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SN 1006 at optical and UV wavelengths

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Abstract. Optical and UV emission from SN 1006 is observed on the periphery of the SNR, particularly in the NW, and arises as material from interstellar gas is ionized behind the shock front. The shapes of the emission lines have been used to infer a shock velocity of about 2900 km s^{-1} and to show that the electron and ion temperatures are close to that expected from standard shock theory. The combination of the shock velocity and the proper motion of the filaments in the NE accurately locates SN1006 at a distance of 2.2 kpc, some 550 pc above the Galactic plane. At UV wavelengths, ejecta from SN 1006 have also been observed as broad absorption lines from Si, Ca and Fe in spectra of the Schweitzer-Middleditch star and two quasars. The observations appear to limit the mass of Fe in SN 1006 to less than 0.16 M$_\odot$, much less than expected from models of Type Ia supernovae. In this brief review of the UV and optical properties of SN 1006, I will summarize how these observations yield a fairly consistent description of SN 1006, and suggest what further observations might be undertaken to extend our understanding of SN 1006 in its second millennium.

Sidney van den Bergh (1976) was the first to observe the remnant of SN 1006 optically. With modern CCDs, Winkler *et al.* (2003) imaged Hα emission from the entire periphery of the SNR and measured the proper motion of the NW filament as 0.280 ± 0.008 arcsec yr^{-1}. As suggested by Chevalier *et al.* (1980), the optical emission is from the primary shock interacting with the ISM, and is due to H atoms being ionized. From the line shapes, Ghavamian *et al.* (2002) estimated a shock velocity of 2890 ± 80 km s^{-1}. As a result, the distance to the SN is geometrically determined to be 2.18 ± 0.18 kpc. Raymond *et al.* (1995) observed emission lines of H, He, C, N, and O from the NW limb in the far UV; the line widths are consistent with velocity randomization in the post-shock gas, implying that ion-ion equilibration is governed mainly by Coulomb processes.

Schweizer & Middleditch (1980) discovered a sub-dwarf OB-type star that is behind SN 1006. Using *IUE*, Fesen *et al.* (1988) and other subsequent observers obtained UV spectra from this star and found broad Fe, Si, and Ca absorption lines from freely expanding ejecta with speeds up to 5000 km s^{-1} in SN 1006. Using *HST*, Winkler *et al.*(2005) observed additional UV lightbulbs behind SN 1006. The line shapes indicate that Si is located mainly outside of the Fe and that the SNR is expanding asymmetrically. This is the only SN whose ejecta have been probed in this fashion. The amount of Fe is less that predicted, but the general characteristics support a Type Ia origin for SN 1006.

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