

## **Kirk Long—Ford Predoctoral Fellowship Application—Research Statement**

Advances in computing are enabling physicists to tackle previously unanswerable questions about our universe, and my deep desire to leverage and help build these technologies motivates my application to your graduate program. I thoroughly explored several different paths in college before landing in physics—I've collected minors in music and applied mathematics—experiences that make me a well-rounded student capable of appreciating interdisciplinary work while simultaneously reinforcing my decision to continue in astrophysics. I have thought carefully about whether graduate school is right for me, and I distinctly remember when I first concluded I needed to continue in the field: last year as part of a scientific computing course I wrote a physics simulator almost entirely from scratch that faithfully reproduced the Apollo 8 mission trajectory with a simulated multi-stage Saturn V, and this culminating experience quelled any doubts I might have had about continuing in graduate school. Academic experiences like this as well as my recent research experience have left me feeling capable and motivated—I'm excited to join modern computational astrophysicists in helping to answer questions in cosmology and high-energy astrophysics.

My undergraduate experience uniquely prepares me to succeed in graduate studies—the intimate instructional setting in the Boise State Physics Department enabled me to develop close and supportive relationships with my professors in both academic and research pursuits, and their patient support is largely responsible for the 4.0 I've attained in my physics coursework. I have had a productive research experience with my mentor, Prof. Daryl Macomb, whose interests involve the search for and analysis of accreting x-ray binary pulsars using archival CHANDRA and XMM Newton data. For that work, we've analyzed likely x-ray time-series observations of putative pulsar sources in the Small Magellanic Cloud to search for changes in period (using Fourier analysis) over many years driven by accretion. The trickiest problem for us has been trying to eke out detections from lower power sources that have thus far gone unnoticed, and my largest

individual contribution has been developing an algorithm to test the statistical significance of finding lower-power pairs from a large background observation map I created and thus strengthening our detection confidence. For this project I've learned Linux, the command line and shell-scripting, learned a new programming language—Julia, have been exposed to deeper languages like Perl and Fortran, and learned to process and reduce datasets with tools like HEASoft and SAS. Our careful analysis contributes to our understanding of high-energy accretion events involving dense stellar objects, as well as putting forward new candidates for further study by the astronomical community—we are writing a paper with our results that we hope will be submitted by early spring.

My end-goal is to become a professor in the field who succeeds both in research and teaching/outreach, and I'm grateful that I've had a wealth of opportunities here in Boise to develop these crucial skills. Outside of research I spend a large portion of my time teaching—another benefit of our smaller department is that I have been invited to teach undergraduate physics and astronomy labs as well as hosting our department's drop-in tutoring lab, experiences that prepare me well for the teaching requirements in graduate school and beyond. In the broader Boise community I've helped run the largest public observatory in the state at Bruneau Sand Dunes State Park, where I've given public talks and had the privilege of sharing the cosmic perspective our dark skies afford with thousands of visitors. I'm also passionate about ensuring education is accessible and equitable to everyone regardless of demographic, and I've put these skills to work in my latest outreach project: teaching physics and programming in prison as a volunteer for the Idaho Department of Corrections—I've even had the opportunity to share my research and methods to some of my inmate students!

Becoming a Ford fellow would allow me to collaborate with a wealth of likeminded scholars wherever I end up going to graduate school, and the financial freedom the fellowship presents would enable me to

pursue a wider variety of potential research topics as well as supporting my existing outreach efforts. I hope to use the knowledge and skills I gain in graduate school not only to advance our cosmic quest but to uplift and inspire others to follow suit—especially those whose privilege hasn't been as great as mine. I've been fortunate to have a wealth of opportunities to practically demonstrate these ideals, from working with inmates in prison to designing and teaching STEM programs for financially challenged youth through the YMCA. I intend to continue to help advance a more welcoming astronomy and physics culture throughout my future career, and becoming a Ford fellow would be a great honor in regard to that goal.

**List of Publications:**

Macomb, D. & **Long, K.** (2020). Identifying accreting x-ray binaries. *In preparation*.

Barkley, K., Belnap, K., Keller, M., Larson, J., **Long, K.**, McCarthy, K., Myers, M., & Withers, J. (2017). *Idaho State University (a campus history)*. Charleston, SC: Arcadia. ISBN: 1467125512.

**List of Presentations:**

**Long, K.** (2018). *To the Moon and Back—Simulating the Trajectory of a Multi-Stage Rocket Similar to Saturn V in an Apollo 8 Mission Analogue*.

Poster available on Github: <https://github.com/kirklong/Posters>.

Presented 02/2019: Research Computing Days, Boise State University.

Presented 12/2018: PHYS 325—Scientific Computing, Boise State University. Won best class poster.