393.409	54393.453	22.2

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
992	03 41 35.160	+18 08 28.70	54392.406	54392.453	21.5	54393.430	54393.474	21.6
993	03 43 41.520	+18 08 28.30	54392.409	54392.457	21.7	54393.433	54393.477	21.6
994	03 15 56.880	+22 41 00.20	54392.538	54392.541	21.1	54393.440	54393.509	21.8
995	03 31 17.040	+22 41 01.00	54392.447	54392.490	21.8	54393.443	54393.490	21.8
996	03 33 27.000	+22 41 00.20	54392.450	54392.493	21.8	54393.446	54393.493	21.7
997	01 54 34.920	+31 46 03.40	54392.140	54392.146	21.3	54393.304	54393.349	21.3
998	01 56 56.040	+31 46 03.70	54392.143	54392.186	21.4	54393.308	54393.352	21.6
999	02 46 36.840	+09 03 18.40	54393.316	54393.363	21.9	54394.199	54394.270	21.0
1000	03 39 45.000	+13 35 50.60	54393.484	54393.516	21.8	54394.284	54394.329	21.5
1001	03 54 23.400	+13 35 51.40	54393.532	54393.538	21.4	54394.288	54394.333	21.5
1002	02 56 17.160	+22 40 53.80	54393.502	54393.523	21.3	54394.182	54394.226	21.4
1003	02 58 27.120	+22 40 54.10	54393.506	54393.526	21.4	54394.186	54394.229	21.3
1004	03 13 47.280	+22 40 53.80	54393.467	54393.519	21.7	54394.192	54394.274	21.2
1005	03 00 48.240	-00 02 22.20	54419.259	54419.304	21.7	54420.363	54420.404	21.7
1006	03 37 42.600	+13 35 12.50	54419.416	54419.461	22.3	54420.401	54420.448	22.3
1007	03 58 36.840	+18 07 44.00	54419.433	54419.477	22.1	54420.421	54420.465	22.0
1008	04 00 42.840	+18 07 44.40	54419.436	54419.481	22.1	54420.425	54420.468	22.1
1009	02 03 48.240	+22 40 16.30	54419.270	54419.314	22.0	54420.095	54420.353	21.5
1010	02 05 58.200	+22 40 16.30	54419.274	54419.318	21.8	54420.343	54420.356	21.7
1011	03 48 48.600	+22 40 16.00	54419.501	54419.522	21.7	54420.428	54420.472	22.0
1012	03 50 58.560	+22 40 16.30	54419.440	54419.484	21.9	54420.431	54420.475	21.9
1013	03 20 48.480	+27 12 47.90	54419.427	54419.474	22.0	54420.415	54420.458	21.9
1014	03 23 03.480	+27 12 47.90	54419.430	54419.471	22.0	54420.418	54420.462	21.9
1015	03 39 00.720	+27 12 48.60	54419.505	54419.515	21.4	54420.434	54420.479	21.6
1016	03 41 15.360	+27 12 47.50	54419.450	54419.491	21.6	54420.438	54420.482	21.7
1017	03 31 57.720	+31 45 19.80	54419.498	54419.511	21.8	54420.492	54420.509	21.9
1018	03 21 36.360	+36 17 51.70	54419.508	54419.518	21.6	54420.495	54420.515	21.8
1019	03 24 05.400	+36 17 51.40	54419.447	54419.495	22.0	54420.488	54420.499	22.0
1020	03 41 42.720	+36 17 51.70	54419.443	54419.488	21.8	54420.485	54420.512	21.7
1021	01 26 12.120	+40 50 23.60	54419.263	54419.308	21.6	54420.088	54420.346	21.4
1022	01 28 50.880	+40 50 23.30	54419.267	54419.311	21.3	54420.091	54420.350	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1023	02 30 24.480	+40 50 23.30	54419.409	54419.457	21.2	54420.394	54420.441	21.3
1024	02 33 02.880	+40 50 23.30	54419.413	54419.454	21.3	54420.397	54420.445	21.4
1025	02 51 48.240	+40 50 24.00	54419.420	54419.464	21.4	54420.408	54420.452	21.4
1026	02 54 27.000	+40 50 23.30	54419.423	54419.467	21.5	54420.411	54420.455	21.5
1027	03 17 24.360	-09 07 26.80	54419.246	54419.291	21.5	54422.315	54422.359	21.7
1028	02 26 24.360	-00 02 22.60	54419.233	54419.277	21.6	54422.296	54422.339	21.6
1029	02 28 24.240	-00 02 22.90	54419.236	54419.281	21.5	54422.299	54422.342	21.6
1030	02 42 36.360	-00 02 22.60	54419.239	54419.284	21.8	54422.302	54422.345	21.8
1031	02 44 36.240	-00 02 22.60	54419.243	54419.287	21.9	54422.306	54422.349	21.9
1032	02 58 48.360	-00 02 22.60	54419.256	54419.301	21.9	54422.329	54422.376	22.0
1033	02 42 36.360	+04 30 09.00	54419.250	54419.294	21.7	54422.318	54422.362	21.8
1034	02 58 48.360	+04 30 08.60	54419.325	54419.369	22.1	54422.352	54422.400	22.0
1035	03 00 48.960	+04 30 09.00	54419.328	54419.372	22.1	54422.355	54422.403	22.0
1036	02 44 36.240	+09 02 40.60	54419.321	54419.365	21.9	54422.332	54422.379	21.9
1037	03 15 00.360	-00 02 22.60	54419.331	54419.375	21.9	54423.159	54423.200	21.6
1038	03 17 00.600	-00 02 22.60	54419.334	54419.379	22.0	54423.162	54423.204	21.8
1039	03 31 12.360	-00 02 22.60	54419.352	54419.396	22.0	54423.173	54423.221	21.7
1040	03 33 12.600	-00 02 21.80	54419.355	54419.399	22.0	54423.176	54423.224	21.7
1041	03 49 24.960	-00 02 29.00	54422.389	54422.445	21.8	54423.190	54423.285	21.7
1042	04 03 37.080	+04 30 03.20	54422.406	54422.449	22.0	54423.272	54423.316	22.0
1043	04 05 37.320	+04 30 02.90	54422.410	54422.452	22.1	54423.275	54423.319	22.1
1044	04 06 37.080	+09 02 34.40	54422.420	54422.463	21.9	54423.329	54423.374	22.0
1045	04 08 38.400	+09 02 35.20	54422.423	54422.466	22.0	54423.333	54423.377	22.0
1046	02 21 18.360	+22 40 16.30	54419.338	54419.382	21.7	54423.152	54423.193	21.7
1047	02 23 28.320	+22 40 16.30	54419.341	54419.385	21.8	54423.156	54423.197	21.7
1048	02 38 48.480	+22 40 16.30	54419.359	54419.403	22.0	54423.180	54423.227	21.9
1049	02 40 58.440	+22 40 16.00	54419.362	54419.406	22.2	54423.183	54423.231	22.1
1050	03 02 36.600	+27 12 42.50	54422.393	54422.435	22.0	54423.265	54423.309	22.0
1051	03 04 51.600	+27 12 42.10	54422.396	54422.438	22.0	54423.268	54423.312	22.1
1052	03 10 36.840	+31 45 13.70	54422.413	54422.456	22.0	54423.278	54423.323	22.1
1053	03 12 57.960	+31 45 13.70	54422.417	54422.459	22.0	54423.282	54423.326	22.2

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1054	03 29 36.960	+31 45 14.00	54422.427	54422.469	22.0	54423.336	54423.381	22.1
1055	02 01 12.360	+36 17 51.70	54419.345	54419.389	21.9	54423.166	54423.214	22.0
1056	03 01 30.720	+36 17 45.61	54422.481	54422.491	21.4	54423.295	54423.340	21.8
1057	03 03 59.760	+36 17 45.61	54422.477	54422.484	21.6	54423.299	54423.343	22.0
1058	04 51 37.080	-04 32 32.30	54424.276	54424.322	21.4	54425.315	54425.361	20.9
1059	05 09 49.320	-04 32 31.90	54424.299	54424.346	21.6	54425.338	54425.384	20.8
1060	04 51 36.720	+00 00 00.00	54424.289	54424.336	21.4	54425.278	54425.322	21.3
1061	04 53 36.960	+00 00 00.00	54424.292	54424.339	21.6	54425.281	54425.325	21.4
1062	04 38 48.841	+09 05 03.50	54424.316	54424.363	21.5	54425.254	54425.298	21.5
1063	04 40 50.519	+09 05 03.10	54424.319	54424.366	21.8	54425.257	54425.301	21.5
1064	05 02 40.560	+13 37 35.80	54424.463	54424.507	21.3	54425.261	54425.305	21.7
1065	04 51 37.080	-02 16 16.00	54424.282	54424.329	21.4	54425.328	54425.375	20.7
1066	04 53 37.320	-02 16 16.00	54424.286	54424.332	21.4	54425.331	54425.378	20.8
1067	04 51 36.720	+02 16 15.60	54424.302	54424.349	21.7	54425.341	54425.388	21.1
1068	04 53 36.960	+02 16 16.00	54424.306	54424.352	21.5	54425.345	54425.391	21.1
1069	05 42 12.960	+02 16 15.60	54424.470	54424.480	21.7	54425.465	54425.508	21.6
1070	04 51 36.720	+06 48 47.50	54424.396	54424.443	21.4	54425.264	54425.308	21.1
1071	04 53 37.320	+06 48 47.50	54424.399	54424.446	21.5	54425.268	54425.311	21.2
1072	04 38 48.841	+11 21 20.20	54424.389	54424.436	22.3	54425.247	54425.291	22.0
1073	04 40 50.519	+11 21 19.10	54424.393	54424.439	22.2	54425.251	54425.295	22.1
1074	05 02 40.560	+15 53 51.70	54424.484	54424.504	21.9	54425.451	54425.498	21.8
1075	04 40 42.959	+24 58 54.50	54424.494	54424.527	21.4	54425.225	54425.271	22.6
1076	04 42 52.921	+24 58 55.20	54424.473	54424.497	23.0	54425.229	54425.274	22.8
1077	02 47 36.600	-11 23 36.20	54433.177	54433.225	21.0	54437.206	54437.249	21.5
1078	02 49 40.080	-11 23 36.20	54433.181	54433.228	21.2	54437.209	54437.252	21.5
1079	02 30 14.040	+11 19 02.30	54433.221	54433.270	21.5	54437.226	54437.270	21.4
1080	02 14 12.480	+15 51 34.20	54433.117	54433.164	21.4	54437.219	54437.263	21.6
1081	02 16 15.960	+15 51 34.20	54433.120	54433.167	21.4	54437.222	54437.266	21.8
1082	01 59 36.240	+20 24 05.80	54433.097	54433.144	21.4	54437.213	54437.256	21.6
1083	02 01 42.600	+20 24 06.10	54433.100	54433.147	21.4	54437.216	54437.259	21.8
1084	04 36 01.079	-04 34 43.00	54437.236	54437.280	21.3	54438.206	54438.252	21.1

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1085	04 38 01.320	-04 34 42.20	54437.239	54437.283	21.3	54438.209	54438.256	21.1
1086	05 08 25.079	-04 34 42.60	54437.320	54437.363	21.5	54438.299	54438.343	21.2
1087	05 24 37.079	-04 34 42.60	54437.400	54437.471	21.7	54438.333	54438.377	21.7
1088	05 26 37.680	-04 34 42.20	54437.404	54437.447	21.6	54438.336	54438.380	21.7
1089	04 19 49.079	-00 02 10.70	54437.229	54437.273	21.5	54438.213	54438.259	21.5
1090	04 21 48.959	-00 02 10.30	54437.233	54437.276	21.5	54438.216	54438.263	21.4
1091	04 36 01.079	-00 02 10.70	54437.293	54437.337	21.6	54438.226	54438.273	21.2
1092	04 38 00.961	-00 02 10.30	54437.296	54437.340	21.7	54438.229	54438.276	21.3
1093	05 10 25.319	-00 02 11.00	54437.397	54437.444	21.2	54438.340	54438.384	21.2
1094	05 42 49.319	-00 02 10.30	54437.478	54437.495	21.6	54438.474	54438.491	21.5
1095	04 19 49.079	+04 30 22.00	54437.243	54437.286	21.8	54438.219	54438.266	21.7
1096	04 21 49.320	+04 30 20.90	54437.246	54437.290	21.7	54438.222	54438.269	21.4
1097	04 36 01.079	+04 30 21.60	54437.313	54437.357	21.9	54438.239	54438.286	21.6
1098	04 38 01.320	+04 30 21.20	54437.316	54437.360	21.8	54438.243	54438.289	21.6
1099	04 23 00.961	+09 02 52.80	54437.306	54437.350	21.8	54438.246	54438.293	21.5
1100	04 25 02.640	+09 02 52.80	54437.310	54437.354	21.8	54438.249	54438.296	21.5
1101	04 11 06.721	+13 35 25.10	54437.300	54437.343	22.2	54438.233	54438.279	22.0
1102	04 13 10.200	+13 35 24.70	54437.303	54437.347	22.5	54438.236	54438.283	22.3
1103	04 27 48.961	+13 35 24.70	54437.381	54437.427	22.0	54438.310	54438.354	22.2
1104	04 29 52.440	+13 35 24.70	54437.384	54437.431	22.1	54438.313	54438.357	22.1
1105	04 15 36.720	+18 07 56.60	54437.330	54437.374	22.1	54438.303	54438.347	22.1
1106	04 17 43.080	+18 07 56.60	54437.333	54437.377	22.2	54438.306	54438.350	22.3
1107	04 32 36.960	+18 07 57.00	54437.407	54437.451	21.6	54438.387	54438.431	21.7
1108	04 34 43.320	+18 07 56.60	54437.411	54437.454	21.6	54438.390	54438.434	21.7
1109	04 49 36.840	+18 07 56.60	54437.420	54437.464	22.1	54438.417	54438.461	22.1
1110	04 51 43.200	+18 07 56.60	54437.424	54437.467	22.1	54438.420	54438.464	22.0
1111	04 06 18.719	+22 40 29.30	54437.323	54437.367	21.5	54438.316	54438.360	21.5
1112	04 08 29.039	+22 40 28.20	54437.327	54437.370	21.8	54438.320	54438.363	21.9
1113	04 23 48.841	+22 40 28.90	54437.414	54437.457	21.7	54438.394	54438.437	21.6
1114	04 25 59.161	+22 40 28.20	54437.417	54437.461	21.6	54438.397	54438.440	21.6
1115	04 41 18.960	+22 40 29.30	54437.481	54437.498	21.9	54438.424	54438.471	21.8

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1116	04 43 28.920	+22 40 28.90	54437.474	54437.484	22.2	54438.427	54438.468	22.3
1117	05 08 24.720	-00 02 07.40	54438.330	54438.374	21.3	54439.219	54439.266	21.2
1118	05 40 49.081	-00 02 07.40	54438.484	54438.502	21.3	54439.324	54439.368	21.6
1119	04 52 12.721	+04 30 24.10	54438.323	54438.367	21.1	54439.212	54439.259	21.0
1120	04 54 13.320	+04 30 24.50	54438.327	54438.370	21.1	54439.215	54439.263	21.0
1121	04 57 50.401	+09 02 56.00	54438.410	54438.454	21.3	54439.239	54439.286	21.5
1122	05 14 14.280	+09 02 56.80	54438.478	54438.505	20.9	54439.327	54439.371	21.3
1123	04 44 30.840	+13 35 27.60	54438.400	54438.444	22.2	54439.222	54439.270	22.3
1124	04 46 34.319	+13 35 28.30	54438.404	54438.447	22.2	54439.225	54439.273	22.4
1125	05 01 12.719	+13 35 28.00	54438.488	54438.498	21.3	54439.320	54439.364	21.7
1126	04 17 39.480	+27 13 03.70	54438.414	54438.457	21.5	54439.307	54439.351	21.8
1127	05 40 49.081	-04 34 51.20	54439.252	54439.300	22.3	54440.292	54440.336	22.0
1128	05 42 49.680	-04 34 51.20	54439.256	54439.303	22.5	54440.295	54440.339	22.0
1129	05 24 37.079	-00 02 19.30	54439.246	54439.293	21.6	54440.234	54440.278	21.4
1130	05 26 37.319	-00 02 19.30	54439.249	54439.297	21.7	54440.237	54440.281	21.4
1131	05 24 37.079	+04 30 12.20	54439.314	54439.358	21.5	54440.299	54440.342	21.2
1132	05 26 37.680	+04 30 12.60	54439.317	54439.361	21.4	54440.302	54440.345	21.1
1133	04 55 49.081	+09 02 44.20	54439.229	54439.276	21.5	54440.227	54440.271	21.4
1134	04 15 24.839	+27 12 51.10	54439.242	54439.290	21.7	54440.244	54440.288	21.5
1135	04 36 01.079	-02 18 35.30	54439.338	54439.381	21.4	54440.211	54440.254	21.3
1136	04 38 01.320	-02 18 35.60	54439.341	54439.385	21.4	54440.214	54440.258	21.3
1137	04 19 49.079	+02 13 56.30	54439.331	54439.375	21.7	54440.204	54440.248	21.7
1138	04 21 48.959	+02 13 56.30	54439.334	54439.378	21.9	54440.207	54440.251	21.7
1139	04 19 49.079	+06 46 29.30	54439.344	54439.388	21.7	54440.217	54440.261	21.7
1140	04 21 49.320	+06 46 28.60	54439.347	54439.391	21.7	54440.220	54440.265	21.9
1141	04 17 43.441	+20 24 03.60	54439.398	54439.443	22.4	54440.224	54440.268	22.3
1142	07 53 49.560	+22 40 19.20	54446.551	54446.561	21.4	54447.406	54447.450	21.3
1143	07 55 59.880	+22 40 19.60	54446.554	54446.564	21.4	54447.409	54447.454	21.6
1144	05 14 14.640	+11 19 00.10	54446.424	54446.440	21.6	54447.416	54447.467	21.6
1145	05 10 25.680	+04 30 19.10	54447.322	54447.368	21.1	54448.324	54448.371	21.3
1146	07 39 37.800	+18 07 54.50	54447.504	54447.564	21.0	54448.405	54448.449	21.3

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
1147	07 41 44.160	+18 07 54.50	54447.508	54447.541	21.4	54448.409	54448.452	21.4
1148	07 58 44.040	+18 07 54.50	54447.501	54447.538	21.5	54448.412	54448.456	21.5
1149	07 18 49.679	+22 40 26.00	54447.484	54447.531	21.4	54448.415	54448.459	21.4
1150	07 21 00.000	+22 40 26.40	54447.488	54447.534	21.5	54448.418	54448.463	21.6
1151	07 35 37.680	+27 12 58.00	54447.518	54447.558	21.2	54448.425	54448.469	21.5
1152	07 37 52.680	+27 12 58.00	54447.521	54447.548	21.4	54448.429	54448.472	21.4
1153	07 53 49.920	+27 12 57.60	54447.524	54447.554	21.5	54448.432	54448.476	21.5
1154	07 56 04.920	+27 12 58.30	54447.527	54447.551	21.2	54448.435	54448.479	21.3
1155	05 24 37.440	-02 18 29.20	54447.311	54447.358	21.8	54448.315	54448.361	21.6
1156	05 26 37.680	-02 18 28.40	54447.315	54447.362	21.9	54448.318	54448.365	21.7
1157	04 36 01.079	+02 14 03.10	54447.204	54447.248	21.8	54448.207	54448.251	21.6
1158	04 38 00.961	+02 14 03.80	54447.207	54447.251	21.7	54448.211	54448.254	21.7
1159	05 08 25.440	+02 14 03.10	54447.305	54447.352	21.5	54448.308	54448.355	21.4
1160	05 10 25.319	+02 14 03.50	54447.308	54447.355	21.5	54448.311	54448.358	21.3
1161	04 36 01.079	+06 46 34.70	54447.224	54447.268	21.7	54448.227	54448.271	21.6
1162	04 38 01.680	+06 46 35.00	54447.227	54447.271	21.8	54448.231	54448.274	21.6
1163	04 23 00.961	+11 19 07.00	54447.217	54447.261	22.4	54448.220	54448.264	22.3
1164	04 25 02.640	+11 19 06.60	54447.221	54447.265	22.2	54448.224	54448.268	22.0
1165	04 11 07.080	+15 51 39.20	54447.211	54447.254	22.5	54448.214	54448.258	22.4
1166	04 13 10.561	+15 51 38.50	54447.214	54447.258	22.6	54448.217	54448.261	22.5
1167	04 27 48.961	+15 51 38.50	54447.298	54447.345	22.2	54448.301	54448.348	22.1
1168	04 29 52.440	+15 51 38.90	54447.302	54447.348	22.3	54448.304	54448.351	22.1
1169	04 15 37.081	+20 24 10.40	54447.244	54447.288	22.1	54448.241	54448.284	21.9
1170	04 32 36.960	+20 24 11.20	54447.325	54447.372	22.3	54448.328	54448.375	22.2
1171	04 34 43.320	+20 24 10.40	54447.328	54447.375	22.2	54448.331	54448.378	22.1
1172	04 49 37.201	+20 24 10.80	54447.399	54447.440	21.7	54448.398	54448.445	21.5
1173	04 51 43.560	+20 24 10.40	54447.402	54447.443	21.7	54448.402	54448.442	21.4
1174	04 06 19.080	+24 56 42.00	54447.238	54447.281	21.7	54448.244	54448.288	21.4
1175	04 08 29.039	+24 56 42.40	54447.241	54447.285	22.0	54448.247	54448.291	21.8
1176	04 23 49.199	+24 56 42.70	54447.332	54447.379	22.3	54448.334	54448.381	22.1
1177	04 25 59.161	+24 56 42.40	54447.335	54447.382	22.1	54448.338	54448.385	22.0

