On The Spectrum and Spectropolarimetry of Type Ic Hypernova SN 2003dh/GRB 030329

Based on data obtained at the Subaru Telescope, which is operated by the National Astronomical Observatory of Japan (NAOJ)


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abstract

Spectroscopic and spectropolarimetric observations of SN 2003dh/GRB 030329 obtained in 2003 May using the Subaru 8.2 m telescope are presented. The properties of the SN are investigated through a comparison with spectra of the Type Ic hypernovae SNe 1997ef and 1998bw. (Hypernovae being a tentatively defined class of SNe with very broad absorption features: these features suggest a large velocity of the ejected material and possibly a large explosion kinetic energy.) Comparison with spectra of other hypernovae shows that the spectrum of SN 2003dh obtained on 2003 May 8 and 9, i.e., 34–35 rest-frame days after the GRB (for $z = 0.1685$), are similar to those of SN 1997ef obtained ~34 – 42 days after the fiducial time of explosion of that SN. The match with SN 1998bw spectra is not as good (at rest 7300–8000 Å), but again spectra obtained ~33 – 43 days after GRB 980425 are preferred. This indicates that the SN may have intermediate properties between SNe 1997ef and 1998bw. Based on the analogy with the other hypernovae, the time of explosion of SN 2003dh is then constrained to be between ~8 and +2 days of the GRB. The Si and O P-Cygni lines of SN 2003dh seem comparable to those of SN 1997ef, which suggests that the ejected mass in SN 2003dh may match that in SN 1997ef. Polarization was marginally detected at optical wavelengths. This is consistent with measurements of the late afterglow, implying that it mostly originated in the interstellar medium of the host galaxy.