How certain is the distance to the most luminous supernova?

H. Arp

Max-Planck-Institut für Astrophysik, D-85741 Garching, Germany

arp@mpa-garching.mpg.de

ABSTRACT

A recent supernova has been reported as exceeding "the light output of an ordinary supernova by at least two orders of magnitude". It is noted that it falls in a minor galaxy in the Perseus Cluster. Some evidence indicating a ten times closer distance for the Perseus Cluster than its redshift distance is discussed here.

1. Introduction

In an informative display of supernovae light curves (Fig.1 in Physics Today, July 2007, p 17) it was clear that SN2006gy was about "10 times brighter than the peak luminosity of type Ia". Implied was a total radiated energy "two orders of magnitude" greater than ordinary supernovae.

The first question that naturally arises is: With what certainty is its distance from the observer known? The Smith et al. paper[1] mentions that the galaxy in which SN2006 appears is a "minor member of the Perseus cluster". Indeed it is, NGC 1260, with a redshift of 5703 km/sec. But readers who are familiar with the sky recognize this as the Perseus - Pisces cluster which extends over large regions of the sky. In fact it extends in filaments over about 90 degrees in angle which would require a structure of startlingly large size at its redshift distance of 74 Mega parsecs.

2. The Perseus-Pisces Cluster

Detailed information on this large region is available from the long term Cataloguing work done by Fritz Zwicky and his associates. The galaxies in this large region down to the classification limit of the Palomar 18-inch Schmidt are shown in Arp[2] Figs. 13 - 15. The strongest line of galaxies, however, consists mostly of E's and S0's originating from the large Sb (NGC 891) and ending on NGC 1260 and the supernova SN2006gy. All the galaxies with redshifts $4800 < cz < 6000$ as given in NED are shown here in Figure 1.

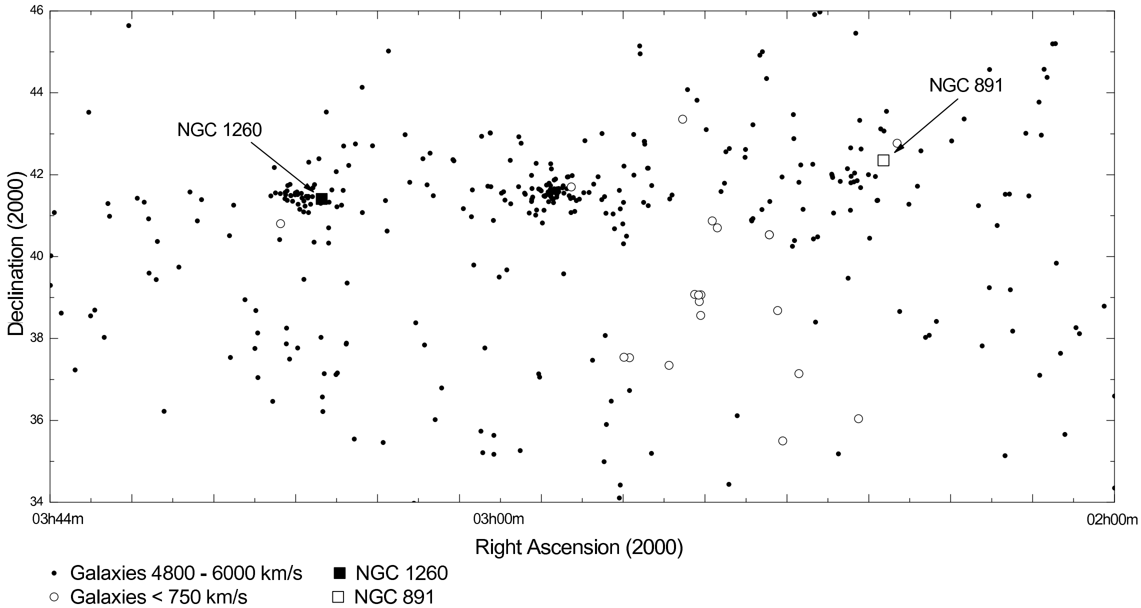

Fig. 1.— Computer plot of all galaxies $4800 < cz < 6000$ in the eastern end of the Perseus-Pisces filament (from the NED Catalogue courtesy D. Carosati). Note that the subclusters are elongated along the filament and the filament appears to start at NGC 891.

Although the galaxies in the line originating in NGC 891 are predominantly in the 5300 to 5700 km/sec range of redshift, the redshift of NGC891 itself is only cz = 528 km/sec. It is intriguing to note that it would imply a distance closer by a factor 10 and luminosity smaller by about a factor of 100 for the supernova if its progenitor had been ejected out of NGC 891 along with some of the higher redshift material.