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1178	03 57 12.960	+29 29 14.60	54447.291	54447.338	21.8	54448.295	54448.341	21.5
1179	03 59 27.960	+29 29 13.90	54447.295	54447.342	22.0	54448.298	54448.345	21.9
1180	05 08 25.440	+04 30 19.10	54447.318	54447.365	21.3	54449.210	54449.254	21.4
1181	07 50 17.160	+13 35 24.00	54448.510	54448.543	21.1	54449.318	54449.362	21.4
1182	07 56 38.040	+18 07 55.20	54448.499	54448.570	21.1	54449.322	54449.366	21.7
1183	07 36 19.801	+22 40 27.50	54448.493	54448.533	21.5	54449.325	54449.369	21.9
1184	07 38 29.760	+22 40 27.50	54448.496	54448.536	21.5	54449.328	54449.372	21.9
1185	07 19 40.800	+27 12 58.00	54447.514	54447.544	21.2	54449.332	54449.376	21.4
1186	07 00 59.039	+31 45 30.60	54448.516	54448.560	21.1	54449.379	54449.423	21.5
1187	07 36 37.799	+31 45 30.60	54448.526	54448.556	21.2	54449.382	54449.426	21.6
1188	07 38 58.921	+31 45 30.60	54448.530	54448.553	21.3	54449.386	54449.429	21.7
1189	05 08 25.440	-02 18 28.40	54447.231	54447.274	21.4	54449.203	54449.247	21.3
1190	05 10 25.680	-02 18 28.10	54447.234	54447.278	21.5	54449.206	54449.250	21.5
1191	05 40 49.440	+02 14 03.80	54447.413	54447.471	21.4	54449.315	54449.359	21.6
1192	05 26 37.680	+06 46 35.00	54447.420	54447.464	21.7	54449.311	54449.355	22.0
1193	04 44 31.200	+15 51 38.20	54447.385	54447.426	22.1	54449.213	54449.257	22.1
1194	04 46 34.680	+15 51 38.90	54447.388	54447.429	22.4	54449.216	54449.261	22.2
1195	05 01 13.080	+15 51 38.90	54447.423	54447.457	21.1	54449.301	54449.345	21.9
1196	04 17 40.200	+29 29 14.30	54447.392	54447.433	22.1	54449.237	54449.281	22.1
1197	07 48 13.680	+13 35 24.40	54449.494	54449.534	21.0	54450.293	54450.335	21.4
1198	07 17 37.680	+31 45 31.70	54449.501	54449.538	21.1	54450.297	54450.338	21.5
1199	07 19 58.801	+31 45 31.70	54449.504	54449.541	21.2	54450.300	54450.341	21.5
1200	07 55 37.919	+31 45 31.70	54449.507	54449.548	21.6	54450.304	54450.345	21.8
1201	07 57 59.041	+31 45 31.70	54449.511	54449.545	21.6	54450.307	54450.348	21.8
1202	05 40 49.440	-02 18 26.60	54449.291	54449.335	22.0	54450.273	54450.318	22.2
1203	05 42 49.680	-02 18 26.60	54449.295	54449.338	21.7	54450.276	54450.321	22.0
1204	05 24 37.440	+02 14 04.90	54449.240	54449.285	21.5	54450.242	54450.286	21.6
1205	05 26 37.319	+02 14 05.30	54449.244	54449.288	21.6	54450.239	54450.245	21.6
1206	05 08 25.440	+06 46 36.80	54449.230	54449.274	21.3	54450.211	54450.256	21.3
1207	05 10 25.680	+06 46 37.20	54449.233	54449.277	21.3	54450.215	54450.259	21.4
1208	05 24 37.440	+06 46 36.50	54449.308	54449.352	21.5	54450.290	54450.331	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1209	04 55 49.081	+11 19 08.80	54449.220	54449.264	21.3	54450.218	54450.263	22.0
1210	04 57 50.760	+11 19 08.80	54449.223	54449.267	21.9	54450.221	54450.266	22.1
1211	05 12 13.320	+11 19 08.40	54449.305	54449.349	21.9	54450.283	54450.328	21.9
1212	04 15 25.200	+29 29 16.40	54449.227	54449.271	22.2	54450.225	54450.269	22.2
1213	05 12 13.320	+09 02 55.30	54450.279	54450.324	21.4	54451.309	54451.358	21.6
1214	03 57 12.960	+27 13 01.20	54450.204	54450.249	21.4	54451.291	54451.337	21.5
1215	03 59 27.960	+27 13 02.30	54450.208	54450.252	21.7	54451.295	54451.340	21.7
1216	07 17 25.801	+27 13 01.60	54450.310	54450.352	21.5	54451.313	54451.361	21.5
1217	03 48 37.080	+31 45 33.50	54450.362	54450.409	22.0	54451.302	54451.343	22.1
1218	03 50 58.200	+31 45 33.80	54450.365	54450.413	21.8	54451.305	54451.347	22.0
1219	06 58 37.560	+31 45 33.80	54450.456	54450.500	21.5	54451.316	54451.365	21.6
1220	08 14 38.041	+31 45 33.80	54450.466	54450.510	21.5	54451.319	54451.368	21.7
1221	07 02 43.799	+36 18 05.00	54450.473	54450.517	21.4	54451.323	54451.372	21.8
1222	07 05 12.841	+36 18 05.39	54450.476	54450.520	21.5	54451.326	54451.375	21.9
1223	07 22 49.799	+36 18 05.39	54450.480	54450.523	21.5	54451.329	54451.378	21.9
1224	07 25 18.839	+36 18 05.00	54450.483	54450.527	21.5	54451.333	54451.381	21.9
1225	07 42 55.800	+36 18 05.39	54450.486	54450.530	21.7	54451.350	54451.391	22.0
1226	07 45 24.839	+36 18 05.39	54450.490	54450.533	21.7	54451.354	54451.395	21.9
1227	08 03 02.160	+36 18 05.39	54450.493	54450.547	21.1	54451.385	54451.429	21.4
1228	08 05 30.840	+36 18 05.39	54450.496	54450.537	21.6	54451.388	54451.432	21.6
1229	06 47 13.920	+40 46 57.00	54464.338	54464.382	21.7	54465.260	54465.305	21.9
1230	07 08 38.040	+40 46 57.40	54464.436	54464.483	21.3	54465.347	54465.395	21.6
1231	06 32 02.039	+45 19 28.60	54464.317	54464.362	21.5	54465.246	54465.292	21.8
1232	06 55 01.920	+45 19 28.90	54464.415	54464.462	21.4	54465.329	54465.377	21.8
1233	06 57 52.921	+45 19 28.60	54464.419	54464.466	21.4	54465.333	54465.380	21.9
1234	06 42 14.039	+49 52 00.50	54464.409	54464.456	21.5	54465.322	54465.370	21.8
1235	07 10 26.760	+49 52 00.80	54464.493	54464.536	21.4	54465.360	54465.408	21.6
1236	07 35 32.640	+49 52 00.80	54464.519	54464.549	21.5	54465.418	54465.462	21.5
1237	06 58 37.920	+33 58 09.51	54464.324	54464.369	21.4	54465.250	54465.295	21.7
1238	07 19 59.159	+33 58 09.11	54464.425	54464.472	21.4	54465.336	54465.384	21.7
1239	07 05 13.200	+38 30 41.01	54464.399	54464.446	21.5	54465.326	54465.374	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1240	06 47 13.920	+43 03 13.30	54464.344	54464.389	21.6	54465.270	54465.316	21.9
1241	06 49 52.679	+43 03 12.60	54464.347	54464.392	21.7	54465.274	54465.319	21.9
1242	06 32 02.039	+47 35 44.90	54464.331	54464.375	21.3	54465.253	54465.299	21.9
1243	06 34 53.040	+47 35 44.50	54464.334	54464.379	21.6	54465.256	54465.302	22.0
1244	08 12 51.120	+40 49 09.80	54465.449	54465.492	22.0	54466.342	54466.389	21.8
1245	08 15 29.879	+40 49 09.80	54465.452	54465.495	21.6	54466.345	54466.392	21.6
1246	08 34 15.240	+40 49 09.80	54465.455	54465.499	21.6	54466.348	54466.395	21.5
1247	07 50 26.879	+04 28 35.00	54476.223	54476.267	21.4	54477.226	54477.284	21.5
1248	07 52 27.120	+04 28 35.00	54476.226	54476.270	21.3	54477.230	54477.281	21.5
1249	07 56 15.000	+09 01 06.60	54476.229	54476.274	21.4	54477.254	54477.309	21.5
1250	07 58 16.320	+09 01 07.00	54476.233	54476.277	21.5	54477.257	54477.312	21.6
1251	08 04 57.002	+13 33 38.90	54476.236	54476.280	21.6	54477.341	54477.383	21.5
1252	08 07 00.481	+13 33 38.50	54476.240	54476.284	21.5	54477.345	54477.386	21.4
1253	08 11 20.761	+22 38 42.00	54476.260	54476.304	21.7	54477.410	54477.454	21.4
1254	08 13 31.079	+22 38 41.60	54476.263	54476.307	21.8	54477.413	54477.457	21.3
1255	08 12 02.880	+27 11 13.90	54476.311	54476.355	21.9	54477.417	54477.461	21.2
1256	08 14 17.881	+27 11 13.90	54476.314	54476.358	21.8	54477.420	54477.464	21.1
1257	07 51 27.000	+40 48 49.00	54476.328	54476.372	21.8	54477.434	54477.477	21.2
1258	07 54 05.760	+40 48 49.30	54476.331	54476.376	21.9	54477.437	54477.481	21.0
1259	07 18 02.521	+45 21 20.50	54476.247	54476.291	22.0	54477.355	54477.397	21.5
1260	07 20 53.519	+45 21 20.50	54476.250	54476.294	22.1	54477.358	54477.400	21.7
1261	07 41 02.761	+45 21 20.50	54476.318	54476.362	21.9	54477.424	54477.468	21.5
1262	08 04 03.000	+45 21 21.20	54476.334	54476.379	21.9	54477.447	54477.491	21.4
1263	08 06 53.999	+45 21 20.90	54476.338	54476.382	21.9	54477.450	54477.494	21.3
1264	08 29 53.879	+45 21 20.90	54476.402	54476.450	21.9	54477.501	54477.541	21.2
1265	07 32 26.880	+49 53 52.80	54476.324	54476.369	22.0	54477.430	54477.474	21.3
1266	07 50 26.879	+06 44 51.00	54476.413	54476.461	21.3	54477.236	54477.291	21.7
1267	07 52 27.120	+06 44 51.00	54476.416	54476.464	21.3	54477.240	54477.295	21.6
1268	07 56 15.000	+11 17 22.60	54476.427	54476.474	21.4	54477.327	54477.369	21.5
1269	07 58 16.320	+11 17 22.90	54476.430	54476.477	21.3	54477.330	54477.372	21.5
1270	07 18 50.759	+24 54 58.00	54476.420	54476.467	21.5	54477.261	54477.316	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1271	07 21 00.721	+24 54 58.00	54476.423	54476.471	21.5	54477.264	54477.319	21.9
1272	07 19 41.880	+29 27 29.50	54476.436	54476.481	21.3	54477.334	54477.376	21.5
1273	08 25 37.921	+38 32 33.00	54476.504	54476.565	21.2	54477.534	54477.561	21.4
1274	08 15 29.519	+43 05 04.60	54476.491	54476.535	21.4	54477.538	54477.558	21.4
1275	08 52 59.879	+47 37 36.80	54476.525	54476.555	21.7	54477.528	54477.555	21.6
1276	07 41 52.439	+09 00 59.00	54477.233	54477.288	21.7	54478.220	54478.264	21.6
1277	07 33 36.360	+13 33 31.30	54477.243	54477.298	21.9	54478.223	54478.268	21.8
1278	07 24 45.000	+18 06 03.20	54477.247	54477.301	21.7	54478.227	54478.271	21.6
1279	08 17 00.238	+31 43 37.60	54477.440	54477.484	20.9	54478.257	54478.302	21.9
1280	08 23 08.881	+36 16 16.70	54476.341	54476.386	21.7	54478.309	54478.356	21.6
1281	08 25 37.921	+36 16 17.40	54476.345	54476.389	21.8	54478.312	54478.359	21.7
1282	06 49 53.400	+40 48 42.10	54477.267	54477.323	21.9	54478.234	54478.278	22.1
1283	07 11 17.520	+40 48 41.00	54477.348	54477.390	21.2	54478.240	54478.285	21.9
1284	07 30 02.880	+40 48 49.00	54476.253	54476.297	21.8	54478.247	54478.292	21.9
1285	07 32 41.640	+40 48 49.00	54476.257	54476.301	21.8	54478.250	54478.295	21.9
1286	08 36 53.639	+40 48 41.00	54477.531	54477.565	21.4	54478.335	54478.383	21.4
1287	06 34 53.400	+45 21 13.70	54477.250	54477.305	21.9	54478.230	54478.275	21.9
1288	07 43 53.759	+45 21 20.90	54476.321	54476.366	21.9	54478.254	54478.298	21.8
1289	08 27 02.880	+45 21 20.50	54476.399	54476.447	21.8	54478.339	54478.386	21.5
1290	06 45 21.240	+49 53 45.20	54477.337	54477.379	21.5	54478.237	54478.281	22.0
1291	07 07 20.639	+49 53 52.40	54476.243	54476.287	21.9	54478.244	54478.288	21.8
1292	07 57 32.759	+49 53 52.80	54476.348	54476.392	21.7	54478.315	54478.363	21.6
1293	08 00 39.599	+49 53 52.80	54476.351	54476.396	22.0	54478.318	54478.366	21.9
1294	08 22 38.998	+49 53 52.80	54476.406	54476.454	21.7	54478.342	54478.389	21.4
1295	08 25 45.481	+49 53 52.40	54476.409	54476.457	21.8	54478.345	54478.393	21.9
1296	08 17 00.238	+34 00 01.40	54476.484	54476.528	21.4	54478.261	54478.305	21.8
1297	08 23 08.881	+38 32 32.60	54476.501	54476.568	21.0	54478.332	54478.379	21.4
1298	08 12 50.760	+43 05 05.30	54476.488	54476.531	21.6	54478.322	54478.369	22.0
1299	08 34 14.879	+43 05 05.30	54476.508	54476.545	21.6	54478.349	54478.396	21.8
1300	08 36 53.639	+43 05 04.90	54476.511	54476.548	21.6	54478.352	54478.399	21.9
1301	08 04 02.640	+47 37 36.50	54476.495	54476.538	21.3	54478.325	54478.372	21.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1302	09 30 29.519	+13 33 16.20	54478.509	54478.564	21.4	54479.247	54479.288	21.8
1303	07 39 38.880	+20 22 03.70	54478.427	54478.468	21.2	54479.224	54479.268	21.3
1304	07 41 45.240	+20 22 03.70	54478.430	54478.472	21.1	54479.227	54479.272	21.2
1305	08 50 08.881	+47 37 36.80	54476.521	54476.552	21.6	54479.258	54479.302	21.7
1306	08 25 45.481	+52 09 45.69	54478.502	54478.544	21.1	54479.261	54479.306	21.5
1307	08 50 41.640	+27 10 51.20	54478.495	54478.495	21.5	54480.253	54480.299	21.3
1308	09 06 38.519	+27 10 50.50	54479.244	54479.244	21.5	54480.260	54480.306	21.3
1309	09 08 53.520	+27 10 51.20	54478.516	54478.550	21.3	54480.263	54480.309	21.1
1310	09 27 05.039	+27 10 50.50	54479.254	54479.299	21.2	54480.312	54480.358	21.9
1311	07 50 18.240	+15 49 32.20	54478.423	54478.465	21.3	54480.225	54480.270	21.4
1312	08 27 02.880	+47 37 14.89	54478.402	54478.444	21.9	54480.316	54480.361	22.1
1313	08 21 39.240	+13 33 16.90	54480.430	54480.477	21.5	54481.218	54481.263	21.4
1314	08 23 42.359	+13 33 17.30	54480.434	54480.481	21.6	54481.222	54481.266	21.7
1315	10 03 53.281	+13 33 16.90	54480.505	54480.542	21.4	54481.300	54481.348	21.4
1316	08 13 39.000	+18 05 48.80	54480.437	54480.484	21.6	54481.232	54481.276	21.6
1317	08 15 45.360	+18 05 48.80	54480.440	54480.488	21.7	54481.235	54481.279	21.8
1318	09 23 44.879	+18 05 48.80	54480.512	54480.545	21.4	54481.297	54481.345	21.6
1319	09 38 38.040	+18 05 48.80	54480.515	54480.572	21.1	54481.304	54481.352	21.4
1320	09 40 44.400	+18 05 48.80	54480.518	54480.549	21.5	54481.307	54481.355	21.5
1321	09 55 37.921	+18 05 48.80	54480.522	54480.569	21.3	54481.310	54481.358	21.5
1322	09 57 44.281	+18 05 48.80	54480.525	54480.552	21.5	54481.314	54481.362	21.5
1323	10 12 37.799	+18 05 48.80	54480.529	54480.565	21.5	54481.317	54481.365	21.4
1324	09 21 38.519	+22 38 20.80	54480.535	54480.562	21.2	54481.324	54481.372	21.1
1325	09 23 48.480	+22 38 20.80	54480.539	54480.559	21.5	54481.327	54481.375	21.5
1326	07 48 14.760	+15 49 30.70	54479.313	54479.358	21.5	54481.195	54481.239	21.5
1327	08 07 00.481	+15 49 33.20	54480.347	54480.393	21.3	54481.198	54481.242	21.5
1328	07 56 38.760	+20 22 04.40	54480.403	54480.450	21.6	54481.205	54481.249	21.5
1329	07 58 45.120	+20 22 05.20	54480.406	54480.454	21.8	54481.208	54481.252	21.5
1330	07 36 20.881	+24 54 34.90	54479.341	54479.386	21.5	54481.134	54481.181	21.3
1331	07 38 30.840	+24 54 34.90	54479.345	54479.390	21.6	54481.137	54481.184	21.5
1332	07 53 51.000	+24 54 36.70	54480.417	54480.464	21.7	54481.212	54481.256	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1333	07 56 00.960	+24 54 36.70	54480.420	54480.467	21.7	54481.215	54481.259	21.6
1334	07 35 38.760	+29 27 08.60	54480.337	54480.382	21.9	54481.127	54481.174	21.3
1335	07 37 53.760	+29 27 08.60	54480.340	54480.386	21.9	54481.130	54481.178	21.3
1336	07 36 38.879	+33 59 40.60	54480.423	54480.471	21.5	54481.225	54481.269	21.5
1337	07 39 00.000	+33 59 40.60	54480.427	54480.474	21.5	54481.229	54481.272	21.6
1338	07 22 50.879	+38 32 12.10	54480.410	54480.457	21.5	54481.140	54481.188	21.3
1339	07 25 19.921	+38 32 12.10	54480.413	54480.461	21.5	54481.144	54481.191	21.5
1340	07 08 38.761	+43 04 43.69	54480.351	54480.396	21.4	54481.120	54481.168	21.4
1341	07 11 17.520	+43 04 43.69	54480.354	54480.400	22.0	54481.124	54481.171	21.5
1342	06 55 02.640	+47 37 13.40	54479.348	54479.393	21.3	54481.117	54481.164	21.5
1343	08 29 54.239	+47 37 15.20	54480.319	54480.365	22.0	54481.382	54481.424	21.4
1344	06 42 14.760	+52 09 47.49	54480.330	54480.375	21.6	54481.103	54481.151	21.2
1345	06 45 21.240	+52 09 47.21	54480.333	54480.379	21.8	54481.106	54481.154	21.4
1346	09 18 14.400	-09 10 16.70	54502.310	54502.354	21.5	54504.256	54504.299	21.3
1347	09 34 38.280	-09 10 17.00	54502.340	54502.384	21.4	54504.330	54504.374	21.5
1348	09 36 39.600	-09 10 16.30	54502.344	54502.387	21.4	54504.333	54504.377	21.3
1349	08 22 51.241	-04 37 44.40	54502.223	54502.267	21.7	54504.216	54504.259	21.8
1350	08 24 51.480	-04 37 44.80	54502.227	54502.270	21.7	54504.219	54504.263	21.7
1351	08 39 02.879	-04 37 44.80	54502.236	54502.280	21.6	54504.222	54504.266	21.7
1352	08 41 03.482	-04 37 44.80	54502.240	54502.283	21.6	54504.226	54504.269	21.7
1353	08 55 14.881	-04 37 44.80	54502.257	54502.300	21.7	54504.242	54504.286	21.7
1354	08 57 15.119	-04 37 45.10	54502.260	54502.304	21.7	54504.246	54504.289	21.7
1355	09 11 26.518	-04 37 44.40	54502.334	54502.377	21.3	54504.316	54504.360	21.3
1356	09 13 26.760	-04 37 44.80	54502.337	54502.381	21.4	54504.320	54504.363	21.4
1357	08 22 51.241	-00 05 12.50	54502.230	54502.273	21.6	54504.229	54504.273	21.7
1358	08 24 51.119	-00 05 12.80	54502.233	54502.277	21.5	54504.232	54504.276	21.7
1359	08 39 02.879	-00 05 12.80	54502.250	54502.293	21.8	54504.249	54504.293	21.7
1360	08 41 03.121	-00 05 12.80	54502.253	54502.307	21.6	54504.252	54504.296	21.5
1361	08 55 14.881	-00 05 13.20	54502.327	54502.371	21.3	54504.309	54504.353	21.6
1362	08 57 14.759	-00 05 12.80	54502.330	54502.374	21.5	54504.313	54504.357	21.5
1363	08 22 51.241	+04 27 19.40	54502.243	54502.287	21.5	54504.236	54504.279	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1364	08 24 51.480	+04 27 19.10	54502.247	54502.290	21.6	54504.239	54504.283	21.7
1365	08 39 02.879	+04 27 19.40	54502.314	54502.357	21.6	54504.303	54504.347	21.7
1366	08 41 03.482	+04 27 19.10	54502.317	54502.361	21.4	54504.306	54504.350	21.7
1367	08 55 14.881	+04 27 18.70	54502.347	54502.391	21.6	54504.336	54504.380	21.5
1368	08 57 15.119	+04 27 18.70	54502.350	54502.394	21.7	54504.340	54504.384	20.9
1369	08 29 03.118	+08 59 51.00	54502.320	54502.364	21.7	54504.323	54504.367	21.6
1370	08 31 04.442	+08 59 50.60	54502.324	54502.367	21.8	54504.326	54504.370	21.6
1371	09 39 14.041	+22 37 25.70	54502.455	54502.502	21.4	54504.411	54504.455	20.8
1372	09 41 24.359	+22 37 25.30	54502.459	54502.499	21.5	54504.414	54504.458	21.0
1373	10 32 01.320	+22 37 25.70	54502.489	54502.536	21.6	54504.428	54504.472	21.5
1374	10 34 11.638	+22 37 26.00	54502.492	54502.533	21.6	54504.431	54504.475	21.5
1375	10 19 25.680	+27 09 58.00	54502.506	54502.539	21.3	54504.418	54504.462	21.0
1376	10 21 40.682	+27 09 58.00	54502.509	54502.543	21.4	54504.421	54504.465	21.2
1377	10 37 37.199	+27 09 58.00	54502.513	54502.556	21.1	54504.479	54504.522	21.3
1378	10 39 52.201	+27 09 57.60	54502.516	54502.552	21.7	54504.482	54504.525	21.4
1379	10 10 58.799	+31 42 29.50	54502.486	54502.529	21.1	54504.424	54504.468	20.9
1380	10 29 58.561	+31 42 29.50	54502.522	54502.549	21.4	54504.488	54504.532	21.3
1381	09 05 49.561	+36 15 01.10	54502.452	54502.496	21.8	54504.407	54504.452	21.0
1382	09 04 38.641	+18 04 54.10	54502.424	54502.465	21.4	54505.262	54505.306	21.2
1383	09 06 45.001	+18 04 54.10	54502.427	54502.469	21.7	54505.265	54505.309	21.4
1384	09 21 38.519	+18 04 54.50	54502.434	54502.475	21.3	54505.272	54505.316	21.1
1385	08 48 37.080	+22 37 26.40	54502.421	54502.462	21.5	54505.259	54505.303	21.3
1386	10 27 37.439	+31 42 29.50	54502.519	54502.546	21.2	54505.337	54505.384	21.3
1387	10 48 58.321	+31 42 34.60	54504.495	54504.545	21.3	54505.340	54505.388	21.5
1388	10 03 37.801	+36 15 06.10	54504.502	54504.535	21.1	54505.286	54505.330	21.3
1389	10 06 06.840	+36 15 06.50	54504.498	54504.505	21.4	54505.289	54505.333	21.7
1390	09 41 04.920	+40 47 38.40	54504.518	54504.539	21.3	54505.276	54505.320	21.5
1391	09 36 20.161	+45 20 10.01	54504.512	54504.542	21.2	54505.279	54505.323	21.5
1392	09 39 11.160	+45 20 11.00	54504.508	54504.515	21.1	54505.282	54505.327	21.6
1393	09 27 38.160	-04 37 49.40	54505.371	54505.418	21.4	54506.236	54506.279	21.5
1394	09 29 38.402	-04 37 49.80	54505.374	54505.422	21.5	54506.239	54506.283	21.6

