Presentations:

Sfiligoi, Igor, Frank Würthwein, and **Christopher Theissen**. “Using Condor Glideins for Distributed Testing of Network-facing Services.” Paper presented at the 2010 International Workshop on HPC and Grid Applications, 29 May 2010.

Theissen, Christopher, and David Tytler. “PyTracker: Automated Spectroscopic Target Acquisition using Cross-Correlation with Existing Astrometric Positions.” Paper presented at the University of California San Diego Undergraduate Research Conference, 24 April 2010.

Publications:

Sfiligoi, Igor, Haifeng Pi, Frank Würthwein, **Christopher Theissen**, and Jeffrey. M. Dost. "Scalability of network facing services used in the Open Science Grid." In review.

Quimby, Robert, Shrinivas Kulkarni, Mansi Kasliwal, Avishay Gal-Yam, Iair Arcavi, Mark Sullivan, Peter Nugent, Rollin Thomas, Andy Howell, Ehud Nakar, Lars Bildsten, **Christopher Theissen**, Nicholas Law, Richard Dekany, Gustavo Rahmer, David Hale, Roger Smith, Eran Oded Ofek, Jeffrey Zolkower, Viswa Velur, Richard Walters, John Henning, Khanh Bui, Daniel McKenna, Dovi Poznanski, Brad Cenko, and David Levitan. “Hydrogen-poor superluminous stellar explosions.” Nature 474(2011): 487-489.

Posters:

Sfiligoi, Igor, Frank Würthwein, and **Christopher Theissen**. “GlideTester - A framework for distributed testing of network-facing services using Condor glideins on Grid resources (poster).” 2010 TeraGrid Conference, 3 Aug. 2010.

Theissen, Christopher, Robert Quimby, Shrinivas Kulkarni, “Automated Cross-Correlative Spectroscopic Analysis of the Optical Transient Sky via Images Acquired using the Palomar Transient Factory (poster).” California Institute of Technology Summer Seminar, 21 Aug. 2009.

It is my belief that people set limits upon themselves: personal limits on what they think can be achieved, thereby constraining society. In physics, it is seen most often in people who are discouraged to pursue interests because of perceived difficulty or limited resources. Throughout my scientific career, I have made attempts to address these barriers in students in order to widen accessibility to higher education in physics. Knowing from personal experience the difficulty faced by students in accessing resources for learning complex topics in physics and astronomy, I have led efforts targeted towards bringing such resources to students in underrepresented, underserved communities, feeling that these are the students most affected by these barriers. Through scientific outreach, I hope to change our definition of the physics community in a way that is more inclusive, and therefore expand our capability of making scientific achievements as a society.

I believe there exists a gap between classroom education at the high school level and higher academic communities. The high school curriculum often administers the broadest, most fundamental approach to basic sciences in a way that is primarily catered towards standardized testing. Within grade schools, there are few opportunities for students to pursue specific scientific interests. By bringing modules on specialized subjects from the university to the high school classroom, we can bridge the gap between fundamental lessons and more complex topics: topics which ultimately attract our interests during higher education and drive us to pursue a career in research. When I transferred to UC San Diego from community college, I began volunteering weekly with the program CREATE, the Center for Research on Educational Equity, Assessment and Teaching Excellence. This program had a partnership with San Diego Lincoln High School located in southeast San Diego, a region comprised of many low-income, minority families and well-known for gang violence. Within the program I taught subjects ranging from geometry to advanced algebra, showing students new ways to approach mathematics, different problem solving techniques, and creating a newfound interest through real-world applications of the material they were learning. By creating an interest in these students, I opened new possibilities for their future and to the society to which they ultimately contribute. I have made a commitment to education, and plan to create opportunities for others within my field to help bridge this gap between a general approach to science and more applicable, hands-on approaches that help launch student interests.

During my second year at UCSD, I became president of the Astrophysics Club. The first change I initiated in the club was developing an outreach program to local schools to spread interest in astronomy. Although we attempted to focus our efforts on low-income, minority schools, believing these to be the most to gain from our efforts, we took every opportunity to teach and in the end, reached students of many different age levels across communities of different socioeconomic status. Our priority was in teaching astronomy, a subject not commonly offered in public grade school. Since the club dealt with students of all ages, it was important for us to teach subjects at different levels of complexity, which was challenging yet enjoyable. Experiences such as these are the hallmark of my goals to make higher education more accessible to anyone who has an interest. As a result, I create an ever growing, collaborative environment for physicists and astronomers.

Utilizing my memberships with the National Society of Hispanic Physicists and California Alliance for Minority Participation in Science, I plan to administer a larger communal outreach effort in astronomy. Through these programs I hope to recruit others that have faced similar barriers in the pursuit of higher education and who share a goal to make science more accessible. I will continue my commitment to scientific outreach in the hopes of changing the dynamic of the physics community, allowing everyone the opportunity to experience the profound nature of physics, thereby creating a more synergistic fellowship of scientists.

Circumstellar disks, dust and gas around young stars, are likely precursors to planet formation. To date, minimal data has been analyzed from large populations of these disks to quantify general principles regarding correlations between disk, host star, and their place in the Galaxy. How many stars actually have disks? Are there correlations between disks and stellar properties that can be used to constrain stellar age? With the advent of large-survey space observatories, such as the Wide-field Infrared Survey Explorer (WISE), we now have the ability to examine large populations of stars with infrared signatures of disks to study the correlation between disk and stellar age, and the distribution of stars with disks in a galactic context. Using large-scale surveys and investigating alongside Dr. Andrew West, I will collect and analyze photometric measurements to determine the fraction of M dwarfs with circumstellar disks, model the distribution within our Galaxy, and estimate a constraint on stellar age using disks as a proxy.