In fact there are 13 smaller galaxies within 5 deg of NGC 891 with redshifts $527 < v_0 < 637 km/sec$. One could take the least radical position that SN2006gy ocurred in such a companion that was faint enough to escape spectroscopic measurement. The near proximity (1") to NGC 1260 would then be an accident. But I believe there is enough evidence that large galaxies like NGC 891 eject material which becomes higher redshift companions that I would argue for the ejection of the supernova progenitor in that process.

3. Does the supernova progenitor come from NGC 891?

That NGC 891 could have ejected the extremely active radio, X-ray, infra red galaxy Perseus A (NGC 1275) is suggested by the elongation of the perseus A cluster back along the line to NGC 891. Moreover the NGC 891 minor axis is only about 18 deg. off the line to Per A. Of course the low redshift material which gave rise to the supernova would have had to have been entrained along with the ejection of the higher redshift cluster galaxies.

That companion galaxies have an ejection origin along the minor axes of edge on disk galaxies was first pointed out by Holmberg[3] whose observations demonstrated in 1969 preferential alignment along minor axes of disk galaxies. It was then demonstrated by Arp[4] and López Corredoira and Gutiérrez[5] that companions came out in a cone with half opening angle about 35 degrees and quasars within ±20 degrees. As mentioned, the minor axis of NGC 891 is aligned with the nearest galaxies in Fig 1 and to within about 18 deg. of the Perseus cluster to the east.

As for entraining low redshift material from the parent there are now a number of cases where smaller dwarfs are considered to be physical companions which have arisen as fragments from disturbed regions of parent galaxies. A good example of this is NGC 5985 in Fig.2 where this Seyfert galaxy has ejected a quasar but only 2.4 arcsec from it is attached a dwarf with the same small redshift as the big, low redshift, parent galaxy.

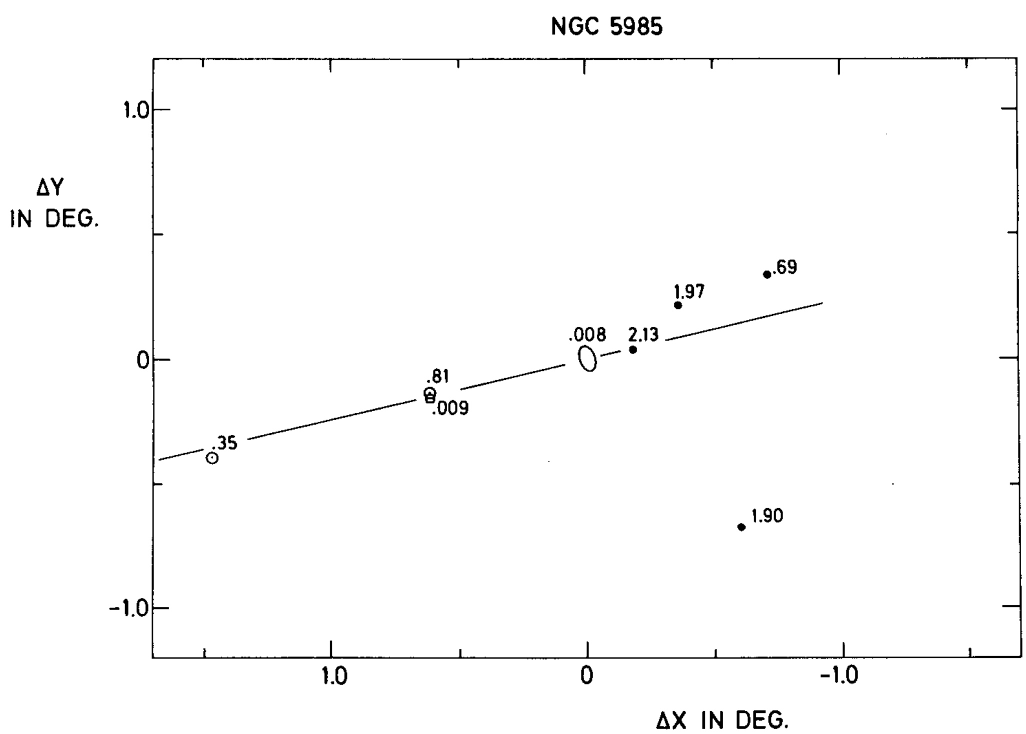

Fig. 2.— The minor axis of the Seyfert Galaxy NGC 5985 (z = .008) leads through the quasar (z = .81) and the dwarf galaxy (z = .009). The latter two are separated by 2.4”.

4. Lines of higher redshift galaxies from bright apparent magnitude galaxies

.

But perhaps the strongest argument for the ejection origin of the Perseus Cluster extending eastward from NGC 891 is the study of the 20 brightest galaxies in apparent magnitude north of Declination = 0 deg. Of the 14 that are uncrowded by nearby bright galaxies, a total of 13 have well marked lines and concentrations of fainter, higher redshift galaxies[2]. Figure 3 shows the range in redshift of the lines of fainter galaxies which are strongly associated with almost every bright galaxy in the sky. This 1990 study was followed by a 2001 study of 14 examples of higher redshift Abell clusters which were paired and aligned across bright apparent magnitude galaxies[6].

