ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

Astron. Astrophys. Suppl. Ser. **139**, 531–536 (1999)

The Asiago Supernova Catalogue - 10 years after*

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Received May 7; accepted August 6, 1999

Abstract. Ten years after the publication of the previous release, we present a new edition of the Asiago Supernova Catalogue updated to December 31, 1998 and containing data for 1447 supernovae and their parent galaxies. In addition to the list of the data for a large number of new SNe, we made an effort to search the literature for new information on past SNe as well. We also tried to update and homogenize the data for the parent galaxies. To allow a global view of the Catalogue, a few descriptive figures and a summary table are reported. The present Catalogue is intended as a large and modern database for statistical studies on the supernova phenomenon.

Key words: supernovae and supernova remnants: general — surveys — galaxies: general — galaxies: stellar contents of

1. Introduction

The interest of the scientific community on supernovae (SNe) has enormously increased in the recent years for several reasons. The advances in the understanding of the SN phenomena obtained with the intensive study of nearby SNe, first of all SN 1987A, have raised new more fundamental questions with regard to progenitor evolution, explosion mechanism and nucleosynthesis. In addition, the calibration of the absolute magnitudes of a few SNIa obtained using the Cepheid variables found in their parent galaxies (Saha et al. 1999, and references therein), and the discovery of empirical relations between the absolute magnitudes at maximum and the shape of the light curves of SNIa (Phillips 1993; Riess et al. 1996) have renewed the interest for the utilization of SNIa as distance indicators up to cosmological distances. Other exciting advances are expected for the association of some SNe with the mysterious GRBs. Such wide interest has triggered new, deep SN searches which, in a few years have doubled the number of SN discoveries.

The history of the Asiago SN catalogue began in 1984 with the publication of data for 568 objects (Barbon et al. 1984). This was compiled starting from the Palomar Supernova Master List which has since 1958 from time to time appeared in the literature (Zwicky 1958 and 1965; Kowal & Sargent 1971; Sargent et al. 1974). During the same period two other SN listing have been published, by Karpowicz & Rudnicki (1968) and by Flin et al. (1979), the latter giving also the complete bibliography for each object. The 1984 Asiago SN Catalogue was superseded by a new edition in 1989 (Barbon et al. 1989, [ASC89]) which listed information for the 661 supernovae discovered up to December 31, 1988.

More recently, van den Bergh (1994) published a list containing the 203 supernovae discovered between January 1, 1989 and April 3, 1994 and a *Catalogue of extragalactic Supernovae*, complete up to 1993, was published in volume V of the *General Catalogue of Variable Stars* (Samus 1995).

In the last few years we made available through the WEB at the URL *athena.pd.astro.it/∼supern/* a running SN list which has been widely utilized in the literature. Other supernova listings are available electronically, e.g. the list at the CBAT (*www.harvard.edu/iau/lists/Supernovae.html*), and that at Sternberg Astronomical Institute (*www.sai.msu.su/cgi-bin/wdb-p95/sn/sncat/form*).

The many requests for a new, reliable edition give the motivation for the preparation of the present paper.

2. The catalogue

The new edition of the Asiago SN Catalogue lists data for 1447 SNe and for their parent galaxies discovered up to 31 December, 1998. For the galaxy data we made large use of the *Third Reference Catalogue of Bright Galaxies* by de

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* The complete Catalogue is only available in electronic form at the CDS via anonymous ftp to cdsarc.u-strasbg.fr (130.79.128.5) or via http://cdsweb.u-strasbg.fr/Abstract.html

Table 3. Supernovae not included in the ASC89

1945B	1975U?	1983ab
1950N?	1975V?	1985S
1950O?	1976O?	1985T?
1951J?	1976P?	1986P?
1953J?	1976Q?	1987Q?
1953K?	1977I?	1987R?
1953L?	1978J	1987S
1954ac?	1978K	1988ac
1954ad?	1978L?	1988ad?
1955Q?	1980Q	1988ae
1955R?	1982Z?	1988af
1955S?	1982aa	1988ag
1962R?		