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
1395	09 11 26.518	-00 05 17.90	54505.357	54505.405	21.2	54506.242	54506.286	21.5
1396	09 13 26.400	-00 05 18.20	54505.361	54505.408	21.4	54506.245	54506.290	21.6
1397	09 13 27.121	+04 27 19.10	54502.408	54502.448	21.1	54506.262	54506.306	21.4
1398	09 29 38.759	+04 27 13.70	54505.255	54505.299	21.2	54506.266	54506.310	21.7
1399	08 45 26.999	+08 59 46.00	54505.364	54505.412	21.5	54506.249	54506.293	21.8
1400	08 47 28.319	+08 59 45.60	54505.367	54505.415	21.5	54506.252	54506.296	21.7
1401	09 36 39.961	+08 59 50.60	54502.431	54502.472	21.2	54506.269	54506.313	21.4
1402	09 53 03.481	+08 59 46.00	54505.436	54505.476	21.2	54506.272	54506.316	21.4
1403	08 38 20.760	+13 32 17.50	54505.377	54505.425	21.6	54506.256	54506.300	21.6
1404	08 40 24.600	+13 32 17.20	54505.381	54505.429	21.7	54506.259	54506.303	21.9
1405	10 16 35.760	+22 37 20.30	54505.473	54505.517	21.3	54506.351	54506.399	21.4
1406	09 43 01.921	+27 09 52.90	54505.456	54505.504	21.3	54506.330	54506.372	21.5
1407	09 45 16.919	+27 09 52.60	54505.459	54505.500	21.3	54506.333	54506.375	21.6
1408	10 03 28.799	+27 09 52.90	54505.541	54505.548	20.9	54506.347	54506.395	21.4
1409	09 13 59.520	+31 42 24.50	54505.442	54505.483	21.5	54506.276	54506.320	21.8
1410	09 30 38.160	+31 42 24.80	54505.449	54505.493	21.3	54506.323	54506.365	21.6
1411	09 32 59.280	+31 42 24.50	54505.452	54505.497	21.5	54506.327	54506.368	21.7
1412	09 49 37.920	+31 42 24.50	54505.466	54505.511	21.3	54506.341	54506.389	21.7
1413	09 51 59.039	+31 42 24.50	54505.470	54505.514	21.5	54506.344	54506.392	21.8
1414	10 08 37.679	+31 42 25.20	54505.480	54505.527	21.2	54506.354	54506.402	21.5
1415	09 59 49.560	+40 47 28.30	54505.487	54505.534	21.3	54506.358	54506.406	21.6
1416	10 02 28.679	+40 47 28.00	54505.490	54505.531	21.2	54506.361	54506.409	21.5
1417	10 21 13.319	+40 47 28.30	54505.521	54505.558	21.1	54506.378	54506.423	21.4
1418	10 23 52.082	+40 47 28.00	54505.524	54505.554	21.3	54506.382	54506.426	21.8
1419	09 16 05.520	+45 19 59.90	54505.463	54505.507	21.8	54506.337	54506.385	22.0
1420	09 43 49.801	+04 27 13.00	54506.416	54506.458	21.6	54507.240	54507.284	21.6
1421	09 45 50.400	+04 27 13.70	54506.419	54506.461	21.4	54507.243	54507.288	21.4
1422	09 51 01.800	+08 59 45.20	54506.430	54506.471	21.2	54507.247	54507.291	21.2
1423	10 07 25.681	+08 59 45.20	54506.440	54506.482	21.3	54507.257	54507.302	21.6
1424	10 09 27.001	+08 59 45.20	54506.444	54506.485	21.2	54507.260	54507.305	21.5
1425	08 48 26.639	+27 09 52.20	54506.413	54506.454	21.4	54507.236	54507.281	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1426	10 01 13.801	+27 09 52.90	54506.464	54506.506	21.2	54507.270	54507.315	21.5
1427	09 11 38.401	+31 42 24.50	54506.433	54506.475	21.4	54507.250	54507.295	21.6
1428	10 46 36.841	+31 42 24.10	54506.495	54506.533	21.1	54507.329	54507.370	21.4
1429	09 03 20.521	+36 14 56.80	54506.437	54506.478	21.4	54507.253	54507.298	21.7
1430	09 23 26.161	+36 14 56.40	54506.447	54506.489	21.5	54507.264	54507.308	21.7
1431	09 25 55.201	+36 14 56.40	54506.451	54506.492	21.7	54507.267	54507.312	21.8
1432	09 43 31.800	+36 14 55.70	54506.526	54506.540	21.0	54507.274	54507.319	21.7
1433	09 46 00.840	+36 14 56.40	54506.468	54506.509	21.3	54507.277	54507.322	21.7
1434	10 23 43.440	+36 14 55.70	54506.499	54506.554	21.3	54507.332	54507.374	21.7
1435	10 26 12.480	+36 14 55.70	54506.502	54506.536	21.5	54507.336	54507.377	21.8
1436	10 43 49.080	+36 14 55.70	54506.513	54506.547	21.4	54507.339	54507.381	21.7
1437	10 46 18.120	+36 14 55.70	54506.516	54506.543	21.5	54507.342	54507.384	21.9
1438	09 38 26.161	+40 47 27.60	54506.523	54506.550	21.2	54507.325	54507.367	21.8
1439	09 28 26.039	-13 42 59.00	54507.353	54507.395	21.6	54508.243	54508.291	21.3
1440	09 30 29.519	-13 42 59.40	54507.356	54507.398	21.4	54508.247	54508.295	21.3
1441	09 01 50.519	-09 10 27.10	54507.346	54507.388	21.4	54508.237	54508.284	21.3
1442	09 03 52.199	-09 10 27.50	54507.349	54507.391	21.3	54508.240	54508.288	21.2
1443	10 34 25.320	-00 05 23.60	54507.439	54507.480	21.6	54508.332	54508.380	21.1
1444	10 48 36.719	-00 05 24.00	54507.446	54507.487	21.5	54508.339	54508.387	21.1
1445	10 50 36.961	-00 05 23.60	54507.449	54507.490	21.2	54508.343	54508.390	20.9
1446	11 04 48.721	-00 05 24.00	54507.459	54507.501	21.4	54508.356	54508.404	21.3
1447	11 06 48.599	-00 05 24.00	54507.463	54507.504	21.5	54508.360	54508.407	21.4
1448	11 15 02.160	+08 59 39.10	54507.477	54507.521	21.4	54508.363	54508.411	21.3
1449	11 29 24.360	+08 59 39.80	54507.508	54507.558	21.3	54508.366	54508.414	21.3
1450	11 31 25.680	+08 59 39.50	54507.511	54507.541	21.3	54508.370	54508.417	21.2
1451	11 45 48.240	+08 59 39.80	54507.514	54507.555	21.4	54508.373	54508.420	21.4
1452	11 47 49.560	+08 59 39.10	54507.518	54507.545	21.5	54508.376	54508.424	21.3
1453	12 02 11.760	+08 59 39.50	54507.524	54507.548	21.4	54508.427	54508.468	21.2
1454	10 01 49.441	+13 32 12.10	54507.442	54507.484	21.7	54508.336	54508.383	21.5
1455	10 20 34.801	+13 32 11.00	54507.534	54507.538	21.3	54508.353	54508.400	21.6
1456	08 30 38.881	+18 04 43.00	54507.360	54507.402	21.6	54508.250	54508.298	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1457	08 32 45.241	+18 04 43.30	54507.363	54507.405	21.8	54508.254	54508.301	21.7
1458	09 56 49.559	+22 37 15.60	54507.453	54507.494	21.2	54508.346	54508.394	21.1
1459	09 58 59.881	+22 37 14.90	54507.456	54507.497	21.6	54508.350	54508.397	21.5
1460	08 54 59.761	+31 42 18.40	54507.425	54507.466	21.6	54508.274	54508.322	21.6
1461	08 55 38.639	+40 47 22.20	54507.429	54507.470	21.8	54508.277	54508.325	21.9
1462	08 58 17.401	+40 47 22.20	54507.432	54507.473	21.8	54508.281	54508.329	21.9
1463	10 00 02.160	+04 26 52.80	54508.448	54508.500	20.9	54509.418	54509.461	21.2
1464	12 04 13.441	+08 59 39.80	54507.528	54507.551	21.4	54509.443	54509.488	21.3
1465	08 47 39.120	+18 04 28.60	54508.257	54508.305	21.5	54509.344	54509.391	21.3
1466	08 49 45.480	+18 04 28.60	54508.260	54508.308	21.5	54509.347	54509.395	21.6
1467	09 04 03.000	+22 37 00.50	54508.458	54508.493	21.3	54509.454	54509.474	21.3
1468	09 24 50.759	+27 09 32.00	54508.434	54508.475	21.1	54509.422	54509.464	21.3
1469	08 52 38.998	+31 42 04.70	54508.452	54508.496	21.2	54509.447	54509.499	21.2
1470	09 17 02.758	+40 47 07.80	54508.438	54508.479	21.3	54509.425	54509.468	21.4
1471	09 19 41.521	+40 47 07.80	54508.441	54508.482	21.4	54509.429	54509.471	21.4
1472	09 13 14.881	+45 19 40.10	54508.444	54508.486	21.5	54509.436	54509.481	21.4
1473	13 53 34.799	-18 18 37.40	54593.192	54593.236	21.2	54594.188	54594.235	21.0
1474	13 55 41.159	-18 18 37.40	54593.195	54593.239	21.2	54594.192	54594.238	21.0
1475	14 47 43.439	-13 46 05.90	54593.283	54593.326	21.1	54594.208	54594.255	21.0
1476	14 10 34.320	-18 18 39.20	54594.202	54594.249	21.1	54596.240	54596.284	21.0
1477	14 12 40.680	-18 18 39.60	54594.205	54594.252	21.2	54596.243	54596.288	21.0
1478	14 27 34.201	-18 18 40.00	54594.261	54594.305	21.0	54596.250	54596.297	21.0
1479	14 44 34.079	-18 18 37.40	54593.266	54593.309	21.2	54596.254	54596.301	21.2
1480	14 29 46.319	-09 13 36.10	54594.289	54594.332	21.1	54596.261	54596.304	21.0
1481	13 57 38.160	-13 46 07.70	54594.176	54594.222	21.0	54597.170	54597.212	21.2
1482	14 28 58.078	-13 45 33.80	54596.291	54596.333	21.0	54597.185	54597.227	21.0
1483	15 21 06.840	-13 45 34.20	54596.357	54596.397	21.0	54597.222	54597.263	21.1
1484	15 54 30.238	-13 45 34.20	54596.379	54596.423	21.3	54597.247	54597.292	21.3
1485	14 38 22.559	-22 51 05.80	54597.267	54597.309	21.4	54598.264	54598.306	21.2
1486	14 40 32.521	-22 51 05.40	54597.270	54597.313	21.4	54598.267	54598.309	21.2
1487	15 31 09.482	-22 51 05.80	54597.280	54597.323	21.3	54598.281	54598.303	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1488	15 52 26.759	-13 45 34.20	54596.375	54596.419	21.3	54598.413	54598.434	21.3
1489	17 03 08.642	-04 38 37.70	54613.404	54613.475	21.5	54614.402	54614.445	21.5
1490	16 26 32.640	-18 16 13.40	54613.327	54613.370	21.7	54615.243	54615.290	21.3
1491	16 28 39.003	-18 16 13.10	54613.331	54613.373	21.6	54615.246	54615.294	21.4
1492	16 43 32.157	-18 16 13.10	54613.341	54613.383	22.1	54615.257	54615.299	21.6
1493	16 45 38.521	-18 16 13.40	54613.345	54613.386	22.0	54615.263	54615.305	21.7
1494	16 09 08.637	-13 43 41.20	54613.334	54613.376	21.5	54615.206	54615.249	21.1
1495	16 25 50.521	-13 43 40.40	54613.348	54613.390	21.6	54615.216	54615.260	21.3
1496	16 27 54.001	-13 43 41.50	54613.351	54613.393	21.5	54615.224	54615.267	21.3
1497	16 44 35.878	-13 43 41.50	54613.364	54613.408	21.9	54615.230	54615.274	21.7
1498	16 57 20.163	-09 11 09.60	54614.389	54614.461	21.3	54615.227	54615.270	21.5
1499	17 01 08.040	-04 38 38.00	54613.401	54613.478	21.2	54615.350	54615.422	21.3
1500	16 44 56.402	+04 26 25.40	54614.465	54614.475	20.9	54615.200	54615.309	21.1
1501	16 11 12.123	-13 43 41.50	54613.338	54613.379	21.5	54616.210	54616.357	21.4
1502	16 26 34.082	-09 13 00.10	54615.203	54615.277	21.2	54616.206	54616.371	21.4
1503	16 40 56.282	-09 12 59.80	54615.213	54615.280	21.4	54616.213	54616.374	21.7
1504	17 13 44.043	-09 12 59.40	54615.343	54615.392	22.2	54616.391	54616.434	22.4
1505	17 15 45.360	-09 12 59.40	54615.347	54615.395	22.2	54616.394	54616.438	22.4
1506	16 12 33.120	-04 40 28.20	54615.182	54615.236	21.2	54616.183	54616.227	21.5
1507	16 14 33.358	-04 40 27.80	54615.186	54615.239	21.2	54616.186	54616.354	21.5
1508	16 28 44.757	-04 40 27.80	54615.190	54615.284	21.3	54616.197	54616.377	21.6
1509	16 30 45.003	-04 40 27.50	54615.193	54615.287	21.4	54616.200	54616.381	21.7
1510	16 44 56.402	-04 40 27.10	54615.336	54615.385	21.8	54616.217	54616.384	21.7
1511	16 46 56.640	-04 40 27.50	54615.340	54615.388	21.7	54616.220	54616.387	21.8
1512	17 17 20.041	-04 40 27.80	54615.360	54615.426	22.2	54616.397	54616.441	22.6
1513	17 19 20.280	-04 40 27.50	54615.363	54615.429	22.3	54616.401	54616.445	22.6
1514	17 33 31.679	-04 40 28.20	54615.433	54615.458	22.2	54616.404	54616.475	22.4
1515	16 09 32.758	-18 18 02.90	54615.312	54615.353	21.3	54617.263	54617.306	21.6
1516	16 42 32.399	-13 45 31.30	54615.319	54615.367	22.1	54617.277	54617.320	22.4
1517	16 59 14.283	-13 45 31.70	54615.322	54615.370	22.1	54617.288	54617.331	22.4
1518	17 01 17.763	-13 45 31.30	54615.326	54615.374	22.1	54617.291	54617.335	22.4

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
1519	16 10 10.558	-09 12 54.00	54616.193	54616.364	21.5	54617.267	54617.309	21.7
1520	16 24 32.758	-09 12 53.60	54616.203	54616.367	21.3	54617.281	54617.323	21.7
1521	16 59 21.843	-09 11 09.20	54614.392	54614.458	21.5	54617.326	54617.391	22.0
1522	16 28 44.400	+04 26 25.10	54614.424	54614.455	21.0	54617.358	54617.402	21.7
1523	14 12 16.922	-13 45 28.40	54617.181	54617.250	21.2	54618.222	54618.269	21.1
1524	14 13 22.798	-09 12 56.50	54617.188	54617.257	21.5	54618.229	54618.276	21.4
1525	16 12 33.120	-00 07 52.70	54617.295	54617.338	21.8	54618.331	54618.377	21.5
1526	16 14 33.001	-00 07 53.40	54617.298	54617.341	21.6	54618.334	54618.381	21.5
1527	16 28 44.757	-00 07 53.40	54617.347	54617.395	21.7	54618.347	54618.388	21.6
1528	16 30 45.003	-00 07 53.40	54617.351	54617.398	21.7	54618.350	54618.392	21.7
1529	17 01 08.397	-00 07 53.40	54617.438	54617.461	21.8	54618.399	54618.477	21.6
1530	17 03 08.278	-00 07 53.00	54617.442	54617.465	21.8	54618.402	54618.474	21.8
1531	16 08 30.837	-22 50 04.90	54618.250	54618.292	21.4	54619.275	54619.318	21.1
1532	16 41 32.640	-22 50 31.90	54617.270	54617.313	21.8	54619.278	54619.322	21.4
1533	16 43 42.601	-22 50 31.90	54617.274	54617.316	21.7	54619.282	54619.325	21.4
1534	14 48 11.519	-09 12 29.50	54618.264	54618.306	21.4	54619.214	54619.258	21.2
1535	16 08 08.878	-09 12 54.40	54616.190	54616.361	21.4	54619.224	54619.268	21.3
1536	16 44 56.402	-00 07 26.00	54618.370	54618.417	21.5	54619.288	54619.331	21.6
1537	16 46 56.283	-00 07 25.70	54618.373	54618.420	21.3	54619.291	54619.335	21.4
1538	17 17 20.041	-00 07 26.00	54618.410	54618.447	21.6	54619.295	54619.338	21.9
1539	17 19 19.923	-00 07 25.70	54618.414	54618.450	21.7	54619.298	54619.341	22.0
1540	17 33 31.679	-00 07 25.70	54618.424	54618.454	21.7	54619.301	54619.345	21.9
1541	17 35 31.561	-00 07 25.70	54618.427	54618.457	21.6	54619.305	54619.348	21.7
1542	17 01 08.040	+04 25 05.90	54618.431	54618.470	21.5	54619.308	54619.352	21.6
1543	17 03 08.642	+04 25 05.90	54618.434	54618.460	21.6	54619.311	54619.355	21.7
1544	17 17 20.041	+04 25 05.90	54618.440	54618.467	21.5	54619.358	54619.401	21.6
1545	17 19 20.280	+04 25 05.90	54618.443	54618.463	21.5	54619.361	54619.405	21.6
1546	17 33 31.679	+04 24 41.80	54616.408	54616.472	21.4	54619.365	54619.408	21.3
1547	17 49 43.317	+04 24 41.40	54616.414	54616.468	21.9	54619.372	54619.415	21.6
1548	17 51 43.919	+04 24 41.40	54616.418	54616.451	22.0	54619.375	54619.418	21.7
1549	14 03 11.159	-22 50 33.40	54619.184	54619.228	21.1	54620.188	54620.222	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1550	16 23 20.757	-27 23 02.40	54620.269	54620.303	21.9	54621.260	54621.304	21.7
1551	16 25 35.758	-27 23 02.40	54620.272	54620.306	21.9	54621.263	54621.307	21.6
1552	16 06 20.882	-22 50 04.90	54618.247	54618.289	21.5	54621.267	54621.311	21.4
1553	15 01 33.961	-18 17 58.90	54620.208	54620.242	21.1	54621.243	54621.287	21.0
1554	15 20 39.841	-18 17 58.60	54620.262	54620.296	21.2	54621.256	54621.301	21.2
1555	14 45 39.959	-13 45 01.80	54618.240	54618.284	21.5	54621.253	54621.297	21.2
1556	14 19 10.921	-04 40 24.60	54619.204	54619.248	21.1	54621.270	54621.331	21.4
1557	14 21 11.520	-04 40 25.30	54619.207	54619.251	21.2	54621.273	54621.328	21.2
1558	14 35 22.559	-04 40 24.60	54619.217	54619.261	21.4	54621.280	54621.322	21.3
1559	14 35 22.202	+04 24 40.30	54620.324	54620.370	21.1	54621.335	54621.362	21.1
1560	14 55 58.081	-22 50 30.50	54620.191	54620.225	21.3	54623.190	54623.233	21.3
1561	15 13 33.599	-22 50 30.50	54620.201	54620.235	21.2	54623.196	54623.247	21.2
1562	15 15 43.921	-22 50 30.50	54620.205	54620.239	21.2	54623.200	54623.250	21.1
1563	15 04 25.320	-13 45 26.60	54620.286	54620.320	21.0	54623.210	54623.260	21.3
1564	14 37 23.161	-04 40 25.30	54619.221	54619.265	21.3	54623.223	54623.274	21.6
1565	16 14 33.358	+04 25 22.10	54621.352	54621.369	21.3	54623.332	54623.374	21.6
1566	14 45 39.959	+13 29 44.50	54620.327	54620.363	21.3	54623.295	54623.337	21.6
1567	16 05 09.238	-27 22 52.70	54623.240	54623.288	21.2	54624.236	54624.273	21.4
1568	16 07 24.239	-27 22 52.70	54623.243	54623.291	21.4	54624.239	54624.277	21.5
1569	14 20 46.680	-22 50 21.10	54623.186	54623.230	21.2	54624.182	54624.219	21.3
1570	14 58 08.039	-22 50 30.50	54620.195	54620.229	21.2	54624.185	54624.222	21.5
1571	15 18 33.839	-18 17 49.20	54623.203	54623.254	21.3	54624.189	54624.226	21.5
1572	15 35 33.720	-18 17 48.80	54623.216	54623.267	21.3	54624.206	54624.253	21.4
1573	15 37 39.719	-18 17 49.20	54623.220	54623.270	21.3	54624.209	54624.256	21.4
1574	15 02 21.840	-13 45 16.60	54623.206	54623.257	21.3	54624.192	54624.229	21.4
1575	15 19 03.721	-13 45 17.60	54623.227	54623.277	21.5	54624.233	54624.280	21.5
1576	14 46 10.199	-09 12 45.70	54623.213	54623.264	21.4	54624.202	54624.243	21.5
1577	15 02 34.080	-09 12 45.00	54623.281	54623.324	21.5	54624.284	54624.318	21.5
1578	15 04 35.400	-09 12 45.70	54623.284	54623.327	21.4	54624.287	54624.322	21.5
1579	16 12 33.120	+04 24 49.30	54623.320	54623.367	21.7	54624.374	54624.411	21.6
1580	15 02 34.080	+08 57 21.60	54623.298	54623.340	21.4	54624.325	54624.361	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1581	15 04 35.400	+08 57 21.60	54623.301	54623.343	21.6	54624.329	54624.364	21.7
1582	15 53 46.681	+08 57 22.00	54623.315	54623.361	21.6	54624.368	54624.404	21.6
1583	16 08 09.242	+08 57 21.60	54623.352	54623.396	21.3	54624.379	54624.416	21.4
1584	15 48 45.360	-22 50 26.90	54624.212	54624.247	21.5	54625.214	54625.259	21.4
1585	15 50 55.318	-22 50 26.50	54624.216	54624.250	21.5	54625.218	54625.262	21.2
1586	15 52 33.241	-18 17 54.60	54624.195	54624.260	21.7	54625.194	54625.249	21.5
1587	15 54 39.601	-18 17 55.00	54624.199	54624.263	21.5	54625.204	54625.265	21.4
1588	16 10 10.558	+08 57 21.20	54623.356	54623.399	21.4	54625.302	54625.347	21.6
1589	17 01 08.397	+02 08 28.00	54624.390	54624.433	21.5	54625.306	54625.350	21.7
1590	17 03 08.278	+02 08 28.00	54624.394	54624.436	21.5	54625.309	54625.353	21.7
1591	17 17 20.041	+02 08 28.30	54624.453	54624.468	21.4	54625.313	54625.357	21.4
1592	17 19 19.923	+02 08 28.30	54624.456	54624.471	21.5	54625.316	54625.360	21.4
1593	17 33 31.679	+02 08 28.30	54624.459	54624.474	21.2	54625.319	54625.363	21.4
1594	15 10 33.959	-27 22 50.50	54625.197	54625.242	21.3	54626.195	54626.240	21.4
1595	15 12 48.961	-27 22 50.90	54625.201	54625.245	21.4	54626.198	54626.244	21.3
1596	15 28 45.839	-27 22 50.90	54625.208	54625.252	21.4	54626.210	54626.254	21.4
1597	15 31 00.840	-27 22 50.50	54625.211	54625.255	21.4	54626.213	54626.258	21.3
1598	16 23 56.758	-22 50 26.90	54624.266	54624.302	21.5	54626.237	54626.278	21.4
1599	15 35 45.599	-13 45 15.10	54625.232	54625.276	21.2	54626.223	54626.268	21.5
1600	15 37 49.078	-13 45 15.10	54625.235	54625.279	21.2	54626.227	54626.271	21.4
1601	15 18 57.960	-09 12 42.80	54625.282	54625.326	21.3	54626.275	54626.318	21.5
1602	15 20 59.280	-09 12 43.20	54625.286	54625.330	21.4	54626.282	54626.324	21.5
1603	15 35 21.481	-09 12 43.60	54625.289	54625.333	21.4	54626.292	54626.334	21.3
1604	15 37 23.161	-09 12 43.20	54625.292	54625.336	21.4	54626.295	54626.337	21.4
1605	15 51 45.361	-09 12 43.20	54625.295	54625.340	21.6	54626.299	54626.341	21.5
1606	15 53 47.042	-09 12 43.20	54625.299	54625.343	21.6	54626.302	54626.344	21.5
1607	14 51 34.200	-04 40 11.60	54625.221	54625.269	21.4	54626.217	54626.261	21.6
1608	14 53 34.799	-04 40 12.00	54625.225	54625.272	21.6	54626.220	54626.265	21.7
1609	15 58 21.360	-00 07 39.70	54625.394	54625.407	21.5	54626.311	54626.354	21.7
1610	16 44 36.242	-11 28 59.50	54625.390	54625.400	22.1	54626.314	54626.357	22.0
1611	16 30 45.360	+06 41 07.10	54625.367	54625.411	21.4	54626.349	54626.390	21.6

