

SN 1991T: FURTHER EVIDENCE OF THE HETEROGENEOUS NATURE OF TYPE Ia SUPERNOVAE¹

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ABSTRACT

Optical spectra of SN 1991T obtained approximately one week before *B* maximum showed no evidence of the Si, Ca, and S absorption lines which normally dominate the spectra of type Ia supernovae at early phases. Nevertheless, within two weeks after maximum, the spectrum of SN 1991T had evolved to resemble closely that of other type Ia events. These observations suggest that the abundances of Si, Ca, and S in the outer ejecta of SN 1991T were unusually low. The *B* and *V* light curves of SN 1991T resembled those of other type Ia supernovae, but the slope of the initial decline following maximum was less steep than normal in both colors. In spite of these spectroscopic and photometric peculiarities, the absolute magnitude of SN 1991T at *B* maximum was apparently similar to that of a typical type Ia event. Thus, although the data suggest that SN 1991T was a type Ia supernova with peculiar surface abundances, in most other ways it seems to have been a completely normal type Ia explosion.

1. INTRODUCTION

It is well known that the spectral evolution and light curves of type Ia supernovae (SNe Ia) follow a reproducible pattern (Minkowski 1939; Barbon *et al.* 1973; Kirshner *et al.* 1973), but the extent to which intrinsic differences exist between individual events has been the subject of considerable debate. Convincing evidence for inhomogeneities in the optical spectra of SNe Ia was presented by Branch (1987), who showed that the spectrum of SN 1984A near maximum light was blueshifted by several thousand km s⁻¹ with respect to that of the well-observed type Ia event SN 1981B. In a follow-up to this work, Branch *et al.* (1988) collected wavelength measurements of the Si II λ 6355 absorption minimum in a sample of 24 SNe Ia and showed that significant differences existed in the velocity evolution of this line. Further evidence for inhomogeneities in the photometric and spectroscopic properties of SNe Ia was provided by Phillips *et al.* (1987) and Frogel *et al.* (1987), who obtained detailed optical and infrared observations of SN 1986G in Centaurus A (NGC 5128). The *B* and *V* light curves of this supernova were found to decline faster than those of SN 1981B, while differences in the infrared light curves were even more pronounced. In addition, Phillips *et al.* found evidence of small, yet detectable, differences between the relative strengths of certain absorption lines in the spectra of SNe 1986G and 1981B at maximum light.

The existence of these photometric and spectroscopic inhomogeneities raises questions regarding the suitability of SNe Ia as cosmological standard candles. In defense of SNe Ia as reliable distance indicators, it might be argued reasona-

bly that events such as 1986G with peculiar light curves are relatively rare, and that the majority of SNe Ia display a much greater degree of homogeneity. Indeed, comparison of the optical and infrared light curves of the two SNe Ia (1980N and 1981D) which appeared in Fornax A (NGC 1316) reveals an amazing degree of similarity (Elias *et al.* 1985; Hamuy *et al.* 1991). In this paper, however, we present observations of the recent type Ia event SN 1991T which, more dramatically than ever, confirm the existence of a significant dispersion in the spectroscopic and photometric properties of SNe Ia.

SN 1991T was discovered in the Sb(s)II galaxy NGC 4527 by Stephen Knight on April 13.17 (UT) at about 14th mag (Waagen 1991). Subsequent brightness estimates by Knight (1991), Evans (1991), Villi & Cortini (1991), Johnson (1991), and Cutispoto (1991) revealed that the supernova had been caught significantly before maximum, providing an excellent opportunity for detailed study. The first optical spectra, which were obtained on April 16 (UT) and reported by Cappellaro (1991) and Kirshner (1991), were unusual in showing a nearly featureless continuum with two strong lines at approximately 4240 and 4940 Å. Both Cappellaro and Kirshner suggested that SN 1991T might be a type Ia event on the rise, but this was not confirmed until Phillips & Hamuy (1991a) announced the appearance of Si II λ 6355 absorption in a spectrum obtained on April 25 (UT). However, Phillips and Hamuy emphasized the peculiar nature of the spectrum of SN 1991T, calling particular attention to the weakness of the Si II and Ca II *H* and *K* absorption features.

In Sec. 2 of this paper, we present a preliminary summary of optical photometry and spectra of SN 1991T obtained at Cerro Tololo Inter-American Observatory (CTIO), the F. L. Whipple Observatory, and the Multiple Mirror Telescope (MMT) from about 2 weeks before to 10 weeks past maximum. These data, which confirm the unusual nature of the spectral evolution of SN 1991T in the days leading up to maximum light, are compared with similar-epoch observa-

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tions of two other well-observed SNe Ia (1989B and 1990N) in Sec. 3. The resulting conclusions are summarized in Sec. 4.