Vaucouleurs et al. (1991, [RC3]) and of the LEDA[1] and NED[2] databases.

The format of the new edition follows that of ASC89 with some improvements. In particular, we have now included:

1. Accurate supernova positions;
2. Position angles of the major axes;
3. Morphological type code of the parent galaxies.

Accurate SN positions are mostly useful to compare observations at different wavelengths, from X-ray to radio, which in recent years had a large impact in SN research. Note that in the present Catalogue all coordinates are given at the 2000.0 epoch. Major axis position angles were introduced to study the position of the SNe within the galaxies and numerical morphological type code to facilitate the derivation of descriptive statistics.

Instead, we choose to drop the information on the parent galaxy luminosity classes because this information is available only for a small fraction (less than 20%) of the objects. The galaxy integrated luminosity can be computed from the apparent magnitudes and distances of the galaxies.

To facilitate the consultation of the Catalogue, we present it with two different sortings: in Table 1 the list is arranged chronologically according to the date of SN discovery while in Table 2 the same data are listed in order of Right Ascension.

In the tables, the content of the different columns is as follows:

[1] LEDA Lyon-Meudon Extragalactic Database; www-obs.univ-lyon1.fr

[2] The NASA/IPAC Extragalactic Database (NED) is operated by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

Table 4. Objects which turned out not to be real supernovae

1950E	1986F	1991W
1956C	1986H	1991ap
1967F	1987E	1992W
1973G	1987H	1993U
1893H	1988X	1993V
1985J	1990C	1998di
1986D	1992X	

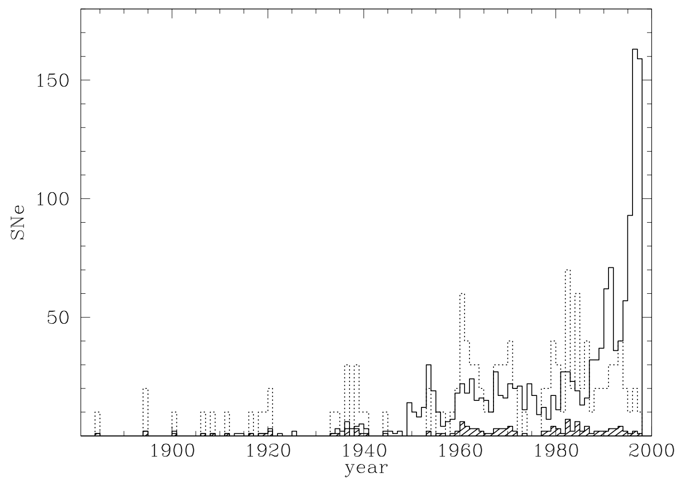


Fig. 1. Histogram of the number of SNe discovered per year. The shaded area refers to SNe with magnitude at maximum (or at discovery) brighter than 14 which, enlarged by a factor 10, are also shown as dotted lines

1: supernova designation. The symbols "?" denote an unconfirmed SN and "*" the occurrence of multiple SN discoveries in the same galaxy.

2: parent galaxy identification. In case a galaxy has different identifications, we adopted the following priority: NGC, IC, MCG (M), UGC, ESO (E), PGC, Leda, others. In some cases specific names are reported, e.g. LMC. Anonymous galaxies are listed with the letter A followed by the coordinates. In a few cases, where the association with a definite parent galaxy was not possible, we have filled the field with INTERGALACTIC.

3-4: equatorial coordinates of the parent galaxy at the 2000.0 epoch.

5-6: equatorial coordinates of the supernova at the 2000.0 epoch.

7: morphological type of the parent galaxy.

8: morphological type code for the parent galaxy (coding as in RC3).

9: only for disk-like system, inclination of the polar axis with respect to the line of sight in degrees (0 for face on systems).

10: position angle of the major axis of the parent galaxy (North Eastwards) in degrees.

