Identification of Type Ia Supernova Explosion Mechanisms in Dwarf Spheroidal Galaxies

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Through the fusion of nucleons to produce elements heavier than hydrogen and helium, stellar nucleosynthesis produces many of the elements in the universe. However, nearly all elements heavier than those of iron-peak elements, atomic numbers 21 through 30, are created through nucleosynthesis in supernova explosions. In this study, we determine the best theoretical supernova model appropriate for the stars in the dwarf spheroidal galaxies Sculptor, Fornax, Ursa Minor, and Leo II by calculating the abundances of iron-peak elements in these stars. To determine iron-peak elemental abundances, we use Interactive Data Language to compare synthesized spectra with observed medium-resolution spectra, obtained from DEIMOS at Keck Observatory, and determine the best-fitting spectrum by way of a chi-squared minimization. Through inspecting the relationship between the iron-peak elemental abundances and the abundance of iron itself and by comparing them to previously hypothesized supernova model theories, we discover that the near-Chandrasekhar mass "n1" model, as predicted by Seitenzahl et al., most accurately represents the trends and patterns within our data. Our findings suggest that a low number of ignition kernels is characteristic of the mechanism behind Type Ia supernova explosions in dwarf spheroidal galaxies, presenting new insight into supernovae explosions within our Milky Way and beyond.

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