2. OBSERVATIONS AND RESULTS

Optical photometric and spectroscopic observations of SN 1991T were initiated at CTIO, the F. L. Whipple Observatory, and the MMT shortly after the discovery announcement. A detailed presentation of these data will be given in a later paper. Figure 1 [Plate 100] shows a CCD image of NGC 4527 and SN 1991T taken through an *I* filter with the CTIO 0.91 m telescope on 1991 July 1 UT (62 days after *B* maximum). Broadband *B* and *V* light curves and the *B* - *V* color evolution derived from CCD images and spectrophotometry obtained at CTIO, and from photoelectric photometry reported in the IAU Circulars (Cappellaro 1991; Menzies 1991; Gilmore 1991a,b,c,d; Holberg *et al.* 1991a,b), are plotted in Fig. 2. Included in the *V* light curve is the discovery observation by Knight and an upper limit due to Villi & Cortini (1991). The sky measurements for the CCD photometry and spectrophotometry were taken within a few arcseconds of the supernova so as to correct as best as possible for the underlying galaxy. Comparison of the image shown in Fig. 1 with the photograph of NGC 4527 published by

Sandage *et al.* (1985) shows that SN 1991T appeared on the edge of a very low surface brightness spiral arm. Hence, the errors associated with these background estimates should have very little effect (if any) on the precision of the supernova photometry over the ~ 3 month time period that our observations cover.

As is shown in Fig. 2, SN 1991T increased steadily in brightness over the two weeks following discovery, with *B* maximum occurring on 1991 April 28.5 ± 1 UT (JD 2448375.0). Maximum light in *V* was reached approximately two days later. We estimate apparent magnitudes at maximum of 11.64 ± 0.05 and 11.50 ± 0.04 for *B* and *V*, respectively, and a *B* - *V* color at *B* maximum of 0.13 ± 0.04 . According to Burstein & Heiles (1982), the foreground extinction toward NGC 4527 is $A_B = 0.00$ mag. However, the optical spectra showed interstellar Na I D absorption at a heliocentric velocity of ~ 1775 km s $^{-1}$ (Phillips & Hamuy 1991a,b; Sivaraman 1991; Wheeler 1991) and an approximate total equivalent width of 1.5 Å, which under high spectral resolution was found to split into three separate components (Wheeler 1991). This would suggest that the light of SN 1991T probably suffered some extinction due to dust in the disk of NGC 4527.

Figure 2 shows that the photometry for SN 1991T resembles the standard SNe Ia light curves given by Leibundgut (1988), but the slope of the initial decline following maximum was less steep than the template in both colors. We measure a decline rate of 0.099 ± 0.004 mag day $^{-1}$ for the *B* light curve of SN 1991T over the time period from 6 to 20 days past maximum. For reference, the decline rate of the template over this same period is 0.107 mag day $^{-1}$, and that of the "fast" SN Ia 1986G (Phillips *et al.* 1987) was 0.126 ± 0.007 mag day $^{-1}$. Measurements of the *V* light curves over the same phase interval yield rates of 0.052 ± 0.002 mag day $^{-1}$ for SN 1991T, 0.057 mag day $^{-1}$ for the template, and 0.082 ± 0.001 mag day $^{-1}$ for SN 1986G. A month after maximum, these slight differences in decline rates had produced deviations of 0.2–0.3 mag between the observations of SN 1991T and the templates. At later phases, the *V* data seemed to come back into accord with the template, whereas the *B* measurements ran roughly parallel to, but ~ 0.2 mag brighter than, the template. The final point in the *B* light curve, which was obtained on 1991 July 23 UT (84 days after maximum), suggests that the decline rate at these later epochs was also less steep than average, but this needs to be confirmed. As shown in Fig. 2, the *B* - *V* color evolution followed the template curve fairly closely through the first 40–50 days after *B* maximum, but gradually grew bluer than average at later phases.

