25 March 2012

Search Committee
Department of Physics and Astronomy
Whitman College
Walla Walla, WA 99362

Dear Committee Member,

I am pleased that Ms Kathryn Hadley asked me to write a letter in support of her application for the open position in Physics and Astronomy at Whitman College. Based on my experiences with Ms Hadley as an instructor, friend, and research advisor, I feel she is ideally suited for a position at an elite undergraduate college such as Whitman. She exhibits a blend of teaching skills, on levels ranging from classroom settings to small group sessions to one-on-one situations, and the ability to perform original research with a strong interest and knack for involving undergraduate students in her research.

I met Ms Hadley when she joined the Physics department of the University of Oregon as a graduate student seven years ago. I have since observed and interacted with Ms Hadley in several capacities over the ensuing years. I directed her in individual reading courses, guided her on small research projects, and served as her doctoral thesis advisor. She has changed much over the last seven years going from an enthusiastic student to a mature researcher and effective teacher. She finished her doctoral work last spring under my guidance (Ms Hadley defended her thesis, *Linear Stability Analysis of Nonaxisymmetric Instabilities in Self-Gravitating Polytropic Disk*s on 23 February 2011). Both her dissertation and defense talk were well-received by her research committee. I foresee three publications coming from her dissertation. The first, *Nonaxisymmetric Instabilities in Self-Gravitating Star/Disk Systems I. Toroids*, has been published in Astrophysics and Space Science, and the second and third papers are in preparation *Nonaxisymmetric Instabilities in Self-Gravitating Star/Disk Systems II. Star/DIsk Systems* (Hadley *et al.* 2012), and *Nonaxisymmetric Instabilities in Self-Gravitating Star/Disk Systems III. Angular Momentum Transport* (Hadley *et al*. 2012). With these works, Ms Hadley establishes herself as a solid researcher.

Pertinent to her suitability for Whitman College is that during this time she also participated in UCORE, an University of Oregon program supported by the National Science Foundation in which underrepresented community college students from Oregon are invited to the University of Oregon for a ten-week summer program in which they are merged into research groups and learn and experience research through a hands-on approach. In the UCORE program, University of Oregon graduate students mentor the UCORE fellows, guiding them through their assigned research projects and teaching them the ways of physics (and graduate school). The graduate student mentors are responsible for the success of the UCORE program. Ms Hadley was outstanding in this capacity; over the last four summers, my research group hosted eight fellows. Of these eight fellows, five (and soon to be six) enrolled at the University of Oregon and three have joined my research group. This is a strong recommendation for how well Ms Hadley is able to teach and to inspire young students in physics and astronomy. During this time she also distinguished herself as a promising teacher, first as a graduate teaching fellow, earning an award as the Outstanding Graduate Teaching Fellow for 2004, participating in the GK-12 program where University of Oregon graduate students advise and help teachers and students in the local primary and secondary schools, and then as an Instructor at Lane Community College where she was required to develop and teach college-level astronomy courses.

Ms Hadley's doctoral research, the study of nonaxisymmetric instabilities in disks with an emphasis on the types of systems relevant for the understanding of star and planet formation is important for the field of star and planet formation in that the self-gravity and three-dimensional nature of the disks were taken fully into account; massive disks play central roles in almost all scenarios posed for star and planetary formation. Ms Hadley performed an extensive search of the relevant parameter space for such disks in which she delineated regions where disk systems were stable, unstable, or neutrally stable. Surprisingly, Ms Hadley found that nearly all star/disk systems with parameters typical of protostellar and protoplanetary systems were unstable (Hadley & Imamura 2011, Hadley *et al.* 2012a, in preparation). This has consequences for the formation of multiple star systems and, perhaps, for the formation of planets, and also begs the question of why do we see so many massive disks in protostellar systems? (Hadley *et al*. 2012b). This opens up several avenues of inquiry which Ms Hadley and I propose to

pursue in the future.

Ms Hadley was also always interested in the strongly magnetic rotating neutron stars known as Magnetars. This pursuit required the development of a high-performance computer code. Ms Hadley, in collaboration with fellow University of Oregon graduate student, Mr. Scott Ernst, wrote and developed the high-performance magnetohyrodynamics (MHD) computer code, Imogen. Imogen is novel in that it was developed using a functional language (Matlab), not a compiled language (*e.g.*, C++ or Fortran). Imogen is thus not platform dependent and so easily portable. Mr. Ernst and Ms Hadley started work on the code four years ago and have developed a working version of Imogen which is in a form mature enough that it formed the basis for Mr. Ernst's doctoral research (Mr. Ernst defended his dissertation, *A Nonlinear Investigation of Corrugation Instabilities in Magnetic Accretion Shocks*, on 15 January 2011) and has been made available to the general community (https://github.com/imogenproject/Imogen). Although Mr. Ernst and Ms Hadley performed rapid work and Imogen is ready to perform studies of systems where the motion is subject to external forces such as shocks and low mass accretion disks, Imogen does not yet include a Poisson equation solver and self-gravitating objects cannot be considered, in particular, *Magnetars*. Mr. Ernst, Ms Hadley, and my current student, Mr. Erik Keever are in the process of adding a Poisson solver to Imogen. Despite good progress, the version of Imogen with a Poisson solver will not be fully tested and thus not ready for use as a research tool for a year or so. Imogen with Poisson solver will be very versatile and I expect that it will serve as my research group's and Ms Hadley's future research group's primary research tool for the next five to ten years.

Ms Hadley was unusual for a graduate student in that she always tried to get at the physics, she was always probing. This trait served her well in her doctoral research and I am sure, will serve her well in teaching and in future research pursuits. Ms Hadley's combination of analytic skills, common sense, and love of physics will make her an outstanding researcher and gifted teacher. Ms Hadley is one of the best, if the not the best such student I have interacted with at Oregon during my tenure of 25 years.

Sincerely yours,

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