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Possible Recovery of SN 1961V in *Hubble Space Telescope* Archival Images[1]

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ABSTRACT. SN 1961V in NGC 1058 was originally classified by Fritz Zwicky as a "Type V" supernova. However, it has been argued that SN 1961V was not a genuine supernova, but instead the superoutburst of an η Carinae–like luminous blue variable star. In particular, Filippenko et al. used pre-refurbishment *Hubble Space Telescope* (*HST*) Wide Field Planetary Camera (WFPC) images and the known radio position of SN 1961V to conclude that the star survived the eruption and is likely coincident with a $V \approx 25.6$, $V-I \approx 1.9$ mag object. Recently, Stockdale et al. recovered the fading SN 1961V at radio wavelengths and argue that its behavior is similar that of some Type II supernovae. We have analyzed post-refurbishment archival *HST* WFPC2 data and find that the new radio position is still consistent with the Filippenko et al. object, which has not changed in brightness or color, but is also consistent with an adjacent, fainter ($I \approx 24.3$ mag), and very red ($V-I > 1.0$ mag) object. We suggest that this fainter object could be the survivor of SN 1961V. Forthcoming *HST* observations may settle this issue.

1. INTRODUCTION

Supernova 1961V in NGC 1058 is an unusual object among the nearly 2100 historical supernovae (SNe), and its nature is unclear. Discovered in 1961 July by P. Wild, SN 1961V had perhaps the most bizarre light curve ever recorded for a SN, with premaximum and postmaximum plateaus of ~0.5 yr, a sustained 3 yr plateau at $m_{pg} \approx 18.5$ mag, and a subsequent decline to $m_{pg} \approx 21$–22 mag (see Humphreys & Davidson 1994; Humphreys, Davidson, & Smith 1999). Spectroscopically, it is one of very few members of the archaic Zwicky (1964, 1965) "Type V" SN classification. Its spectrum, dominated by narrow emission lines of H, He I, and Fe II, suggested a maximum expansion velocity of only ~2000 km s^{-1}. Along with only SN 1987A in the Large Magellanic Cloud (LMC; e.g., Gilmozzi et al. 1987; Sonneborn, Altner, & Kirshner 1987), SN 1993J in M81 (Aldering, Humphreys, & Richmond 1994; Cohen, Darling, & Porter 1995), and SN 1997bs in M66 (Van Dyk et al. 2000), SN 1961V has a possible progenitor star identified on pre-SN images.

The progenitor of SN 1961V may have been one of the most extraordinary stars known. Identified as an $m_{pg} \approx 18$ mag star in many photographs of NGC 1058 prior to the explosion (Bertola 1964; Zwicky 1964; Klemola 1986), it was extremely luminous, at $M^0_{pg} \approx -12$ mag for a distance of 9.3 Mpc (determined using *Hubble Space Telescope* [*HST*] observations of Cepheids; Silbermann et al. 1996), leading to an initial (almost certainly erroneous) theoretical mass estimate of ~2000 $M_\odot$ (Utrobin 1984). Nonetheless, with somewhat more likely mass estimates of $\gtrsim$100–200 $M_\odot$ (Goodrich et al. 1989), it was among the most luminous and massive known individual stars in any galaxy.

Based on an optical spectroscopic detection of SN 1961V in 1986 and reanalysis of older data, Goodrich et al. (1989) postulate that SN 1961V was not a genuine supernova (defined as the explosion of a star at the end of its life), but rather was the giant eruption of a luminous blue variable (LBV) star, much like an exaggerated version of η Carinae (see Davidson & Humphreys 1997 for a review of η Car). Goodrich et al. suggest that SN 1961V actually survived the eruption and that the progenitor faded because of the formation of optically thick dust in the ejecta. They further predict that at the site of SN 1961V should be a quiescent S Dor–type, hot Of/WN star enshrouded by dust and possibly a dense wind; if its circumstellar extinction $A_V \approx 5$ mag and its bolometric correction BC ≈ -4 mag, the star should now have $V \approx 27$ mag. Alternatively, if $A_V \approx 4$ mag, as in the case of η Car, and BC ≈ -3 mag, then $V \approx 25$–26 mag. Finally, V could be as bright as 22–23 mag if the star has $A_V = 4$–5 mag and an active, optically thick wind with BC ≈ 0 mag.

[1] Based on observations made with the NASA/ESA *Hubble Space Telescope*, obtained from the data archive of the Space Telescope Science Institute, which is operated by the Association of Universities for Research in Astronomy, Inc., under NASA contract NAS 5-26555.

