ABSTRACT

TITLE:	Investigating Elemental Abundances in the Crab Nebula to Determine Properties of the Presupernova Star
AUTHOR(S):	Lowry, Daniel James ; Tyler, Craig
PRESENTED AT:	5th Annual Natural & Behavioral Sciences Undergraduate Research Symposium, Fort Lewis College

ABSTRACT: The elemental abundances remaining in the nebula surrounding a neutron star provide insight into the stellar nucleosynthesis processes that were taking place in the original star immediately preceding core collapse. The Crab Nebula is one of the closest and most recent supernova remnants visible from earth and because of its location above the galactic disk, the atomic debris from the progenitor star has remained undisturbed by interactions with the interstellar medium and neighboring stars. At the time of type-II supernova explosion the original star should have contained a mixture of many fusion burning atomic layers whose relative abundances can be examined by studying the light emission intensity ratios from the elements remaining within the Crab Nebula Supernova Remnant. Using singly ionized sulfur (S II), doubly ionized oxygen (O III), and Hydrogen Alpha (H) narrowband filtered images of the Crab Nebula, an intensity ratio between various regions were determined. Comparisons between observational results and published literature values were used to validate the method developed as well as verify the 30-year-old literature emission ratios. The primary goal of the project was to use the filtered narrowband images obtained from the Fort Lewis College Observatory to provide observational evidence of an onion shell structure which would be expected if a massive main sequence star was responsible for creating the nebula when it went supernova. Observed intensity ratios correlated closely with published values in both region by region comparisons as well as for the entire nebula. Specific shell studies demonstrated that the central core had the largest SII/H ratio in the nebula. Upon examining each outer shell it was determined that this ratio decreased consistently as the shells got further away from the central core. In the central core of the nebula the OIII/H- ratio was the lowest observed in the nebula. Upon examining each outer shell the intensity ratio increased until it reached a maximum ratio in the middle Shell. In the outer shell the OIII/H ratio and the SII/H ratio decreased. Since the observed SII/OIII ratio between the middle and outer shells remained identical, it can be deduced that the hydrogen concentration is increasing as the distance away from the central neutron star is increased. The shell results suggest that sulfur has remained toward the center of the nebula, the oxygen is surrounding the sulfur, and there is hydrogen that surrounds the oxygen.