

OPTICAL SPECTROSCOPY SN 2007gr OF TYPE Ic

TARASOVA, T. N.

Crimean Astrophysical Observatory, Crimea, Nauchnyj, Ukraine; email: taya@crao.crimea.ua

SN 2007gr was discovered on 2007 August 15.51 UT (Li et al., 2007) in NGC 1058 which is a member of a group of nearby galaxies. The distance to this galaxy is 10.6 ± 1.3 Mpc (Pilyugin et al., 2004). Chornock et al. (2007) classified SN 2007gr as Type Ib/c based on the spectrum obtained on the night after the discovery. The later spectral evolution did not confirm the presence of He, therefore SN 2007gr was classified as Type Ic. This supernova is one of the nearest stripped-envelope SNe ever observed.

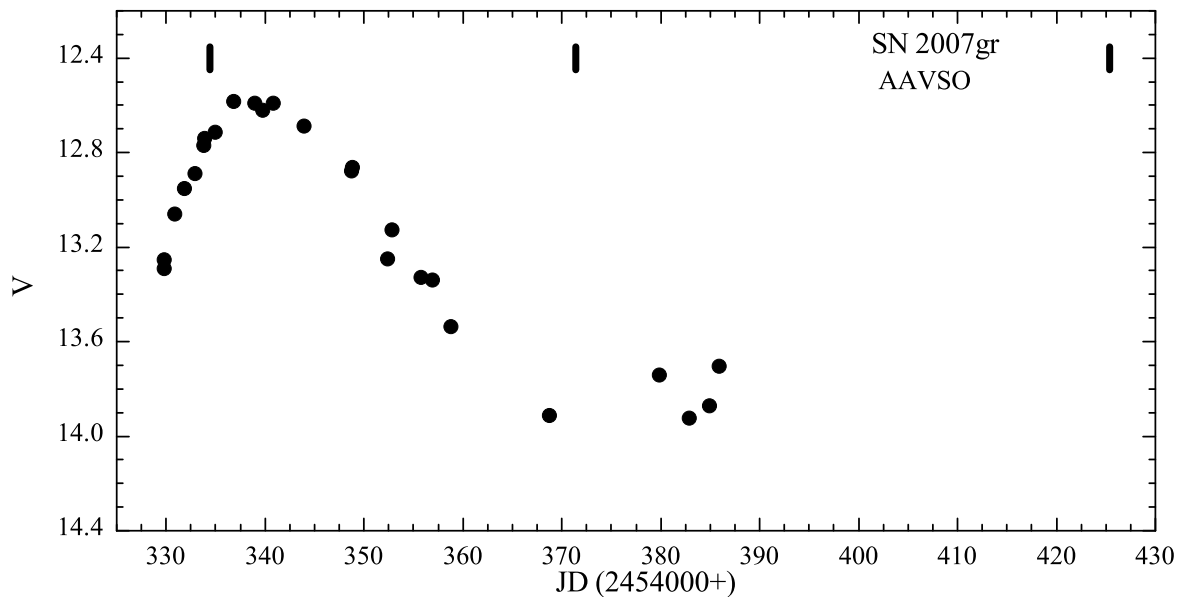


Figure 1. Light curve of SN 2007gr based on AAVSO data. Vertical bars indicate the time of our spectral observations

The spectral observations were carried out at the Crimean Astrophysical Observatory at the Nasmyth focus of the 2.6m Shajn telescope. The spectra with dispersion of 2 \AA pix^{-1} were registered in two spectral regions 3700 - 6190 \AA , 5600 - 7600 \AA and were combined with the exception of the first spectrum. It was obtained on August 21.9 and covered the spectral region 5600 - 7600 \AA . The spectral images were processed in standard fashion for CCD frames, including bias subtraction, flat-field corrections, wavelength

calibration. The spectrophotometric standard HR 788 (Kharitonov et al., 1988) was used for flux calibration of the SN spectrum.

The light curve of SN 2007gr based on AAVSO data (Henden, 2007) is shown in Fig. 1. The observation span a period of ~ 56 days. A preliminary analysis of the light curve gives $V_{max}=12.6$ in period from 24 till 28 August. The dates when spectra were taken, are labeled by vertical bars. The first spectrum was obtained before the maximum, the second and the third spectra were taken in the phase of brightness fading. All our spectra are shown in Fig. 2. The spectra are separated vertically by a constant offset.