TABLE 1
HST WFPC2 PHOTOMETRY OF THE SN 1961V ENVIRONMENT

Object	m_{F450W}	m_{F606W}	m_{F814W}	*B*	*V*	*I*
1	24.51(02)	25.07(35)	24.15(24)	24.49	24.97	24.15
2	...	24.95(24)	23.57(12)	...	25.47	23.58
3	...	...	23.15(08)	...	...	$\gtrsim$23.2
4	23.84(10)	24.22(14)	24.09(17)	23.82	24.22	24.10
5	24.76(25)	24.39(16)	...	24.82	24.50	...
6	...	25.00(27)	23.73(13)	...	25.49	23.73
7	24.02(14)	23.84(14)	23.83(14)	24.04	23.85	23.83
8	...	24.29(01)	...	...	~24.3	...
9	23.63(10)	23.84(10)	23.76(13)	23.61	23.83	23.76
10	24.79(24)	24.07(12)	24.48(26)	24.90	24.13	24.46
11	...	...	24.31(22)	...	...	$\gtrsim$24.3

NOTE.—Values given in parentheses are the uncertainties in the last two digits of the magnitudes.

Motivated by this prediction, Filippenko et al. (1995, hereafter F95) attempted to recover the surviving star via multiband imaging using *HST*, utilizing the radio position obtained by Cowan, Henry, & Branch (1988). Their pre-refurbishment WFPC *VRI* (flight system filters F555W, F702W, and F785LP) images, accompanied by precise astrometry obtained from deep ground-based optical data, led them to associate SN 1961V with one star in a cluster of three stars, all within ~2″ (~90 pc) of each other, as the possible eruption survivor. Their most likely candidate ("object 6"), shown in Figure 1 of the present paper,[2] has $V \approx 25.6$, $V-R \approx 1.0$, and $R-I \approx 0.9$ mag, roughly the colors of a mid-K–type supergiant; if dereddened by reasonable amounts of interstellar and circumstellar reddening, the colors are consistent with those of O-type stars. F95 point out that unaberrated images, particularly in bluer bands, are required to better isolate the possible survivor.

Based on its fading radio emission recently detected in new observations using the Very Large Array (VLA), Stockdale et al. (2001) argue that the current radio properties of SN 1961V are consistent with those of some "peculiar" Type II radio SNe. In particular, they compare SN 1961V with SN 1986J in NGC 891 (Weiler, Panagia, & Sramek 1990), which was originally classified as Type V (Rupen et al. 1987), but is generally considered to be a prototypical Type IIn SN (see Schlegel 1990 and Filippenko 1997 for discussion of this SN subtype). Stockdale et al. contend that it is less likely, based on its radio properties, that SN 1961V was similar to η Car or other LBVs. (However, there is a lack of radio observations of bright LBVs with ages similar to that of SN 1961V, preventing a secure determination of the true nature of SN 1961V.) In other words, they argue that there should be no survivor, only a very old SN or young SN remnant emerging 40 yr after explosion.

In this paper we further investigate whether SN 1961V survived a LBV superoutburst by exploiting archival *HST* WFPC2 images that contain the SN site. We recover "object 6" of F95, and we show that an *additional* faint and very red object is consistent with the radio position of SN 1961V and may represent the possible surviving star. We consider it less likely to be a fading, very old SN, but additional observations are necessary to further clarify this issue.

2. ANALYSIS OF ARCHIVAL *HST* WFPC2 IMAGES

Two *HST* programs, GO-5446 and GO-9042, have imaged NGC 1058, the host galaxy of SN 1961V; the data sets are publicly available in the *HST* archive. The former program obtained on 1994 September 8 a pair of 80 s exposures with the F606W filter, while the latter program obtained on 2001 July 3 two pairs of 230 s exposures, one pair with the F450W filter and the other with the F814W filter. These bandpasses roughly correspond to *V*, *B*, and *I*. Using the radio position of SN 1961V from Stockdale et al. (2001; it is coincident with the position measured by Cowan et al. 1988, to within the errors) and correcting for geometric distortions on the WF3 chip, we isolate the site of the SN for both sets of observations.

Figures 2 and 3 show the SN site on the F814W and F450W images, respectively. An error circle is plotted at the radio position, based on the astrometric information in the headers of the F450W and F814W images, with a (conservative) radius of ~1″.5 (the observations by GO-9042 employed the fine-lock mode, which results in about this level of astrometric uncertainty; see the discussions of *HST* astrometry in F95 and Van Dyk et al. 1999a). Figure 4 shows the site in the F606W image; this exposure was obtained in "gyro" mode and likely has less reliable astrometry than the F814W and F450W images, so we impose the error circle of Figures 2 and 3 onto Figure 4. The source numbering is from Figure 1, as in F95. Object 8 is situated off the F450W and F814W images but is detected on the F606W image.

To measure the brightnesses of the various sources through each of the three bands, we employed version 1.1 of the package HSTphot (Dolphin 2000a, 2000b). We followed the "recipe" in the HSTphot on-line manual,[3] initially adopting a 4 σ detection threshold and using the following tasks in sequential order: *mask*, *crmask*, *coadd*, *getsky*, *hotpixels*, and *hstphot*. As Dolphin (2000b) has shown, HSTphot produces results that are quite consistent with those obtained from both the DAOPHOT and DoPHOT packages, while accounting for WFPC2 point-spread function variations and charge-transfer effects across the chips, zero points, aperture corrections, etc., automatically within one package. (We have also conducted limited tests of HSTphot vs. DAOPHOT and find very good agreement in the results.) Table 1 gives the results of our photometry in the flight system bandpasses. Not all sources were detected in all three bands, given the relatively low signal-to-noise ratio (S/N)

[2] This is Fig. 2 in F95; it is given again here because it came out so poorly in F95, both in the original version and in the Erratum.