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1612	16 44 56.759	+06 41 08.20	54625.370	54625.414	21.5	54626.372	54626.413	21.5
1613	16 46 56.998	+06 41 08.20	54625.373	54625.417	21.5	54626.375	54626.416	21.6
1614	17 01 08.397	+06 41 07.80	54625.377	54625.421	21.9	54626.382	54626.424	21.8
1615	17 03 08.642	+06 41 07.40	54625.380	54625.424	21.7	54626.386	54626.428	21.8
1616	17 17 20.041	+06 41 07.80	54625.383	54625.427	21.6	54626.393	54626.437	21.7
1617	17 19 20.637	+06 41 07.40	54625.387	54625.431	21.5	54626.397	54626.440	21.7
1618	14 19 10.560	-00 07 45.10	54626.188	54626.230	21.4	54627.183	54627.213	21.2
1619	14 21 10.438	-00 07 45.10	54626.191	54626.233	21.5	54627.186	54627.216	21.2
1620	14 37 22.440	-00 07 45.50	54626.205	54626.251	21.6	54627.193	54627.223	21.3
1621	14 51 34.200	-00 07 44.80	54626.285	54626.327	21.7	54627.196	54627.227	21.4
1622	14 53 34.081	-00 07 45.50	54626.288	54626.331	21.7	54627.199	54627.230	21.4
1623	15 07 45.841	-04 40 19.90	54627.246	54627.276	21.6	54628.191	54628.214	21.3
1624	15 23 57.479	-04 40 19.60	54627.266	54627.294	21.3	54628.207	54628.231	21.3
1625	15 25 58.081	-04 40 19.60	54627.273	54627.301	21.5	54628.211	54628.234	21.3
1626	15 40 09.480	-04 40 19.90	54627.316	54627.346	21.8	54628.251	54628.277	21.4
1627	15 42 09.719	-04 40 19.90	54627.323	54627.353	21.7	54628.254	54628.281	21.4
1628	15 07 45.841	-00 07 48.40	54627.261	54627.291	21.5	54628.201	54628.224	21.4
1629	15 09 45.719	-00 07 47.60	54627.269	54627.298	21.7	54628.204	54628.227	21.4
1630	15 23 57.479	-00 07 48.00	54627.313	54627.343	21.9	54628.244	54628.271	21.6
1631	15 25 57.721	-00 07 48.00	54627.320	54627.350	21.9	54628.247	54628.274	21.6
1632	14 51 33.839	+04 24 43.20	54627.254	54627.283	21.4	54628.194	54628.217	21.3
1633	14 53 34.442	+04 24 43.90	54627.258	54627.288	21.4	54628.197	54628.221	21.5
1634	15 07 45.841	+04 24 43.60	54627.306	54627.336	21.6	54628.238	54628.264	21.2
1635	15 09 46.079	+04 24 43.90	54627.309	54627.340	21.7	54628.241	54628.268	21.2
1636	15 23 57.479	+04 24 43.60	54627.329	54627.361	21.4	54628.258	54628.284	21.3
1637	15 25 58.081	+04 24 43.90	54627.333	54627.364	21.4	54628.261	54628.288	21.2
1638	15 40 09.120	+04 24 43.60	54627.358	54627.387	21.6	54628.291	54628.317	21.6
1639	15 42 09.001	-00 07 44.00	54628.307	54628.331	21.6	54629.194	54629.241	21.1
1640	15 56 20.761	-00 07 44.80	54628.343	54628.367	21.6	54629.204	54629.251	21.1
1641	15 56 20.761	+04 24 47.50	54628.377	54628.400	21.6	54629.215	54629.261	21.3
1642	15 58 21.360	+04 24 47.50	54628.381	54628.403	21.4	54629.218	54629.265	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1643	15 35 21.120	+08 57 19.40	54628.347	54628.370	21.5	54629.208	54629.255	21.0
1644	15 37 22.801	+08 57 19.10	54628.350	54628.374	21.6	54629.211	54629.258	21.3
1645	16 08 08.521	+11 13 35.00	54628.311	54628.354	21.7	54629.225	54629.272	21.3
1646	16 10 10.201	+11 13 35.00	54628.314	54628.357	21.7	54629.228	54629.275	21.3
1647	19 19 54.118	-22 50 19.00	54629.359	54629.402	20.9	54630.346	54630.388	21.0
1648	19 22 04.079	-22 50 19.30	54629.362	54629.406	20.8	54630.349	54630.391	21.0
1649	19 33 29.880	-18 17 47.80	54629.396	54629.454	20.9	54630.327	54630.369	21.0
1650	19 46 11.638	-13 45 15.50	54629.382	54629.436	21.3	54630.317	54630.358	21.3
1651	19 41 17.877	-09 12 43.90	54629.342	54629.389	21.4	54630.297	54630.339	21.4
1652	19 43 19.200	-09 12 43.60	54629.345	54629.393	21.4	54630.300	54630.342	21.3
1653	19 41 17.877	-06 56 28.30	54629.370	54629.416	21.6	54630.291	54630.333	21.4
1654	15 46 55.559	-27 22 35.40	54641.217	54641.241	21.4	54642.199	54642.220	21.3
1655	15 46 55.559	-25 06 19.80	54641.189	54641.210	21.1	54642.189	54642.213	21.1
1656	15 49 10.560	-25 06 19.40	54641.192	54641.213	21.3	54642.192	54642.216	21.5
1657	16 08 29.402	-20 33 47.50	54641.200	54641.207	21.5	54642.203	54642.247	21.6
1658	16 23 55.323	-20 33 47.90	54641.234	54641.278	21.7	54642.223	54642.267	21.4
1659	16 26 05.277	-20 33 47.90	54641.238	54641.281	22.0	54642.227	54642.271	21.7
1660	16 28 37.561	-16 01 16.00	54641.261	54641.305	21.6	54642.264	54642.305	21.1
1661	16 27 52.559	-11 28 43.70	54641.275	54641.319	21.7	54642.281	54642.322	22.0
1662	16 59 12.841	-11 28 43.70	54641.285	54641.329	21.8	54642.285	54642.326	22.0
1663	17 01 15.957	-11 28 44.40	54641.288	54641.332	21.7	54642.288	54642.329	21.9
1664	16 57 18.721	-06 56 12.80	54641.292	54641.336	22.1	54642.298	54642.346	22.3
1665	16 59 20.401	-06 56 12.80	54641.295	54641.339	21.9	54642.302	54642.349	22.1
1666	16 28 42.958	+02 08 51.70	54641.298	54641.342	21.3	54642.309	54642.353	21.4
1667	16 30 43.197	+02 08 51.40	54641.302	54641.346	21.3	54642.312	54642.356	21.4
1668	16 25 35.037	-25 06 07.90	54642.240	54642.260	21.2	54643.219	54643.226	21.7
1669	17 33 30.958	-02 23 29.00	54642.339	54642.381	22.0	54643.216	54643.427	21.2
1670	16 44 54.960	+02 08 51.40	54641.322	54641.365	21.3	54644.355	54644.376	21.7
1671	16 46 54.841	+02 08 50.60	54641.325	54641.368	21.3	54644.359	54644.379	21.7
1672	19 07 05.521	-27 22 21.40	54644.362	54644.383	21.2	54645.306	54645.332	21.0
1673	19 09 20.522	-27 22 20.60	54644.366	54644.386	21.2	54645.309	54645.336	21.1

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1			Night 2		
			MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1674	20 22 07.677	-27 22 20.60	54644.403	54644.426	21.6	54645.397	54645.424	21.5
1675	20 24 28.439	-18 17 17.20	54644.463	54644.473	21.5	54645.326	54645.375	21.6
1676	20 26 34.803	-18 17 17.20	54644.466	54644.476	21.4	54645.329	54645.378	21.7
1677	20 19 34.679	-13 44 45.20	54644.397	54644.440	21.6	54645.299	54645.342	21.3
1678	20 21 38.158	-13 44 45.20	54644.400	54644.443	21.5	54645.303	54645.345	21.3
1679	20 36 16.199	-13 44 45.20	54644.470	54644.480	21.0	54645.388	54645.434	21.5
1680	16 07 23.161	-25 06 07.60	54642.210	54642.233	21.0	54645.190	54645.215	21.4
1681	16 23 20.043	-25 06 07.90	54642.236	54642.257	21.6	54645.205	54645.230	21.8
1682	19 39 39.240	-20 33 32.80	54644.372	54644.429	21.4	54645.313	54645.356	21.3
1683	16 09 32.038	-16 01 04.10	54642.250	54642.292	21.4	54645.186	54645.212	21.5
1684	16 11 38.401	-16 01 04.40	54642.254	54642.295	21.6	54645.193	54645.218	21.6
1685	19 33 29.159	-16 01 01.60	54644.390	54644.459	21.3	54645.275	54645.316	21.2
1686	19 35 35.522	-16 01 01.60	54644.393	54644.456	21.2	54645.278	54645.320	21.2
1687	16 09 07.202	-11 28 43.70	54641.265	54641.309	21.6	54645.196	54645.222	21.8
1688	20 01 41.521	-27 22 12.40	54645.381	54645.407	21.5	54646.343	54646.364	21.5
1689	20 19 53.040	-27 22 12.40	54645.394	54645.421	21.6	54646.361	54646.382	21.4
1690	21 14 28.318	-27 22 12.40	54645.401	54645.427	21.4	54646.407	54646.429	21.3
1691	21 16 43.320	-27 22 12.00	54645.404	54645.431	21.6	54646.411	54646.432	21.5
1692	20 30 16.919	-22 49 40.10	54645.365	54645.414	21.5	54646.354	54646.396	21.3
1693	20 32 27.237	-22 49 39.70	54645.369	54645.417	21.6	54646.357	54646.399	21.5
1694	16 41 32.283	-20 33 24.80	54645.243	54645.268	21.7	54646.186	54646.232	21.8
1695	16 43 42.601	-20 33 23.80	54645.246	54645.271	21.7	54646.189	54646.236	22.0
1696	19 50 29.762	-18 17 11.80	54646.300	54646.389	21.3	54647.299	54647.350	21.4
1697	19 52 36.118	-18 17 12.10	54646.304	54646.392	21.5	54647.302	54647.354	21.5
1698	20 07 29.643	-18 17 12.50	54646.309	54646.414	21.6	54647.306	54647.357	21.5
1699	20 09 35.999	-18 17 11.80	54646.313	54646.418	21.6	54647.309	54647.361	21.6
1700	20 02 53.522	-13 44 40.60	54646.284	54646.330	21.8	54647.281	54647.322	21.5
1701	19 07 06.599	-25 05 59.60	54646.316	54646.337	21.1	54647.313	54647.338	20.9
1702	19 19 54.118	-20 33 28.80	54646.290	54646.375	21.1	54647.289	54647.331	21.0
1703	19 22 04.443	-20 33 28.10	54646.294	54646.379	21.1	54647.293	54647.334	21.0
1704	16 43 32.521	-16 00 56.50	54646.192	54646.242	22.1	54647.192	54647.237	21.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1705	16 45 38.878	-16 00 56.20	54646.195	54646.246	22.0	54647.186	54647.196	21.7
1706	16 42 32.399	-11 28 24.60	54646.207	54646.259	22.5	54647.220	54647.263	22.2
1707	16 10 10.558	-06 55 52.70	54646.214	54646.263	21.8	54647.208	54647.250	21.7
1708	16 24 32.758	-06 55 53.00	54646.218	54646.266	22.1	54647.223	54647.267	21.9
1709	16 26 34.439	-06 55 53.00	54646.221	54646.270	22.2	54647.227	54647.270	21.8
1710	20 50 02.399	-22 49 45.80	54647.397	54647.439	21.4	54648.383	54648.427	21.3
1711	21 05 27.962	-22 49 45.50	54647.421	54647.455	21.2	54648.393	54648.438	21.1
1712	21 07 37.917	-22 49 45.50	54647.424	54647.459	21.4	54648.396	54648.441	21.3
1713	20 43 34.677	-18 17 13.60	54647.404	54647.445	21.6	54648.390	54648.434	21.5
1714	16 25 50.157	-11 28 26.40	54647.201	54647.242	21.7	54648.190	54648.232	21.4
1715	16 40 55.918	-06 55 54.50	54647.230	54647.274	22.1	54648.195	54648.237	21.6
1716	16 42 57.242	-06 55 54.50	54647.233	54647.277	21.9	54648.198	54648.241	21.4
1717	19 45 44.282	-27 22 17.00	54647.388	54647.407	21.4	54649.324	54649.345	21.4
1718	20 47 52.437	-22 49 45.80	54647.394	54647.435	21.4	54649.358	54649.402	21.5
1719	20 41 28.321	-18 17 13.60	54647.400	54647.442	21.6	54649.331	54649.374	21.5
1720	20 58 28.202	-18 17 13.20	54648.417	54648.459	21.3	54649.338	54649.384	21.4
1721	21 00 34.559	-18 17 13.20	54648.421	54648.455	21.2	54649.341	54649.388	21.3
1722	20 04 57.002	-13 44 40.60	54646.287	54646.333	21.8	54649.278	54649.320	21.8
1723	20 52 58.441	-13 44 41.60	54648.400	54648.465	21.5	54649.309	54649.351	21.4
1724	20 55 01.920	-13 44 41.60	54648.403	54648.462	21.5	54649.312	54649.354	21.5
1725	16 05 08.517	-25 06 01.40	54647.189	54647.211	21.2	54649.186	54649.207	21.2
1726	19 09 21.237	-25 06 00.00	54646.320	54646.340	21.2	54649.306	54649.327	21.0
1727	19 37 30.000	-20 33 28.10	54646.297	54646.386	21.5	54649.290	54649.334	21.4
1728	19 43 29.280	-27 22 15.20	54649.364	54649.391	21.4	54650.319	54650.342	21.3
1729	21 23 03.838	-22 49 43.30	54649.450	54649.479	21.6	54650.406	54650.428	21.8
1730	21 25 14.163	-22 49 43.30	54649.453	54649.469	21.6	54650.410	54650.431	21.7
1731	21 15 28.077	-18 17 11.80	54649.395	54649.440	21.6	54650.414	54650.474	21.6
1732	21 17 34.440	-18 17 11.80	54649.398	54649.444	21.6	54650.417	54650.457	21.6
1733	21 09 39.961	-13 44 39.50	54649.378	54649.420	21.8	54650.400	54650.441	21.7
1734	21 28 25.318	-13 44 39.80	54649.462	54649.476	21.7	54650.454	54650.470	21.8
1735	21 03 16.202	-09 12 08.30	54649.368	54649.411	21.9	54650.377	54650.421	21.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1736	21 05 17.883	-09 12 08.30	54649.371	54649.414	21.9	54650.381	54650.424	21.8
1737	21 19 40.083	-09 12 08.30	54649.434	54649.482	21.4	54650.435	54650.460	21.6
1738	21 21 41.399	-09 12 07.90	54649.437	54649.465	21.7	54650.438	54650.463	21.7
1739	19 25 18.118	-27 22 11.30	54650.312	54650.345	21.2	54651.302	54651.335	21.1
1740	19 27 32.763	-27 22 10.90	54650.315	54650.349	21.2	54651.305	54651.338	21.1
1741	19 37 29.643	-22 49 39.00	54650.357	54650.384	21.3	54651.308	54651.342	21.2
1742	21 11 43.798	-13 44 39.80	54649.381	54649.423	21.7	54651.381	54651.423	21.4
1743	21 26 21.839	-13 44 40.20	54649.459	54649.472	21.6	54651.392	54651.434	21.4
1744	19 25 18.118	-25 05 55.00	54650.325	54650.364	21.1	54651.318	54651.359	21.0
1745	19 27 32.763	-25 05 55.00	54650.322	54650.329	21.2	54651.315	54651.322	21.0
1746	19 39 39.961	-22 49 39.00	54650.360	54650.388	21.3	54653.298	54653.341	21.2
1747	19 55 05.518	-22 49 39.40	54650.367	54650.393	21.6	54653.313	54653.359	21.6
1748	19 57 15.480	-22 49 39.00	54650.370	54650.396	21.7	54653.316	54653.362	21.7
1749	20 12 41.401	-22 49 42.60	54651.363	54651.385	21.3	54653.320	54653.366	21.6
1750	20 14 51.719	-22 49 42.60	54651.366	54651.388	21.2	54653.324	54653.370	21.5
1751	19 35 36.237	-18 17 11.40	54651.291	54651.349	21.1	54653.264	54653.310	21.2
1752	21 32 28.322	-18 17 11.40	54651.395	54651.437	21.3	54653.345	54653.387	21.4
1753	21 34 34.679	-18 17 11.00	54651.398	54651.440	21.2	54653.348	54653.390	21.4
1754	21 43 04.081	-13 44 39.10	54651.427	54651.456	21.4	54653.334	54653.380	21.4
1755	19 57 41.758	-09 12 07.90	54651.252	54651.295	21.2	54653.246	54653.291	21.3
1756	19 59 43.081	-09 12 07.60	54651.256	54651.298	21.3	54653.249	54653.294	21.5
1757	21 36 04.320	-09 12 07.60	54651.402	54651.443	21.2	54653.327	54653.373	21.5
1758	21 38 05.637	-09 12 06.80	54651.405	54651.447	21.2	54653.331	54653.376	21.4
1759	19 43 29.637	-25 05 55.30	54650.336	54650.374	21.4	54653.352	54653.383	21.3
1760	19 45 44.639	-25 05 55.00	54650.332	54650.339	21.4	54653.338	54653.355	21.5
1761	17 13 44.043	-06 55 51.60	54651.214	54651.267	22.0	54653.187	54653.229	22.3
1762	17 15 45.717	-06 55 51.60	54651.217	54651.270	22.1	54653.190	54653.232	22.1
1763	20 58 31.800	-27 22 07.00	54653.417	54653.455	21.3	54654.361	54654.404	21.6
1764	20 14 05.281	-09 12 00.70	54653.277	54653.396	21.3	54654.257	54654.300	21.5
1765	20 16 06.962	-09 12 00.00	54653.281	54653.400	21.3	54654.261	54654.303	21.5
1766	20 32 30.842	-09 12 00.40	54653.288	54653.406	21.2	54654.267	54654.310	21.3

