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OBSERVATIONS OF SUPERNOVA IN NGC 3169

The supernova in NGC 3169 was discovered independently by N.Metlova and Kiyomi Okazaki on March 26, 1984 and by R.Evans on March 29 (IAU Circ.No. 3931). Its precise optical position was determined by H.Kosai and R.W.Argyle (IAU Circ. No. 3936) to be $\alpha=10^{\text{h}}11^{\text{m}}35^{\text{s}}.37$, $\delta=+3^{\circ}43'07''.6$ (1950.0); offset from the nucleus $60''\text{W}$, $15''\text{N}$.

Photographic U, B and V observations of the supernova were carried out with the 50/70 cm Maksutov telescope and the 40 cm astrograph of Sternberg State Astronomical Institute Crimean Station and also with the 70 cm reflector in Moscow. Observations were continued until May 3; 4 plates in U, 24 in B and 10 in V have been obtained. The supernova was also found visible on two plates taken with the 40 cm astrograph about a month before discovery.

Figure 1 shows the sequence of comparison stars around the supernova, their U, B and V magnitudes are reported in Table I. Stars 1-7 were measured photo-electrically with the 60 cm reflector of Sternberg Astronomical Institute Crimean Station, magnitudes of other stars have been measured on plates obtained with the Racine wedge.

Table I. Magnitudes of comparison stars

star	B	V	U
1	8.35	7.76	8.22
2	10.19	9.62	10.12
3	10.91	9.96	11.47
4	11.80	11.28	11.77
5	13.27	12.50	14.40:
6	13.74	13.28	13.70
7	14.52	14.54	14.48:
8	14.66	14.38	14.5
9	15.58	15.02	15.6
10	15.89	15.33	16.0
11	16.14	15.18	
12	16.36	15.95	
13	16.87	16.39	
14	17.43	16.10	
15	17.28	16.88	
16	17.4	17.3	
17	17.9		
18	18.3	17.5	

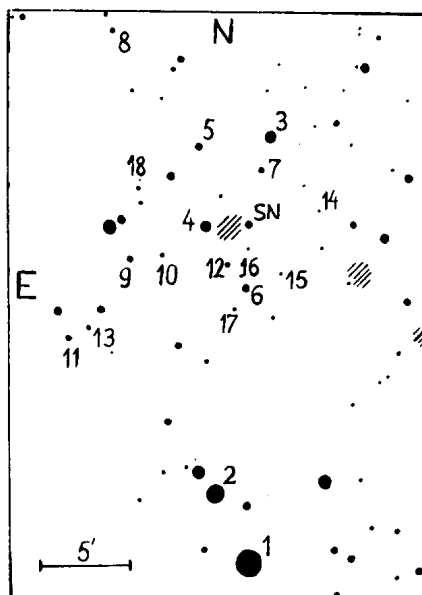


Figure 1

Table II
Observations of the supernova

JD 2445..	telescope	B	V	U
757.46	40 cm	18.1		
758.43	"	17.7		
761.44	"	> 18		
786.35	"	15.36		
789.25	"	15.29		
.26	50 cm		15.10	
.28	40 cm	15.31		
.31	"	15.36		
.35	"	15.18		
.38	"	15.35		
.41	"	15.18		
.46	"	15.30		
790.29	"	15.21		
739.28	"	15.18		
.30	50 cm			14.65
.34	"	15.27		
.37	"		15.17	
794.29	"			14.78
.33	"	15.24		
.35	"		15.13	
795.43	"			14.75
796.39	40 cm	15.39		
.40	50 cm	15.28		
.42	"		15.06	
797.42	40 cm	15.54		
.45	50 cm			15.0
798.28	70 cm		15.08	
.30	"	15.38		
799.36	"	15.52		
.38	"		15.28	
808.26	40 cm	16.35		
811.39	70 cm	16.10		
813.35	40 cm	16.60		
815.28	70 cm		16.08	
.30	"	16.61		
820.31	"	17.05		
.32	"		16.35	
821.29	"		16.40	
.39	"	17.0		
823.33	40 cm	17.5		
824.29	50 cm		16.87	

Magnitudes of the supernova are reported in Table II and the light curves are represented in Figure 2. The mean error of a magnitude is between 0.1^m and 0.2^m , the magnitudes of the supernova below $B=17^m$ are more uncertain, their error is of order $0.3^m - 0.5^m$.