[3] See http://www.noao.edu/staff/dolphin/hstphot.

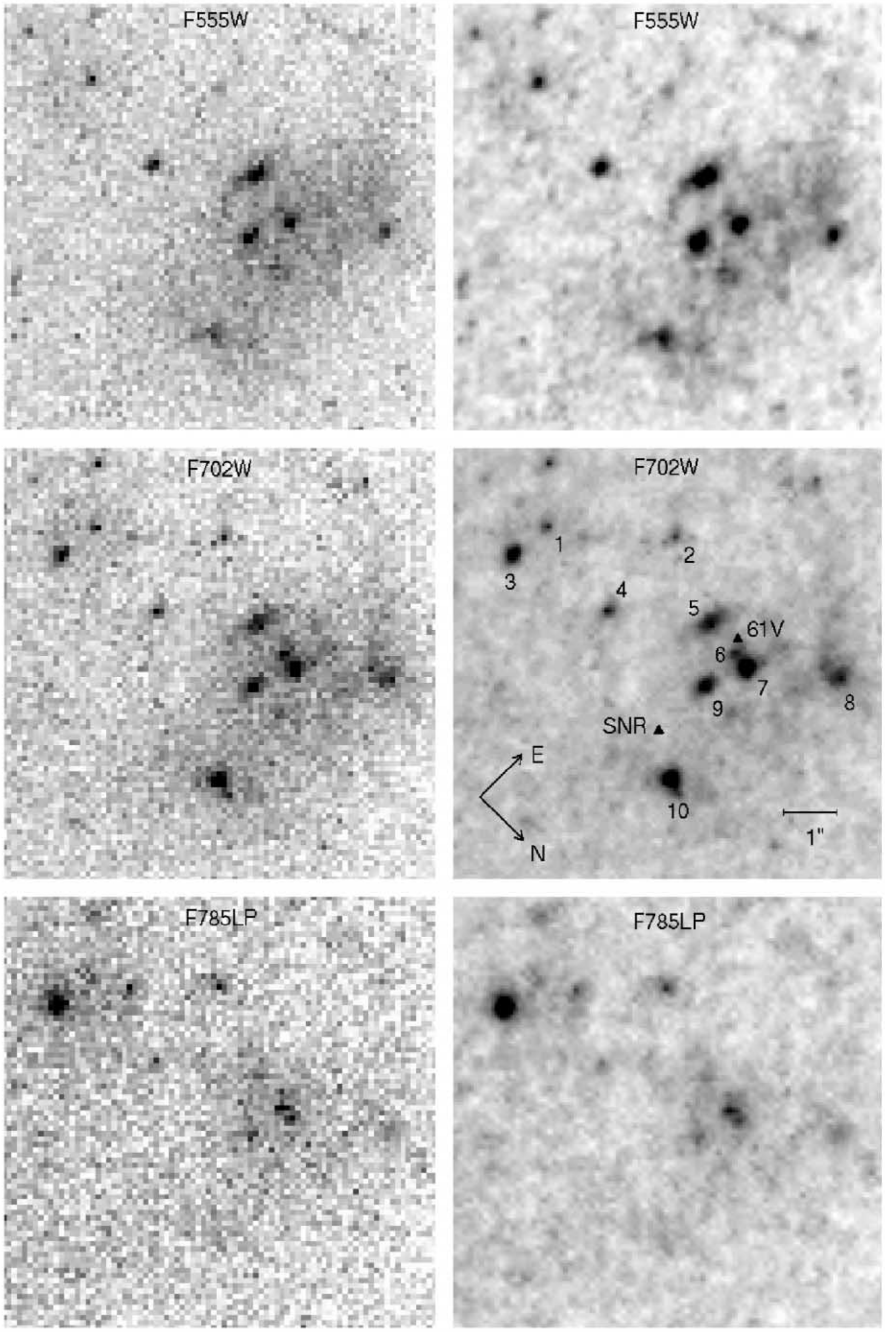

FIG. 1.—Fig. 2 of F95, showing *HST* WFPC unrestored (*left*) and deconvolved (*right*; Lucy-Richardson algorithm) images of the SN 1961V environment. Objects discussed in the present paper are labeled. The nominal radio positions (Cowan et al. 1988; uncertainties $\pm 0\farcs3$) of SN 1961V and an old radio supernova remnant are marked with triangles labeled "61V" and "SNR," respectively.

of these images. Detection limits (3 σ) are $m_{\rm F450W} \approx 25.3$, $m_{\rm F606W} \approx 25.4$, and $m_{\rm F814W} \approx 25.3$ mag.

