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Multi-Epoch Spectropolarimetry Reveals Asphericity in Type IIb Supernova Explosions

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Type IIb supernovae (SNe IIb) are core-collapse events whose optical spectra show strong hydrogen features that disappear over time, implying that their progenitors were nearly, but not completely, stripped of their hydrogen envelopes prior to core collapse. Thus, compared to hydrogen-rich SNe II, SNe IIb can provide a closer examination of the underlying structure of the progenitor system, particularly during early photospheric phases (less than +70 days relative to max. light). I will present early-time multi-epoch optical spectropolarimetry of several SNe IIb, obtained using the SPOL instrument at the University of Arizona. Using polarization diagnostics provides a way to track structural changes in the depleted hydrogen envelopes of these SNe as deeper layers of helium and other elements emerge and evolve. I find significant temporal polarization increases in the absorption wings of their H and He lines. Some of these line features make “loops” in Stokes Q-U diagrams, suggesting non-axisymmetic structure in the ejecta, perhaps arising from a transient absorbing clump. Furthermore, the majority of these SNe show polarimetric evidence for aspherical explosions along a preferred, or dominant, axis. I discuss the implications these findings have on the 3D geometry of the explosions by comparing the observed polarization to published synthetic spectropolarimetry that models axial symmetry and clump structures in stripped-envelope, core-collapse SNe. This comparative study naturally facilitates a broader discussion around the unresolved question as to what extent this SNe subclass shows common polarization characteristics.