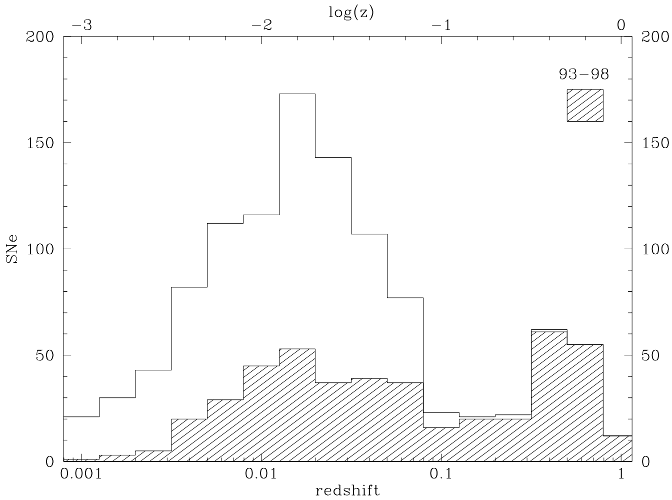


Fig. 2. Distribution of SNe with the redshift of the host galaxy. The shaded area is relative to the SNe discovered in the last 6 years

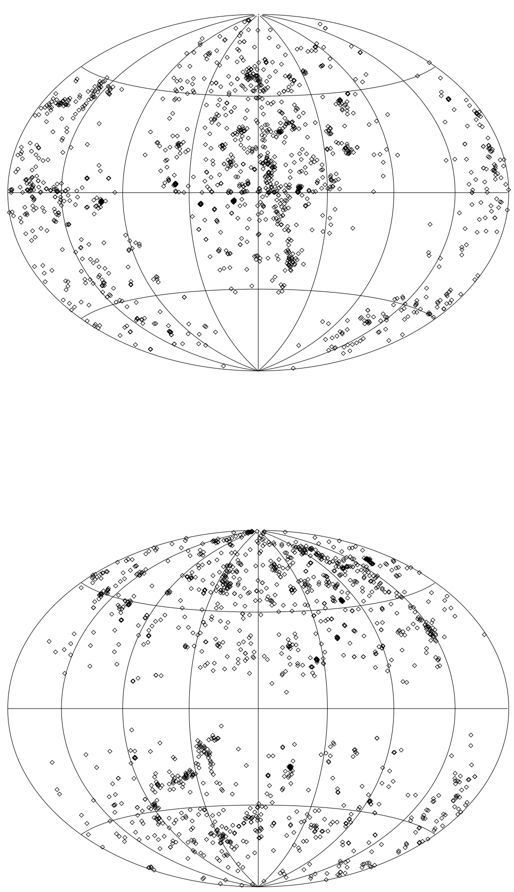


Fig. 3. Distribution of SNe in the sky in equatorial (top) and galactic (bottom) coordinates

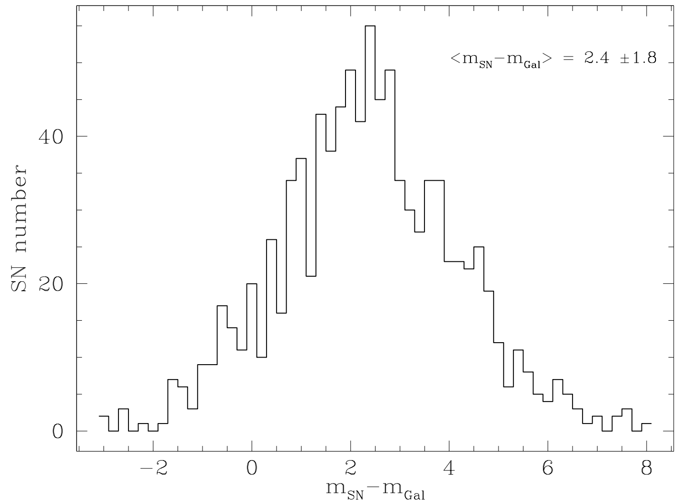


Fig. 4. Histogram of the difference between the SN and galaxy magnitudes

11: heliocentric radial velocity of the parent in km s^{-1}, but for objects with redshift $z \geq 0.1$ where the z value has been listed.

12: integrated B magnitude of the parent, mostly from the RC3 or LEDA. In a few cases only photographic magnitudes (prefixed by "p") are available.