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
1767	20 46 53.042	-09 11 59.30	54653.303	54653.410	21.2	54654.277	54654.322	21.3
1768	20 48 54.723	-09 12 00.00	54653.306	54653.413	21.3	54654.280	54654.325	21.3
1769	20 40 19.917	-27 22 04.10	54654.356	54654.400	21.4	54655.347	54655.368	21.6
1770	21 49 27.840	-18 16 59.90	54654.372	54654.415	21.6	54655.357	54655.402	21.5
1771	20 30 29.162	-09 11 56.80	54654.306	54654.349	21.5	54655.330	54655.372	21.5
1772	20 31 41.157	-04 39 24.80	54654.336	54654.380	21.6	54655.340	54655.382	21.7
1773	20 33 41.402	-04 39 25.20	54654.339	54654.384	21.7	54655.343	54655.385	21.8
1774	20 47 52.801	-04 39 24.80	54654.343	54654.387	21.8	54655.350	54655.395	21.8
1775	20 49 53.397	-04 39 24.80	54654.346	54654.390	21.8	54655.354	54655.399	21.7
1776	21 20 16.441	-04 39 24.80	54654.315	54654.365	21.8	54655.333	54655.375	21.8
1777	21 22 16.679	-04 39 24.50	54654.318	54654.368	21.8	54655.336	54655.378	21.8
1778	16 12 32.763	-02 23 08.90	54654.199	54654.241	21.2	54655.187	54655.211	21.3
1779	16 14 33.358	-02 23 08.90	54654.202	54654.244	21.2	54655.191	54655.315	21.3
1780	16 28 44.757	-02 23 08.90	54654.205	54654.250	21.5	54655.194	54655.319	21.6
1781	16 30 45.003	-02 23 09.20	54654.208	54654.254	21.7	54655.197	54655.322	21.6
1782	21 40 40.077	-22 49 31.80	54654.394	54654.438	21.6	54656.370	54656.393	21.4
1783	21 42 50.039	-22 49 31.80	54654.397	54654.442	21.6	54656.373	54656.396	21.3
1784	21 58 15.602	-22 49 31.80	54654.407	54654.448	21.6	54656.384	54656.406	21.3
1785	20 56 17.163	-27 22 00.50	54656.417	54656.435	21.5	54657.426	54657.436	21.5
1786	16 44 56.759	-02 23 06.40	54656.194	54656.217	21.8	54657.192	54657.215	21.4
1787	17 03 08.999	-02 23 06.40	54656.204	54656.227	21.7	54657.202	54657.225	20.9
1788	17 19 20.637	-02 23 05.60	54656.210	54656.238	22.3	54657.208	54657.232	21.9
1789	21 34 55.203	-27 21 56.90	54657.446	54657.453	21.1	54659.371	54659.396	21.3
1790	19 59 17.881	-04 39 22.00	54656.242	54656.292	21.8	54660.214	54660.260	21.2
1791	20 01 18.120	-04 39 22.70	54656.245	54656.295	21.8	54660.218	54660.264	21.2
1792	21 32 40.201	-27 21 40.00	54659.407	54659.428	21.2	54661.363	54661.405	21.2
1793	21 53 07.079	-27 21 40.30	54659.420	54659.447	21.3	54661.378	54661.420	21.3
1794	20 15 29.162	-04 38 43.40	54672.200	54672.242	21.9	54673.311	54673.354	21.7
1795	20 17 29.400	-04 38 43.40	54672.203	54672.245	22.0	54673.314	54673.357	21.8
1796	20 15 28.798	-00 06 11.50	54672.206	54672.249	21.6	54673.361	54673.406	21.5
1797	20 17 29.043	-00 06 11.90	54672.210	54672.252	21.7	54673.364	54673.410	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1798	20 15 29.162	+04 26 20.40	54672.220	54672.263	21.9	54673.367	54673.413	21.7
1799	20 17 29.400	+04 26 20.40	54672.224	54672.266	21.8	54673.371	54673.417	21.7
1800	20 33 41.038	+04 26 20.00	54672.315	54672.358	21.7	54673.400	54673.443	21.2
1801	20 47 52.437	+04 26 20.40	54672.368	54672.410	21.6	54673.429	54673.465	21.2
1802	20 30 28.798	+08 58 51.60	54672.374	54672.417	21.8	54673.450	54673.475	21.3
1803	20 32 30.121	+08 58 52.00	54672.378	54672.420	21.7	54673.446	54673.471	21.4
1804	20 46 52.321	+08 58 52.00	54672.371	54672.413	21.7	54673.440	54673.468	21.3
1805	20 07 29.279	-16 00 02.90	54672.227	54672.269	21.5	54673.242	54673.290	21.2
1806	20 24 28.803	-16 00 02.90	54672.276	54672.322	21.5	54673.270	54673.318	21.3
1807	20 58 28.202	-16 00 02.50	54672.289	54672.335	21.3	54673.302	54673.344	21.1
1808	20 52 58.441	-11 27 31.00	54672.299	54672.342	21.6	54673.350	54673.396	21.4
1809	20 38 04.559	-27 21 22.30	54672.296	54672.318	21.5	54674.295	54674.342	21.6
1810	20 31 40.800	-00 06 11.50	54672.303	54672.347	21.9	54674.190	54674.234	21.7
1811	20 33 40.681	-00 06 11.50	54672.306	54672.350	21.8	54674.193	54674.238	21.5
1812	20 47 52.437	-00 06 11.50	54672.361	54672.404	21.6	54674.199	54674.241	21.5
1813	20 49 52.319	-00 06 11.50	54672.364	54672.407	21.6	54674.202	54674.244	21.4
1814	20 31 40.800	+04 26 20.80	54672.311	54672.354	21.8	54674.186	54674.231	21.4
1815	19 50 29.398	-16 00 02.90	54672.213	54672.256	21.6	54674.208	54674.251	21.5
1816	19 52 35.761	-16 00 02.90	54672.217	54672.259	21.8	54674.211	54674.254	21.6
1817	20 09 35.278	-16 00 03.20	54672.231	54672.273	21.6	54674.221	54674.265	21.5
1818	20 26 35.160	-16 00 02.90	54672.279	54672.325	21.6	54674.248	54674.291	21.5
1819	20 41 28.678	-16 00 02.50	54672.283	54672.329	21.8	54674.258	54674.302	21.6
1820	20 43 35.041	-16 00 02.90	54672.286	54672.332	21.6	54674.261	54674.305	21.5
1821	21 00 34.559	-16 00 02.50	54672.293	54672.339	21.4	54674.268	54674.312	21.4
1822	21 04 04.082	-04 38 34.80	54674.335	54674.381	22.0	54675.221	54675.264	21.5
1823	21 06 04.320	-04 38 34.40	54674.338	54674.385	22.0	54675.224	54675.267	21.5
1824	21 04 04.082	-00 06 02.50	54674.393	54674.435	21.7	54675.207	54675.257	21.5
1825	21 06 03.963	-00 06 02.50	54674.396	54674.438	21.7	54675.211	54675.261	21.4
1826	21 20 15.720	-00 06 02.90	54674.369	54674.415	21.9	54675.315	54675.374	22.0
1827	21 22 15.958	-00 06 02.50	54674.372	54674.418	22.0	54675.319	54675.377	22.0
1828	21 06 04.677	+04 26 28.70	54674.407	54674.451	21.8	54675.201	54675.248	21.5

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1829	21 03 16.202	+08 59 01.70	54674.421	54674.485	21.3	54675.214	54675.273	21.4
1830	21 05 17.519	+08 59 01.00	54674.425	54674.462	21.5	54675.217	54675.276	21.4
1831	20 52 58.077	+13 31 33.20	54674.428	54674.469	21.7	54675.392	54675.437	21.8
1832	20 55 01.563	+13 31 32.90	54674.431	54674.465	21.7	54675.389	54675.433	21.8
1833	19 55 05.161	-20 32 25.80	54674.281	54674.324	21.5	54675.280	54675.322	21.4
1834	19 57 15.123	-20 32 25.40	54674.285	54674.327	21.6	54675.283	54675.325	21.5
1835	21 50 51.363	-27 21 13.30	54674.354	54674.376	21.5	54676.343	54676.386	21.4
1836	19 48 14.760	-13 43 37.90	54675.194	54675.236	21.4	54676.216	54676.262	21.8
1837	20 38 20.043	-13 43 37.60	54675.302	54675.347	21.4	54676.306	54676.355	21.6
1838	20 01 17.042	-00 06 02.20	54675.197	54675.243	21.6	54676.316	54676.379	21.8
1839	20 49 52.683	+04 26 29.00	54675.395	54675.440	21.4	54676.455	54676.478	21.5
1840	20 48 54.002	+08 59 01.00	54675.399	54675.444	21.4	54676.418	54676.458	21.6
1841	20 12 41.037	-20 32 25.10	54675.286	54675.329	21.6	54676.251	54676.295	21.8
1842	20 14 50.998	-20 32 25.10	54675.290	54675.332	21.6	54676.254	54676.299	21.8
1843	20 30 16.562	-20 32 25.40	54675.293	54675.336	21.6	54676.282	54676.329	21.6
1844	20 32 26.523	-20 32 25.40	54675.297	54675.339	21.6	54676.285	54676.332	21.7
1845	21 15 28.077	-15 59 53.20	54675.305	54675.351	21.3	54676.319	54676.382	21.4
1846	21 09 39.961	-11 27 22.00	54675.309	54675.354	21.9	54676.346	54676.399	22.0
1847	21 11 43.441	-11 27 22.00	54675.312	54675.357	22.2	54676.349	54676.402	22.4
1848	20 03 56.158	-27 21 13.30	54676.279	54676.302	21.6	54677.276	54677.297	21.6
1849	21 04 04.082	+04 26 29.40	54674.404	54674.448	21.9	54677.408	54677.450	21.8
1850	20 47 52.437	-20 32 25.40	54676.288	54676.336	21.7	54677.313	54677.355	21.6
1851	20 50 02.399	-20 32 25.80	54676.292	54676.339	21.8	54677.316	54677.359	21.7
1852	21 32 27.601	-15 59 53.50	54676.322	54676.389	21.4	54677.347	54677.388	21.3
1853	21 34 33.958	-15 59 53.50	54676.326	54676.393	21.5	54677.350	54677.391	21.4
1854	20 02 53.158	-11 27 21.60	54676.219	54676.266	21.8	54677.210	54677.253	21.5
1855	20 04 56.638	-11 27 22.30	54676.223	54676.269	21.7	54677.213	54677.257	21.6
1856	20 19 34.679	-11 27 22.00	54676.226	54676.272	21.6	54677.217	54677.260	21.4
1857	20 38 20.043	-11 27 22.00	54676.312	54676.375	21.6	54677.224	54677.265	21.3
1858	20 01 41.157	-25 04 57.00	54677.269	54677.291	21.4	54678.263	54678.287	21.4
1859	20 03 56.158	-25 04 57.00	54677.272	54677.294	21.5	54678.267	54678.290	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1860	20 19 52.683	-25 04 56.60	54677.279	54677.301	21.5	54678.277	54678.300	21.4
1861	20 22 07.677	-25 04 57.40	54677.282	54677.304	21.4	54678.280	54678.303	21.4
1862	20 38 04.559	-25 04 57.00	54677.309	54677.334	21.3	54678.293	54678.320	21.4
1863	21 05 27.962	-20 32 25.40	54677.319	54677.362	21.3	54678.270	54678.313	21.1
1864	21 23 03.838	-20 32 25.10	54677.328	54677.372	21.4	54678.326	54678.373	21.4
1865	21 25 13.799	-20 32 25.40	54677.331	54677.376	21.4	54678.336	54678.384	21.4
1866	19 46 11.281	-11 27 22.00	54677.204	54677.247	21.5	54678.208	54678.250	21.6
1867	19 48 14.760	-11 27 22.00	54677.207	54677.250	21.5	54678.211	54678.254	21.5
1868	20 36 16.563	-11 27 21.60	54676.309	54676.372	21.6	54678.351	54678.394	21.4
1869	20 56 16.442	-25 04 57.40	54678.307	54678.330	21.6	54679.306	54679.328	21.4
1870	20 58 31.079	-25 04 57.40	54678.310	54678.333	21.7	54679.309	54679.331	21.4
1871	21 07 38.281	-20 32 25.40	54677.323	54677.365	21.5	54679.270	54679.313	21.2
1872	21 40 39.720	-20 32 25.40	54678.355	54678.397	21.6	54679.293	54679.334	21.4
1873	21 42 49.682	-20 32 25.10	54678.359	54678.401	21.6	54679.296	54679.338	21.3
1874	21 26 21.839	-11 27 22.30	54677.395	54677.437	21.8	54679.253	54679.299	21.5
1875	21 28 25.318	-11 27 21.60	54677.398	54677.440	21.8	54679.256	54679.303	21.6
1876	20 16 06.241	-06 54 50.40	54678.348	54678.390	21.5	54679.187	54679.229	21.2
1877	20 32 30.121	-06 54 50.40	54678.365	54678.408	21.7	54679.194	54679.236	21.2
1878	21 19 39.719	-06 54 50.00	54677.402	54677.444	21.9	54679.240	54679.281	21.6
1879	21 21 41.399	-06 54 50.00	54677.405	54677.447	21.8	54679.243	54679.285	21.6
1880	21 14 27.961	-25 04 56.60	54679.346	54679.368	21.6	54680.308	54680.330	21.5
1881	21 16 42.962	-25 04 57.00	54679.349	54679.372	21.6	54680.311	54680.334	21.6
1882	21 34 54.839	-25 04 57.40	54679.356	54679.378	21.6	54680.324	54680.347	21.2
1883	20 30 28.441	-06 54 50.40	54678.362	54678.404	21.6	54680.191	54680.234	21.1
1884	20 46 52.321	-06 54 49.70	54678.377	54678.419	21.6	54680.199	54680.241	21.2
1885	20 48 54.002	-06 54 50.00	54678.380	54678.422	21.6	54680.202	54680.245	21.2
1886	21 03 16.202	-06 54 50.40	54679.384	54679.427	21.6	54680.212	54680.254	21.3
1887	21 05 17.519	-06 54 50.40	54679.388	54679.430	21.5	54680.216	54680.258	21.3
1888	21 04 04.082	-02 22 18.10	54679.391	54679.433	21.6	54680.206	54680.248	21.4
1889	21 06 04.677	-02 22 18.10	54679.394	54679.437	21.6	54680.209	54680.251	21.4
1890	21 20 16.077	-02 22 18.50	54679.397	54679.440	21.6	54680.219	54680.261	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1891	21 22 16.322	-02 22 18.50	54679.401	54679.443	21.6	54680.222	54680.265	21.2
1892	19 57 41.037	-06 54 50.40	54680.295	54680.352	21.6	54681.212	54681.259	21.5
1893	19 59 42.717	-06 54 50.00	54680.298	54680.356	21.4	54681.216	54681.263	21.3
1894	20 31 40.800	-02 22 18.10	54680.366	54680.407	21.8	54681.298	54681.350	21.8
1895	20 33 41.038	-02 22 18.50	54680.369	54680.411	21.6	54681.301	54681.353	21.7
1896	20 47 52.437	-02 22 18.10	54680.372	54680.414	21.5	54681.374	54681.381	21.7
1897	20 49 52.683	-02 22 18.10	54680.376	54680.417	21.4	54681.378	54681.422	21.5
1898	21 04 04.082	+02 10 13.80	54680.379	54680.421	21.6	54681.398	54681.441	21.7
1899	21 06 03.963	+02 10 13.10	54680.382	54680.424	21.6	54681.401	54681.445	21.6
1900	21 20 15.720	+02 10 13.40	54680.386	54680.427	21.8	54681.411	54681.455	21.7
1901	21 22 15.958	+02 10 13.40	54680.389	54680.431	21.9	54681.415	54681.458	21.8
1902	21 32 39.837	-25 04 56.60	54679.353	54679.375	21.5	54683.320	54683.341	21.4
1903	21 53 07.079	-25 04 34.30	54681.343	54681.367	21.3	54683.326	54683.352	21.3
1904	19 59 17.881	-02 21 55.10	54681.246	54681.291	21.9	54683.182	54683.189	21.8
1905	20 01 18.120	-02 21 54.70	54681.249	54681.295	21.8	54683.186	54683.231	21.8
1906	20 15 29.519	-02 21 55.10	54681.274	54681.316	21.5	54683.192	54683.234	21.5
1907	20 17 30.121	-02 21 54.70	54681.277	54681.319	21.0	54683.195	54683.237	21.5
1908	20 15 29.519	+02 10 37.20	54681.284	54681.331	21.5	54683.199	54683.241	21.4
1909	20 17 29.757	+02 10 36.80	54681.288	54681.334	21.3	54683.202	54683.244	21.2
1910	20 31 41.521	+02 10 37.20	54681.305	54681.356	21.6	54683.206	54683.247	21.5
1911	20 33 41.402	+02 10 36.10	54681.308	54681.360	21.7	54683.209	54683.251	21.6
1912	20 47 53.158	+02 10 36.80	54681.384	54681.428	21.7	54683.214	54683.256	21.4
1913	20 49 53.040	+02 10 36.80	54681.388	54681.431	21.7	54683.217	54683.259	21.5
1914	20 47 53.158	+06 43 08.40	54681.391	54681.434	21.7	54683.221	54683.227	21.6
1915	20 49 53.397	+06 43 08.80	54681.394	54681.438	21.7	54683.224	54683.266	21.6
1916	21 04 04.803	+06 43 08.80	54681.404	54681.448	21.7	54683.263	54683.272	21.6
1917	21 06 05.398	+06 43 08.40	54681.408	54681.451	21.8	54683.269	54683.316	21.7
1918	20 14 06.002	-06 54 03.60	54683.293	54683.338	21.4	54684.205	54684.253	21.5
1919	20 15 29.883	+06 43 32.50	54683.296	54683.345	21.8	54684.209	54684.257	21.8
1920	20 17 30.478	+06 43 31.80	54683.299	54683.348	21.8	54684.212	54684.260	21.8
1921	20 31 41.878	+06 43 32.20	54683.303	54683.356	21.8	54684.215	54684.250	21.8

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1922	20 33 42.123	+06 43 31.80	54683.306	54683.359	21.8	54684.246	54684.288	21.8
1923	20 30 29.883	+11 16 03.70	54683.309	54683.362	21.7	54684.263	54684.277	21.9
1924	20 32 31.199	+11 16 03.70	54683.313	54683.366	21.7	54684.274	54684.319	21.8
1925	20 46 53.400	+11 16 03.70	54683.369	54683.413	21.8	54684.305	54684.346	21.7
1926	20 48 55.080	+11 16 03.70	54683.372	54683.416	21.7	54684.308	54684.350	21.7
1927	21 03 17.280	+11 16 04.10	54683.376	54683.419	21.8	54684.370	54684.415	21.8
1928	21 05 18.961	+11 16 03.70	54683.379	54683.422	21.7	54684.374	54684.419	21.9
1929	20 52 59.519	+15 48 36.40	54683.383	54683.426	21.6	54684.377	54684.422	21.7
1930	22 06 28.442	-18 15 23.40	54684.291	54684.332	21.2	54686.279	54686.323	21.3
1931	22 08 34.799	-18 15 22.70	54684.295	54684.336	21.3	54686.282	54686.326	21.2
1932	22 23 27.960	-18 15 22.70	54684.298	54684.339	21.4	54686.293	54686.337	21.5
1933	22 25 34.323	-18 15 22.70	54684.301	54684.343	21.4	54686.296	54686.340	21.4
1934	21 59 46.679	-13 42 50.80	54684.267	54684.312	21.2	54686.259	54686.303	21.5
1935	22 01 49.801	-13 42 51.10	54684.270	54684.315	21.2	54686.262	54686.306	21.3
1936	22 16 28.200	-13 42 50.80	54684.357	54684.402	21.5	54686.269	54686.313	21.3
1937	22 18 31.679	-13 42 51.10	54684.360	54684.405	21.6	54686.272	54686.316	21.4
1938	21 52 28.558	-09 10 19.60	54684.281	54684.322	21.3	54686.240	54686.286	21.2
1939	21 54 30.238	-09 10 19.20	54684.284	54684.326	21.4	54686.266	54686.309	21.5
1940	22 08 52.439	-09 10 19.20	54684.364	54684.409	21.5	54686.276	54686.320	21.5
1941	22 10 53.762	-09 10 19.20	54684.367	54684.412	21.6	54686.299	54686.343	21.5
1942	21 52 40.437	-04 37 46.90	54684.381	54684.426	21.7	54686.289	54686.333	21.7
1943	21 54 41.039	-04 37 47.60	54684.384	54684.429	21.7	54686.370	54686.413	21.7
1944	22 08 52.439	-04 37 47.60	54684.388	54684.432	21.9	54686.380	54686.423	21.8
1945	22 10 52.677	-04 37 47.60	54684.391	54684.436	21.9	54686.383	54686.427	21.8
1946	22 33 09.363	-13 43 02.60	54686.347	54686.393	21.5	54687.277	54687.321	21.3
1947	22 35 12.843	-13 43 02.60	54686.350	54686.397	21.6	54687.281	54687.324	21.4
1948	22 25 15.598	-09 10 31.10	54686.373	54686.417	21.4	54687.257	54687.300	21.0
1949	22 41 39.479	-09 10 31.10	54686.437	54686.472	21.3	54687.270	54687.314	21.3
1950	22 43 40.802	-09 10 30.70	54686.440	54686.475	21.2	54687.294	54687.338	21.4
1951	22 25 03.362	-04 37 59.20	54686.386	54686.430	21.4	54687.242	54687.284	21.1
1952	22 27 03.958	-04 37 59.20	54686.390	54686.433	21.6	54687.248	54687.291	21.2

