The empirical Luminosity distance - velocity relation and galaxy distance formula

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Pages – 12, Figures – 2, Tables – 1

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Abstract

This article reports a relation between Heliocentric velocities of galaxies v⊙ and Luminosity distances dL : $dL \approx \frac{v\odot}{H0} + \frac{dL}{c} * v\odot$

Data of 3655 Ia type Supernovas from Open Supernova Catalog (https://sne.space/) data with Heliocentric velocities v⊙ between 240 and 142100 km/sec was utilized and shows accuracy about 3%.

The relation utilized for developing the distance calculation formula: $dV = \frac{v\odot}{H0*\left(1 - \frac{v\odot}{C}\right)}$.

Luminosity distances, Heliocentric velocities, Distance - Velocity Relation, Galaxy Distance formula, Hubble's law

1 Introduction:

As we know Hubble's law v=D*H0 [1] enables us to calculate a galaxy distance D from the recessional velocities v. However, the last year's researches for example [2],[3] show that this formula doesn't work for distant galaxies.

This work is an attempt to determine a relation between the Luminosity distances dL type Ia supernovas and Heliocentric velocities v⊙ listed in the catalogue and to identify the formula to calculate the distance to any galaxy with the known velocity v⊙.

As a result the formula $dV = \frac{v\odot}{H0*\left(1-\frac{v\odot}{C}\right)}$ that allows to calculate a "Visual" (Luminosity) distance to any galaxy with known velocities was obtained.

2 Materials and method:

As mentioned above, the data used in this work was retrieved from the Open catalogue of supernovas available on the Open Supernova Catalog website (https://sne.space/ [4]).

First, data on type Ia supernovas was selected from the catalogue and populated a Microsoft Excel spreadsheet comprising 6501 galaxies. Subsequently, velocities *v* were calculated based on the redshift *z* via the formula $v = \frac{(z+1)^2-1}{(z+1)^2+1}$ *c and, in order to decrease the probability of errors, a selection was made from the main table of galaxies with v⊙ that differ from v no more than by ±1%. Finally, 180 galaxies with dL indicators drastically different from other galaxies with similar velocities v⊙ or dL bigger Hubble length were also excluded from the spreadsheet. Hence, the final spreadsheet contained 3655 galaxies with velocities v⊙ between 240 and 142100 km/sec

For convenience, I left the following columns visible in the spreadsheet: Name (the name of the supernova), Host Name (the name of the galaxy where the supernova is located), z – Redshift, v⊙ (km/s) – Heliocentric velocity of the galaxy and dL (Mpc) – Luminosity distance to the galaxy at the moment of light emission that can be seen during the observation. The remaining columns in the spreadsheet can be revealed if necessary by the Excel *Unhide* command.

Several parameters added at the top of the spreadsheet were used in calculations: Hubble Length – 4550 Mpc, Age of the Universe – 4.3522E+17 sec, Speed of light C - 299792.458 km/s, Hubble constant – 67,74 (the results obtained during the experiment Planck Mission in 2014).

To determine the relation between the Luminosity distances dL type Ia supernovas and Heliocentric velocities v⊙ let's add the following columns to the Spreadsheet (see short Spreadsheet in appendix):

- ΔT(year) – time in years between the light emission by galaxy and the observation: $\Delta T = \frac{dL}{c}$;

- ΔD(Mpc) – galaxy distance change between the emission and the observation (in case of steady vΘ): $\frac{\mathrm{dL}}{\mathrm{C}} * v\odot$;
- HLDfromvΘ - Distance calculated via Hubble's Law from v⊙: $\mathrm{HLDfromv}\odot = \frac{\mathrm{v}\odot}{H0}$;
- HLD+ΔD – Distance calculated via Hubble's Law plus ΔD;
- RPtodL(%) – Relative Precision (accuracy) calculated as the percentage difference between HLD+ΔD and Luminosity distance dL (referred to as RP hereafter).

As we see in column RPtodL(%), the difference between Luminosity distance dL and HLD+ΔD is no more than 3.66%. Fig. 1 demonstrates the same difference. This relation $\mathrm{dL} \approx \frac{\mathrm{v}\odot}{\mathrm{H0}} + \frac{\mathrm{dL}}{\mathrm{c}} * \mathrm{v}\odot$ can be utilized as the basis for developing the distance calculation formula. From relation $\mathrm{dL} \approx \frac{\mathrm{v}\odot}{\mathrm{H0}} + \frac{\mathrm{dL}}{\mathrm{c}} * \mathrm{v}\odot$, we obtain:

$$\mathrm{dL} \approx \frac{\mathrm{v}\odot}{\mathrm{H0}*\left(\mathbf{1} - \frac{\mathrm{v}\odot}{\boldsymbol{c}}\right)}$$

Let us introduce dV "Visual distance" i.e. the estimate of the distance to a galaxy at the moment of light emission, and add it to the appropriate column of the Spreadsheet.