A selection of spectra obtained with the CTIO 4.0 and 1.5 m telescopes covering the period from 8 days before to 67 days after *B* maximum are displayed in Fig. 3. Also shown is a spectrum taken with the F. L. Whipple Observatory 1.5 m telescope on April 16 UT and corresponding to 12 days before *B* maximum. This spectrum, and the one obtained at CTIO 8 days before maximum (April 20 UT) clearly illustrate the two main peculiarities initially reported for this supernova—the blue and nearly featureless continuum, and the two lines at approximately 4260 and 4965 Å. Additional weaker absorptions are present in these early spectra, including a feature at an observed wavelength of ~ 3208 Å. However, the biggest anomaly is the absence of Si II λ 6355 and Ca II *H* and *K* absorption. The latter features are barely visible in the third spectrum displayed in Fig. 3 which was ob-

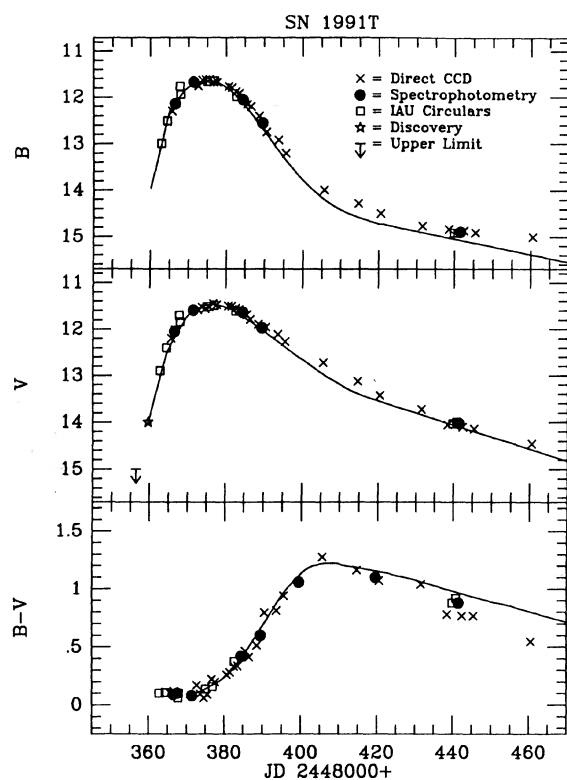


FIG. 2. *B* and *V* light curves and *B* - *V* color evolution of SN 1991T. Included are photometry from direct CCD images taken with the CTIO 0.9 and 4.0 m telescopes, synthetic magnitudes derived from spectrophotometry obtained with the CTIO 1.5 and 4.0 m telescopes, and photometry reported in the IAU Circulars. The observations are compared to the SNe Ia template light curves given by Leibundgut (1988). The *B* - *V* template has been adjusted to match the observed color of 0.13 at *B* maximum for SN 1991T.

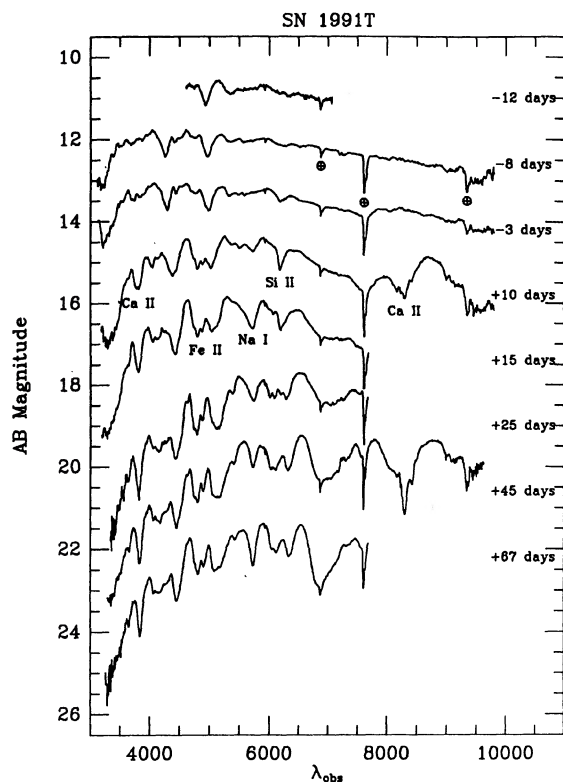


FIG. 3. Spectral evolution of SN 1991T based on observations made with the CTIO 1.5 and 4.0 m telescopes. The spectra are plotted on an AB magnitude scale ($AB = -2.5 \log F_\nu - 48.595$), but are shifted with respect to each other by arbitrary amounts.

tained on April 25 (UT), or 3 days before B maximum. By the time of the fourth spectrum, which is a composite of observations obtained on May 8 and 9 (UT) corresponding to a phase ~ 10 days after maximum, the Si II and Ca II lines have grown considerably in strength and the Ca II triplet has appeared in emission in the far red with a clear P Cygni profile. These data leave no doubt that SN 1991T was a genuine type Ia event. The four remaining spectra plotted in Fig. 3, which cover the light curve phases from 15 to 67 days after B maximum, are dominated by Fe II absorption bands as is typical of SNe Ia at such epochs.