In order to further analyze the archival images, we have transformed our flight system magnitudes into Johnson-Cousins *BVI* magnitudes, in a manner analogous to that of F95, i.e., via synthetic photometry of normal stars of a wide span of spectral types and luminosity classes, obtained by applying the STSDAS package SYNPHOT to the Bruzual Spectral Synthetic Atlas. In Table 1 we list the *BVI* magnitudes, wherever possible, for the objects in the SN 1961V environment. In two cases,

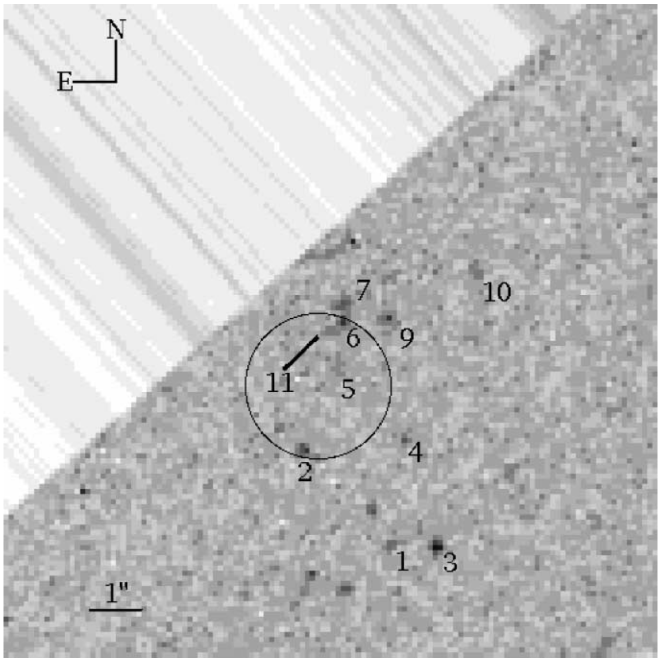

Fig. 2.—*HST* WFPC2 F814W image of the SN 1961V environment, obtained by program GO-9042 and available in the archive. An error circle of radius 1".5 is plotted at the radio position of SN 1961V. Note how close the environment is to the edge of the WF3 chip. Source numbering is given in Fig. 1. Also labeled is object 11, which is coincident with the radio position of SN 1961V, as indicated by F95, and which we suggest may be the survivor of SN 1961V.

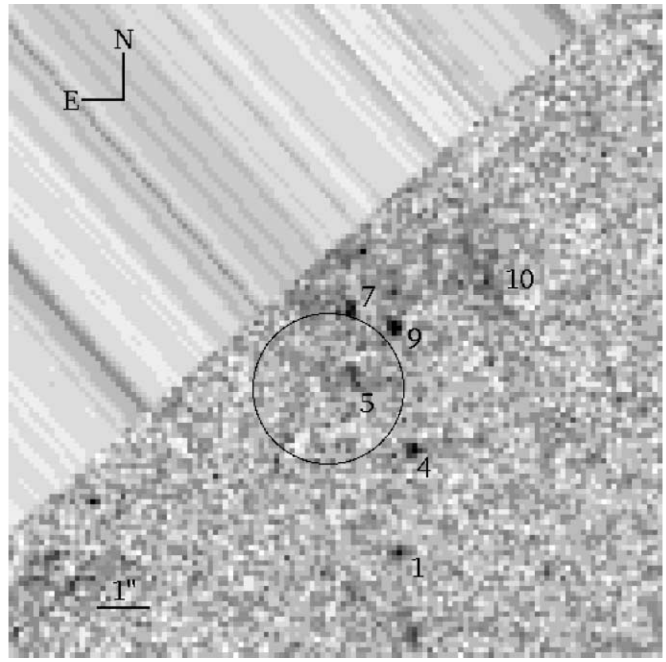

Fig. 3.—*HST* WFPC2 F450W image of the SN 1961V environment, obtained by program GO-9042, with the same scale, position, and orientation as in Fig. 2. Object 8, as in Fig. 2, is off the WF3 chip.

we used the detection limit at F606W to set a lower limit on the *I* magnitude; for object 8, we could only approximate the transformation.

Despite the passband differences between the two studies (F606W and F814W here vs. F555W and F785LP in F95), the *V* and *I* magnitudes of objects 1–10 agree fairly well overall. Our *V*-band magnitudes are brighter by -0.08 mag, but with a rather large dispersion, 0.34 mag. Our *I*-band magnitudes are fainter by 0.04 mag, with a dispersion of 0.20 mag. The average errors in our *V* and *I* magnitudes are 0.18 and 0.17 mag, respectively; for the measurements in F95, they are 0.14 and 0.20 mag, respectively. Thus, the *I*-band magnitudes agree to within the errors, but the dispersion in our *V* magnitudes is about a factor of 2 larger than the uncertainties in either study. We cannot account for this discrepancy entirely through differences in bandpass or S/N; it may arise from underestimates of the uncertainty in the aberrated WFPC photometry. For example, the largest disagreements are for object 5 (which is clearly extended), object 7 (which is in a crowded environment with a high background), and object 10 (which also may well be extended).