Replacing dL with dV we've found the sought formula:

$$\mathrm{dV} = \frac{\mathrm{v}\odot}{\mathrm{H0}*\left(\mathbf{1} - \frac{\mathrm{v}\odot}{\boldsymbol{c}}\right)}$$

Simplifying the notation, we obtain d=v/(H0*(1-v/c)) where d – "Visual distance" to a galaxy, H0 – Hubble constant, **v** – recessional velocity and **c** – speed of light

3 Results:

There is a relation with the accuracy about 3% between Luminosity distances dL and Heliocentric velocities vΘ of galaxies: $dL \approx \frac{v\odot}{H0} + \frac{dL}{c} * v\odot$

The relation utilized for developing the "Visual" (Luminosity) distance calculation formula:

$$dV = \frac{v\odot}{H0*\left(1-\frac{v}{c}\odot\right)}.$$

The dV values were compared to dL distances given in the Catalog. The outcome of this comparison is given in the column RPdVtodL(%) (Relative Precision (accuracy) dV to dL). The calculated values, as well as Fig. 2, display the accuracy of the comparison as ±5-6%, which gives ground to presume that the formula can be used to find distances to galaxies specifically when other methods do not work, in particular when there are no type Ia supernovas in galaxies.

4 Discussion:

Based on the calculations stated above and on The Open Supernova Catalog (https://sne.space/) data, the following conclusions were made:

1. There is the relation between Luminosity distances dL measurable using the Magnitude of supernovas type la and Heliocentric velocities of galaxies vΘ:

$$dL \approx \frac{v\odot}{H0} + \frac{dL}{c} * v\odot$$

The determined relation is interesting not only from a practical point of view, allowing to calculate a distance to any galaxy, but also theoretically as it makes us think about the galaxy velocity change rate, which can be a subject for further research.

2. Based on this relation, the sought formula calculating the distance to any galaxy with a known velocity vΘ was derived including galaxies for which other methods do not work, for instance if no supernovas are observed:

$$dV = \frac{v\odot}{H0*\left(1 - \frac{v\odot}{c}\right)}$$

Where dV is the "visual" (or Luminosity) distance to the galaxy, vΘ - measured Heliocentric velocities, H0 – Hubble constant and C – Speed of light.

The presented formula enables the calculation of distances to any galaxies with ±5-6% accuracy.

5 Acknowledgments

In conclusion, I would like to thank the scientists and specialists who compiled the catalogue The Open Supernova Catalog (https://sne.space/) and released it for common usage.

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Appendices:

First, middle and last part of the spreadsheet on 6 sheets;

Full spreadsheet in the file named Calculations on The Open Supernova Catalog.xlsx on a CD-ROM and SD-CARD

References

1. *Hubble, E. (1929). "A relation between distance and radial velocity among extra-galactic nebulae". Proceedings of the National Academy of Sciences. **15** (3): 168–73. Bibcode:1929PNAS...15..168H. doi:10.1073/pnas.15.3.168. PMC 522427 . PMID 16577160.*

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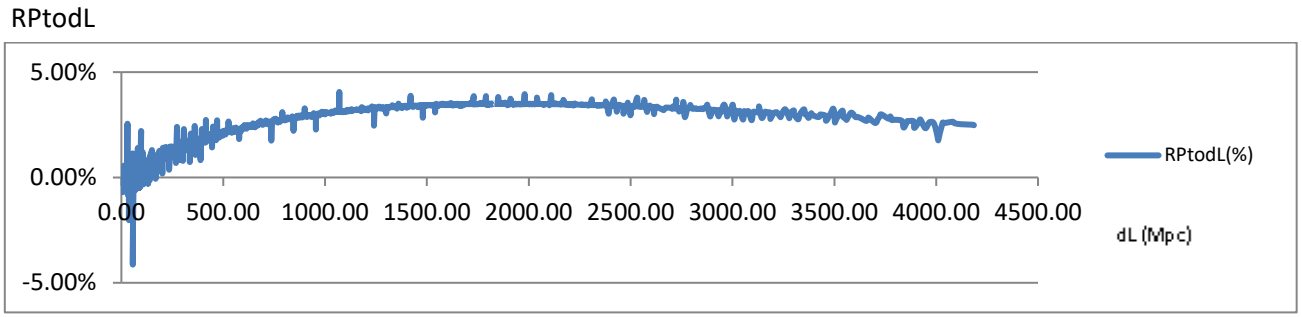

Fig 1. Comparison HLD+ΔD and dL in (%)