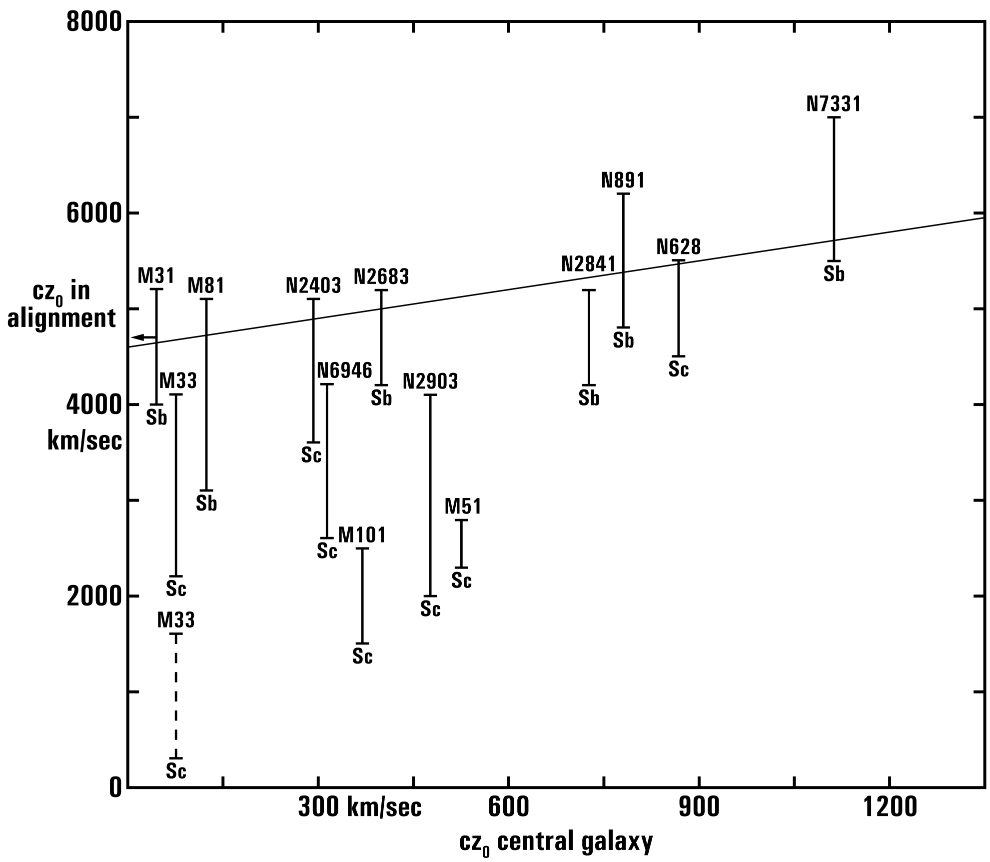

Fig. 3.— Redshift ranges of galaxies which are aligned with bright apparent magnitude spirals (ordinate) correlated with redshift of the bright apparent magnitude galaxy (abscissa).

If such strong ejections take place it is reasonable to expect some of the material of the ejecting galaxy to be carried along with it. Along with ejected gas and plasma which is observed we only need to include a few old stars or groups of stars among which to find the very occasional supernova.

Supernovae of type Ia are much discussed today because of their interpretation in terms of a universe that is expanding faster now than in the past - in other words, “dark energy’.’ But if their luminosity is over estimated the sole reason for this radical postulate falls. If the distance to SN2006gy is strongly overestimated this may also effect to some extent the models of supernovae on which dark energy has been hypothesized.

Generally one could reason that objects at appreciably large distances tend to be younger because of the look-back time. Younger objects tend have built up less metal abundance which in turn lowers the luminosity of objects like Cepheid variables. If intrinsic redshifts of younger material is operative, galaxies like the Perseus Cluster would need low particle masses[4] to explain their apparent association with NGC 891. The smaller elementary particle masses would give smaller luminosities of objects in those galaxies. All of these effects would combine in the direction of making the Hubble constant appear lower in the past and lead to the impression that it was speeding up at present.

Ironically, if we move SN2006gy to this closer distance it could reinstate supernovae I as, at least, approximate distance indicators.

5. References

1. N. Smith et al. Astrophys. J. and http://arXiv.org/abs/astro-ph/0612617 (version 3).

2. H. Arp, J. Astrophys. Astr. (India) **11**, 411 (1990)

3. E. Holmberg, Ark. Astron. **5**, 305 (1969).

4. H. Arp, Astrophys. J. **496**, 661 (1998). H. Arp, Seeing Red (pp.86-87) Apeiron, Montreal.

5. M. López and C.M. Gutiérrez, Astron. Astrophys. **461** 59. (2007)

6. H. Arp and D. Russell, Astrophys. J. **549**, 802 (2001)