13: decimal logarithm of the apparent isophotal diameter, in 0.1 arcmin units.

14-15: SN offset from the galaxy nucleus in arcsec, in the E/W and N/S direction respectively.

16: if available, supernova magnitude at maximum (photometric band indicated); otherwise discovery magnitude (labelled by "*"). A magnitude without band means that the observation has not been made in a standard photometric system (e.g. those reported in the discovery announcement as photographic, blue plate, red plate, CCD without filter, and so on).

17: supernova type, mostly from spectroscopy. In a few cases, marked by "*", types have been inferred from the light curve.

18: if known, epoch of maximum, otherwise "*" marks date of discovery.

19: name(s) of discoverer(s). For organized search teams the acronyms are given.

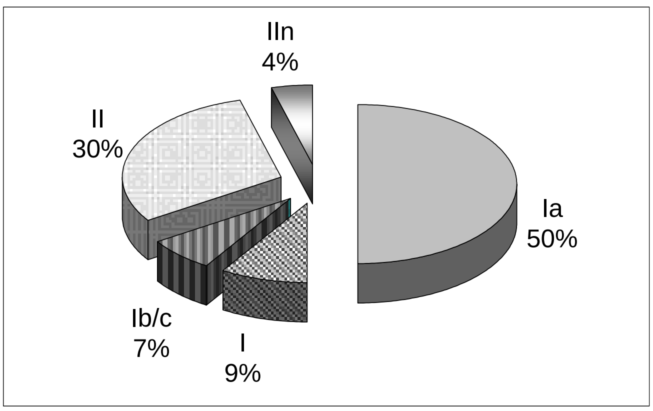
3. Remarks

A major effort has been devoted in searching the literature for accurate magnitudes, epochs of maximum and for assigning supernova types. For this latter task we are indebted to D. Branch (private communication) who provided us with a list of revised supernova types for many SNe. For the supernovae discovered in the periods from 1989 to 1992 and from 1992 to 1998 we have cross checked our data with those of van den Bergh (1994) and the electronic list supplied by the CBAT, respectively.

Table 5. Distribution of supernovae according to the morphological types of their parent galaxies

	E	S0	S0/a	Sa	Sab	Sb	Sbc	Sc	Scd	Sd	Sdm	Sm	S	I0	Im	I	Pec	nc	Total
I	10	2	5	9	3	8	6	13		2			1					18	77
Ia	24	31	6	20	13	28	32	35	10	5		1	18					187	410
Iapec	3	4			2	1	3	2		1			1				1	1	19
Ib			1		1	1	1	9	1						1	1		1	17
Ib/c							2	2		1		1	1					2	9
Ic			1	1	1	2	3	9	2				4					4	27
Iac						2													2
II			2	7	5	32	23	73	12	8	3	1	11	1	2	6		56	242
IIb					1			2	1			1							5
IIn			1	1		5	4	10	1				1			2		9	34
IIpec				1		1		4					1					2	9
Pec				1	1	1		1	1									2	7
nc	38	14	15	32	16	62	42	91	7	8	1	6	58		2	19	1	177	589
Total	75	51	31	72	43	143	116	251	35	25	4	10	96	1	5	28	2	459	1447

Notes: nc means not classified supernovae and/or galaxies.



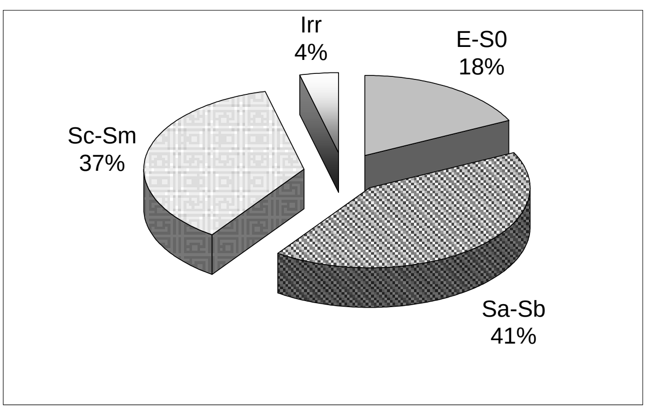


Fig. 5. Distributions of SN types (top) and of the parent galaxy morphological types (bottom)