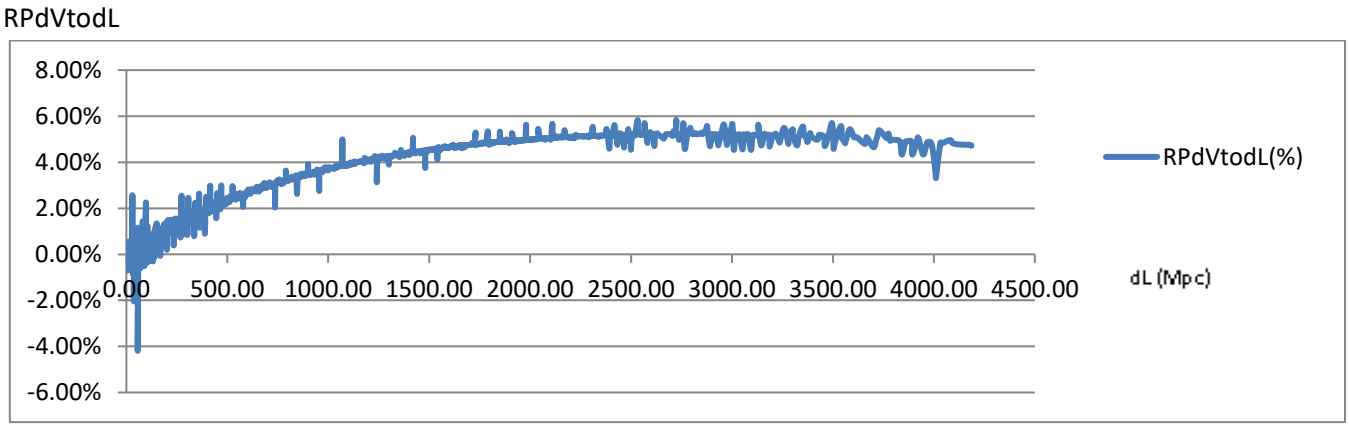

Fig 2. Comparison calculated by formula dV with Luminosity distances dL in %

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	*Δ*T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdVto*dL(%)
1	SN2011fe	NGC 5457	0.000804	240	3.56	1.16E+07	0.00	3.56	3.54	0.40%	3.55	0.40%
2	SN2012cg	NGC 4424	0.001458	440	6.46	2.11E+07	0.01	6.47	6.50	-0.70%	6.50	-0.70%
3	SN2013hg	A120955+2953	0.002031	609	9.00	2.94E+07	0.02	9.02	8.99	-0.07%	9.01	-0.07%
4	SN2011by	NGC 3972	0.002843	847	12.61	4.12E+07	0.04	12.65	12.50	0.56%	12.54	0.56%
5	SN2006mq	ESO 494-G26	0.003229	968	14.33	4.68E+07	0.05	14.37	14.29	-0.07%	14.34	-0.07%
6	SN2013dy	NGC 7250	0.003889	1165	17.26	5.63E+07	0.07	17.33	17.20	-0.01%	17.27	-0.01%
7	SN2011B	NGC 2655	0.004670	1407	20.74	6.77E+07	0.10	20.84	20.77	-0.62%	20.87	-0.62%
8	SN2011ek	NGC 918	0.005027	1502	22.33	7.29E+07	0.11	22.44	22.17	0.22%	22.28	0.22%
9	ASASSN-14lp	NGC 4666	0.005101	1525	22.66	7.40E+07	0.12	22.78	22.51	0.16%	22.63	0.16%
10	SN2014bv	NGC 4386	0.005594	1677	24.86	8.11E+07	0.14	25.00	24.76	-0.13%	24.90	-0.13%
11	ASASSN-15us	NGC 7213	0.005839	1745	25.96	8.47E+07	0.15	26.11	25.76	0.18%	25.91	0.18%
12	SN2011ae	MCG -03-30-19	0.006046	1814	26.88	8.77E+07	0.16	27.04	26.78	-0.23%	26.94	-0.23%
13	ASASSN-15hf	ESO 375-G41	0.006178	1846	27.47	8.97E+07	0.17	27.64	27.25	0.18%	27.42	0.19%
14	SN1983W	NGC 3625	0.006470	1937	28.78	9.39E+07	0.19	28.97	28.59	0.00%	28.78	0.00%
15	SN2004ea	MCG -03-11-19	0.006500	1940	28.90	9.43E+07	0.19	29.09	28.64	0.26%	28.83	0.26%
16	SN1995D	NGC 2962	0.006561	1967	30.00	9.79E+07	0.20	30.20	29.04	2.55%	29.23	2.57%
17	ASASSN-15ga	NGC 4866	0.006631	1981	29.50	9.63E+07	0.19	29.69	29.24	0.19%	29.44	0.19%
18	SN2011at	MCG -02-24-27	0.006758	2022	30.06	9.81E+07	0.20	30.27	29.85	0.04%	30.05	0.04%
19	SN2003hx	NGC 2076	0.007152	2156	31.83	1.04E+08	0.23	32.05	31.83	-0.72%	32.06	-0.73%
20	SN2000cm	A121259+0718	0.007200	2170	32.00	1.04E+08	0.23	32.23	32.03	-0.83%	32.27	-0.84%
21	SN2015I	NGC 2357	0.007589	2270	33.78	1.10E+08	0.26	34.04	33.51	0.04%	33.77	0.04%