3. DISCUSSION

We have shown that the B and V light curves of SN 1991T resembled those of other SNe Ia, although the slope of the decline phase immediately following maximum was significantly less steep than average in both colors. These observations, taken together with the precision photometry published in recent years for SNe 1980N (Hamuy *et al.* 1991), 1986G (Phillips *et al.* 1987), 1989B (Wells *et al.* 1992), and 1990N (Leibundgut *et al.* 1991), prove that subtle deviations in the post-maximum decline rates of SNe Ia exist. *We can now definitively state that the light curves of SNe Ia are not all identical.* The premaximum photometry for SN 1991T also implies a rise time significantly in excess of 15 days, consistent with the recently published light curves of SNe 1980N and 1981D (Hamuy *et al.* 1991) and 1990N

(Leibundgut *et al.* 1991) but inconsistent with many theoretical attempts to model SNe Ia light curves as deflagrations (e.g., Woosley & Weaver 1986; but see also Harkness 1991), detonations (e.g., Woosley *et al.* 1986), or delayed detonations (Höflich *et al.* 1991; but see also Khokhlov *et al.* 1991).

The unusual character of the spectrum of SN 1991T at early phases is best appreciated by direct comparison with observations of the two well-observed SNe Ia 1989B (Barbon *et al.* 1990; Wells *et al.* 1992) and 1990N (Leibundgut *et al.* 1991), both of which were discovered well before maximum. The photometry for these two supernovae, as well as that for SN 1991T, allow the respective dates of B maximum to be ascertained to within a precision of ± 1 day. A comparison of the spectra of these supernovae as they appeared a week before B maximum is illustrated in Fig. 4(a). Although the general shape of the continuum radiation is similar for all three objects, the extreme weakness of the Si II λ 6355 and Ca II H and K absorption in SN 1991T is strikingly apparent. The Si II lines at 4129 and 5972 Å, and the S II λ 5454, 5640 lines are also unusually weak, which explains the initial reports of the “featureless” character of the optical spectrum. However, from Fig. 4(a) it is apparent that the spectra of SNe 1990N and 1989B were not identical at this early phase either. This point was made by Leibundgut *et al.* (1991) who called attention to the weakness of the Si II and S II absorp-

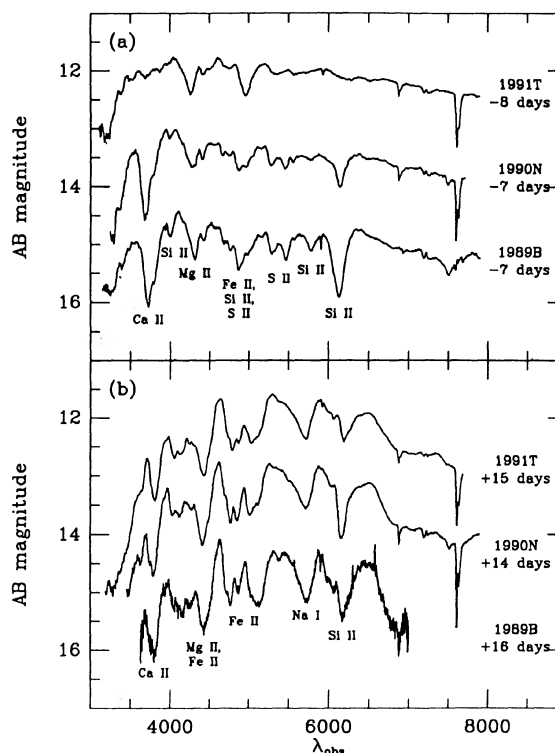


FIG. 4. (a) Comparison of the spectrum of SN 1991T obtained approximately one week before B maximum with similar epoch spectra of the SNe Ia 1990N and 1989B. The spectra are plotted on an AB magnitude scale, but have been shifted with respect to each other by arbitrary amounts. Line identifications as given by Branch *et al.* (1983) are indicated. (b) Similar comparison of the spectra of SNe 1991T, 1990N, and 1989B at a phase corresponding to approximately two weeks after maximum.

tion in SN 1990N, and to the presence of an absorption feature at $\sim 5560 \text{ \AA}$ which is only faintly visible in the spectrum of SN 1989B. Indeed, the Si II and S II lines in SN 1990N are intermediate in strength between those of SNe 1989B and 1991T. However, the same does not apply to the Ca II *H* and *K* absorption which is just as strong in the spectrum of SN 1990N as it is in SN 1989B.