In Figures 5 and 6 we show the color-magnitude diagrams for the objects in the SN 1961V environment. As pointed out by F95, SN 1961V appears to have occurred in a region

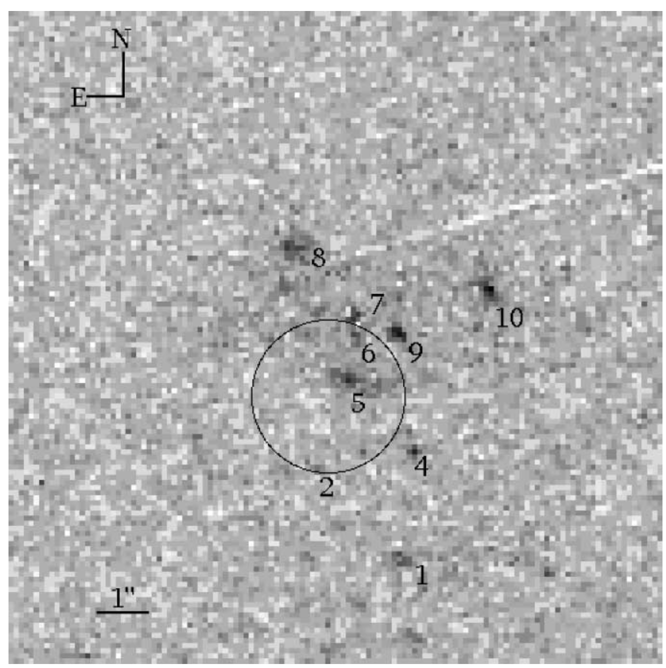

Fig. 4.—*HST* WFPC2 F606W image of the SN 1961V environment, obtained by program GO-5446, with the same scale, position, and orientation as Fig. 2. Object 8, which is off the WF3 chip in Figs. 2 and 3, is labeled.

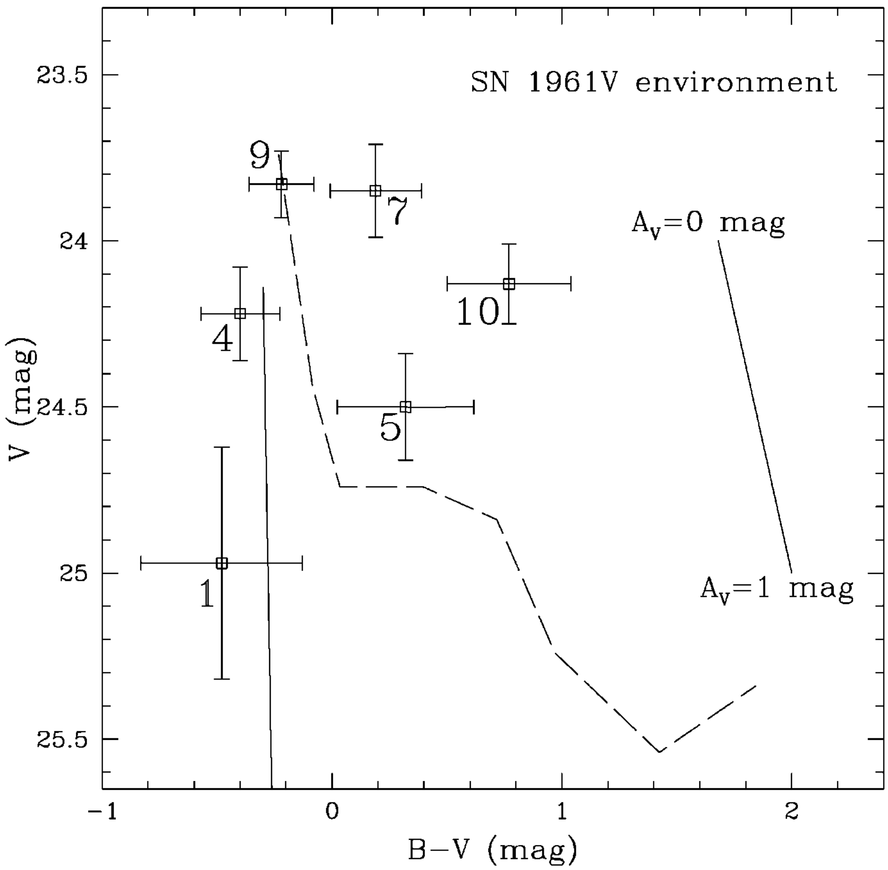

FIG. 5.—$B-V$ vs. V color-magnitude diagram for the objects in the SN 1961V environment. The points for the objects are labeled. Shown is the locus for the main sequence (*solid line*) and for supergiants (*dashed line*) derived from Bessell (1990) and Binney & Merrifield (1998). Also shown is the reddening vector from Cardelli, Clayton, & Mathis (1989).

