

**State-Dependent Modulation of
Neuronal Circuits in *C. elegans*
Sleep**

Thesis by
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In Partial Fulfillment of the Requirements
for the degree of
Doctor of Philosophy



CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

2013
(Defended May 2, 2013)

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ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor, Paul Sternberg. It is hard to find the words to properly describe my experience working for Paul. In addition to the art of rapid communication and wild gesticulation, he showed me the skill of tempering fearless experimentation and boundless enthusiasm with pragmatism and discipline. Paul pushed me harder than I expected and tested the limits of my endurance and ingenuity while being a good sport when I pushed back on the limits of his patience, support, and knowledge. I appreciate his enduring many awkward moments, answering countless questions (both scientific and random), working with me side by the side when I was on the brink of boredom or despair, and finding funding for use of special facilities and equipment.

I thank my committee: David Anderson for his patience, thoroughness, and constructive suggestions; David Prober for his generous time and advice, for his openness with both praise and criticism, and his constant thoughtfulness and concern throughout my time at Caltech; Thanos Siapas for providing perspective and a little bit of humor during my committee meetings; and Masakazu Konishi for joining my committee at the eleventh hour and making it complete. My graduate work would have been very different had it not been for members of my committee, and I have benefitted greatly from both their brilliance and kindness.

Most of the work described in this thesis involves techniques and tools new to the lab, and I could not have done any of it without the help of many people. My training prior to joining the Sternberg lab was pivotal in providing the technical training for large portions of my graduate work. Specifically, I thank members of the Erin Schuman group (Daniela Dietrech, Anne Taylor, Jenn Hodas) for training in imaging, microfluidics, and basic neuroscience methods. I thank the Richard Andersen group (He Cui) for knowledge of electrophysiology and programming. I could not have made any of my microfluidic devices in a timely manner without the help of the Michael Rourkes group (Trevor Fowler, Gustavo Rios, Alex Romero), the Watson facility, and Alireza Ghafferi. I additionally thank Cindy Chiu, Arya Khosravi, Oliver Loson, and Christopher Cronin for their help with all other technical issues.

I want to thank Cheryl Van Buskirk, Alon Zaslaver, Anusha Narayan, Yen-Ping Hsueh, Meenakshi Doma, Mihoko Kato, Hillel Schwartz, Jagan Srinivasan, Lindsay Brenner, Gil Sharon, Rell Parker, Lauren LeBon, Trevor Fowler, and the Prober lab for reading drafts, discussing ideas,

and providing intellectual feedback. I thank all members of the Sternberg lab, especially Meenakshi Doma, Srimoyee Ghosh, Yen-Ping Hsueh, and Pei Shih for making it fun to come to work. I could not have made it through grad school without copious amounts of food and people to enjoy it with: Jennifer Hodas, Tammy Chow, Rebecca Denson, Melanie Lee, KJ-Tiffany Chang, Diane Lim, and Anh Pham.

Some of the work shown in my thesis could not have been done without the help of my summer students: Jordan Shaw, John Chen, and Elizabeth Ryan. I could not have finished imaging of my co-labeled strains in a timely manner without the help of John Demodena. Thanks to Shahla Gharib and Barbara Perry for keeping the lab running smoothly. Vivian Chiu was here to help test calcium channel mutants that are not mentioned in this thesis.

Special thanks have to be made to my family: Michael, Shelly, Norm, and Mom. They have been so patient and understanding throughout my “obsession with science”. Only people who truly love and support you can sit through hours of one-sided conversations involving worms and tolerate habitual absentmindedness. I am sorry for forgetting many things including my own birthday dinner while working late in lab. I also thank them in advance for their continued patience as I finish medical school.

Preface

“You have brains in your head. You have feet in your shoes.
You can steer yourself any direction you choose. You’re on your
own. And you know what you know. And YOU are the one
who’ll decide where to go...”

— Doctor Seuss, *Oh the Places You’ll Go*

It is always a joy to start something new. There is nothing like the initial excitement of getting a machine to work for the first time or the gratification of being surprised by the result of an experiment. It is the promise of something novel: another puzzle to solve.

In contrast, the real work is staying the course and finishing the story. Although I have provided most of the labor for the work shown here, its existence has to be attributed to others: partly to Paul who used both carrot and stick to drive me through my graduate career, partly to Michael who showed me how to start being an adult, and to my father who taught me responsibility. I hope that I’m not too far from the mark.

I am not sure how to feel about the end result, but there were definitely a lot of surprises along the way. It is shocking how four pairs of neurons and one question can elude a person for several years. Three hundred and two will take over your life... ask Paul.

ABSTRACT

C. elegans is a compact system of 302 neurons with identifiable and mapped connections that makes it ideal for systems analysis. This work is a demonstration of what I have been able to learn about the nature of state-specific modulation and reversibility during a state called lethargus, a sleep-like state in the worm. I begin with a description about the nervous system of the worm, the nature of sleep in the worm, the questions about its behavior and apparent circuit properties, the tools available and used to manipulate the nervous system, and what I have been able to learn from these studies. I end with clues that the physiology helps teach us about the dynamics of state specific modulation, what makes sleep so different from other states, and how we can use these measurements in understanding which modulators, neurotransmitters, and channels can be used to create different dynamics in a simple model system.

for my parents

and maybe Paul...

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