Spectra of these same supernovae obtained ~ 15 days after maximum are displayed in Fig. 4(b). The overall resemblance is now very close. In fact, the only obvious difference is in the relative strength of the Si II $\lambda 6355$ absorption, which is still weakest in SN 1991T—although the magnitude of this effect is much less than in the premaximum spectra. Spectra of these three supernovae obtained at later phases show even closer agreement. Hence, the gross spectral anomalies observed for SN 1991T were confined to the premaximum and maximum phases only.

The identifications of the two absorption features at approximately 4260 and 4965 $\text{\AA}$ which were the strongest lines in the premaximum optical spectra of SN 1991T are unclear. As may be seen in Fig. 4(a), the 4260 $\text{\AA}$ feature bears a strong resemblance to an absorption line which has traditionally been identified with Mg II $\lambda 4481$ (Branch *et al.* 1982). The 4965 $\text{\AA}$ feature falls at approximately the same wavelength as a blend of lines that has been identified with transitions of Fe II, Si II, and S II. However, the Si II and S II identifications are clearly doubtful due to the extreme weakness of the other transitions of these elements. Fe II alone also seems unlikely since the shape of the absorption is inconsistent with the blend of Fe II multiplets (42, 48, and 49) which are routinely observed in this wavelength region in type II SNe (e.g., see Branch *et al.* 1981), and in the postmaximum phases of SNe I [cf. Fig. 4(b)]. An alternative identification that we have considered is Mg Ib $\lambda 5175$, but it seems very unlikely that there would be much neutral magnesium at these early phases which are characterized by a photospheric temperature of $\sim 20\,000 \text{ K}$.³ The absorption feature at $\sim 3208 \text{ \AA}$ observed early on in SN 1991T resembles a feature seen in SNe 1981B and 1990N which has been attributed to a blend of Co II lines (Branch *et al.* 1983; Branch *et al.* 1985).

In Fig. 5(a), we have plotted the expansion velocities inferred from the minimum of the Si II $\lambda 6355$ absorption in SN 1991T. Note that these measurements were made from all of the spectra taken at CTIO, the F. L. Whipple Observatory, and the MMT, and not just those shown in Fig. 3. These data are compared with similar velocity measurements for SNe 1989B and 1990N, and also for SN 1981B (Branch *et al.* 1983) which has served as the prototype for the SN Ia class over the last decade. A time interval of 20 days between explosion and *B* maximum (see Leibundgut *et al.* 1991) is assumed in this diagram. The Si II velocities for SN 1991T are remarkable in having remained essentially constant over the 20 day period from when this line was first identified (3 days before *B* maximum) to when it became impossible to measure due to blending with Fe II lines (~ 16 days after *B* maximum). This implies that the Si⁺ zone in the expanding ejecta of SN 1991T was confined to a fairly restricted layer characterized by velocities in the range $\sim 9000\text{--}10\,000$