M dwarf stars, which make up approximately 70% of the stellar population[1] and have lifetimes longer than the current age of the Universe, provide an exciting opportunity for studying circumstellar disks within the context of stellar age and evolution. Recently, large-scale surveys of these stars have made it possible to quantify the range of stellar ages most likely to contain disks. These stars have additionally demonstrated predictable diffusive migration from the Galactic plane with age[3], such that the existence of a relationship between disk formation and stellar age may also indicate a relationship between the existence of debris disks and location in the Galaxy. My proposed program aims to examine the population density of stars with disks, in a Galactic context. In addition, this study will quantify the relationship between disk formation and M dwarf stellar age, providing a valuable tool for studies of stellar evolution, magnetic activity, and galactic evolution. Since studies have shown that M dwarfs are likely to host the largest fraction of terrestrial planets[2], the information gathered from this study may influence considerations on future projects designed to identify and study exoplanets.

To collect data from a large population of M dwarf stars, I will to use a spectroscopic catalog of over 70,000 M dwarfs compiled by West et al.[4] using the Sloan Digital Sky Survey (SDSS). This catalog contains coordinates, distances, SDSS and Two Micron All-Sky Survey (2MASS) photometry and spectroscopic data, and spectral types. With this catalog it is possible to acquire photometric data from a large sample of M dwarfs to model and analyze spectral energy distributions (SEDs). Coursework in stellar structure, evolution, and planetary formation will provide insights into modeling SEDs for M dwarf stars and circumstellar disks.

In executing my proposed study, I will first cross-match the photometric data from WISE, 2MASS, and SDSS. To fully characterize the disk population, photometric data must be collected over longer wavelengths to probe these colder, more diffuse disk states. I will supplement the WISE, 2MASS, and SDSS data with photometric measurements at longer wavelengths (40–670μm) from the Herschel Space Observatory and Spitzer. These longer wavelengths will allow the proper modeling of the SED for characterizing cooler disks.

Due to the large-scale nature of this project, there will be ample opportunity to involve undergraduate students in data collection, modeling, and analysis. As part of my long-term outreach efforts, I would also like to propose time for the Discovery Channel Telescope, which Boston University is assured 15% usage, to perform spectroscopy on candidate M dwarfs that show interesting emission features. Observation is one of the hallmarks of Astronomy outreach, and by involving students, both at the university and high school level, I hope to introduce young minds to more advanced topics in astronomy and bring a fresh new perspective to our science.

References:

1. Bochanski, J. J., et al. 2010, AJ, 139, 2679
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3. West, A. A., et al. 2006, AJ, 132, 2507
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My first research experience was in the laboratory of Dr. Brian Keating working on "POLARBEAR", a project measuring the gravitational signature of the Cosmic Microwave Background (CMB) in the form of electromagnetic B-modes, the curl component of the CMB's polarization, left over by the inflationary period of the early universe. Discovery of these B-modes would be a huge step for the inflationary theory of the early universe. The team I worked with designed the testing apparatus to measure the sensitivity of POLARBEAR's bolometer to small temperature fluctuations. The B-mode signature embedded in the CMB has a temperature orders of magnitude smaller than the temperature of the CMB itself, therefore POLARBEAR required sensitivity to a fraction of a micro-Kelvin. Simulating CMB radiation from different sources we began testing the sensitivity of the detector to determine if it was within required tolerances to measure the predicted B-mode signature at theoretically predicted levels. Although I left the research team before testing was completed I was told that the detector was found to be working within the required tolerances. I became adept at machining and using *Labview* and *SolidWorks* to design and build the apparatus that evaluated the sensitivity of POLARBEARS's detector. I enjoyed the diversity of working with members of a collaborative scientific team that were in very different stages of their academic careers.

As a minority undergraduate research fellow at the California Institute of Technology, I joined the Palomar Transient Factory (PTF) under Dr. Shrinivas Kulkarni and Dr. Robert Quimby. PTF is a dynamic, large-scale survey to locate and examine variable stars, supernovae, and other transient events that can increase our understanding of the transient phase-space. In addition to reducing raw images from the telescope and visually scanning reduced images for transients, I created a program (termed PyTracker) to automate target acquisition during follow-up observations. My scanning efforts identified two of three cataclysmic events discovered by

PTF, which have high luminosities, approximately 10 times brighter than typical Ia supernovaes, and high redshifts (z between 0.5 and 0.2), whose processes cannot be explained by typical supernovae models. These events fall within the theoretical range of pair-instability supernovae and thus strengthen our understanding of stellar evolution for massive stars with low metallicity. Using this large dataset, I was required to learn efficient data storage, reduction and analysis methods, spectroscopic and photometric instrumentation, and observation techniques for using Keck and Palomar telescopes.

PTF gave me insight into what could be accomplished through a large collaboration of physicists working with a comprehensive dataset. I applied this knowledge to an international project using another large dataset: the Large Hadron Collider (LHC). I joined the High Energy Physics group at UCSD to work with Dr. Frank Würthwein and Igor Sfiligoi on the Compact Muon Solenoid (CMS) experiment, which examines energy levels of muons created by proton-proton interactions. I created and administered open-source testing tools for distributed computing environments. These tools test the scalability and reliability of network-facing services for large-scale grid computing environments such as the Open Science Grid (OSG), and help system administrators keep their computing clusters efficient so that researchers have dependable access to CMS data from the LHC. The project also allowed me to present our products at a number of grid-computing, OSG, and CMS conferences, to instruct on reliable access within the scientific community to extensive collaborative datasets. Although not directly related to the science being conducted at the LHC, the work I did helped lay groundwork for the data pipeline from the LHC to research facilities throughout the world and improve the ease and efficiency of access to CMS data for scientists.