The maximum brightness was reached on JD 2445792+2 (April 1) with $B_{\max} = 15.2 \pm 0.1^m$, $V_{\max} = 15.1 \pm 0.1^m$. The light and colour curves are typical of type II supernova of "linear" subclass (Barbon et al., 1979, Tsvetkov, 1985). The rate of decline was 0.07 mag/d in B and 0.055 mag/d in V. The colour index (B-V) increased from 0.1^m to 0.6^m in 40 days, (U-B) was about -0.5^m near maximum light. Comparison with the intrinsic colour curve for type II supernovae (Tsvetkov, 1985) yields the colour excess $E_{B-V} = 0.1 \pm 0.05^m$.

According to Burstein and Heiles (1984), galactic absorption in the direction of NGC 3169 is $A_B = 0.04$, and the colour excess of the supernova is due to absorption in NGC 3169.

The radial velocity of NGC 3169 is $V_0 = 1051 \text{ km s}^{-1}$ (de Vaucouleurs et al., 1976), assuming for the Hubble constant the value $H_0 = 75 \text{ km s}^{-1} \text{ Mpc}^{-1}$ the distance should be 14 Mpc, and the absolute magnitude of the supernova at maximum light $M_B = -15.9 \pm 0.3^m$.

Comparison of these parameters with the data for other type II supernovae (Tsvetkov, 1985) shows that the supernova in NGC 3169 is distinguished by its low luminosity at maximum light and high rate of brightness decline.

Spectroscopic observations of the supernova have been reported by Gaskell (1984) and Dopita et al. (1984). The characteristic feature of the spectrum is strong, narrow Balmer emission superimposed on an otherwise normal type II supernova spectrum. It is supposed that this peculiar feature is due to a strong episode of mass loss from the precursor star immediately prior to the supernova event.

As we have already mentioned, the supernova is visible on two plates obtained before discovery, on February 26 and 27, but it is invisible on a plate taken on March 1, although the limiting magnitude was nearly the same for all three plates, about $18^m - 18.5^m$. The brightness of the supernova was certainly not increasing, and perhaps even declined from February 27 to March 1.

It is possible that this supernova had a premaximum plateau, the existence of which for some type II supernovae has been suspected by de Vaucouleurs (1974), or an outburst before the main explosion. The absolute B magnitude of the supernova at that time was about -13^m . The supernova is invisible that is $B > 17.5^m$, on plates obtained earlier in February, and nothing is visible on the Palomar Sky Survey at the position of the supernova.

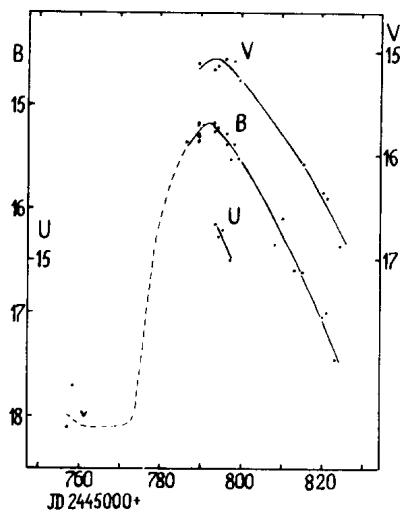


Figure 2

There is a possibility that the existence of a premaximum plateau or outburst may be connected with the spectral peculiarity of this supernova. It is also interesting to note that this is the first type II supernova discovered in Sa galaxy.

N.V.METLOVA, V.G.METLOV
Sternberg State Astronomical
Institute Crimean Station,
Nauchny, Crimea, 334413, USSR

D.Yu.TSVETKOV
Sternberg State Astronomical
Institute, Universitetskij Pr. 13,
Moscow, 119899, USSR

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