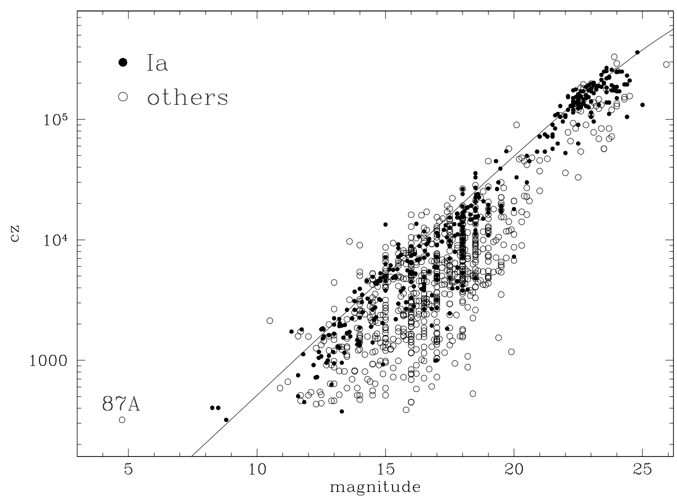


Fig. 6. The Hubble diagram for all the SNe with redshift discovered up to Dec. 31, 1998. The magnitudes are those reported in the Catalogue, i.e. those at maximum when available, or those at discovery. The line is the expected position for "standard" SNIa having $M(\max) = -19.50$, $H_0 = 65$ km s^{-1} Mpc, $q_0 = 0$

Discrepancies, in both cases, have been solved by looking at the original literature, mostly consisting of IAU circulars.

The galaxy coordinates are given with various degrees of accuracy depending on the accuracy of the original Catalogue. For many anonymous galaxies, in particular for the parent galaxies of high-z SNe, the approximate galaxy position is derived from the supernova coordinates. In some cases, discrepancies may arise between the quoted off-sets of the supernova from the galaxy nucleus and the same data derived from the SN-parent relative coordinates (see e.g. SN 1965C). This happens especially for parent galaxies with ill-defined nuclei. Finally, a few supernovae have been discovered and observed only spectroscopically (e.g. SN 1995bb) and therefore they lack a photometric magnitude.

In Table 3 we list the 37 SNe (excluding SN 1998ab, added in the proofs) which, though announced after the publication of ASC89, were discovered on old plates obtained before December 31, 1988.

Instead, Table 4 lists the 20 objects which, from the beginning of the searches up to the present time, turned out not to be supernovae. Among these latter objects, SN 1950E and 1956C were still included in ASC89. SN 1987G has been deleted because it turned out to be the same object as SN 1987D.

4. Basic statistics

In Fig. 1 the productivity of world wide supernova searches through the years is shown. The enormous improvement of the last few years stands out clearly. The dashed area refers to SNe brighter than 14 mag. It must be noted that, despite the renewed effort in SN search, the rate of discovery of bright SNe is not increasing.

In Fig. 2 we plot the distribution of redshifts and highlight (shaded area) the SNe discovered in the last 6 years. It appears that almost all SNe at redshift $z > 0.1$ have been discovered recently and that the recent high-z surveys favour discoveries in the range $0.3 < z < 0.8$.

In Fig. 3 the sky distribution of the 1447 supernovae both in equatorial (top panel) and galactic (bottom panel) coordinates is shown. Neglecting the avoidance zone defined by the galactic plane, the outcome of the SN searches of the last years makes the SN sky distributions more homogeneous compared with the same plot reported in ASC89. Overposed to the clustered pattern of the distribution of nearby parent galaxies is evident a smooth background component due to the high-z SNe.

Figure 4 shows the distribution of the difference between the SN and parent galaxy magnitude. The peak of the distribution is at $(m_{\rm SN} - m_{\rm Gal}) = 2.4$ with $\sigma = 1.8$ which fairly compares with the same result found by Barbon (1968). These numbers may be useful to prepare the strategy of a SN search in given galaxy samples.

