2021_SSP Faculty Projects

Row 7

Research Group	De Pree
Project Title	**Gas Outflow in the Galactic Star Forming Region K3-50A**
Research Question, Hypothesis, or Conjecture	We have an available dataset of Very Large Array (VLA) radio frequency observations of a Galactic star forming region, K3-50A. We will generate a set of continuum and recombination line images to determine whether gas is outflowing along the long axis of the source.
Project Description	High mass star formation, while rare in any galaxy, is a very disruptive process that injects material and energy into the surrounding interstellar medium. Once a high-mass star begins to produce energy, it ionizes the surrounding molecular material to produce a bounded region of ionized gas, or HII region. "HII" refers to the singly ionized hydrogen that comprises most of these clouds. These HII regions are visible at all wavelengths. A famous example of an HII region is the Orion Nebula (M42) in the Orion Constellation. One of the earliest stages of star formation (for both low and high mass stars) leaves the star with an accretion disk, and some sort of bipolar outflow process begins. In the case of low mass stars, this outflow is often observed as Herbig-Harot objects: long, linear jets carrying momentum away from the young star. In the case of high mass stars, this stage of formation is very short, and can often be observed in the morphology (shape) and kinematics (movement) of the ionized gas that forms around massive stars. These sources are said to have a "bipolar" morphology, and can look "peanut-shaped". The expectation is that such sources are relatively young, and that the distribution of material near to the high mass star is directing the outflow in this manner. Since these objects are young, they tend to be deeply embedded in molecular gas, and thus often unobservable with optical or even infrared (longer wavelength) telescopes. The best way to observed these regions is in the radio (even longer wavelength) part of the spectrum. Since these sources are (1) small and (2) distant, high spatial resolution is required to observe these sources. Radio interferometers like the Very Large Array (VLA) provide the best observations of these types of sources. We have an available, unpublished dataset of VLA radio-frequency observations of a Galactic star forming region called K3-50A. This source has a distinct bipolar morphology (as seen in previous observations), and the new observations will allow us to study both the morphology (shape) of the source and the gas kinematics (motions). This summer, we will generate a set of continuum and recombination line images to determine whether gas is outflowing along the long axis of the source, and also use these data (and previously published data) to explore other physical parameters such as gas density.
Introductory References	De Pree, C. G.; Goss, W. M.; Palmer, Patrick; Rubin, Robert H., A Bipolar Outflow of Ionized Gas in K3-50A: H76 alpha Radio Recombination Line and Continuum Observations of K3-50, Astrophysical Journal v.428, p.670
Project Timeline (weekly), during June 1 - July 31	Week 1: Literature Review Week 2: Source Review/Introduction to CASA Software Week 3: CASA tutorials Week 4: Preliminary dataset calibration Week 5: Continuum Imaging Week 6: Line Imaging Week 7: Paper/Results Draft Week 8: Project Review/Flexible time (in case we get behind)
Expected	Research Students will be able to: 1. Formulate a testable scientific

Learning Outcomes	hypothesis 2. Calibrate and image data in the CASA software 3. Write up and present scientific results
Research Team & Environment	I have worked with students most summers at Bradley Observatory. It is a casual environment. In past summers, we have had lunch together once per week. We typically work together more closely in the first few weeks, and then students work more independently later in the project.
Department	Physics & Astronomy
4 or 8 Week Project	8 weeks
# of full-time student positions requested (1-3)	2 (1 advanced and 1 novice would be ideal, but 2 novices would work as well)
Minimum Requirements (for research novices)	Astronomy 120/121; transportation (if living off campus)
Requirements for Advanced students	Previous astronomy summer research experience
Recommended Preparation (but not required)	
Modification for Remote Research (IF needed)	If we are not able to have in-person meetings, I will propose that the (2) students have singles on campus, and we will stagger their work at the Observatory (Room 107). In a dire situation, the needed computers (Macs that are located in the Observatory) could be located in their dorm rooms. There are two of the required Macs. There will not be other students or faculty in the Observatory in such a situation, and it will be safe to have a single student in the research space at a time.