containing several massive supergiant stars. Objects 4, 7, and 9 are consistent with being early-type supergiants. Objects 1 and 10 are also of early type and are possible supergiants, but we cannot be certain because substantial disagreement exists between their respective $B-V$ and $V-I$ colors. Object 5 is consistent with either an intermediate-type supergiant or an early-type supergiant reddened by $A_V \approx 0.8$ mag. We have no color information for object 8, but F95 identified it as an intermediate-type supergiant. Both objects 2 and 6 have quite similar colors and brightnesses, consistent with late-type supergiants. An additional faint, red object is detected only in the F814W image, just to the southeast of object 6, and was not identified by F95. We list this in Table 1 as "object 11" and represent it with limits in Figure 6 (its I-band brightness and $V-I$ color limits are based on the 3 σ detection limit of the F606W image).

Figure 3 also hints at an underlying population of fainter blue stars, extending from object 5 northeast to object 8, and to the west around object 10. Such a background of blue stars may have also been detected by Utrobin (1987) and Goodrich et al. (1989). Figure 4 hints at extended nebular emission, primarily Hα falling within the F606W bandpass, that appears to trace these blue stars. The S/N in both the F450W and F606W images is simply not sufficient to better detect this population and nebulosity.

3. DISCUSSION

As can be seen in Figure 2, objects 2, 5, 6, and 11 are within the positional error circle for SN 1961V and therefore can be considered viable candidates for its survivor or remnant. Object 5 is quite diffuse and fairly blue: barely visible in Figure 2, it is not detected as a source in the F814W image. F95 identify it as a possible O6 I–III star, although it appears here as a possible supergiant intermediate in type, or perhaps of early type and somewhat reddened. Even if SN 1961V were a fading Type II SN, its color should be fairly red, even without local interstellar or circumstellar reddening, since its optical spectral energy distribution should be dominated by Hα emission (e.g., Long, Blair, & Krzeminski 1989; Fesen 1993; Chevalier &

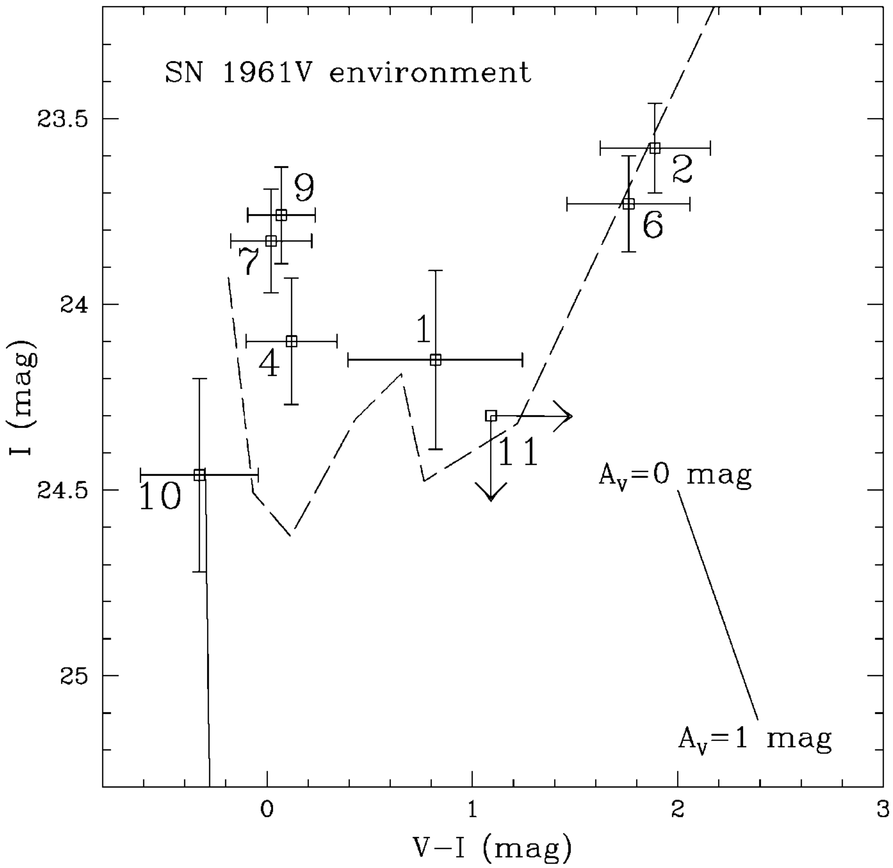

FIG. 6.—$V-I$ vs. I color-magnitude diagram for the objects in the SN 1961V environment. The points for the objects are labeled. An upper limit for the magnitude and lower limit for the color of object 11 are represented. Shown are the loci for the main sequence (*solid line*) and for supergiants (*dashed line*) derived from Bessell (1990) and Binney & Merrifield (1998). Also shown is the reddening vector from Cardelli et al. (1989).

Fransson 1994). We therefore do not further consider object 5 as a possible candidate.

