Investigating Type Ia Supernovae Formation Processes via the Kinematics of Their Ejecta

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Type Ia Supernovae (SNe Ia) are a class of stellar explosions that serve as tools for measuring cosmic distance. They have been hypothesized to result from the explosion of a white dwarf star. When a white dwarf star explodes, it throws out material at high speeds, which is known as supernova ejecta. The speed of the material in this ejecta, specifically the Silicon II material at a wavelength of 6355 Angstroms, helps us understand the subclasses in the SNe Ia population and supernovae formation processes. This project aimed to investigate SNe Ia formation processes through the speeds of the material in these ejecta and thus the speed of the ejecta themselves. The Si II Lambda 6355 absorption line data from approximately 100 Type Ia supernovae was obtained from the Carnegie Supernova Project. After removing targets that didn't fit the project purpose, an algorithm was developed to fit this supernova data to Gaussian profiles, which served as a preliminary step to estimate the expansion velocities of the SNe Ia. Then, we used Markov Chain Monte Carlo to calculate the precise velocity measurements of the Si II Lambda 6355 material. It was demonstrated that there are possibly two distinct subclasses of SNe Ia based on their characteristic maximum brightness and Si II velocities. This finding suggests the possibility of more than one formation process within the SNe Ia population because of the two distinct subclasses. This research contributes to research helping probe Type Ia Supernovae explosion mechanisms.

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