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1953	22 41 15.357	-04 37 58.10	54686.400	54686.443	21.5	54687.264	54687.307	21.4
1954	22 43 15.602	-04 37 58.80	54686.403	54686.447	21.5	54687.288	54687.331	21.6
1955	22 43 15.238	-00 05 26.90	54686.410	54686.454	21.6	54687.274	54687.317	21.6
1956	21 50 52.798	-25 04 10.60	54684.329	54684.354	21.4	54687.327	54687.349	21.6
1957	22 49 51.241	-13 43 04.40	54687.361	54687.409	21.4	54688.323	54688.367	21.3
1958	22 51 54.720	-13 43 04.10	54687.365	54687.412	21.5	54688.288	54688.326	21.3
1959	23 06 32.761	-13 43 04.40	54687.388	54687.435	21.5	54688.350	54688.394	21.6
1960	23 08 36.241	-13 43 04.10	54687.392	54687.439	21.4	54688.300	54688.343	21.4
1961	22 58 03.002	-09 10 32.90	54687.382	54687.429	21.5	54688.329	54688.377	21.6
1962	23 00 04.319	-09 10 32.50	54687.385	54687.432	21.5	54688.347	54688.390	21.7
1963	23 16 28.200	-09 10 32.50	54687.459	54687.482	21.4	54688.370	54688.417	21.4
1964	22 57 27.002	-04 38 00.20	54687.368	54687.415	21.7	54688.266	54688.307	21.3
1965	22 59 27.240	-04 38 00.60	54687.372	54687.418	21.7	54688.333	54688.380	21.8
1966	23 13 38.639	-04 38 01.00	54687.395	54687.442	21.5	54688.353	54688.397	21.6
1967	23 15 39.242	-04 38 01.00	54687.398	54687.445	21.4	54688.363	54688.407	21.6
1968	22 41 15.357	-00 05 27.20	54686.407	54686.450	21.6	54688.241	54688.284	21.2
1969	22 57 27.002	-00 05 29.00	54687.375	54687.422	21.8	54688.252	54688.293	21.2
1970	22 59 26.883	-00 05 29.00	54687.378	54687.425	21.6	54688.269	54688.311	21.3
1971	23 13 38.639	-00 05 28.70	54687.402	54687.449	21.5	54688.357	54688.400	21.7
1972	23 15 38.878	-00 05 29.00	54687.405	54687.452	21.8	54688.360	54688.404	21.9
1973	22 15 51.478	-22 48 05.00	54688.314	54688.336	21.4	54689.304	54689.339	21.2
1974	22 18 01.439	-22 48 05.40	54688.318	54688.340	21.3	54689.308	54689.343	21.1
1975	23 30 50.400	-09 10 30.00	54688.411	54688.454	21.4	54689.298	54689.353	21.1
1976	23 32 51.723	-09 10 30.00	54688.414	54688.458	21.4	54689.301	54689.356	21.0
1977	23 29 50.277	-04 37 58.10	54688.384	54688.426	21.4	54689.281	54689.349	21.2
1978	22 08 51.718	-00 05 26.20	54688.229	54688.272	21.4	54689.214	54689.256	21.0
1979	22 10 51.599	-00 05 26.50	54688.232	54688.276	21.5	54689.217	54689.259	21.3
1980	22 25 03.362	-00 05 26.50	54688.236	54688.281	21.3	54689.225	54689.269	21.1
1981	21 54 39.597	-00 05 19.70	54689.240	54689.291	21.3	54690.204	54690.225	21.1
1982	22 59 26.883	+04 27 12.20	54689.265	54689.336	21.4	54690.237	54690.260	21.1
1983	23 13 38.282	+04 27 12.20	54689.274	54689.361	21.3	54690.252	54690.274	20.9

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1984	22 09 03.597	-27 18 24.10	54701.281	54701.302	21.2	54702.277	54702.300	21.5
1985	22 11 18.598	-27 18 23.80	54701.284	54701.306	21.4	54702.283	54702.303	21.5
1986	22 27 15.123	-27 18 23.80	54701.292	54701.316	21.1	54702.328	54702.357	21.4
1987	22 29 30.117	-27 18 24.50	54701.334	54701.358	21.2	54702.331	54702.360	21.4
1988	22 45 26.999	-27 18 24.10	54701.338	54701.361	21.3	54702.334	54702.366	21.4
1989	22 47 42.000	-27 18 24.50	54701.341	54701.364	21.3	54702.338	54702.369	21.4
1990	22 33 27.003	-22 45 51.80	54701.344	54701.370	21.2	54702.286	54702.309	21.4
1991	22 35 37.321	-22 45 52.60	54701.348	54701.373	21.1	54702.289	54702.312	21.3
1992	22 51 02.878	-22 45 52.20	54701.351	54701.376	21.2	54702.341	54702.372	21.3
1993	22 53 12.840	-22 45 51.80	54701.354	54701.380	21.1	54702.344	54702.376	21.2
1994	23 08 38.397	-22 45 52.60	54701.385	54701.406	21.0	54702.348	54702.379	21.1
1995	23 10 48.722	-22 45 52.60	54701.389	54701.409	21.0	54702.351	54702.382	21.2
1996	23 26 14.279	-22 45 52.20	54701.392	54701.413	21.2	54702.386	54702.409	21.1
1997	22 42 33.477	-18 13 20.60	54701.268	54701.313	21.1	54702.264	54702.321	21.3
1998	22 57 26.638	-18 13 20.60	54701.274	54701.319	21.1	54702.270	54702.324	21.3
1999	21 36 28.078	-04 35 45.60	54701.193	54701.237	21.4	54702.169	54702.213	21.4
2000	21 38 28.317	-04 35 45.20	54701.197	54701.241	21.2	54702.172	54702.216	21.5
2001	21 36 28.078	-00 03 13.30	54701.200	54701.246	21.6	54702.176	54702.184	21.7
2002	21 38 27.960	-00 03 13.70	54701.204	54701.249	21.5	54702.181	54702.225	21.7
2003	21 52 39.723	-00 03 13.70	54701.259	54701.328	21.7	54702.191	54702.238	21.8
2004	21 36 28.078	+04 29 18.20	54701.252	54701.296	21.4	54702.188	54702.232	21.6
2005	21 38 28.317	+04 29 18.20	54701.256	54701.299	21.3	54702.195	54702.241	21.4
2006	22 08 51.361	+04 29 18.60	54701.395	54701.437	21.5	54702.198	54702.245	21.6
2007	22 10 51.963	+04 29 18.20	54701.399	54701.440	21.5	54702.201	54702.248	21.5
2008	22 25 03.362	+04 29 18.60	54701.402	54701.444	21.6	54702.229	54702.273	21.7
2009	22 40 27.120	-18 13 21.40	54702.258	54702.316	21.3	54703.258	54703.302	21.2
2010	23 23 14.282	-13 40 48.70	54702.389	54702.431	21.4	54703.272	54703.328	21.4
2011	23 25 17.761	-13 40 48.70	54702.392	54702.434	21.4	54703.276	54703.331	21.3
2012	23 39 56.159	-13 40 48.70	54702.395	54702.438	21.2	54703.286	54703.334	21.1
2013	23 14 26.519	-09 08 17.20	54702.251	54702.293	21.2	54703.251	54703.298	21.2
2014	22 57 26.638	+04 29 18.20	54702.255	54702.296	21.7	54703.254	54703.305	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2015	23 05 53.519	-27 18 24.10	54703.348	54703.370	21.1	54704.311	54704.333	21.2
2016	00 00 38.160	-22 45 51.80	54703.380	54703.415	21.4	54704.354	54704.377	21.1
2017	23 46 00.123	-22 45 51.80	54703.377	54703.405	21.5	54704.340	54704.361	20.9
2018	23 14 26.519	-18 13 20.30	54703.279	54703.321	21.5	54704.284	54704.327	21.4
2019	23 16 32.883	-18 13 20.30	54703.282	54703.324	21.4	54704.288	54704.330	21.3
2020	23 31 26.401	-18 13 20.60	54703.352	54703.395	21.1	54704.300	54704.343	21.0
2021	23 33 32.400	-18 13 20.60	54703.355	54703.398	20.8	54704.304	54704.347	21.1
2022	21 52 39.723	+04 29 18.20	54703.166	54703.209	21.2	54704.195	54704.239	21.2
2023	21 54 39.961	+04 29 18.20	54703.169	54703.213	21.3	54704.199	54704.242	21.2
2024	22 41 15.000	+04 29 18.60	54703.190	54703.236	21.6	54704.219	54704.263	21.6
2025	22 43 15.238	+04 29 18.20	54703.193	54703.239	21.5	54704.222	54704.266	21.5
2026	22 08 51.361	+09 01 49.80	54703.173	54703.216	21.4	54704.206	54704.212	21.2
2027	22 41 39.122	+09 01 49.80	54703.198	54703.244	21.5	54704.226	54704.269	21.5
2028	22 43 40.438	+09 01 50.20	54703.202	54703.247	21.6	54704.229	54704.273	21.6
2029	22 58 02.639	+09 01 50.20	54703.263	54703.310	21.8	54704.232	54704.276	21.5
2030	23 00 04.319	+09 01 49.80	54703.267	54703.314	21.8	54704.236	54704.279	21.5
2031	22 49 50.877	+13 34 22.10	54703.289	54703.338	21.8	54704.249	54704.291	21.6
2032	22 51 54.363	+13 34 21.70	54703.293	54703.341	21.9	54704.252	54704.295	21.3
2033	23 43 50.161	-22 45 52.20	54703.374	54703.402	21.4	54705.324	54705.347	21.3
2034	22 10 53.041	+09 01 49.80	54703.176	54703.220	21.3	54705.171	54705.217	21.2
2035	22 27 16.922	+09 01 50.20	54703.186	54703.232	21.1	54705.175	54705.220	21.2
2036	21 28 25.682	+13 34 22.80	54704.202	54704.246	21.5	54705.168	54705.213	21.5
2037	23 03 38.882	-27 18 24.10	54705.310	54705.336	21.3	54706.306	54706.327	21.3
2038	23 24 05.403	-27 18 24.10	54705.365	54705.395	21.4	54706.320	54706.346	21.2
2039	23 48 25.918	-18 13 19.60	54705.375	54705.422	21.3	54706.295	54706.340	21.1
2040	23 50 32.281	-18 13 20.60	54705.378	54705.425	21.4	54706.298	54706.343	21.2
2041	00 00 38.160	-00 03 13.30	54705.449	54705.483	21.4	54706.487	54706.514	21.0
2042	00 02 38.040	-00 03 13.30	54705.452	54705.486	21.3	54706.249	54706.292	21.1
2043	00 33 02.160	-00 03 13.30	54705.462	54705.489	21.6	54706.497	54706.511	21.4
2044	00 35 02.040	-00 03 13.30	54705.465	54705.493	21.6	54706.268	54706.313	21.2
2045	00 16 50.160	+04 29 19.00	54705.456	54705.506	21.7	54706.490	54706.504	21.7

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
2046	00 18 50.400	+04 29 18.60	54705.459	54705.502	21.8	54706.493	54706.507	21.7
2047	21 19 40.083	+09 01 50.20	54705.178	54705.226	21.5	54706.177	54706.183	21.7
2048	21 21 41.763	+09 01 50.20	54705.181	54705.229	21.4	54706.180	54706.223	21.7
2049	21 36 03.963	+09 01 49.80	54705.193	54705.241	21.5	54706.195	54706.202	21.6
2050	21 38 05.280	+09 01 50.50	54705.197	54705.245	21.2	54706.199	54706.245	21.4
2051	21 52 27.837	+09 01 50.20	54705.200	54705.248	21.3	54706.205	54706.252	21.4
2052	21 54 29.160	+09 01 50.20	54705.204	54705.251	21.3	54706.166	54706.209	21.3
2053	22 25 15.241	+09 01 50.20	54705.277	54705.320	21.4	54706.265	54706.316	21.4
2054	21 09 40.318	+13 34 21.70	54705.185	54705.233	21.8	54706.188	54706.231	21.9
2055	21 11 43.798	+13 34 22.10	54705.188	54705.236	21.6	54706.161	54706.192	21.7
2056	21 59 45.601	+13 34 22.10	54705.207	54705.254	21.6	54706.226	54706.242	21.6
2057	22 01 49.081	+13 34 22.10	54705.210	54705.258	21.5	54706.238	54706.282	21.6
2058	22 16 27.479	+13 34 22.40	54705.280	54705.328	21.5	54706.275	54706.333	21.7
2059	22 18 30.958	+13 34 22.10	54705.284	54705.331	21.6	54706.170	54706.214	21.5
2060	21 49 27.840	+18 06 53.60	54705.261	54705.303	21.8	54706.235	54706.279	21.9
2061	21 51 34.203	+18 06 54.00	54705.265	54705.306	21.8	54706.256	54706.302	21.8
2062	22 06 27.357	+18 06 53.30	54705.289	54705.340	21.8	54706.288	54706.336	21.8
2063	22 08 33.721	+18 06 53.30	54705.293	54705.343	21.7	54706.370	54706.415	21.7
2064	22 40 27.120	+18 06 53.60	54705.435	54705.476	21.6	54706.173	54706.217	21.6
2065	22 42 33.120	+18 06 53.60	54705.438	54705.479	21.6	54706.425	54706.467	21.6
2066	22 35 37.321	+22 39 25.20	54705.445	54705.509	21.1	54706.429	54706.470	21.4
2067	23 14 26.519	-06 52 01.20	54705.270	54705.314	21.1	54706.259	54706.309	21.2
2068	23 16 28.200	-06 52 01.20	54705.274	54705.317	21.2	54706.272	54706.324	21.2
2069	23 13 38.639	-02 19 29.30	54705.296	54705.351	21.2	54706.391	54706.432	21.2
2070	23 15 38.878	-02 19 29.30	54705.300	54705.354	21.5	54706.394	54706.436	21.4
2071	00 00 38.160	-27 18 24.10	54705.388	54705.415	21.1	54707.349	54707.373	21.1
2072	00 02 53.160	-27 18 24.10	54705.391	54705.418	20.9	54707.346	54707.370	20.9
2073	23 42 17.279	-27 18 24.10	54705.371	54705.401	21.0	54707.329	54707.352	20.9
2074	23 58 13.803	-27 18 24.50	54705.381	54705.408	21.1	54707.339	54707.363	21.1
2075	00 33 02.160	+04 29 18.20	54705.469	54705.499	21.7	54707.255	54707.297	21.2
2076	00 35 02.400	+04 29 18.60	54705.472	54705.496	21.6	54707.259	54707.301	21.3

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2077	22 33 08.999	+13 34 22.80	54706.397	54706.439	21.6	54707.167	54707.214	21.3
2078	22 35 12.479	+13 34 22.10	54706.401	54706.442	21.7	54707.171	54707.217	21.5
2079	22 23 27.239	+18 06 53.60	54706.404	54706.446	21.7	54707.174	54707.181	21.6
2080	23 13 38.639	+02 13 02.30	54706.418	54706.460	21.6	54707.205	54707.249	21.3
2081	23 15 38.521	+02 13 02.60	54706.422	54706.463	21.5	54707.209	54707.252	21.2
2082	23 39 24.478	-27 10 56.60	54711.340	54711.366	20.8	54712.333	54712.356	20.9
2083	21 25 44.403	+13 41 49.60	54711.251	54711.295	21.6	54712.172	54712.214	21.6
2084	21 42 26.281	+13 41 50.30	54711.275	54711.322	21.8	54712.182	54712.224	21.7
2085	21 44 29.760	+13 41 49.90	54711.278	54711.326	21.8	54712.151	54712.186	21.7
2086	22 32 49.560	+22 46 53.40	54711.370	54711.413	21.2	54712.359	54712.401	21.3
2087	22 32 31.563	-11 17 05.30	54711.244	54711.288	21.1	54712.245	54712.292	21.2
2088	22 34 35.043	-11 17 04.90	54711.247	54711.291	21.2	54712.248	54712.295	21.2
2089	22 49 13.077	-11 17 05.30	54711.254	54711.299	21.1	54712.251	54712.299	21.2
2090	22 51 16.563	-11 17 05.30	54711.258	54711.302	21.1	54712.255	54712.302	21.2
2091	22 41 01.322	-06 44 33.00	54711.261	54711.309	21.1	54712.193	54712.235	21.0
2092	22 57 25.203	-06 44 33.40	54711.281	54711.333	21.2	54712.258	54712.305	21.3
2093	22 59 26.519	-06 44 33.40	54711.285	54711.336	21.3	54712.265	54712.312	21.4
2094	22 24 25.562	-02 12 01.40	54711.268	54711.316	21.1	54712.176	54712.218	21.1
2095	22 26 25.801	-02 12 01.80	54711.271	54711.319	21.1	54712.179	54712.221	21.1
2096	22 40 37.200	-02 12 01.40	54711.343	54711.386	21.3	54712.189	54712.238	21.2
2097	22 42 37.803	-02 12 01.40	54711.347	54711.390	21.2	54712.261	54712.309	21.3
2098	22 56 49.202	-02 12 01.10	54711.350	54711.393	21.4	54712.268	54712.316	21.4
2099	22 58 49.440	-02 12 01.40	54711.353	54711.396	21.3	54712.279	54712.323	21.4
2100	23 29 12.477	-02 12 01.40	54711.359	54711.402	21.2	54712.349	54712.391	21.3
2101	23 31 13.080	-02 12 01.40	54711.363	54711.406	21.2	54712.352	54712.394	21.3
2102	21 57 37.803	-20 22 08.80	54713.241	54713.283	21.1	54714.252	54714.293	21.1
2103	21 59 48.121	-20 22 08.40	54713.244	54713.286	21.0	54714.255	54714.297	21.1
2104	22 05 49.921	-15 49 36.80	54712.228	54712.272	21.2	54714.201	54714.245	21.1
2105	22 07 55.921	-15 49 36.50	54712.231	54712.275	21.2	54714.204	54714.248	21.3
2106	22 22 49.439	-15 49 36.80	54712.241	54712.289	21.3	54714.258	54714.302	21.4
2107	22 39 49.320	-15 49 36.80	54713.259	54713.301	21.1	54714.269	54714.312	21.1

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
2108	21 59 07.801	-11 17 05.30	54711.179	54711.221	21.4	54714.171	54714.214	21.3
2109	22 01 11.281	-11 17 05.30	54711.182	54711.224	21.2	54714.174	54714.218	21.2
2110	22 15 49.679	-11 17 05.30	54711.192	54711.234	21.2	54714.184	54714.227	21.1
2111	22 17 53.158	-11 17 04.90	54711.195	54711.238	21.1	54714.188	54714.231	21.1
2112	23 05 54.961	-11 17 03.80	54713.272	54713.315	21.1	54714.322	54714.364	21.2
2113	23 07 58.441	-11 17 04.90	54713.276	54713.318	21.1	54714.326	54714.368	21.3
2114	23 22 36.482	-11 17 04.90	54713.327	54713.369	21.1	54714.338	54714.380	21.1
2115	23 24 39.961	-11 17 04.90	54713.330	54713.372	21.4	54714.341	54714.383	21.3
2116	21 51 50.037	-06 44 33.00	54711.161	54711.203	21.1	54714.151	54714.193	21.0
2117	22 08 13.918	-06 44 33.40	54711.172	54711.214	21.2	54714.164	54714.208	21.1
2118	22 10 15.241	-06 44 33.40	54711.175	54711.218	21.3	54714.167	54714.211	21.3
2119	22 24 37.441	-06 44 33.00	54711.185	54711.227	21.3	54714.177	54714.221	21.3
2120	22 26 39.122	-06 44 33.40	54711.188	54711.231	21.4	54714.181	54714.224	21.4
2121	23 30 12.600	-06 44 33.00	54712.336	54712.382	21.2	54714.371	54714.415	21.4
2122	23 32 13.923	-06 44 33.00	54712.340	54712.385	21.3	54714.374	54714.419	21.5
2123	21 35 50.278	-02 12 01.40	54713.156	54713.199	21.3	54714.262	54714.306	21.4
2124	21 37 50.517	-02 12 01.40	54713.159	54713.202	21.2	54714.265	54714.309	21.3
2125	21 52 01.923	-02 12 01.40	54712.159	54712.201	21.2	54714.272	54714.316	21.3
2126	21 54 02.162	-02 12 01.40	54712.162	54712.204	21.2	54714.275	54714.319	21.4
2127	22 08 13.561	-02 12 01.40	54712.166	54712.207	21.5	54714.284	54714.329	21.7
2128	22 10 14.163	-02 12 01.40	54712.169	54712.211	21.5	54714.288	54714.333	21.7
2129	22 40 37.200	+02 20 30.50	54713.183	54713.227	21.3	54714.347	54714.390	21.6
2130	22 42 37.439	+02 20 30.10	54713.186	54713.230	21.3	54714.350	54714.393	21.5
2131	22 56 49.202	+02 20 30.50	54712.282	54712.326	21.5	54714.358	54714.401	21.7
2132	22 58 49.083	+02 20 30.10	54712.285	54712.329	21.5	54714.361	54714.404	21.6
2133	23 13 00.840	+06 53 02.00	54713.358	54713.400	21.6	54714.387	54714.430	21.7
2134	23 21 12.601	-27 10 56.30	54713.323	54713.344	21.0	54715.306	54715.332	21.2
2135	22 41 55.677	-15 49 36.80	54713.263	54713.304	21.1	54715.270	54715.318	21.1
2136	22 56 48.838	-15 49 36.80	54713.266	54713.308	20.8	54715.273	54715.322	21.1
2137	22 24 25.562	+02 20 30.80	54713.176	54713.220	21.4	54715.177	54715.225	21.4
2138	22 26 25.437	+02 20 30.50	54713.179	54713.224	21.4	54715.181	54715.228	21.4

