

I intend to complete a Ph.D in astronomy research in the field of extrasolar planet and brown dwarf detection, characterization, and formation. Following completion of my Ph.D, I intend to continue to work as an astronomy researcher, ideally at an observatory or research institution such as NASA. University faculty is also a position I will consider. I intend to pursue a career path that will allow me to continue to do astronomy research.

My path to astronomy is non-traditional and non-linear, but **it is precisely because of this winding path I now know for certain that a career as a researcher in exoplanetary astronomy is the ideal path for my future.** Every choice I have made as a student, every opportunity I have pursued, has been with this goal in mind.

As detailed in my personal statement, I returned to university to pursue a career in astronomy following a career in the US Navy and another as a middle school science teacher. While a second-time student at the University of Texas at Austin, I worked in the Hobby-Eberly Telescope Dark Energy Experiment instrumentation laboratory, assembling the units of the VIRUS instrument for UT's ambitious research project to measure the expansion rate of the universe. During my first summer I participated in a Research Experience for Undergraduates (REU) at Northern Arizona University (NAU) in the field of planetary science, determining if it is possible for the lakes on Titan to freeze during seasonal variations. I spent this past summer with the Berkeley SETI Research Center at the University of California Berkeley, on the Breakthrough Listen (BL) project to search for technosignatures in primarily radio wavelengths. Working with Howard Isaacson, I developed the "1 Million Star" target list for BL's upcoming observing campaign with the MeerKAT telescope in South Africa, which will be the largest Search for Extraterrestrial Intelligence (SETI) search in history.

But the most impactful research experience was my work with Dr. Adam Kraus on **an orbit study of the wide planetary mass companion GSC 6214-210 b.** Dr. Kraus' program has been monitoring several of these type of companions for many years with images from the Keck Telescope, enough time to measure orbital motion. Planetary mass companions (PMCs) are large companions ($\sim 13 M_{jup}$) on wide orbits (≥ 100 AU) from their hosts that have been detected in imaging of young systems. I find PMCs exceedingly interesting because they occupy a parameter space that is difficult to explain with current brown dwarf and planetary formation mechanisms. In my work on the PMC system GSC 6214-210, I measured the astrometric relative motion of GSC 6214-210 b, fit Keplerian orbital parameters to the motion, and studied the fit for clues which could point to formation mechanism, building my own statistical algorithms. I concluded that the $\sim 14.5 M_{jup}$ companion was unlikely to have formed at a close radius, where the disk is thicker, and then been scattered out to its current wide orbit through a dynamical scattering interaction. **My first author paper has been submitted for publication to the Astrophysical Journal.**

Study of these systems is hampered by the exceedingly small population that is known today. Bowler (2016) determined the occurrence rate of planets ($5-13 M_{jup}$) at separations observable in imaging (30-300 AU) to be only $0.6_{-0.5}^{+0.7}\%$. With such a low occurrence rate, direct imaging survey strategies must be optimized to select targets that maximize the likelihood of finding a giant planet or brown dwarf companion.

This led me to propose a project for the NSF Graduate Research Fellowship Program to use multi-epoch astrometry to optimize a target list to detect new directly imaged companions. As recent studies have shown (Snellen & Brown (2018), Bowler et al. (2018), Calissendorff & Janson (2018)), the large time baseline between *Hipparcos* and *Gaia* astrometry allows for detection of long period accelerations due to the presence of a companion of a wide orbit. Thus, by

comparing the two epochs, I proposed to look for stars experiencing acceleration, and develop a target list optimized to identify substellar companions. I then proposed to follow up the target list of ~ 50 targets, which is the upper end of the number of targets that could reasonably be surveyed during my PhD tenure, with a high-contrast imaging survey to detect the companions.

The University of Michigan, with its wealth of exoplanetary knowledge and access to observing resources, is an ideal institution to pursue a graduate degree in exoplanet studies. I have very much enjoyed my work with high-contrast imaging. It is the most satisfying way to study planets and planet formation to me, to directly observe their photons, and is the most powerful tool for understanding planet formation. Michigan Astronomy has many experts and exciting programs in direct imaging that I am very interested in, and the promise exciting returns in imaging planets. **John Monnier's** work with adaptive optics and the fringe tracker on CHARA array is on the cutting edge of imaging planets and planet-forming disks in infrared. I recently read his paper from this summer about the proposed Planet Formation Imager, which is so exciting and the next step in evolution of studying planet formation, to see it actually occurring in the infrared. I am also very interested in the work of **Ted Bergin's** research group on observing the formation of planets and protoplanetary disks in radio wavelengths.

I love the promise of high-contrast imaging for study of planet formation, but I am open to other fields within the exoplanet community as well. The exoplanet community at Michigan, from what I have learned about your program, sounds like just the kind of learning and research atmosphere I am looking for in a Ph.D program. I am committed to pursuing exoplanet research, and I am very flexible and open to adjusting the course of my Ph.D work. I do hope to be able to pursue my Ph.D at Michigan for all of the reasons I have listed above, in addition to the appeal of living in Ann Arbor. Thank you for considering my application to your prestigious research institution. My research, cv, and bio can also be found at www.loganpearcescience.com.

References

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