22	SN2013cg	NGC 2891	0.007952	2358	35.41	1.16E+08	0.28	35.69	34.81	0.90%	35.09	0.91%
23	SN2014D	UGC 7170	0.008179	2464	36.42	1.19E+08	0.30	36.72	36.37	-0.69%	36.68	-0.69%
24	SN1989A	NGC 3687	0.008359	2514	37.00	1.21E+08	0.31	37.31	37.11	-1.14%	37.43	-1.15%
25	SN2008hy	IC 334	0.008459	2536	37.00	1.21E+08	0.31	37.31	37.44	-2.03%	37.76	-2.05%
26	PTF10icb	MCG +10-19-01	0.008544	2550	38.06	1.24E+08	0.32	38.38	37.64	0.24%	37.97	0.24%
27	SN2009ag	ESO 492-G2	0.008640	2604	38.49	1.26E+08	0.33	38.82	38.44	-0.74%	38.78	-0.75%
28	SN1996bt	A065157+1617	0.008923	2675	39.76	1.30E+08	0.35	40.11	39.49	-0.21%	39.84	-0.21%
29	SN2004fu	NGC 6949	0.009210	2752	41.05	1.34E+08	0.38	41.43	40.63	0.12%	41.00	0.12%
30	ASASSN-15kk	UGC 4883	0.009893	2951	44.11	1.44E+08	0.43	44.55	43.56	0.26%	44.00	0.27%
31	PTF10xgp		0.010000	3000	45.00	1.47E+08	0.45	45.45	44.29	0.58%	44.73	0.59%
32	MASTER OT J233743.22-473039.3	ESO 240-G10	0.010000	3000	45.00	1.47E+08	0.45	45.45	44.29	0.58%	44.73	0.59%
33	SN2010lp	NGC 1137	0.010100	3004	45.04	1.47E+08	0.45	45.49	44.35	0.54%	44.79	0.54%
34	SN2016brx	NGC 7391	0.010167	3032.5	45.35	1.48E+08	0.46	45.80	44.77	0.26%	45.22	0.27%
35	SN2010B	NGC 5370	0.010200	3057	45.49	1.48E+08	0.46	45.95	45.13	-0.22%	45.59	-0.23%
36	SN2009fj	ESO 267-G16	0.010400	3110	46.39	1.51E+08	0.48	46.87	45.91	0.00%	46.39	0.00%
37	SN2008cc	ESO 107-G4	0.010400	3128	46.39	1.51E+08	0.48	46.87	46.18	-0.58%	46.66	-0.59%
38	SN2011ao	IC 2973	0.010694	3206	47.72	1.56E+08	0.51	48.23	47.33	-0.26%	47.84	-0.26%
39	ASASSN-15aj	NGC 3449	0.010921	3256.2	48.74	1.59E+08	0.53	49.27	48.07	0.28%	48.60	0.29%
40	ASASSN-15db	NGC 5996	0.010998	3279	49.08	1.60E+08	0.54	49.62	48.41	0.29%	48.94	0.29%
41	PTF13cad		0.011000	3300	49.10	1.60E+08	0.54	49.64	48.72	-0.32%	49.26	-0.32%
42	SN2012V	NGC 6829	0.011000	3311	49.10	1.60E+08	0.54	49.64	48.88	-0.65%	49.42	-0.66%
43	SN2004db	NGC 7377	0.011100	3325	49.54	1.62E+08	0.55	50.09	49.08	-0.19%	49.64	-0.19%
44	ASASSN-14jc	2MASX J07353554-6246099	0.011325	3375.9	50.55	1.65E+08	0.57	51.12	49.84	0.30%	50.40	0.30%