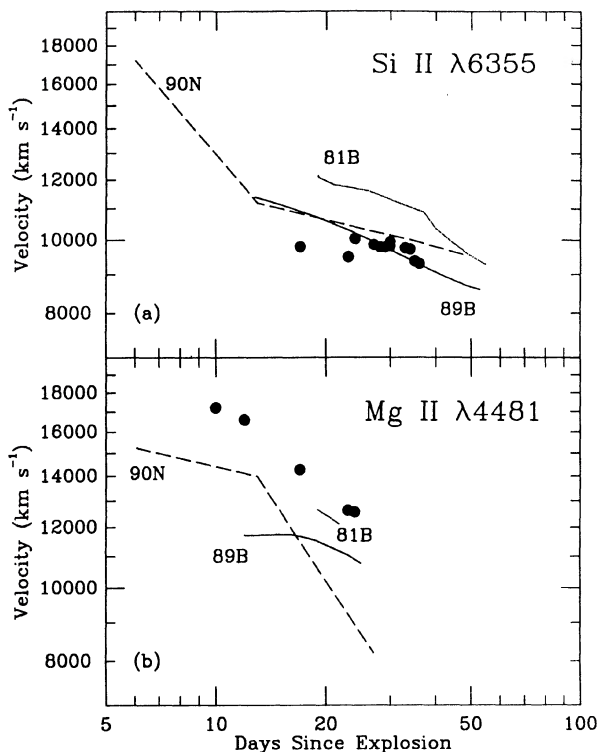


FIG. 5. (a) Expansion velocities inferred from the absorption minimum of the Si II $\lambda 6355$ line in the spectra of SN 1991T. The measurements were made from spectra obtained with the MMT, the F. L. Whipple Observatory 1.5 m, and CTIO 1.5 and 4.0 m telescopes. Similar velocity data for the SNe Ia 1981B, 1989B, and SN 1990N are plotted for comparison. (b) Comparison of expansion velocities inferred from the absorption minimum of the Mg II $\lambda 4481$ line for the same four SNe Ia.

km s⁻¹. Likewise, the velocities inferred from the minimum of the Ca II *H* and *K* absorption are only slightly higher ($\sim 12\,000\text{--}13\,000 \text{ km s}^{-1}$). This is in striking contrast to the observations of SN 1990N, which yielded velocities for both the Si⁺ and Ca⁺ absorption minima ranging from $\sim 10\,000\text{--}20\,000 \text{ km s}^{-1}$ at similar phases [see Fig. 5(a) and Leibundgut *et al.* 1991].

Figure 5(b) shows velocity data for Mg II $\lambda 4481$, assuming that this is the correct identification for the 4260 $\text{\AA}$ feature in SN 1991T. Here a very large decrease in velocity is observed during the period running from 12 days before to 4 days after *B* maximum. The gradient of this decrease is clearly similar to that observed for SN 1990N, although the absolute values of the 1991T velocities are significantly higher. Measurements at epochs later than 4 days after *B* maximum are not included in Fig. 5(b) since the 4260 $\text{\AA}$ feature clearly becomes blended with one or more other absorption features.

SNe Ia have received renewed attention of late as potential cosmological standard candles (Leibundgut & Tammann 1990; Miller & Branch 1990; Leibundgut 1991). In view of the significant differences observed in the premaximum spectra of SN 1991T, it is important to check whether the absolute luminosity of this supernova was typical of other SNe Ia. The mean apparent magnitude of SNe Ia in the Virgo cluster, corrected for the foreground extinction of our

³ In a preprint received after submission of this paper, Filippenko *et al.* (1992) argue that the 4260 and 4965 $\text{\AA}$ features are due to blends of Fe III lines at rest wavelengths of 4400 and 5100 $\text{\AA}$, respectively.

own Galaxy, is $B_{\max} \approx 11.9 \pm 0.2$ (Leibundgut & Tammann 1990; Capaccioli *et al.* 1990). Capaccioli *et al.* (1990) and Hamuy *et al.* (1991) have argued that the intrinsic $B - V$ color of SNe Ia at B maximum is ~ 0.0 . Assuming that SN 1991T had the same intrinsic $B - V$ color at maximum, and adopting the normal extinction relationship $A_B = 4 \times E(B - V)$, implies that SN 1991T was $\sim 0.8 \pm 0.3$ mag brighter than the Virgo SNe Ia. The host galaxy of SN 1991T, NGC 4527, lies to the south of the main Virgo cluster in the so-called "X cloud" (de Vaucouleurs 1973). Recent work by Peletier & Willner (1991) on the infrared Tully-Fisher relation for Virgo cluster spiral galaxies indicates that NGC 4527 lies on the near side of the cluster by an amount $\Delta(m - M)_0 = 0.71 \pm 0.24$ mag. An independent Tully-Fisher measurement by Pierce & Tully (1992) based on a weighted mean of B , R , and I band CCD images (B given half of the weight of R and I) also places NGC 4527 closer than Virgo, although by a smaller amount $\Delta(m - M)_0 = 0.33 \pm 0.24$ mag. A simple average of these results yields $\Delta(m - M)_0 = 0.52 \pm 0.17$ mag, which is not significantly different than the observed brightness difference. Hence, the maximum-light luminosity of SN 1991T appears to have been fairly typical of other SNe Ia.⁴

The relatively small color excess, $E(B - V) = 0.13$, that we derive for SN 1991T is less than the value of ~ 0.38 implied from the plot of interstellar Na I D line equivalent widths versus color excess given by Barbon *et al.* (1990). This is in large part due to the fact that Barbon *et al.* assumed an intrinsic $B - V$ color at B maximum for SNe Ia of approximately -0.3 . In any case, we consider the equivalent width of the interstellar Na I D lines to be an unreliable indicator of the reddening (e.g., see Cohen 1973). The assumption that SN 1991T had a "normal" intrinsic $B - V$ color at maximum light may appear inconsistent with the fact that this supernova did not show strong Ca II H and K and Si II λ 6355 absorption at this phase. However, tests carried out with the maximum-light spectrum of SN 1989B show that the absence of these absorption features affects the $B - V$ color by < 0.02 mag. Note that a color excess of $E(B - V) \sim 0.13$ is also consistent with the color evolution of SN 1991T during the weeks following maximum when the spectrum was very similar to that of a normal SN Ia (cf. Fig. 2).