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2139	22 56 49.202	+06 53 02.40	54713.347	54713.389	21.6	54715.363	54715.408	21.7
2140	22 58 49.440	+06 53 02.00	54713.351	54713.393	21.6	54715.366	54715.411	21.7
2141	23 15 01.078	+06 53 02.00	54713.361	54713.403	21.6	54715.379	54715.422	21.7
2142	22 59 33.001	-18 13 20.60	54715.249	54715.293	21.3	54716.239	54716.281	21.2
2143	23 41 59.639	-13 40 48.70	54715.283	54715.335	21.5	54716.338	54716.382	21.3
2144	22 27 16.558	-09 08 17.20	54715.194	54715.242	21.1	54716.176	54716.220	20.9
2145	22 27 03.237	-00 03 13.30	54715.174	54715.219	21.2	54716.156	54716.198	21.3
2146	22 27 03.601	+04 29 18.60	54715.184	54715.232	21.5	54716.180	54716.226	21.4
2147	23 15 38.878	+04 29 18.20	54715.372	54715.419	21.7	54716.372	54716.415	21.6
2148	22 25 33.602	+18 06 54.00	54715.198	54715.245	21.6	54716.358	54716.405	21.5
2149	22 15 51.121	-20 29 36.20	54715.254	54715.299	21.4	54716.242	54716.288	21.2
2150	22 18 01.439	-20 29 36.60	54715.257	54715.302	21.2	54716.245	54716.291	21.2
2151	23 14 26.519	-15 57 04.70	54715.277	54715.325	21.3	54716.265	54716.307	21.1
2152	23 16 32.883	-15 57 05.00	54715.280	54715.328	21.3	54716.268	54716.310	21.1
2153	23 39 56.159	-11 24 32.40	54715.287	54715.342	21.3	54716.342	54716.385	21.3
2154	23 41 59.639	-11 24 32.80	54715.290	54715.345	21.5	54716.345	54716.388	21.5
2155	21 52 39.723	+02 13 02.60	54715.161	54715.204	21.5	54716.159	54716.204	21.5
2156	21 54 39.597	+02 13 02.30	54715.164	54715.207	21.4	54716.163	54716.207	21.5
2157	22 08 51.361	+02 13 02.30	54715.168	54715.213	21.4	54716.166	54716.213	21.5
2158	22 10 51.599	+02 13 02.30	54715.171	54715.216	21.4	54716.170	54716.216	21.5
2159	22 41 15.000	+06 45 34.60	54715.188	54715.235	21.6	54716.349	54716.392	21.7
2160	22 43 15.238	+06 45 34.20	54715.191	54715.238	21.6	54716.352	54716.395	21.8
2161	22 51 02.878	-20 29 36.20	54716.258	54716.300	21.2	54717.239	54717.283	20.9
2162	22 53 12.840	-20 29 36.60	54716.261	54716.304	21.2	54717.242	54717.286	21.0
2163	21 36 28.078	+02 13 03.00	54716.149	54716.192	21.5	54717.159	54717.205	21.2
2164	22 08 51.361	+06 45 34.20	54716.173	54716.223	21.6	54717.270	54717.314	21.7
2165	00 02 48.120	-22 45 52.90	54716.331	54716.376	21.4	54718.313	54718.339	20.9
2166	21 38 27.960	+02 13 02.60	54716.153	54716.195	21.5	54718.150	54718.197	21.2
2167	21 36 27.721	+06 45 33.80	54717.169	54717.218	21.1	54718.153	54718.201	21.0
2168	21 54 39.961	+06 45 34.60	54717.181	54717.188	21.1	54718.157	54718.204	21.0
2169	22 25 03.362	+06 45 34.60	54716.183	54716.232	21.4	54718.160	54718.167	21.1

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2170	22 27 03.601	+06 45 34.20	54716.186	54716.235	21.5	54718.163	54718.207	21.3
2171	22 58 02.639	+11 18 05.80	54716.399	54716.440	21.4	54718.170	54718.214	21.4
2172	23 00 04.319	+11 18 05.80	54716.402	54716.443	21.1	54718.173	54718.218	21.4
2173	23 31 50.522	-04 35 44.90	54715.359	54715.405	21.6	54719.227	54719.272	21.0
2174	00 00 38.160	-20 29 36.20	54718.282	54718.329	20.8	54719.284	54719.331	21.0
2175	23 10 48.722	-20 29 36.20	54717.260	54717.304	21.1	54719.247	54719.288	20.9
2176	22 10 53.041	+11 18 06.10	54718.194	54718.239	21.4	54719.150	54719.191	21.0
2177	22 25 15.241	+11 18 05.80	54718.363	54718.406	21.4	54719.157	54719.201	21.0
2178	22 27 16.922	+11 18 06.10	54718.366	54718.409	21.6	54719.160	54719.204	21.0
2179	22 41 39.122	+11 18 05.80	54718.375	54718.419	21.4	54719.164	54719.207	21.0
2180	22 49 50.877	+15 50 38.00	54718.386	54718.430	21.3	54719.170	54719.214	21.0
2181	22 51 54.363	+15 50 37.70	54718.390	54718.433	21.4	54719.174	54719.217	20.9
2182	00 16 50.160	-04 35 44.90	54719.263	54719.312	21.3	54720.229	54720.272	20.9
2183	00 18 50.400	-04 35 44.90	54719.267	54719.316	21.4	54720.233	54720.275	21.1
2184	22 11 20.040	-25 03 12.20	54729.219	54729.242	20.7	54730.226	54730.247	21.2
2185	22 45 28.441	-25 03 12.60	54729.245	54729.266	21.2	54730.233	54730.258	21.3
2186	22 47 43.442	-25 03 12.20	54729.248	54729.269	21.0	54730.237	54730.261	21.2
2187	21 20 17.519	+06 44 29.80	54729.137	54729.178	21.7	54730.132	54730.179	21.9
2188	21 22 18.121	+06 44 30.10	54729.140	54729.181	21.8	54730.135	54730.182	21.9
2189	21 52 41.158	+06 44 30.50	54729.285	54729.327	21.2	54730.169	54730.216	21.7
2190	21 19 41.518	+11 17 01.70	54729.146	54729.187	21.6	54730.139	54730.186	21.7
2191	21 21 43.198	+11 17 01.70	54729.149	54729.190	21.3	54730.142	54730.189	21.6
2192	21 36 05.398	+11 17 01.70	54729.159	54729.200	21.4	54730.152	54730.199	21.7
2193	21 38 07.079	+11 17 01.70	54729.163	54729.204	21.4	54730.155	54730.202	21.7
2194	21 52 29.279	+11 17 02.80	54729.288	54729.330	21.2	54730.172	54730.219	21.9
2195	21 54 30.602	+11 17 01.70	54729.292	54729.334	21.3	54730.175	54730.222	21.8
2196	22 08 52.803	+11 17 01.70	54729.304	54729.348	21.2	54730.230	54730.272	21.7
2197	21 09 41.760	+15 49 33.60	54729.152	54729.194	21.4	54730.145	54730.192	21.7
2198	21 11 45.240	+15 49 33.60	54729.156	54729.197	21.4	54730.149	54730.195	21.6
2199	21 26 23.638	+15 49 33.60	54729.166	54729.207	21.4	54730.159	54730.165	21.9
2200	21 28 27.117	+15 49 34.00	54729.169	54729.210	21.4	54730.162	54730.206	21.8

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2201	21 43 05.159	+15 49 33.60	54729.297	54729.341	21.3	54730.209	54730.251	21.8
2202	21 45 08.638	+15 49 33.20	54729.301	54729.345	21.4	54730.212	54730.254	21.8
2203	21 59 47.043	+15 49 34.00	54729.308	54729.351	21.1	54730.240	54730.282	21.5
2204	22 01 50.522	+15 49 33.60	54729.311	54729.354	21.2	54730.244	54730.286	21.6
2205	21 49 29.282	+20 22 05.50	54729.314	54729.358	21.2	54730.265	54730.309	21.5
2206	21 51 35.638	+20 22 05.50	54729.318	54729.361	21.2	54730.268	54730.313	21.6
2207	23 47 15.722	-09 08 59.30	54730.275	54730.320	21.2	54731.195	54731.237	21.2
2208	23 46 03.721	-04 36 27.70	54730.302	54730.347	21.3	54731.179	54731.221	21.1
2209	23 48 04.323	-04 36 27.40	54730.306	54730.350	21.3	54731.182	54731.225	21.2
2210	23 29 52.083	-00 03 55.40	54730.296	54730.340	21.3	54731.155	54731.198	21.2
2211	23 31 51.958	-00 03 55.40	54730.299	54730.343	21.3	54731.159	54731.202	21.1
2212	23 46 03.721	-00 03 54.70	54730.363	54730.405	21.2	54731.166	54731.208	21.0
2213	23 48 03.959	-00 03 55.40	54730.367	54730.408	21.3	54731.170	54731.211	21.2
2214	23 29 52.083	+04 28 36.50	54730.326	54730.370	21.2	54731.147	54731.188	21.1
2215	23 31 52.321	+04 28 36.50	54730.330	54730.373	21.2	54731.150	54731.191	21.2
2216	00 00 39.960	-09 08 59.30	54730.289	54730.333	21.0	54732.244	54732.286	21.4
2217	23 49 17.403	-09 08 58.90	54730.279	54730.323	21.1	54732.191	54732.234	21.4
2218	00 00 39.960	-04 36 24.10	54731.296	54731.340	21.3	54732.184	54732.227	21.2
2219	00 02 40.200	-04 36 23.80	54731.299	54731.343	21.2	54732.187	54732.231	21.1
2220	00 16 51.960	-00 03 52.20	54731.353	54731.396	21.3	54732.194	54732.238	21.4
2221	00 18 51.840	-00 03 51.80	54731.356	54731.399	21.5	54732.197	54732.241	21.5
2222	00 49 15.960	-00 03 52.20	54731.383	54731.427	21.3	54732.248	54732.289	21.5
2223	00 51 15.840	-00 03 52.20	54731.386	54731.430	21.2	54732.251	54732.292	21.4
2224	01 23 39.840	-00 03 52.60	54731.442	54731.485	21.2	54732.261	54732.302	21.6
2225	00 00 39.960	+04 28 40.10	54731.346	54731.389	21.4	54732.164	54732.207	21.4
2226	00 02 40.200	+04 28 40.10	54731.350	54731.393	21.5	54732.167	54732.211	21.4
2227	01 05 27.960	+04 28 39.40	54731.436	54731.479	21.3	54732.254	54732.296	21.7
2228	01 07 28.200	+04 28 40.10	54731.439	54731.482	21.1	54732.258	54732.299	21.6
2229	01 21 39.960	+04 28 39.70	54731.452	54731.499	21.2	54732.271	54732.313	21.6
2230	01 23 40.200	+04 28 39.70	54731.456	54731.495	21.4	54732.274	54732.316	21.8
2231	23 46 03.721	+04 28 40.10	54731.331	54731.374	21.4	54732.155	54732.201	21.3

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
2232	23 48 04.323	+04 28 39.70	54731.334	54731.377	21.4	54732.158	54732.204	21.4
2233	00 17 03.840	+09 01 10.90	54731.365	54731.408	21.7	54732.170	54732.214	21.7
2234	00 19 05.520	+09 01 11.60	54731.369	54731.411	21.8	54732.174	54732.217	21.6
2235	00 33 27.720	+09 01 11.30	54731.420	54731.463	21.5	54732.177	54732.221	21.6
2236	00 35 29.400	+09 01 11.30	54731.424	54731.466	21.4	54732.180	54732.224	21.5
2237	01 06 15.840	+09 01 11.60	54731.446	54731.488	21.3	54732.264	54732.306	21.7
2238	01 08 17.160	+09 01 11.30	54731.449	54731.492	21.1	54732.268	54732.309	21.5
2239	00 33 03.600	-04 36 24.80	54732.325	54732.367	21.4	54733.207	54733.249	21.2
2240	00 35 04.200	-04 36 25.20	54732.329	54732.370	21.5	54733.210	54733.252	21.3
2241	00 49 15.600	-04 36 24.50	54732.336	54732.377	21.4	54733.215	54733.258	21.2
2242	01 05 27.600	-00 03 53.30	54732.348	54732.389	21.0	54733.218	54733.261	20.9
2243	01 07 27.840	-00 03 53.30	54732.351	54732.393	21.3	54733.222	54733.264	21.1
2244	01 21 39.600	-00 03 52.60	54732.406	54732.450	21.5	54733.227	54733.270	21.3
2245	00 49 15.600	+04 28 38.30	54732.341	54732.382	21.6	54733.200	54733.243	21.3
2246	00 51 16.200	+04 28 38.30	54732.344	54732.386	21.6	54733.203	54733.246	21.4
2247	00 49 51.600	+09 01 10.20	54732.354	54732.396	21.6	54733.186	54733.230	21.4
2248	00 51 53.280	+09 01 09.80	54732.358	54732.399	21.4	54733.190	54733.234	21.3
2249	00 52 49.080	+13 33 41.80	54732.415	54732.459	21.8	54733.183	54733.197	21.7
2250	00 00 39.960	-13 41 29.40	54733.323	54733.365	21.1	54734.216	54734.258	21.1
2251	00 02 43.440	-13 41 29.40	54733.327	54733.368	21.3	54734.219	54734.261	21.3
2252	00 17 21.840	-13 41 29.40	54733.330	54733.372	21.3	54734.228	54734.270	21.2
2253	00 19 25.320	-13 41 29.40	54733.333	54733.375	21.1	54734.231	54734.273	21.1
2254	23 56 39.843	-13 41 29.40	54733.317	54733.358	21.4	54734.209	54734.251	21.3
2255	23 58 43.322	-13 41 29.40	54733.320	54733.362	21.1	54734.213	54734.255	21.1
2256	00 17 03.840	-09 08 57.10	54733.338	54733.380	21.2	54734.235	54734.277	21.1
2257	00 19 05.520	-09 08 57.80	54733.342	54733.384	21.3	54734.238	54734.280	21.2
2258	00 49 51.960	-09 08 57.80	54733.352	54733.393	21.2	54734.245	54734.286	21.1
2259	00 51 53.280	-09 08 57.80	54733.355	54733.397	21.4	54734.248	54734.290	21.4
2260	01 05 27.960	-04 36 25.90	54733.402	54733.443	21.3	54734.265	54734.308	21.3
2261	01 07 28.200	-04 36 26.30	54733.405	54733.447	21.3	54734.293	54734.335	21.3
2262	01 21 39.960	-04 36 26.30	54733.416	54733.457	21.7	54734.302	54734.344	21.7

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Table A.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
2263	01 23 40.200	-04 36 25.60	54733.419	54733.461	21.4	54734.305	54734.347	21.4
2264	00 00 39.960	+09 01 09.50	54733.160	54733.301	21.6	54734.151	54734.192	21.4
2265	00 02 41.280	+09 01 09.50	54733.163	54733.305	21.6	54734.154	54734.195	21.5
2266	23 30 52.199	+09 01 09.50	54733.147	54733.288	21.5	54734.131	54734.174	21.2
2267	23 32 53.522	+09 01 08.80	54733.150	54733.291	21.6	54734.134	54734.177	21.3
2268	23 47 15.722	+09 01 09.10	54733.154	54733.295	21.7	54734.144	54734.186	21.6
2269	23 49 17.403	+09 01 09.10	54733.157	54733.298	21.6	54734.148	54734.189	21.5
2270	00 00 39.960	+13 33 41.00	54733.167	54733.308	21.3	54734.158	54734.199	21.1
2271	00 02 43.440	+13 33 41.00	54733.170	54733.311	21.5	54734.161	54734.202	21.4
2272	00 17 21.840	+13 33 41.00	54733.409	54733.450	21.5	54734.164	54734.206	21.2
2273	00 19 25.320	+13 33 40.70	54733.412	54733.454	21.4	54734.180	54734.223	21.3
2274	00 34 04.080	+13 33 41.40	54733.422	54733.464	21.6	54734.312	54734.357	21.6
2275	00 36 07.560	+13 33 41.00	54733.426	54733.467	21.8	54734.315	54734.361	21.8
2276	00 50 45.600	+13 33 41.40	54732.411	54732.456	21.6	54734.320	54734.366	21.8
2277	00 51 39.960	+18 06 13.00	54733.435	54733.477	21.6	54734.328	54734.373	21.5
2278	00 53 46.320	+18 06 12.60	54733.438	54733.480	21.7	54734.331	54734.377	21.7
2279	01 06 15.480	-09 09 00.40	54734.391	54734.433	20.9	54735.237	54735.279	20.8
2280	01 08 16.800	-09 09 00.70	54734.394	54734.436	21.2	54735.241	54735.282	21.1
2281	23 14 27.961	+09 01 06.20	54734.138	54734.351	21.4	54735.179	54735.220	21.3
2282	23 16 29.278	+09 01 06.20	54734.141	54734.354	21.4	54735.191	54735.234	21.2
2283	23 39 57.601	+13 33 38.50	54734.380	54734.424	21.6	54735.200	54735.246	21.6
2284	23 42 01.081	+13 33 38.20	54734.383	54734.427	21.7	54735.204	54735.249	21.7
2285	23 56 39.122	+13 33 38.50	54734.398	54734.439	21.3	54735.225	54735.271	21.4
2286	23 58 42.601	+13 33 38.50	54734.401	54734.443	21.2	54735.229	54735.274	21.4
2287	00 17 39.480	+18 06 10.40	54734.406	54734.448	21.4	54735.262	54735.306	21.6
2288	00 19 45.840	+18 06 09.70	54734.410	54734.452	21.3	54735.265	54735.309	21.6
2289	00 34 39.360	+18 06 10.10	54734.413	54734.455	21.4	54735.286	54735.330	21.8
2290	00 36 45.720	+18 06 10.10	54734.416	54734.458	21.4	54735.289	54735.333	21.8
2291	00 34 03.720	-13 41 24.40	54735.323	54735.366	21.3	54736.230	54736.274	21.1
2292	00 33 28.080	-09 08 57.80	54733.345	54733.387	21.1	54736.214	54736.258	20.8
2293	23 06 34.203	+13 33 45.70	54735.348	54735.392	21.8	54736.146	54736.152	21.6

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Table A.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
2294	23 08 37.683	+13 33 45.70	54735.352	54735.395	21.8	54736.149	54736.193	21.7
2295	23 23 16.081	+13 33 45.70	54735.373	54735.415	21.6	54736.164	54736.207	21.5
2296	23 25 19.560	+13 33 45.70	54735.376	54735.418	21.6	54736.168	54736.211	21.5
2297	22 57 28.437	+18 06 17.60	54735.359	54735.406	21.5	54736.156	54736.199	21.3
2298	22 59 34.443	+18 06 17.30	54735.363	54735.409	21.4	54736.159	54736.202	21.4
2299	23 48 27.717	+18 06 17.30	54735.389	54735.431	21.5	54736.181	54736.223	21.4
2300	00 35 51.720	+22 38 48.80	54735.435	54735.477	21.5	54736.248	54736.254	21.7
2301	00 38 01.680	+22 38 49.20	54735.438	54735.480	21.5	54736.251	54736.297	21.6
2302	23 26 16.078	+22 38 49.20	54735.380	54735.421	21.4	54736.171	54736.177	21.3
2303	23 28 26.039	+22 38 49.20	54735.383	54735.425	21.4	54736.174	54736.218	21.3
2304	23 43 51.603	+22 38 49.90	54735.399	54735.442	21.3	54736.184	54736.227	21.4
2305	23 46 01.922	+22 38 49.60	54735.402	54735.445	21.3	54736.190	54736.237	21.5
2306	00 18 51.480	+27 11 21.10	54735.428	54735.471	21.4	54736.245	54736.287	21.6
2307	00 00 39.600	-18 13 44.00	54736.267	54736.314	21.3	54737.219	54737.261	21.5
2308	00 02 45.960	-18 13 44.00	54736.271	54736.317	21.2	54737.222	54737.264	21.6
2309	00 17 39.840	-18 13 44.40	54736.290	54736.333	21.0	54737.231	54737.273	21.1
2310	00 36 07.200	-13 41 24.70	54735.326	54735.370	21.2	54737.225	54737.267	21.1
2311	01 07 27.840	-13 41 12.50	54736.320	54736.363	20.8	54737.250	54737.293	21.1
2312	01 09 31.320	-13 41 12.50	54736.324	54736.366	21.1	54737.254	54737.297	21.2
2313	01 22 39.720	-09 08 40.60	54736.340	54736.383	21.2	54737.240	54737.282	21.3
2314	01 24 41.040	-09 08 40.90	54736.343	54736.386	21.1	54737.243	54737.285	21.2
2315	01 39 03.600	-09 08 40.60	54736.376	54736.420	21.1	54737.257	54737.300	21.1
2316	00 00 39.600	+18 06 29.90	54736.356	54736.398	21.6	54737.132	54737.175	21.5
2317	00 02 45.960	+18 06 29.90	54736.359	54736.402	21.6	54737.135	54737.179	21.5
2318	00 18 15.840	+22 39 01.80	54736.392	54736.436	21.5	54737.138	54737.182	21.6
2319	00 20 25.800	+22 39 01.80	54736.395	54736.439	21.6	54737.142	54737.186	21.4

Table A.1: The center coordinates for all pointings searched for KBOs and used in the analysis presented in this paper. The table includes pointing number, the right ascension and declination of the mosaic center chip (B15), MJD dates of all four observations of the field and limiting magnitudes for each night the field was observed