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	⊿T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdV*todL(%)
45	ASASSN-15ut	NGC 88	0.011471	3419.2	51.21	1.67E+08	0.58	51.80	50.48	0.30%	51.06	0.30%
46	SN2012dq	UGC 4067	0.011548	3462	51.56	1.68E+08	0.60	52.15	51.11	-0.28%	51.70	-0.28%
47	SN2014K	MCG +12-09-21	0.011625	3485	51.91	1.69E+08	0.60	52.51	51.45	-0.28%	52.05	-0.28%
48	SN2009kq	MCG +05-21-01	0.011698	3470	52.23	1.70E+08	0.60	52.84	51.23	0.77%	51.83	0.78%
49	SN2009ev	NGC 5026	0.011838	3549	52.87	1.73E+08	0.63	53.49	52.39	-0.29%	53.02	-0.29%
50	SN2016gfk	IC 1657	0.011952	3561.7	53.38	1.74E+08	0.63	54.01	52.58	0.31%	53.21	0.31%
51	MASTER OT J215050.94-702028.9	NGC 7123	0.012000	3600	53.60	1.75E+08	0.64	54.24	53.14	-0.35%	53.79	-0.36%
52	SN2012id	A044241+1834	0.012000	3600	53.60	1.75E+08	0.64	54.24	53.14	-0.35%	53.79	-0.36%
53	ASASSN-14jz	GALEXASC J184443.33-524819.2	0.012000	3600	53.60	1.75E+08	0.64	54.24	53.14	-0.35%	53.79	-0.36%
54	SN2011gt	IC 4913	0.012100	3625	54.05	1.76E+08	0.65	54.70	53.51	-0.22%	54.17	-0.22%
55	SN2012ah	NGC 7637	0.012400	3664	55.40	1.81E+08	0.68	56.08	54.09	1.14%	54.76	1.16%
56	ASASSN-13dd	NGC 2765	0.012549	3738.5	56.07	1.83E+08	0.70	56.77	55.19	0.32%	55.89	0.33%
57	SN2001eg	UGC 3885	0.012700	3809	56.75	1.85E+08	0.72	57.47	56.23	-0.35%	56.95	-0.36%
58	SN2009kk	2MFGC 3182	0.012859	3830.2	57.47	1.88E+08	0.73	58.20	56.54	0.33%	57.27	0.34%
59	SN1982C	NGC 4185	0.013000	3904	58.10	1.90E+08	0.76	58.86	57.63	-0.50%	58.39	-0.50%
60	PSN J19235601-5955321	NGC 6782	0.013000	3900	58.10	1.90E+08	0.76	58.86	57.57	-0.39%	58.33	-0.40%
61	SN2001ep	NGC 1699	0.013012	3901	56.00	1.83E+08	0.73	56.73	57.59	-4.14%	58.35	-4.19%
62	SN2009im	NGC 1355	0.013100	3926	58.56	1.91E+08	0.77	59.33	57.96	-0.28%	58.73	-0.28%
63	SN2010jv	NGC 2379	0.013469	4030	60.22	1.97E+08	0.81	61.03	59.49	-0.13%	60.30	-0.13%
64	SDSS-SN-081		0.013794	4106.8	61.69	2.01E+08	0.85	62.54	60.63	0.36%	61.47	0.36%
65	iPTF13akc		0.013896	4137	62.15	2.03E+08	0.86	63.01	61.07	0.36%	61.93	0.36%
66	SN2016cvn	NGC 4708	0.013896	4137	62.15	2.03E+08	0.86	63.01	61.07	0.36%	61.93	0.36%
67	ASASSN-15mc	UGC 2295	0.013916	4142.9	62.24	2.03E+08	0.86	63.10	61.16	0.36%	62.02	0.36%
68	SN1993ab	NGC 1164	0.013930	4171	62.31	2.03E+08	0.87	63.17	61.57	-0.22%	62.44	-0.22%
69	SN2011bf	A134903-2803	0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
70	SN2011gb	A013343+3448	0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
71	SDSS2744-54272-561		0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
72	AT2016gtr		0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
73	ASASSN-14kr	GALEXASC J125413.02-073849.5	0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
74	SN2012gx	MCG -02-02-72	0.014000	4200	62.60	2.04E+08	0.88	63.48	62.00	-0.45%	62.88	-0.45%
75	SN2013gy	NGC 1418	0.014023	4204	62.73	2.05E+08	0.88	63.61	62.06	-0.34%	62.94	-0.35%
76	ASASSN-15kg	2MASX J08401168-0435369	0.014257	4243.7	63.78	2.08E+08	0.90	64.69	62.65	0.37%	63.55	0.37%
77	SN2011K	CSS J044530.38-072054.7	0.014500	4320	64.88	2.12E+08	0.93	65.81	63.77	0.26%	64.71	0.27%
78	SN2014ci	PGC 166758	0.014527	4355	65.00	2.12E+08	0.94	65.95	64.29	-0.35%	65.24	-0.36%
79	SN2012fm	UGC 3528	0.014553	4363	65.12	2.13E+08	0.95	66.07	64.41	-0.36%	65.36	-0.36%
80	OGLE-2012-SN-040		0.014690	4372	65.74	2.15E+08	0.96	66.70	64.54	0.37%	65.50	0.37%
81	SN2014cg	UGC 11512	0.014700	4417	65.79	2.15E+08	0.97	66.76	65.21	-0.58%	66.18	-0.59%
82	SN2016adi	NGC 5292	0.014897	4432.7	66.68	2.18E+08	0.99	67.67	65.44	0.38%	66.42	0.39%
83	ASASSN-15pz	ESO 357-G5	0.014903	4434.5	66.71	2.18E+08	0.99	67.69	65.46	0.38%	66.45	0.39%
84	SN2014H	A033701+3204	0.015000	4500	67.10	2.19E+08	1.01	68.11	66.43	-0.50%	67.44	-0.51%
85	LSQ13bug	ESO 530-G6	0.015000	4500	67.10	2.19E+08	1.01	68.11	66.43	-0.50%	67.44	-0.51%
86	SN2011hh	A025704+4947	0.015000	4500	67.10	2.19E+08	1.01	68.11	66.43	-0.50%	67.44	-0.51%
87	SNhunt163	NGC 2924	0.015000	4500	67.10	2.19E+08	1.01	68.11	66.43	-0.50%	67.44	-0.51%
88	SN1987I	IC 4963	0.015000	4501	67.10	2.19E+08	1.01	68.11	66.45	-0.53%	67.46	-0.53%

