

Project Summary

Overview: Two of the most important questions in the study of Galactic chemical evolution are: what astronomical events create the elements and what are the characteristics of these nucleosynthetic processes? With the ongoing work of spectroscopic surveys to measure the elemental abundances of millions of stars in our Galaxy and the recent advances in computing that allow for complex models of supernova nucleosynthesis, now is the time to answer these questions. To constrain the contributions from core-collapse supernovae (CCSN), Type-Ia supernovae (SNIa), and asymptotic giant branch (AGB) stars, we need to directly compare empirical and theoretical yields for each source. Extending her previous work on Galactic abundance trends and CCSN yields at Ohio State University, Emily Griffith, the proposer, will combine observational results from the Milky Way Mapper spectroscopic survey with theoretical supernova yields to constrain the origin of the elements and Galactic enrichment history.

Griffith will empirically derive the prompt and delayed enrichment for the disk, bulge, and Magellanic clouds with Milky Way Mapper data from SDSS-V using a two-process model, which describes stellar abundances as the sum of a CCSN and a SNIa component. She will compile and collaborate with modelers to create CCSN and SNIa yields for progenitors with a range of masses, metallicities, binary interactions. Through a comparison of theoretical and empirical yields, Griffith will determine the variation in the Galactic black hole landscape, explore the impact of binary interactions on CCSN yields, identify yield ratios diagnostic of SNIa enrichment channels, and constrain the SNIa progenitor. To test the underpinnings of her methodology and develop strategies for separating multiple delayed enrichment channels, Griffith will construct a simulated stellar population with known enrichment and will analyze the ability of the two-process model to recover the prompt and delayed components. This work will be carried out in the Department of Astrophysical and Planetary Sciences at the University of Colorado Boulder with sponsoring scientist Dr. Jeremy Darling.

Intellectual Merit: By directly comparing theoretical CCSN and SNIa yields to their empirical counterparts, Griffith will refine our understanding of the nucleosynthetic processes and supernova models, improving on past comparisons of CCSN and SNIa yields to the solar mixture by. Her work will explore the impact of a metallicity dependent black hole landscape and massive star binary interactions on the initial mass function averaged CCSN yields as never done before. Further, Griffith will improve our understanding of the abundance signatures that delayed enrichment sources, such as SNIa and AGB stars, imprint on observed populations.

Broader Impacts: Astronomy and physics suffer from poor retention and representation of minority students at all levels. Science communication and mentoring initiatives are needed to improve science literacy, encourage young students to pursue STEM degrees, and support students to degree completion. As an avid contributor to and support of mentoring and teaching initiatives at Ohio State, Griffith is dedicated to improving the culture within Astronomy. At The University of Colorado Boulder, Griffith will collaborate with the undergraduate STEM mentoring program, CU Prime, to develop near-peer mentor training. Comprehensive training will better equip mentors to support student mentees from all backgrounds through academic and personal hardships. By building mentors' skill sets Griffith will enable the program to improve the mentees' experience, increase their sense of belonging, and improve retention. Concurrently, Griffith will work with Fiske Planetarium director, John Keller, to develop a planetarium show on the SDSS survey and Milky Way Mapper science, bringing current research to the dome. Griffith will workshop the show material with undergraduate planetarium presenters to ensure that the show is accessible to all. The resulting mentor training program and planetarium show will be shared with other universities to increase their impact on the broader community.