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Spectroscopic Study of Nuclear Processing in the Crab Nebula[1]
GORDON MACALPINE, TAIT ECKLUND, WILLIAM LESTER, STEVEN VANDERVEER, Trinity University — We present correlations for optical and near-infrared line intensity measurements at many positions in the Crab Nebula supernova remnant. These correlations suggest the existence of gas produced by a range of nuclear processing, from material in which synthesis ended with the CNO-cycle, to some helium-burning and nitrogen depletion, to regions containing enriched products of oxygen-burning. The latter exhibit a gradual, linear rise of [Ni II] emission with increasing argon enrichment, whereas gas with less nuclear processing shows markedly different [Ni II] emission characteristics, including the highest derived abundances. This suggests two origins for stable, neutron-rich nickel in the nebula: a type of "alpha-rich freezeout" in the most highly processed material, and perhaps removal of ions from the neutron star in other regions. In addition, the data indicate that anomalously strong observed [C I] emission comes from extensive, warm, low-ionization zones. Although the strongest He I emission could also be enhanced in similar low-ionization gas, correlations between relevant line ratios argue against that explanation, strengthening the case for an exceptionally high helium mass fraction in some locations.

[1]This presentation involves data obtained at the Michigan-Dartmouth-MIT Observatory and at the McDonald Observatory of The University of Texas at Austin.

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