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	⊿T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdVto*dL(%)
2302	SN2006hh	SDSS J24226.71-004739.2	0.237440	62920	1226.34	4.00E+09	257.38	1483.72	928.85	3.27%	1175.57	4.14%
2303	2MASS J02484148+0039167	SDSS J24841.49+003916.5	0.237445	62921.3	1226.37	4.00E+09	257.39	1483.76	928.86	3.27%	1175.60	4.14%
2304	SDSS-II SN 8264	SDSS J35009.44+004912.4	0.237519	62938.4	1226.80	4.00E+09	257.55	1484.35	929.12	3.27%	1176.01	4.14%
2305	SDSS-II SN 822	SDSS J24214.58-005143.6	0.237556	62947	1227.02	4.00E+09	257.64	1484.66	929.24	3.27%	1176.21	4.14%
2306	SN2006kt	SDSS J13550.55-010332.2	0.237679	62975.5	1227.74	4.01E+09	257.90	1485.64	929.66	3.27%	1176.89	4.14%
2307	SDSS-II SN 9740	SDSS J13535.31-010142.8	0.238000	63000	1230.00	4.01E+09	258.48	1488.48	930.03	3.37%	1177.47	4.27%
2308	SN2006gu	SDSS J04038.98-000424.8	0.238109	63075	1230.25	4.02E+09	258.84	1489.09	931.13	3.27%	1179.24	4.15%
2309	SDSS-II SN 779	SDSS J14641.70-010114.2	0.238121	63077.8	1230.32	4.02E+09	258.87	1489.19	931.18	3.27%	1179.31	4.15%
2310	SN2006ph	SDSS J13433.31-005305.9	0.238217	63100	1230.88	4.02E+09	259.07	1489.95	931.50	3.27%	1179.83	4.15%
2311	SN2007qq	SDSS J24230.39-005816.5	0.238260	63110	1231.13	4.02E+09	259.17	1490.30	931.65	3.27%	1180.07	4.15%
2312	SDSS-II SN 21605	SDSS J24004.38+002252.6	0.238542	63175.2	1232.78	4.02E+09	259.78	1492.56	932.61	3.28%	1181.61	4.15%
2313	SDSS-II SN 5776	SDSS J15403.29-001830.3	0.238652	63200.6	1233.42	4.03E+09	260.02	1493.44	932.99	3.28%	1182.22	4.15%
2314	SN2007kt	SDSS J15023.83+011020.4	0.238926	63264	1235.02	4.03E+09	260.62	1495.64	933.92	3.28%	1183.72	4.15%
2315	DES14X2raq		0.239000	63300	1235.00	4.03E+09	260.77	1495.77	934.46	3.22%	1184.57	4.08%
2316	SDSS-II SN 16652	SDSS J02243.14+000045.0	0.239340	63360	1237.44	4.04E+09	261.53	1498.97	935.34	3.28%	1186.00	4.16%
2317	SDSS-II SN 13768	SDSS J13218.28-004547.3	0.239600	63420	1239.00	4.04E+09	262.11	1501.11	936.23	3.28%	1187.42	4.16%
2318	SDSS-II SN 13908	SDSS J10339.82+001742.5	0.239774	63460	1239.98	4.05E+09	262.48	1502.46	936.82	3.28%	1188.37	4.16%
2319	SDSS-II SN 20171	SDSS J01202.51+001301.2	0.239900	63490	1240.70	4.05E+09	262.76	1503.46	937.26	3.28%	1189.08	4.16%
2320	DES12C3a		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2321	DES14S2qb		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2322	PTF11jzd		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2323	DES16X3biz		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2324	ESSENCE m022		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2325	PS1-10byr		0.240000	64000	1240.00	4.05E+09	264.72	1504.72	944.79	2.46%	1201.23	3.13%