4. CONCLUSIONS AND SPECULATIONS

Including SN 1991T, we are aware of nine SNe Ia for which spectra have been obtained at least one week before maximum. These are listed in Table 1 along with information concerning the presence of Ca II H and K and Si II λ 6355 absorption. Cases where the wavelength coverage of the spectra did not include one or the other of these features are indicated as "unknown." SN 1991T clearly stands out as unusual in not having developed detectable Ca II and Si II absorption lines at these early phases. Since the photospheric temperature (as indicated by color) of SN 1991T both before and after maximum appears to have been typical of other SNe Ia, the simplest interpretation of the observations is that the abundances of silicon and calcium (and probably sulfur as well) in the outermost layers of the ejecta of SN

TABLE 1. Premaximum spectra of SNe Ia.

SN	Phase (days)	Ca II H & K	Si II λ 6355	Reference
1970J	-8	yes	unknown	Assoua <i>et al.</i> (1976)
1974G	-7	unknown	yes	Iye <i>et al.</i> (1975)
1975N	-7	unknown	yes	Ciatti & Rosino (1978)
1984A	-7	yes	yes	Wegner & McMahan (1987)
1986G	-6	unknown ^a	yes	Phillips <i>et al.</i> (1987)
1989B	-7	yes	yes	Barbon <i>et al.</i> (1990); Wells <i>et al.</i> (1992)
1990N	-14	yes	yes	Leibundgut <i>et al.</i> (1991)
1991T	-12	no ^b	no	This paper
1991aa	(-8)	yes	yes	Phillips (1991)

^aStrong Ca II H & K absorption was observed in a spectrum obtained 4 days before B maximum.

^bFirst spectrum covering Ca II H & K lines obtained 8 days before B maximum.

1991T were unusually low. The intermediate mass elements observed at early phases in SNe Ia are thought to be the products of incomplete nuclear burning—i.e., material which has undergone explosive burning but has not been incinerated completely to nuclear statistical equilibrium. The unusual character of the premaximum spectra of SN 1991T, and the less striking differences observed for other SNe Ia at these phases, are therefore suggestive of differences in the nucleosynthesis that occurs in this partially burned zoned. The fact that the spectrum of SN 1991T eventually evolved into that of a "normal" type Ia event implies that these abundance differences were confined to the outermost layers of the ejecta.

The B and V light curves of SN 1991T declined somewhat more slowly than normal during the first month or so following maximum light. However, the peak luminosity of this supernova was apparently similar to that of other SNe Ia. This latter observation would appear to confirm the conclusion that the differences between this supernova and other type Ia events were confined to the outermost, partially burned layers of the ejecta which, from an energetics point of view, are of negligible importance.

It is worth mentioning the possibility raised by Branch *et al.* (1988) that the heterogeneous character of the premaximum and maximum spectra of SNe Ia might actually be due to the existence of gross asymmetries in the outermost, partially burned layers of the ejecta. Such asymmetries might well result from the instabilities that are expected to accompany a subsonic carbon-oxygen deflagration (see Wheeler & Harkness 1991, and references therein). Depending upon the scale of the asymmetries, the exact appearance of the spectrum at early phases could depend on the viewing aspect. While we don't particularly favor this idea, it cannot be ruled out as an explanation for the spectral peculiarities observed in SN 1991T. Of course, this interpretation also naturally explains the observation that the maximum-light luminosity of SN 1991T was apparently quite typical of other SNe Ia.

The data for SN 1991T that we have presented in this paper leave no doubt that there is a real dispersion in the observed properties of individual type Ia events. While it is unclear whether these differences have significant consequences for cosmological studies, they are of unquestionable relevance when it comes to probing the nature and mechanism(s) of type Ia explosions. These findings for SN 1991T serve to emphasize the importance of pursuing future obser-

⁴ This finding conflicts with the work of Filippenko *et al.* (1992) who concluded that SN 1991T was probably > 0.6 mag more luminous than classical SNe Ia. This discrepancy is due in part to the brighter maximum-light magnitude ($m_V = 11.3$) derived by these authors. Measurement errors associated with their photometry and reddening estimate make this conclusion even more uncertain.

vations of nearby SNe Ia—particularly those which are discovered significantly before maximum light—in similar detail.