Appendix B

Subaru target fields and observation limiting magnitudes

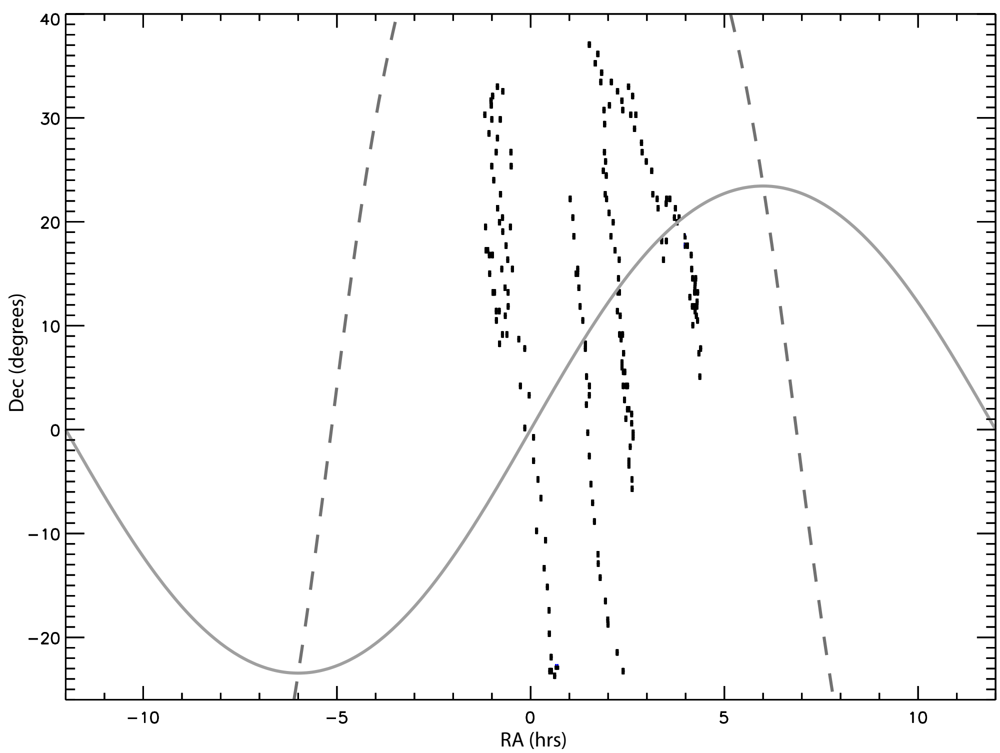

Table B.1: Summary of Subaru survey field positions and image depths

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
1	02 37 13.099	-05 42 04.34	54419.421	54419.500	25.3	54420.421	54420.498	25.3
2	02 36 58.186	-04 48 04.16	54419.419	54419.498	25.3	54420.419	54420.496	25.3
3	02 32 11.286	-03 26 55.43	54419.270	54419.345	25.1	54420.269	54420.345	25.2
4	02 32 10.748	-03 00 03.86	54419.417	54419.496	25.3	54420.416	54420.494	25.3
5	02 34 12.955	-01 38 55.71	54419.268	54419.343	25.1	54420.267	54420.343	25.2
6	02 38 44.554	-00 45 04.07	54419.415	54419.494	25.4	54420.414	54420.492	25.3
7	02 38 44.576	-00 18 04.04	54419.413	54419.492	25.4	54420.412	54420.490	25.3
8	02 36 29.019	+00 36 04.79	54419.266	54419.341	25.1	54420.265	54420.340	25.1
9	02 27 24.755	+01 03 04.85	54419.262	54419.337	25.2	54420.261	54420.336	25.2
10	02 36 28.488	+01 29 55.90	54419.411	54419.490	25.4	54420.410	54420.488	25.3
11	02 29 54.990	+01 57 04.70	54419.264	54419.339	25.2	54420.263	54420.338	25.1
12	02 32 10.736	+01 56 56.10	54419.409	54419.488	25.4	54420.408	54420.485	25.3
13	02 25 22.437	+02 51 04.97	54419.259	54419.335	25.2	54420.259	54420.334	25.1
14	02 23 19.722	+04 12 05.09	54419.257	54419.332	25.2	54420.257	54420.332	25.1
15	02 27 52.137	+04 11 56.10	54419.405	54419.483	25.4	54420.404	54420.481	25.3
16	02 30 08.626	+04 11 56.21	54419.407	54419.485	25.4	54420.406	54420.483	25.3
17	04 22 01.507	+05 05 57.51	54419.556	54419.620	25.1	54420.556	54420.632	25.0
18	02 23 33.316	+05 33 05.10	54419.255	54419.330	25.2	54420.254	54420.330	25.1
19	02 25 49.447	+05 32 56.10	54419.402	54419.481	25.4	54420.402	54420.479	25.3
20	02 21 30.037	+06 00 05.30	54419.253	54419.328	25.2	54420.252	54420.328	25.1
21	02 21 29.443	+06 26 56.53	54419.400	54419.479	25.4	54420.400	54420.477	25.3
22	02 24 00.660	+07 21 05.81	54419.251	54419.326	25.2	54420.250	54420.326	25.1
23	04 20 34.238	+07 20 57.74	54419.550	54419.613	25.1	54420.550	54420.626	25.0
24	04 23 16.465	+07 47 57.93	54419.545	54419.609	25.1	54420.546	54420.622	25.1
25	02 20 06.401	+08 42 05.48	54419.249	54419.324	25.2	54420.248	54420.323	25.1
26	02 17 47.953	+09 08 56.79	54419.396	54419.475	25.4	54420.395	54420.473	25.3
27	02 22 23.564	+09 08 56.57	54419.398	54419.477	25.4	54420.397	54420.475	25.3
28	04 11 08.051	+10 02 58.09	54419.541	54419.605	25.1	54420.541	54420.618	25.1
29	04 18 27.600	+10 29 58.30	54419.539	54419.603	25.1	54420.539	54420.615	25.1
30	02 18 41.726	+10 57 05.52	54419.247	54419.322	25.2	54420.246	54420.321	25.1

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Table B.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
31	04 16 33.779	+10 56 58.54	54419.543	54419.607	25.1	54420.544	54420.620	25.0
32	02 14 17.286	+11 24 05.38	54419.245	54419.320	25.2	54420.244	54420.319	25.1
33	04 14 39.624	+11 23 58.39	54419.537	54419.601	25.2	54420.537	54420.613	25.0
34	04 10 25.943	+11 50 58.59	54419.535	54419.599	25.2	54420.535	54420.611	25.1
35	04 12 45.066	+11 50 58.03	54419.562	54419.626	25.1	54420.563	54420.639	24.9
36	04 15 04.212	+11 50 58.26	54419.552	54419.615	25.1	54420.552	54420.628	25.0
37	04 17 23.351	+11 50 58.29	54419.547	54419.611	25.1	54420.548	54420.624	25.0
38	04 17 48.237	+12 17 58.58	54419.554	54419.617	25.1	54420.554	54420.630	25.0
39	04 06 35.345	+12 44 58.46	54419.533	54419.596	25.2	54420.533	54420.609	25.1
40	02 15 09.440	+13 12 05.13	54419.240	54419.316	25.2	54420.240	54420.315	25.1
41	02 17 29.243	+13 12 05.04	54419.243	54419.318	25.2	54420.242	54420.317	25.1
42	04 13 58.675	+13 11 58.27	54419.558	54419.622	25.1	54420.558	54420.634	25.0
43	04 18 38.301	+13 11 58.84	54419.531	54419.594	25.2	54420.531	54420.607	25.1
44	04 14 23.376	+13 38 58.34	54419.564	54419.628	25.1	54420.565	54420.641	24.9
45	04 14 48.155	+14 05 58.50	54419.560	54419.624	25.0	54420.560	54420.637	25.0
46	02 16 02.273	+14 33 04.77	54419.238	54419.313	25.2	54420.238	54420.313	25.1
47	04 10 56.510	+14 32 59.17	54419.526	54419.590	25.1	54420.527	54420.603	25.1
48	04 15 37.951	+14 32 59.37	54419.528	54419.592	25.2	54420.529	54420.605	25.1
49	04 09 24.511	+15 26 59.45	54419.524	54419.588	25.2	54420.525	54420.601	25.1
50	02 17 09.288	+16 21 04.80	54419.236	54419.311	25.2	54420.235	54420.311	25.1
51	03 25 43.586	+16 21 01.26	54419.392	54419.473	25.3	54420.391	54420.470	25.3
52	04 08 40.862	+16 48 00.02	54419.522	54419.586	25.2	54420.522	54420.598	25.1
53	02 10 42.292	+17 15 05.03	54419.234	54419.309	25.2	54420.233	54420.309	25.1
54	03 58 00.820	+17 42 00.08	54419.518	54419.582	25.2	54420.518	54420.582	25.1
55	04 02 46.441	+17 41 59.91	54419.520	54419.584	25.2	54420.520	54420.584	25.1
56	03 22 59.858	+18 09 02.92	54419.388	54419.468	25.3	54420.387	54420.466	25.3
57	03 30 09.735	+18 09 02.74	54419.390	54419.470	25.3	54420.389	54420.468	25.3
58	02 04 23.844	+18 36 05.07	54419.232	54419.307	25.2	54420.231	54420.307	25.1
59	03 59 12.003	+18 36 00.16	54419.516	54419.579	25.1	54420.516	54420.580	25.1
60	02 07 51.067	+19 57 04.89	54419.230	54419.305	25.2	54420.229	54420.304	25.1
61	03 46 43.872	+19 57 00.62	54419.512	54419.575	25.2	54420.512	54420.576	25.1

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Table B.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
62	03 42 39.176	+20 24 00.71	54419.509	54419.573	25.2	54420.510	54420.573	25.1
63	03 49 54.812	+20 24 00.71	54419.514	54419.577	25.2	54420.514	54420.578	25.1
64	02 01 25.723	+20 51 05.10	54419.228	54419.303	25.2	54420.227	54420.302	25.1
65	03 17 22.454	+21 18 03.62	54419.384	54419.464	25.3	54420.383	54420.462	25.3
66	03 44 09.593	+21 18 00.79	54419.507	54419.571	25.2	54420.508	54420.571	25.1
67	03 29 54.735	+21 45 04.01	54419.386	54419.466	25.3	54420.385	54420.464	25.3
68	01 57 33.795	+22 12 05.39	54419.226	54419.301	25.2	54420.225	54420.300	25.1
69	03 15 55.931	+22 12 04.41	54419.382	54419.462	25.3	54420.381	54420.460	25.3
70	03 30 36.598	+22 12 00.68	54419.503	54419.567	25.2	54420.503	54420.567	25.1
71	03 35 30.471	+22 12 00.74	54419.505	54419.569	25.2	54420.505	54420.569	25.1
72	01 55 30.420	+22 39 05.52	54419.224	54419.299	25.2	54420.223	54420.298	25.1
73	03 09 13.742	+22 39 04.43	54419.379	54419.460	25.3	54420.379	54420.458	25.3
74	01 57 06.340	+24 27 05.48	54419.221	54419.297	25.2	54420.221	54420.296	25.0
75	01 52 30.735	+24 54 05.32	54419.215	54419.290	25.2	54420.214	54420.290	25.1
76	03 07 30.857	+24 54 06.20	54419.377	54419.458	25.4	54420.377	54420.456	25.3
77	01 56 01.158	+25 48 05.42	54419.219	54419.294	25.2	54420.219	54420.294	25.1
78	02 59 04.086	+25 48 07.20	54419.375	54419.456	25.4	54420.374	54420.454	25.4
79	01 54 17.893	+26 42 05.50	54419.217	54419.292	25.2	54420.216	54420.292	25.1
80	02 52 42.701	+26 42 07.54	54419.373	54419.454	25.4	54420.372	54420.451	25.4
81	02 51 41.127	+27 36 07.52	54419.371	54419.451	25.4	54420.370	54420.449	25.4
82	02 40 52.563	+28 57 08.81	54419.369	54419.449	25.4	54420.368	54420.447	25.4
83	01 54 35.264	+29 24 06.35	54419.213	54419.288	25.2	54420.212	54420.288	25.1
84	02 35 02.831	+30 18 08.94	54419.365	54419.445	25.4	54420.364	54420.443	25.4
85	02 42 55.865	+30 18 08.99	54419.367	54419.447	25.4	54420.366	54420.445	25.4
86	01 53 37.652	+30 45 06.18	54419.211	54419.286	25.2	54420.210	54420.285	25.1
87	02 22 41.349	+30 45 09.50	54419.362	54419.443	25.4	54420.362	54420.441	25.4
88	02 01 59.864	+31 12 09.84	54419.354	54419.434	25.5	54420.353	54420.432	25.4
89	02 21 20.612	+31 39 09.19	54419.358	54419.439	25.4	54420.358	54420.437	25.4
90	02 37 55.763	+32 06 09.06	54419.360	54419.441	25.4	54420.360	54420.439	25.4
91	02 14 35.380	+32 33 09.32	54419.352	54419.432	25.4	54420.351	54420.430	25.4
92	02 31 35.373	+33 00 08.82	54419.356	54419.437	25.4	54420.356	54420.435	25.4

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Table B.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
93	01 48 41.592	+33 27 05.92	54419.207	54419.282	25.2	54420.206	54420.281	25.1
94	02 04 59.435	+33 27 09.68	54419.350	54419.430	25.4	54420.349	54420.428	25.4
95	01 49 56.267	+34 21 05.90	54419.205	54419.280	25.2	54420.204	54420.279	25.0
96	01 40 05.486	+35 15 06.21	54419.202	54419.277	25.2	54420.202	54420.277	25.0
97	01 44 04.604	+36 09 06.21	54419.209	54419.284	25.2	54420.208	54420.283	25.0
98	01 30 54.100	+37 03 06.41	54419.200	54419.275	25.2	54420.199	54420.275	25.0
99	00 37 11.127	-23 41 51.83	54739.377	54739.449	25.2	54740.375	54740.447	25.3
100	00 29 38.874	-23 14 51.11	54739.369	54739.441	25.2	54740.367	54740.439	25.2
101	00 32 07.080	-23 14 51.13	54739.371	54739.443	25.2	54740.369	54740.441	25.2
102	02 23 15.938	-23 14 54.52	54739.509	54739.568	25.3	54740.508	54740.566	25.3
103	00 39 23.565	-22 47 51.33	54739.373	54739.445	25.3	54740.371	54740.443	25.3
104	00 41 51.263	-22 47 51.29	54739.375	54739.447	25.2	54740.373	54740.445	25.3
105	00 31 47.416	-21 53 51.92	54739.379	54739.451	25.3	54740.377	54740.449	25.3
106	02 14 00.980	-21 26 54.23	54739.511	54739.570	25.3	54740.510	54740.568	25.3
107	00 28 54.201	-19 38 52.40	54739.381	54739.453	25.3	54740.379	54740.451	25.3
108	01 59 48.411	-18 44 54.48	54739.513	54739.572	25.3	54740.512	54740.570	25.3
109	01 59 24.565	-18 17 54.50	54739.515	54739.574	25.3	54740.514	54740.572	25.3
110	00 28 31.348	-17 23 51.97	54739.383	54739.455	25.2	54740.381	54740.453	25.3
111	01 55 52.114	-16 29 54.20	54739.517	54739.576	25.3	54740.516	54740.574	25.3
112	00 25 50.834	-15 08 52.07	54739.385	54739.457	25.2	54740.383	54740.455	25.3
113	01 47 42.818	-14 14 53.76	54739.519	54739.578	25.3	54740.518	54740.576	25.3
114	00 20 58.662	-13 20 52.77	54739.387	54739.459	25.2	54740.385	54740.457	25.3
115	01 44 41.467	-12 53 53.63	54739.521	54739.580	25.3	54740.520	54740.578	25.3
116	01 44 21.237	-11 59 53.72	54739.523	54739.582	25.3	54740.522	54740.580	25.3
117	00 23 05.016	-10 38 52.27	54739.389	54739.461	25.3	54740.387	54740.459	25.3
118	00 09 12.480	-09 44 52.88	54739.391	54739.463	25.2	54740.389	54740.461	25.3
119	01 38 45.697	-08 50 53.86	54739.525	54739.584	25.3	54740.524	54740.582	25.3
120	01 36 00.340	-07 02 53.40	54739.527	54739.586	25.3	54740.526	54740.584	25.3
121	00 15 58.889	-06 35 52.85	54739.393	54739.465	25.3	54740.391	54740.463	25.3
122	01 33 25.399	-05 14 53.51	54739.529	54739.588	25.3	54740.528	54740.586	25.3
123	00 11 22.882	-04 47 52.90	54739.395	54739.467	25.3	54740.393	54740.465	25.3

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Table B.1 – Continued

Pointing	R.A. (J2000)	Dec. (J2000)	Night 1 MJD obs1	Night 1 MJD obs 2	Night 1 mag. limit	Night 2 MJD obs 1	Night 2 MJD obs 2	Night 2 mag limit
124	00 04 32.976	-02 59 53.81	54739.397	54739.469	25.2	54740.395	54740.467	25.3
125	01 30 51.452	-02 32 54.02	54739.531	54739.590	25.3	54740.530	54740.588	25.3
126	00 04 32.546	-00 44 53.53	54739.399	54739.471	25.2	54740.396	54740.469	25.3
127	01 28 26.778	-00 17 53.96	54739.533	54739.592	25.3	54740.532	54740.590	25.3
128	23 50 56.153	+00 09 06.08	54739.401	54739.473	25.3	54740.399	54740.471	25.3
129	01 26 18.878	+02 24 06.45	54739.535	54739.594	25.3	54740.534	54740.592	25.3
130	01 30 51.436	+03 18 05.18	54739.565	54739.623	25.2	54740.563	54740.621	25.2
131	23 57 44.120	+03 18 05.58	54739.403	54739.475	25.3	54740.401	54740.473	25.3
132	01 31 00.044	+04 12 05.44	54739.558	54739.616	25.2	54740.557	54740.615	25.2
133	23 44 04.938	+04 12 05.73	54739.405	54739.477	25.3	54740.403	54740.475	25.3
134	01 26 35.265	+05 06 06.04	54739.537	54739.596	25.2	54740.536	54740.594	25.3
135	01 24 42.693	+07 48 05.41	54739.539	54739.598	25.3	54740.538	54740.596	25.3
136	23 50 50.934	+07 48 05.57	54739.407	54739.479	25.3	54740.405	54740.477	25.4
137	01 24 50.793	+08 15 05.23	54739.541	54739.600	25.2	54740.540	54740.598	25.3
138	23 11 51.210	+08 15 13.16	54739.249	54739.320	25.3	54740.238	54740.307	25.2
139	23 41 37.931	+08 42 06.24	54739.409	54739.481	25.3	54740.407	54740.479	25.3
140	23 16 22.209	+09 09 12.96	54739.251	54739.322	25.3	54740.240	54740.309	25.3
141	23 23 15.538	+09 09 06.14	54739.411	54739.483	25.3	54740.416	54740.485	25.3
142	01 20 46.401	+10 30 05.17	54739.549	54739.608	25.3	54740.548	54740.607	25.2
143	23 06 55.784	+10 30 13.19	54739.245	54739.316	25.4	54740.234	54740.303	25.3
144	23 20 42.784	+10 57 12.87	54739.253	54739.324	25.4	54740.242	54740.311	25.3
145	23 06 45.564	+11 24 12.72	54739.243	54739.314	25.4	54740.232	54740.301	25.3
146	23 11 23.370	+11 24 12.98	54739.247	54739.318	25.3	54740.236	54740.305	25.3
147	01 16 31.562	+11 51 05.30	54739.543	54739.602	25.3	54740.542	54740.601	25.2
148	23 25 13.339	+11 51 06.02	54739.414	54739.485	25.3	54740.418	54740.487	25.3
149	23 01 45.136	+13 12 00.36	54739.239	54739.310	25.4	54740.228	54740.297	25.3
150	23 04 05.081	+13 12 12.28	54739.241	54739.312	25.4	54740.230	54740.299	25.2
151	23 25 03.318	+13 12 12.23	54739.255	54739.326	25.4	54740.244	54740.313	25.3
152	01 14 41.249	+13 39 05.20	54739.556	54739.614	25.3	54740.554	54740.613	25.2
153	23 20 19.716	+13 39 05.76	54739.416	54739.487	25.3	54740.420	54740.489	25.3
154	01 10 28.628	+15 00 05.49	54739.545	54739.604	25.3	54740.544	54740.603	25.3

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Table B.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
155	01 12 49.585	+15 00 04.75	54739.563	54739.621	25.3	54740.561	54740.619	25.2
156	22 56 34.865	+15 00 11.78	54739.235	54739.306	25.4	54740.224	54740.293	25.3
157	01 12 56.713	+15 27 05.14	54739.547	54739.606	25.3	54740.546	54740.605	25.3
158	23 15 17.853	+15 27 05.40	54739.418	54739.489	25.3	54740.423	54740.491	25.3
159	23 31 46.306	+15 27 12.00	54739.257	54739.329	25.4	54740.246	54740.315	25.3
160	23 24 32.350	+16 21 11.90	54739.259	54739.331	25.4	54740.248	54740.317	25.3
161	22 56 03.578	+16 48 11.71	54739.233	54739.304	25.4	54740.222	54740.291	25.3
162	23 00 47.794	+16 48 11.94	54739.237	54739.308	25.4	54740.226	54740.295	25.3
163	22 51 05.783	+17 15 11.73	54739.228	54739.300	25.4	54740.218	54740.287	25.2
164	22 53 28.358	+17 15 11.73	54739.230	54739.302	25.3	54740.220	54740.289	25.2
165	23 21 55.489	+17 42 11.76	54739.261	54739.333	25.5	54740.250	54740.319	25.3
166	01 06 58.889	+18 36 05.08	54739.561	54739.619	25.3	54740.559	54740.617	25.3
167	23 16 48.432	+19 03 11.94	54739.263	54739.335	25.5	54740.252	54740.321	25.3
168	22 50 10.439	+19 30 11.95	54739.226	54739.298	25.4	54740.216	54740.285	25.2
169	23 28 41.925	+19 30 05.53	54739.420	54739.491	25.4	54740.425	54740.493	25.4
170	23 11 45.937	+19 57 11.92	54739.265	54739.337	25.5	54740.254	54740.323	25.3
171	01 05 20.965	+20 24 04.70	54739.554	54739.612	25.3	54740.552	54740.611	25.3
172	23 16 26.421	+20 24 05.94	54739.422	54739.493	25.3	54740.427	54740.495	25.3
173	23 08 50.375	+21 18 11.78	54739.267	54739.339	25.5	54740.256	54740.325	25.3
174	01 01 13.776	+22 12 04.66	54739.552	54739.610	25.3	54740.550	54740.609	25.3
175	23 13 18.840	+22 39 05.35	54739.424	54739.495	25.4	54740.429	54740.497	25.4
176	23 02 54.209	+24 00 11.89	54739.271	54739.343	25.5	54740.260	54740.330	25.3
177	22 59 47.881	+25 21 11.96	54739.273	54739.345	25.5	54740.262	54740.332	25.4
178	23 29 54.146	+25 21 11.67	54739.269	54739.341	25.4	54740.258	54740.328	25.3
179	23 06 40.256	+26 42 05.59	54739.428	54739.499	25.4	54740.433	54740.501	25.3
180	23 29 31.645	+26 42 05.95	54739.426	54739.497	25.4	54740.431	54740.499	25.4
181	23 08 34.696	+28 03 12.03	54739.275	54739.347	25.5	54740.264	54740.334	25.3
182	22 55 29.448	+28 30 12.03	54739.277	54739.349	25.5	54740.266	54740.336	25.4
183	22 59 53.906	+29 51 12.42	54739.291	54739.364	25.6	54740.280	54740.350	25.4
184	23 12 57.739	+29 51 05.60	54739.430	54739.501	25.3	54740.435	54740.503	25.4
185	22 49 03.515	+30 18 12.33	54739.283	54739.355	25.5	54740.272	54740.342	25.4

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Table B.1 – Continued

Pointing	R.A.	Dec.	Night 1			Night 2		
	(J2000)	(J2000)	MJD obs1	MJD obs 2	mag. limit	MJD obs 1	MJD obs 2	mag limit
186	22 59 00.791	+31 12 12.44	54739.285	54739.357	25.5	54740.274	54740.344	25.4
187	22 58 40.428	+31 39 12.72	54739.287	54739.359	25.5	54740.276	54740.346	25.4
188	23 01 07.356	+32 06 12.71	54739.281	54739.353	25.5	54740.270	54740.340	25.4
189	23 16 56.510	+32 33 12.33	54739.279	54739.351	25.5	54740.268	54740.338	25.3
190	23 08 34.716	+33 00 12.72	54739.289	54739.362	25.5	54740.278	54740.348	25.4

Table B.1: The center coordinates for all pointings searched for KBOs and used in the analysis presented in this paper. The table includes pointing number, the right ascension and declination of the mosaic center , MJD dates of all four observations of the field and for each night the field (average of the two center CCDs) was observed