2326	SDSS-II SN 17408	SDSS J10916.64+004734.4	0.240267	63573.8	1242.87	4.06E+09	263.56	1506.43	938.50	3.28%	1191.08	4.17%
2327	SDSS-II SN 15500	SDSS J15159.89+001806.9	0.240492	63625.7	1244.18	4.06E+09	264.06	1508.24	939.26	3.28%	1192.31	4.17%
2328	DES16C3bq		0.241000	63700	1247.00	4.07E+09	264.96	1511.96	940.36	3.34%	1194.08	4.24%
2329	SN2010fg	A121641+4641	0.241000	63700	1247.00	4.07E+09	264.96	1511.96	940.36	3.34%	1194.08	4.24%
2330	PS1-13boe		0.241000	63700	1247.00	4.07E+09	264.96	1511.96	940.36	3.34%	1194.08	4.24%
2331	SN2009kw	A033823-2815	0.242000	64000	1253.00	4.09E+09	267.49	1520.49	944.79	3.25%	1201.23	4.13%
2332	SDSS-II SN 21266		0.242229	64026.2	1254.36	4.09E+09	267.89	1522.25	945.18	3.29%	1201.85	4.19%
2333	SDSS-II SN 14113	SDSS J15346.68-004906.3	0.242319	64046.9	1254.89	4.10E+09	268.09	1522.98	945.48	3.29%	1202.35	4.19%
2334	SDSS-II SN 14751	SDSS J22515.97+004026.8	0.242695	64133.5	1257.09	4.10E+09	268.92	1526.01	946.76	3.29%	1204.42	4.19%
2335	SDSS-II SN 16637	SDSS J03242.16-001907.8	0.242928	64187.1	1258.46	4.11E+09	269.44	1527.90	947.55	3.30%	1205.70	4.19%
2336	DES12C1b		0.243000	64200	1259.00	4.11E+09	269.61	1528.61	947.74	3.31%	1206.01	4.21%
2337	SN2007ls	A202828+0000	0.243000	64200	1259.00	4.11E+09	269.61	1528.61	947.74	3.31%	1206.01	4.21%
2338	SN2006lj	SDSS J01043.55+001206.6	0.243538	64327.5	1262.04	4.12E+09	270.80	1532.84	949.62	3.30%	1209.05	4.20%
2339	SDSS-II SN 19461	SDSS J35448.53-004241.0	0.244000	64400	1265.00	4.13E+09	271.74	1536.74	950.69	3.36%	1210.79	4.29%
2340	SN2010bc	A104807+5651	0.244000	64400	1265.00	4.13E+09	271.74	1536.74	950.69	3.36%	1210.79	4.29%
2341	SDSS-II SN 2864	SDSS J35748.23-011422.5	0.244100	64460	1265.30	4.13E+09	272.06	1537.36	951.58	3.29%	1212.23	4.19%
2342	SN2007pw	SDSS J33734.57+001450.7	0.244187	64476.7	1265.85	4.13E+09	272.25	1538.10	951.83	3.30%	1212.63	4.20%
2343	SN2003kn	A020915-0335	0.244300	64500	1266.50	4.13E+09	272.49	1538.99	952.17	3.30%	1213.19	4.21%
2344	SDSS-II SN 20088	SDSS J05249.28+003753.4	0.244533	64556.2	1267.88	4.14E+09	273.02	1540.90	953.00	3.30%	1214.53	4.21%
2345	SDSS-II SN 16462	SDSS J10809.75-002309.4	0.244616	64575.2	1268.37	4.14E+09	273.21	1541.58	953.28	3.30%	1214.99	4.21%
2346	SN2006hg	SDSS J14058.47-004342.4	0.244619	64575.9	1268.39	4.14E+09	273.21	1541.60	953.29	3.30%	1215.01	4.21%