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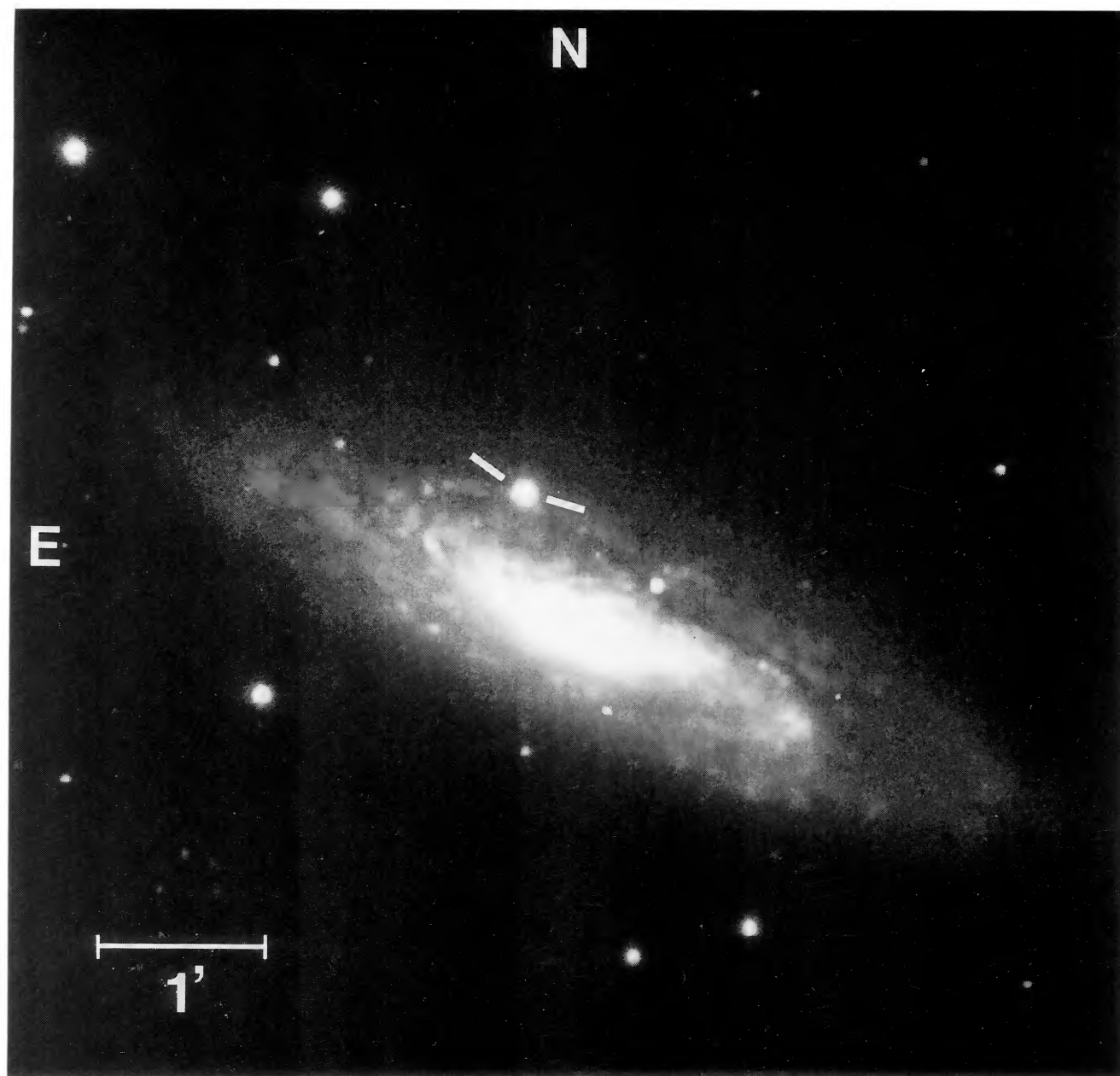


FIG. 1. Direct image of NGC 4527 and SN 1991T obtained through an I filter with the CTIO 0.91 m telescope and a Tektronix 1024² CCD on 1991 July 1 UT (62 days after B maximum). Exposure time was 300 s.

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