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Spectrum of the recent supernova in NGC 4753

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Abstract. Low-resolution spectrograms of SN 1983 in the I0 galaxy NGC 4753, obtained with the 102-cm Kavalur reflector, show it to be a typical type I supernova. The spectrum suggests that the supernova was about 20 days past maximum on 1983 April 13.

Key words : supernovae—spectroscopy

A supernova was discovered 10 arcsec west, 20 arcsec south of NGC 4753 by Okazaki (1983) on 1983 April 4, and independently by Evans (1983) on April 5 and by Tsvetkov (1983) on April 9. Subsequently, three low-resolution spectrograms were obtained with the 102-cm reflector of Kavalur Observatory. The spectrum exhibits features characteristic of a type I SN.

The spectrograms were obtained by placing a 303 l mm^{-1} grating (blazed at λ6100) in the converging beam of the Cassegrain focus, at a distance of about 25mm from the photographic plate (Babu 1983). Kodak 098-02 emulsion was used to record the spectrum in the range of $\lambda\lambda$3800-7000 in the first order (1240 Åmm^{-1}) and between $\lambda\lambda$3800-4800 in the second order (620 Åmm^{-1}). In all, three spectrograms were obtained on 1983 April 13, between 16^h30^m and 20^h15^m UT. The spectrophotometric standard BD 33° 2642 (Stone 1974) was also observed with the same set up. All the spectrograms were widened by 200-300 μm by trailing the stars in the right ascension. The spectrograms were calibrated for relative intensities using an auxiliary calibration spectrograph.

The photographic spectra were digitized at intervals of 8 μm using an automated microdensitometer coupled to a microcomputer (Visvanath 1980). The nearby sky background was also digitized and averaged over 800 μm strips. The deflections were converted to Baker transformed densities (log ω) and then to relative intensities using a linear calibration curve between log ω and log I. The sky background was interpolated for each point and subtracted in the intensity domain. The three spectra were then digitally averaged in the log I domain using the centre of the zero order image as the reference position. The wavelength scale was established by using identifiable features in the spectrum and by imposing the restriction that the first and second order spectra match in wavelength. The intensities were corrected for the

nonuniform wavelength response of the photographic plate by using the spectrum of the standard star.

The reduced spectrum is shown in figure 1. The second-order spectrum. shown by dotted lines shows about 10% higher intensities than the first-order spectrum. We believe the second-order spectrum to be more accurate since the first-order spectrum was underexposed and slightly out of focus in the blue region. An advantage of the objective grating technique employed is that the emission and absorption features due to the sky are not superposed on this spectrum except as a continuous background that could easily be subtracted. Because of the high image scale employed, the underlying galaxy has also not contributed significantly to the spectrum. However, the resolution in wavelength is determined by the seeing image which was about 1.5 arcsec. This corresponds to 110 Å in the first order and 55 Å in the second order. The small-scale features seen in the spectrum in figure 1 are hence due to the photographic noise.

The spectrum of the SN in NGC 4753 shows all the characteristic features of a type I SN, such as the strong absorption feature at λ6150 and emission peaks at λ3950, λ4200, λ4600, λ5180 and λ5900. It has been well known for over a decade that SNI belong to an extremely homogeneous class not only photometrically, but also spectroscopically. The 1983 SN in NGC 4753 is no exception. The spectrum is that of a standard SNI about 20 days past maximum, *i.e.* the transition stage from

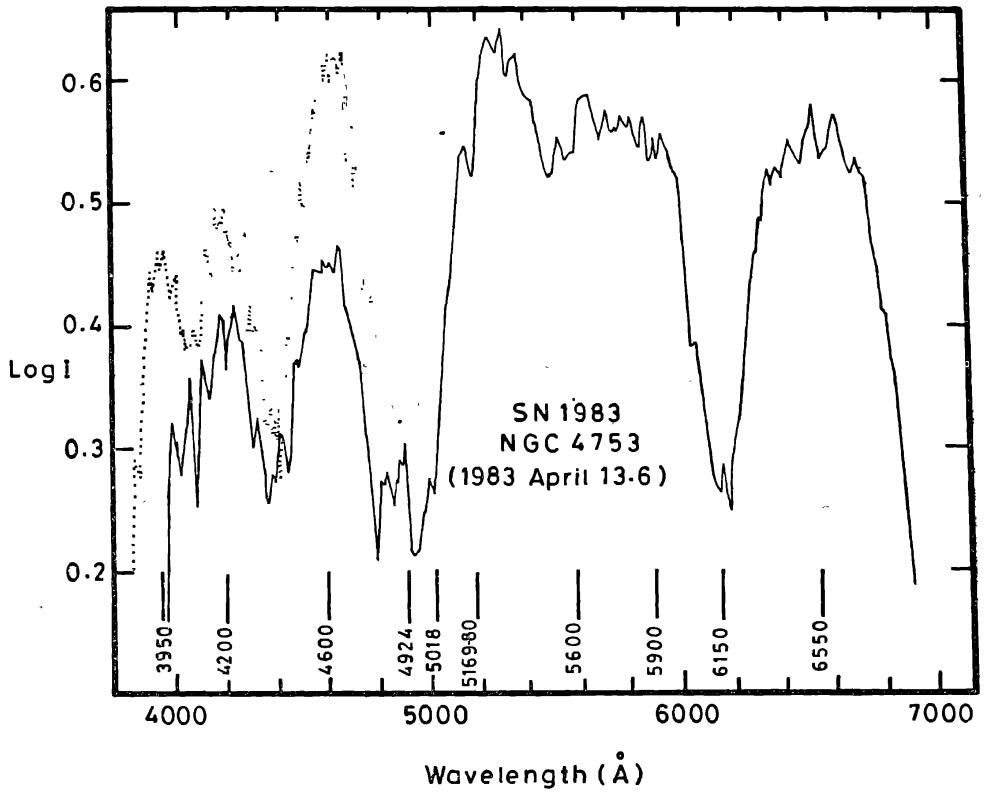

Figure. 1. The spectrum of SN 1983 in NGC 4735 obtained at 1983 April 13.68-13.84. The second-order spectrum shown by dotted line is more reliable than the first-order blue spectrum. Prominent spectral features of type I SN are indicated. Spectral resolution is 110 Å in the first order and 55 Å in the second order.

phase A to B of Oke & Searle (1974). The emission redward of λ5180 feature which characterizes phase B, has started appearing. The new emission peaks at λ4900 and λ6550 are also faintly visible. In this respect, the present supernova resembles the standard spectrum better than the early spectrum of NGC 1316 (Prabhu 1981) which exhibited a few characteristics of Phase B, while agreeing in general with an early evolutionary stage.

NGC 4753 is an I0 galaxy in the southern extension of the virgo cluster. I0 galaxies are generally believed to be elliptical galaxies that have recently ($\lesssim 10^8$ yr) acquired a large amount of external gas. They are also known for their very high SN rate. All the available information suggests that SN in I0 galaxies are always of type I. NGC 4753 is not an exception to this, with an earlier record of a type I SN in 1965.

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Note added in proof

In a recent preprint Harris *et al.* (1983, *D. A. O. preprint*) present the blue-green spectra of the supernova on 1983 April 10 and 11, and the blue spectra on April 21 and 22. A comparison of these data with our spectrum shows that the spectrum evolved more rapidly before April 13.76 than after this date. This is again a characteristic of transition stage from phase A to B. The photometric estimate of Harris *et al.* that the maximum occurred around 1983 March 28 agrees with our spectroscopic estimate that it occurred approximately 20 d before April 13.