Both objects 2 and 6 are quite red, so they are more consistent with our expectations for either an old SN or reddened LBV star. They are roughly equidistant from the radio position (Cowan et al. 1988; Stockdale et al. 2001) on the WFPC2 images. However, central to the argument by F95 that SN 1961V survived the superoutburst as object 6 is its near-coincidence with the radio position projected onto the WFPC images. This projection is based on the application of an independent, accurate astrometric grid, established from deep ground-based imaging, to the WFPC chip on which the SN environment lies, with the knowledge that the relative astrometry within a given chip is excellent. This projection falls within our error circle and may, in fact, better represent the actual SN position on the *HST* images. Object 2 is more distant from this position; hence, we no longer consider it to be a candidate. Furthermore, to within the errors, both objects 2 and 6 have not changed in brightness or color between the WFPC and WFPC2 exposures. It is possible that they are both LBVs, reddened by similar amounts and remaining at relatively the same brightness; it is more likely, however, that both objects 2 and 6 are similar late-type supergiants. We therefore also now consider it less likely that object 6 is the SN 1961V survivor.

Another candidate for the survivor or very young remnant of SN 1961V may be object 11. It is faint ($I \gtrsim 24.3$ mag) but also quite red ($B-I \gtrsim 1.0$ mag and $V-I \gtrsim 1.1$ mag). Unlike the possibly early stellar type object 10, which is actually fainter in I, object 11 is not detected in the F606W and F450W images. From the independent astrometric grid, the radio position actually lies just to the southeast, within a few pixels of object 6 (Fig. 1), and is certainly within the WFPC2 error circle. However, it is virtually coincident with object 11. A hint of this source can be seen in the deconvolved F785LP image (Fig. 1). It is seen in each of the raw F814W images before cosmic-ray rejection and co-addition and is detected by HSTphot in the co-added image at the 5 σ level.

Could the brightness and color of object 11 be consistent with a decades-old SN? If SN 1961V is currently an old radio SN, as Stockdale et al. (2001) suggest, its optical luminosity, particularly at Hα, might still be relatively high, since late-time SN radio and optical emission appear to be correlated (e.g., Chevalier & Fransson 1994). SN 1961V has not dropped off precipitously in radio brightness at very late times, in contrast with SN 1957D (Cowan, Roberts, & Branch 1994; Long, Winkler, & Blair 1992) or SN 1980K (Montes et al. 1998), so we also might not expect the optical emission to have dropped off completely. Therefore, an old SN 1961V could be bright enough to detect with *HST* and may be fairly red.

We can explore this further by comparing SN 1961V with two old Type II radio SNe that are seen in *HST* images. SN 1986J is in publicly available *HST* archival images, obtained by GO-9042 on 2001 July 3 with the F450W and F814W filters (see Van Dyk et al. 1999a, their Fig. 4, for a finder chart). Again, applying HSTphot to these images containing SN 1986J, we obtain $m_{\rm F450W} = 23.13 \pm 0.06$ ($B \approx 23.4$ mag) and $m_{\rm F814W} = 20.39 \pm 0.01$ ($I \approx 20.4$ mag), corresponding to a color $B-I \approx 3.0$ mag. We can also compare with the Type II-L SN 1979C in M100, which Van Dyk et al. (1999b) detect in *HST* images from 1996. We transform the brightness of SN 1979C in the F439W, F555W, and F814W bands to $B \approx 23.2$, $V \approx 22.1$, and $I \approx 21.0$ mag; hence, $B-I \approx 2.2$ and $V-I \approx 1.1$ mag. Both SNe are quite red, but the brightness of SN 1986J is evolving much more slowly than that of SN 1979C (compare $I \approx 20.4$ mag for SN 1986J with Gunn $i \approx 20.2$ mag in 1986; Rupen et al. 1987).

The host galaxies for SNe 1961V and 1986J are in the same group, at a distance of 9.3 Mpc (Silbermann et al. 1996). If we assume $A_V = 1.5$ mag for SN 1986J (Leibundgut et al. 1991), we find that $M_I^0 \approx -10.3$ mag. For SN 1979C, at 16.1 Mpc and $A_V \approx 0.5$ mag (Van Dyk et al. 1999b), $M_I^0 \approx -10.5$ mag. (If either SN is experiencing higher intrinsic circumstellar extinction, then these absolute magnitudes will be even brighter.) In contrast, for object 11, assuming circumstellar $A_V \approx 4$–5 mag, we derive $M_I^0 \approx -7.9$ to -8.5 mag; assuming less extinction, of course, means that object 11 would be intrinsically fainter.

Making a direct comparison of SN 1961V in the optical with these old radio SNe, of course, is difficult, since both SN 1986J and SN 1979C are about 20 yr younger than SN 1961V:[4] they could still significantly fade over the next two decades. Also, SNe II-L and IIn behave differently in both the optical and the radio. Unfortunately, no optical data on old radio SNe as old as SN 1961V are available, other than the ground-based emission-line data for SN 1957D from 1987 through 1988 (Long et al. 1989). Nonetheless, although SNe 1986J and 1979C are indeed quite red, they both appear to be intrinsically brighter than object 11, making it less likely that object 11 is an old SN.