Table 5 shows the distribution of supernovae of different types according to the morphological type of their parent galaxies. With respect to Table 3 of ASC89, new SN types are now listed but the overall distribution remains unchanged. Note that the percentage of classified SNe has increased from 40% to almost 60% of total discoveries.

Concerning the distribution among different SN types (Fig. 5 top), it turns out that type Ia alone make 50% of all classified SNe, whereas Ib/c are only 7%. The same data of ASC89 give 22% and 6%. Actually, in ASC89 a major fraction of type I (54%) were missing a detailed subtype classification whereas in the present version this is only 14%. On the other hand, the percentage of type II SNe (34%) remains constant. These numbers show that, since the last decade, the chase for the SNIa is well under way.

The distribution of the parent galaxy morphological types is also shown in Fig. 5 (bottom). It stands out clearly that most SNe are found in spiral galaxies.

Finally, in Fig. 6 we plot the positions of all SNe with redshift in the Hubble diagram. The line is the expected location for "standard" SNIa having $M(\max) = -19.50$, $H_0 = 65$ km s^{-1} Mpc, $q_0 = 0$. We remark that some SNe, not of type Ia, laying above this line have poor photometry.

Acknowledgements. We are indebted to David Branch for having provided a number of corrections to a previous release of the Catalogue.