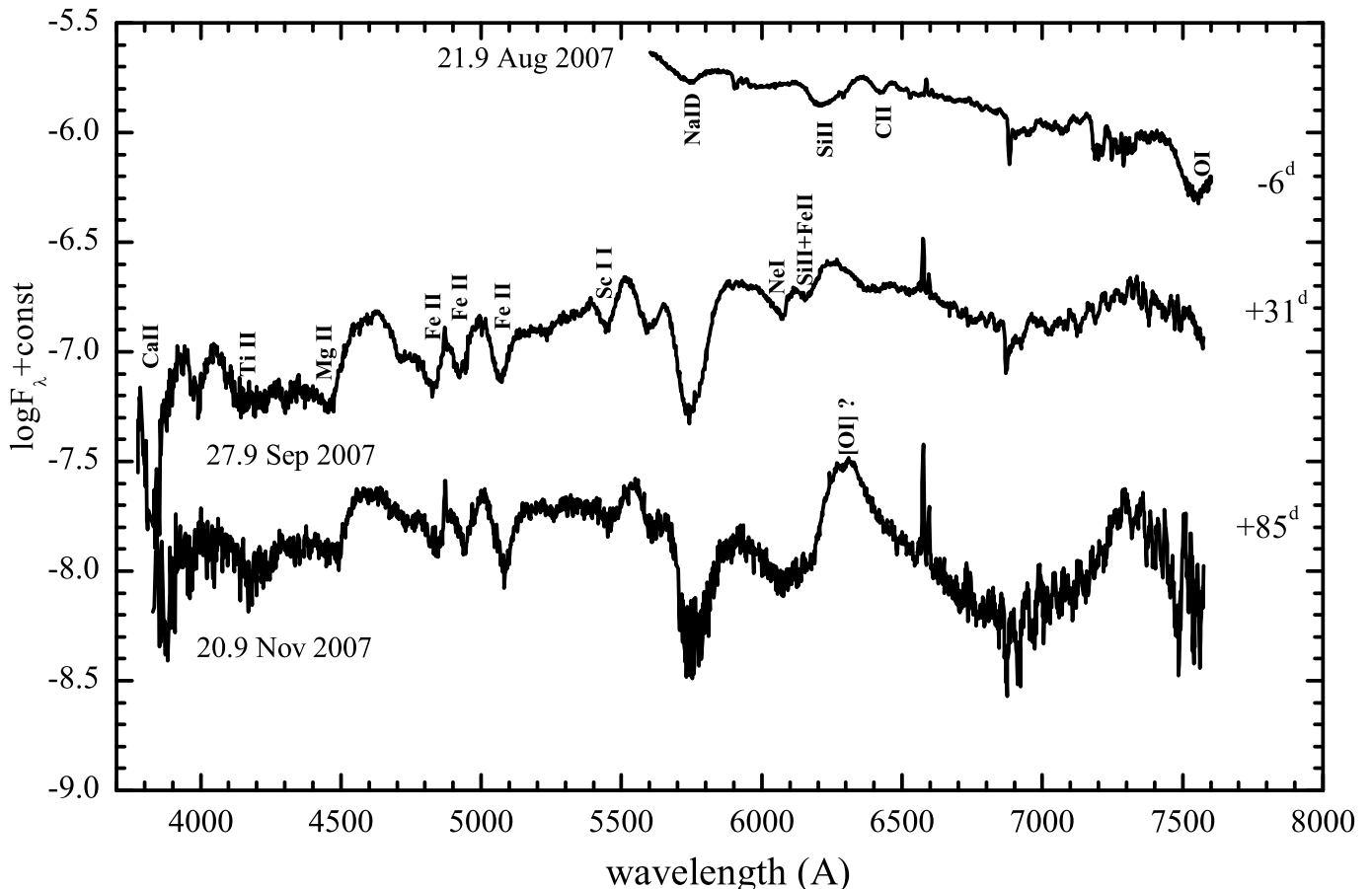


Figure 2. Spectral evolution of SN 2007gr. The lower two spectra are shifted downwards by the const in $\log(F_\lambda)$. Flux F_λ is given in units of $\text{erg cm}^{-2} \text{s}^{-1} \text{\AA}^{-1}$. Epochs (days) are given relative to maximum brightness.

The first spectrum obtained for 6 days before the maximum brightness of the supernova shows shallow absorption features. The features centered at 5750 \AA and 6200 \AA are identified as NaID and SiII 6355 \AA , respectively. The feature centered at 6430 \AA is more likely identified as CII 6580 \AA and the feature centered at 7550 \AA is possibly identified as OI. The feature centered at 6430 \AA was first identified by Chornock et al. (2007) as HeI. The later spectral evolution did not confirm the identification of this line as HeI. Therefore SN 2007gr was classified as SN Ic. This feature was investigated in detail by Valenti et al. (2008). These authors pointed out that the more likely identification for this line is CII 6580 \AA at velocities $\sim 11000 \text{ km/s}$.

The subsequent two spectra, obtained on 31st and 85th day after maximum bright-

ness of the supernova are quite similar. The NaID line dominates in the spectra. The absorption features in these spectra are CaII H and K centered at 3810 Å, FeII 4924 Å, 5018 Å, 5169 Å centered at 4830 Å, 4920 Å, 5070 Å, respectively. Moreover, we identified the features centered at 5450 Å, 6070 Å and 6160 Å as Sc 5552 Å, NeI 6217 Å, SiII 6355 Å + FeII 6316 Å, respectively.

Some broad absorption features are also present in the spectra at 6900 Å and the “W”-shaped absorption feature centered at ~ 4300 Å. However, we cannot tell whether the absorption feature centered at 6900 Å is real or it is a result of noise from the telluric bands at 6880 Å. The “W”-shaped absorption feature is observed in many Type I SNe around and after maximum. It is specified by Valenti et al. (2008) as a blend of two spectral lines TiII 4252 Å and MgII 4354 Å.

The spectral line SiII 6355 Å fades on the 31st day and apparently disappears on the 85th day after maximum brightness. It is possible that the SiII is filled by the forbidden lines of [O] 6300 Å, 6364 Å on the 85th day. Therefore we believe that the spectrum taken on the 85th day after maximum brightness of the supernova probably displays the first signs of the nebular stage.

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