A Search for Variability among Highly Evolved Stars

This research will be conducted at Embry-Riddle Aeronautical University (ERAU) with faculty mentor Dr. Terry Oswalt. ERAU is located in Daytona Beach, Florida.

Research Description: A photometric investigation of micro-variability among cool white dwarf stars (WDs) and hot subdwarf B (sdB) stars will be conducted. Time series observations are obtained for WDs in the temperature ($T_{\text{eff}} < 6000$ K) and period (P < 500 s) regime where micro-variability due to collisionally induced absorption by H2 and/or C2 may occur. In a parallel project, variations in the arrival times of pulsating sdB stars that are in an unstable pre-WD stage of evolution are also being investigated. For example, observations made with the Southeastern Association for Research in Astronomy (SARA) telescope in Arizona helped identify periodic changes in the pulse arrival times for V391 Pegasi [Silvotti et al. (2007) Nature, 449, pp. 189-191] revealing the presence of a surviving planet in this post-main-sequence system. We are continuing observations of this system to fully determine the planet’s orbit and to search for additional planets. About a dozen other pulsating sdB stars are now being monitored for similar evidence of planets. A third project, which overlaps with the other two, involves the determination of rotation periods for the main sequence (solar-type) companions to WDs, from which system ages can be determined. In all three projects, time series observations of the brightest candidates in the sample will be obtained with the new 1 m telescope on the ERAU campus (installed in Feb. 2014) and the SARA observatory in Arizona.

Student Involvement, Expectations, and Deliverables: With faculty guidance, REU interns at ERAU will learn how to operate and use the campus 1 m telescope in Florida and the SARA telescope in Arizona. This includes planning and executing an observational program as well as reducing and analyzing the data that is obtained. In doing so, students will master a variety of instruments and software including CCD cameras, image-processing workstations and associated mathematical tools such as the Discrete Fourier Transform as well as image analysis software such as IDL, IRAF, etc. Each student will be assigned a target object for which they will be responsible for investigating. This will include the entire scientific process, from conducting background literature searches to verifying the data is accurately recorded, logged, and entered into our electronic archive. The student is also responsible for disseminating the research by preparing (and giving) an oral/poster presentation, a written report, and, if sufficient progress is made, writing sections of a manuscript for which they will be designated as co-author.
Peer Collaborators and Summer Activities: The REU student will live on the ERAU campus, working and collaborating with 1 to 3 other undergraduates that typically work in the astrophysics lab each summer. Along with the virtual experiences provided by the REU consortium, the REU student will also take part in activities sponsored by ERAU’s IGNITE Honors research program. This program provides additional informal activities to enhance and encourage social engagement among the student research participants.

**Note:** Other projects are available such as: *Determination of near Earth object orbits and physical characteristics.*

**Research Description:** Using the 3500-km baseline between the ERAU 1 m telescope in Florida and the SARA telescopes in Arizona, Chile, and/or Canary Islands, simultaneous observations of Near Earth Asteroids (NEOs), comets, and space debris can be obtained. Pairs of simultaneous images, repeated several times, allow near real-time distance, angular velocity, and orbit determinations for these potentially hazardous objects. Currently very little follow-up is done on the thousands of new objects discovered by surveys such as the Space Watch and Near Earth Asteroid Tracking projects if they are found to pose no imminent threat. Using BVRI CCD imaging, the campus observatory will support the determination of orbits, rotation rates, taxonomic type, and polar axis orientation. Changes in a minor planet’s color and brightness may identify “spots” produced by differentiation, impacts, or extrusion of materials. Such observations will be useful to choosing the most appropriate target for the President’s recent NASA goal of a manned asteroid mission.