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Catalogue

	SN	GALAXY	R.A.	D.	SN_R.A.	SN_D.	G_TYPE	T	INC	PA	H_VEL	Bt	LgD25	OFF	SET	SN_MAG	SN_TYPE	DATE	DISCOVERER
	1998 cv	E237-G42	220946	-494756	220946.29	-494743.0	S:	5.0	55	48	8102	14.64	0.95	5.0E	12.7N	B17.5*	Ic	Jun24	* Antezana
	1998 cw	A225619-3509	225619	-350959	225619.67	-350959.9										B17.5*	Ia	Jun24	* Antezana
	1998 cx	NGC6209	165459	-723511	165455.31	-723524.0	Sbc	3.8	39	10	5891		1.31	10.9W	12.1S	17.8*	Ia	Jul 4	* Wassilieff
	1998 cy	A140242-0545	140242	-054505	140242.82	-054505.7								near	center	V19.5*		May20	* EROS
	1998 cz	A120306-1237	120306	-123741	120306.50	-123741.5								near	center	V18.5*		May21	* EROS
	1998 da	A002713-3925	002713	-392525	002713.76	-392525.6								2.4W	1.2S	V20.5*		Jul 1	* EROS
	1998 db	A225554-3926	225554	-392629	225554.64	-392629.8								near	center	V19.4*		Jul 1	* EROS
	1998 dc	A222016-4433	222016	-443356	222016.10	-443356.1								24.6W	3.9N	V19.5*		Jul 5	* EROS
	1998 dd	A134733-3302	134733	-330231	134733.95	-330231.4	S							2.8E	2.5N	B17. *		Jul18	* Antezana
	1998 de	NGC 252	004802	+273724	004806.88	+273728.5	S0	-1.0	44	80	5023	13.26	1.18	71.9E	3.4N	18.4*	Iapec	Jul23	* LOSS
	1998 df	A213230-6503	213230	-650332	213230.57	-650332.8	S							1.7W	6.8S	B18.5*		Jul18	* Antezana
	1998 dg	M-03-34-08	131028	-165357	131023.85	-165608.1	S:	2.7	59		2454	14.45	1.12	17.5W	17.1S	B17.5*	Ia	Jul19	* Wischnjewsky
	1998 dh	NGC7541	231443	+043204	231440.31	+043214.1	SBbc:pec	4.0	69	102	2669	12.42	1.54	53.5W	10.4N	16.8*	Ia	Jul20	* LOSS
	1998 dj	NGC 788	020106	-064901	020106.92	-064904.8	S0/a:	0.0	41	75	4109	13.00	1.28	7.1E	8.6S	16.1*	Ia	Aug 8	* LOSS
	1998 dk	UGC 139	001429	-004443	001432.16	-004410.9	Sc:	4.7	63	82	3950	14.42	1.33	5.4E	3.1N	17.6*	Ia	Aug19	* LOSS
*	1998 dl	NGC1084	024600	-073442	024601.47	-073425.1	Sc	5.0	56	115	1414	11.31	1.51	21.6E	11.6N	16.0*	II	Aug 2	* LOSS
	1998 dm	M-01-04-44	012615	-060528	012613.97	-060614.0	Scd:	6.0	81	21	1943	13.25	1.46	13.8W	37.0S	16.8*	Ia	Aug22	* LOSS
	1998 dn	NGC 337A	010134	-073521	010127.08	-073636.7	Sdm	8.0	41	10	388	12.7	1.77	102W	79S	15.8*		Aug19	* BAOSS
	1998 do	A011430+0028	011430	+002813	011430.92	+002813.0					27600			0.2E	0.4N	V19.0*		Aug 1	* MSACSST
	1998 dp	A215828-1958	215828	-195805.	215828.12	-195805.9					17100				0.6N	V20.3*		Aug14	* MSACSST
*	1998 dq	NGC6754	191125	-503831	191123.78	-503825.5	SBb	3.0	60	80	3252	12.89	1.28	18.7W	5N	14.3*	Ia	Aug23	* White
	1998 dr	A000930-4850	000930	-485039	000930.68	-485039.1	S								0.7N	B18.0*	Ia	Aug28	* Antezana
	1998 ds	A031719-5310	031719	-531058	031719.21	-531058.0	S							9.9W	2.9N	B18.5*	Ia	Aug28	* Antezana
	1998 dt	NGC 945	022837	-103222	022835.72	-103259.8	SBc	4.5	34		4484	12.79	1.38	23.1W	39.5S	17.7*	Ib	Sep 1	* LOSS
	1998 du	A004511-6348	004511	-634821	004511.73	-634821.6					22800			1.9E	0.8N	V20.5*		Aug14	* MSACSST
	1998 dv	A042946-6130	042946	-613025	042946.79	-613025.4					0.156			2.1W	0.3N	V20.2*		Aug22	* MSACSST
	1998 dw	A010911-1529	010911	-152946	010911.56	-152946.7					15000			2.7E	1.1N	V18.8*	Ia	Aug28	* MSACSST
	1998 dx	UGC11149	181111	+495142	181111.89	+495140.7			56		16215	14.55	1.07	20.9E	12.2S	18.3*	Ia	Sep10	* LOSS
	1998 dy	A042954-6112	042954	-611243	042954.24	-611243.1										V19.0*		Aug 1	* MSACSST