Another distinct possibility is that no positional coincidence actually exists—SN 1961V is not object 11 or any of the other objects detected in the WFPC2 images. This implies that SN 1961V may have faded below detectability in all of these bands (specifically, it must have $I \gtrsim 25.3$ mag). If SN 1961V is an old SN, then it would have intrinsically faded or circumstellar extinction would have significantly increased since the 1986 spectroscopic observations by Goodrich et al. (1989). (In fact, if this is true, then the SN must also have faded significantly between 1986 and the 1991 WFPC observations by F95.) Even if SN 1961V is an η Car–like LBV that has survived a superoutburst, it also may no longer be detectable: a similar, younger case of a possible η Car–like LBV, SN 1997bs in M66 (Van Dyk et al. 2000), has faded considerably and become bluer in recent *HST* snapshot images (Li et al. 2002), rather than redder and brighter, as predicted for increasing amounts of dust.

4. CONCLUSIONS

Ultimately, we conclude that SN 1961V is most likely object 11 and that it has survived its eruption. The brightness and color limits for object 11, shown in Figure 6, are consistent with an early-type supergiant star with $A_V \gtrsim 1$ mag—specifically, the V magnitude (~27–25 mag) predicted by Goodrich et al. (1989) for circumstellar $A_V \approx 4$–5 mag and BC ≈ -3 to -4 mag of a quiescent LBV surrounded by optically thick dust and a stellar wind. Its current absolute brightness is more consistent with a low-luminosity LBV, such as R71 in the LMC (Humphreys & Davidson 1994), possibly in quiescence, than with a decades-old "peculiar" Type II SN.

Clearly, full resolution of the nature of SN 1961V still eludes us. As Stockdale et al. (2001) point out, further multiwavelength observations are needed. Ideally, one might obtain spectra of the candidates; Gruendl et al. (2002) attempted to detect the SN with the echelle spectrograph on the Kitt Peak 4 m telescope but failed to do so. They conclude that they simply may have misplaced the spectrograph slit. However, if SN 1961V is indeed object 11, an alternative explanation is that its relative faintness and redness may have made detection very difficult.

An upcoming *HST* Cycle 11 program, GO-9371 (PI: Y.-H. Chu), will obtain spectra of the SN 1961V environment within 1″ of the SN position using STIS, to find signatures of LBV ejecta nebulae, old SNe, and SN remnants. They will also obtain WFPC2 *VRI* images. If the slit is centered on object 11 and the exposures are of sufficient depth, these spectra might provide the definitive answer. If the broadband imaging is also sufficiently deep and at the highest possible resolution, the brightnesses and colors of the candidate and other stars in the environment could be more accurately measured. SN 1961V is also a GTO target using the newly installed Advanced Camera for Surveys (ACS) at the F475W, F625W, and F775W bands, complementing the GO program.

In addition, deep, high-resolution, near-infrared imaging may be necessary, since we might expect old, cooling SNe and dust-

[4] Although not discovered until 1986, the explosion date of SN 1986J was possibly sometime between 1978 and 1983 (Rupen et al. 1987).

enshrouded hot LBVs to have different infrared colors. For example, η Car has $J-H \approx 0.9$ mag and $H-K \approx 1.5$ mag (Whitelock et al. 1983), while at late times ($\gtrsim$100 days) the Type IIn SN 1998S (also a radio SN) has $J-H \approx 0.4$ mag and $H-K \approx 0.8$ mag as a result of dust in the circumstellar medium (Fassia et al. 2000). Unfortunately, published data are not available for any SN IIn (and, with the exception of SN 1987A, for any other SN of any type) in the infrared at very late times (i.e., several years to decades after explosion), but we might expect that these SNe get redder through additional dust formation. Although this is not a rigorous test, the infrared detection of SN 1961V would also help determine its nature. The red color of object 11 implies that it should be a relatively bright infrared source for detection with a large-aperture telescope under excellent seeing conditions or with *HST*/NICMOS and *SIRTF*.

Finally, as an important aside, if SN 1961V, SN 1986J, the old "Type V" SN classification, and Type IIn SNe bear any connection, *and* if the progenitor of SN 1961V did survive, then the "explosion" mechanism is not core collapse in all SNe IIn. That is, the SN IIn subclass, which is already known to span a very broad range of properties (e.g., Filippenko 1997), may include a number of SN "impostors." The occurrence of SN 1961V and its possible cousins (SN 1954J, Smith, Humphreys, & Gehrz 2001; SN 1997bs, Van Dyk et al. 2000; SN 1999bw, Filippenko, Li, & Modjaz 1999; and SN 2000ch, Filippenko 2000) and their apparent resemblance to η Car and LBV superoutbursts add an intriguing twist to the evolution of very massive stars.

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