	1998 dz	A032058-4105	032058	-410522	032058.18	-410522.8					27000					V18.5*	Ia	Sep 3	* MSACSST
	1998 ea	A043346-6135	043346	-613520	043346.59	-613520.4					17100			5.9W	1.5N	V19.5*	Ia	Sep 6	* MSACSST
	1998 eb	NGC1961	054204	+692246	054212.02	+692226.3	Sc	5.0	50	85	3983	11.73	1.66	38.8E	17.0S	17.8*	Ia	Sep17	* LOSS
	1998 ec	UGC 3576	065307	+500202	065306.11	+500222.1	SBb	3.0	57	128	5948	14.62	1.20	8.7W	19.5N	16.9*	Ia	Sep26	* BAOSS
	1998 ed	A230014-1313	230015	-131355	230014.64	-131358.2								6W	2.7S	18. *		Sep16	* Mueller
	1998 ee	A015331-5358	015331	-535821	015331.33	-535819.5					14900			5.1E	1.9N	B17.5*	IIpec	Oct14	* Wischnjewsky
	1998 ef	UGC 646	010326	+321406	010326.87	+321412.4	SB:	3.4	63	105	5418	14.90	1.07	6.1E	2.1S	16.7*	Ia	Oct14	* LOSS
	1998 eg	UGC12133	223932	+083637	223930.29	+083620.6	Scd:	6.0	83	44	7391	15.38	1.28	25.9W	25.3S	16.0*	Ia	Oct19	* Boles
	1998 eh	E074-G09	204856	-690536	204857.82	-690505.7			34		11378	15.11	0.70	5.2E	25.5N	B18. *		Oct15	* Wischnjewsky
	1998 ei	A233203-3933	233204	-393320	233203.75	-393318.4	S				16404			11.8W	10.9S	B18.5*		Oct15	* Antezana
	1998 ej	A234100-3856	234101	-385638	234100.95	-385637.2	S							4.1W	6.5N	19. *		Oct15	* Antezana
	1998 ek	A063630-3758	063631	-375840	063630.59	-375840.2								14.0E	4.3N	18. *		Oct15	* Antezana
	1998 el	A032101-4133	032101	-413307	032101.21	-413306.6								0.9E		V19.6*		Oct22	* MSACSST
	1998 em	IC4837A	191516	-540757	191512.69	-540649.7	Sb:	2.5	81	165	4000	12.49	1.61	26W	67N	B16.5*	Ia	Oct26	* Antezana
	1998 en	UGC 3645	070401	+504050	070400.05	+504030.0	Sbc	4.4	82	33	6300	15.55	1.13	10.4W	18.3S	18.4*	II	Oct30	* LOSS
	1998 eo	A045615-0346	045615	-034638	045615.47	-034638.7					0.84			near	center	I23.6*	Ia	Oct15	* SCP
	1998 ep	A231957+1603	231957	+160319	231957.67	+160319.5					0.11			6W	3S	I20.1*	Ia	Oct15	* SCP
	1998 eq	A232027+1555	232027	+155543	232027.47	+155543.7					1.20			near	center	I24.8*	Ia	Oct15	* SCP
	1998 er	GH09-02	055019	-711418	055016.87	-711413.5	SBb							10.5W	4.8N	V18.6*		Nov 3	* MACHO
	1998 es	NGC 632	013718	+055239	013717.60	+055250.6	S0:	-1.5	37	170	3157	13.09	1.19	0.4W	10.8N	14.6*	Iapec	Nov13	* LOSS
	1998 et	A065918+5744	065919	+574437	065918.74	+574441.0					12100			5.4W	5.4N	18. *	IIn	Nov17	* Mueller
	1998 eu	A005958+1418	005958	+141800	005958.66	+141800.4					0.181					R19.7*	Ia	Nov14	* Gal-Yam,Maoz
	1998 ev	A010412+2500	010412	+250059	010412.68	+250059.1					0.157					R21.3*		Nov14	* Gal-Yam,Maoz
	1998 ew	NGC6943	204433	-684450	204432.1	-684337	Scd:	6.0	60	130	3095	12.05	1.60	5W	73N	B14. *	II	Nov23	* Antezana
	1998 ex	M+11-10-16	074142	+644259	074142.28	+644402.3	Sc	4.9	20		11200		0.85	5.1W	10.1N	R18.5*	Ia	Nov25	* Mueller
	1998 ey	NGC7080	213002	+264305	213000.67	+264321.4	SBb	3.0	17	50	4806	13.13	1.26	18W	20N	17.0*	Ic	Dec 5	* Arbour
	1998 ez	A035732-2712	035732	-271213	035732.93	-271213.6					21000			0.7E	4.0N	V20. *	II	Dec 8	* MSACSST
	1998 fa	UGC 3513	064252	+412515	064251.51	+412518.9	Scd:	6.0	68	82	7316	15.60	1.00	4.0W	3.8N	18.2*	IIb	Dec25	* LOSS
	1998 fb	A033045-5232	033045	-523212	033045.86	-523212.2								0.3E	0.1N	V18.4*		Dec20	* MSACSST
	1998 fc	A025912+0329	025912	+032939	025912.61	+032939.0					0.10			21W	16.7S	R20.5*	Ia	Dec20	* Gal-Yam,Maoz
	1998 fd	A011918+1555	011918	+155524	011918.06	+155524.1					0.24			5.8E	2.8N	R21.3*	Ia	Dec24	* Gal-Yam,Maoz