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	⊿T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdVto*dL(%)
2347	SDSS-II SN 18389	SDSS J21636.02+001346.8	0.244902	64640.9	1270.05	4.15E+09	273.85	1543.90	954.25	3.30%	1216.56	4.21%
2348	SN2006gm	SDSS J25907.40-003737.9	0.245000	64700	1271.00	4.15E+09	274.30	1545.30	955.12	3.27%	1217.98	4.17%
2349	SDSS-II SN 8053	SDSS J22300.14-004922.3	0.245000	64700	1271.00	4.15E+09	274.30	1545.30	955.12	3.27%	1217.98	4.17%
2350	DES16C2ma		0.245000	64700	1271.00	4.15E+09	274.30	1545.30	955.12	3.27%	1217.98	4.17%
2351	PS1-1000005		0.245000	64700	1271.00	4.15E+09	274.30	1545.30	955.12	3.27%	1217.98	4.17%
2352	SN2006fb	SDSS J33551.18-001035.7	0.245027	64669.6	1270.78	4.15E+09	274.13	1544.91	954.67	3.30%	1217.25	4.21%
2353	SDSS-II SN 2855	SDSS J10442.09-002122.6	0.245075	64680.6	1271.07	4.15E+09	274.23	1545.30	954.84	3.30%	1217.52	4.21%
2354	SN2005gr	SDSS J33637.48+010443.7	0.245100	64690	1271.20	4.15E+09	274.30	1545.50	954.97	3.30%	1217.74	4.21%
2355	SDSS-II SN 3077	SDSS J15610.54+001255.7	0.245500	64780	1273.60	4.16E+09	275.20	1548.80	956.30	3.31%	1219.90	4.22%
2356	SN2006mz	SDSS J11034.90-000721.6	0.245675	64818.3	1274.59	4.16E+09	275.58	1550.17	956.87	3.31%	1220.82	4.22%
2357	SDSS-II SN 13334	SDSS J12642.47+002340.4	0.245710	64826	1274.80	4.16E+09	275.66	1550.46	956.98	3.31%	1221.01	4.22%
2358	SDSS-II SN 13946	SDSS J21355.22-002857.7	0.245902	64870.4	1275.93	4.16E+09	276.09	1552.02	957.64	3.31%	1222.08	4.22%
2359	SDSS-II SN 14444	SDSS J22648.40-004856.7	0.245916	64873.6	1276.01	4.16E+09	276.12	1552.13	957.69	3.31%	1222.15	4.22%
2360	SDSS-II SN 19652	SDSS J31129.87+010125.7	0.245953	64882.1	1276.23	4.17E+09	276.21	1552.44	957.81	3.31%	1222.36	4.22%
2361	SNLS-05D3mq	[NSB2006] J141900.39+522306.8	0.246000	64900	1277.00	4.17E+09	276.45	1553.45	958.07	3.33%	1222.79	4.25%
2362	SDSS-II SN 3180	SDSS J02826.82+001843.2	0.246952	65111.1	1282.11	4.18E+09	278.46	1560.57	961.19	3.31%	1227.87	4.23%
2363	PTF13arm		0.247000	65100	1282.00	4.18E+09	278.39	1560.39	961.03	3.32%	1227.60	4.24%
2364	iPTF13arm		0.247000	65100	1282.00	4.18E+09	278.39	1560.39	961.03	3.32%	1227.60	4.24%
2365	PS1-10bka		0.247000	65100	1282.00	4.18E+09	278.39	1560.39	961.03	3.32%	1227.60	4.24%
2366	SN2007jb	SDSS J02633.79+000230.9	0.247000	65100	1282.00	4.18E+09	278.39	1560.39	961.03	3.32%	1227.60	4.24%
2367	SDSS-II SN 15262		0.247400	65210	1284.70	4.19E+09	279.44	1564.14	962.65	3.32%	1230.25	4.24%
2368	SN2006ka	SDSS J21826.58+001334.0	0.247421	65218.5	1284.87	4.19E+09	279.52	1564.39	962.78	3.31%	1230.46	4.23%
2369	SN2006hp	SDSS J02414.24-001457.3	0.247488	65233.8	1285.26	4.19E+09	279.67	1564.93	963.00	3.31%	1230.83	4.24%
2370	SN2007qh	SDSS J03931.05+010125.2	0.247700	65280	1286.50	4.20E+09	280.14	1566.64	963.68	3.32%	1231.94	4.24%
2371	SN2006gh	SDSS J05446.95-001503.6	0.247804	65306.2	1287.12	4.20E+09	280.38	1567.50	964.07	3.31%	1232.57	4.24%
2372	SN2006lo	SDSS J13419.18+003519.6	0.248000	65400	1288.00	4.20E+09	280.98	1568.98	965.46	3.23%	1234.84	4.13%
2373	DES15X2mei		0.248000	65400	1288.00	4.20E+09	280.98	1568.98	965.46	3.23%	1234.84	4.13%
2374	SDSS-II SN 14303	SDSS J04227.49-003207.3	0.248600	65490	1291.80	4.22E+09	282.20	1574.00	966.78	3.31%	1237.01	4.24%
2375	SDSS-II SN 15829	SDSS J13220.55-004544.1	0.248862	65548.2	1293.36	4.22E+09	282.79	1576.15	967.64	3.32%	1238.42	4.25%
2376	SDSS-II SN 2551	SDSS J35042.46-010951.3	0.249061	65593.6	1294.53	4.22E+09	283.24	1577.77	968.31	3.32%	1239.52	4.25%
2377	SDSS-II SN 1354	SDSS J33912.65+000524.8	0.249436	65679.3	1296.74	4.23E+09	284.09	1580.83	969.58	3.32%	1241.59	4.25%
2378	SN2005jx	SDSS J13420.02-004052.9	0.249447	65681.8	1296.81	4.23E+09	284.12	1580.93	969.62	3.32%	1241.65	4.25%
2379	SDSS-II SN 19399	SDSS J34252.74+004955.5	0.249500	65690	1297.10	4.23E+09	284.22	1581.32	969.74	3.33%	1241.85	4.26%
2380	SN2006jw	SDSS J22322.22+004908.4	0.249554	65706.3	1297.44	4.23E+09	284.36	1581.80	969.98	3.32%	1242.24	4.25%
2381	SDSS-II SN 8297		0.249700	65740	1298.30	4.24E+09	284.70	1583.00	970.48	3.32%	1243.06	4.25%
2382	SN2005gf	SDSS J21616.45+004228.1	0.249841	65771.8	1299.13	4.24E+09	285.02	1584.15	970.94	3.32%	1243.83	4.26%
2383	SN2007ps	SDSS J21913.44-002304.3	0.249877	65780	1299.35	4.24E+09	285.10	1584.45	971.07	3.32%	1244.03	4.26%
2384	PS1-10cay		0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2385	PS1-10ir		0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2386	PS1-11cn		0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2387	PS1-1000008		0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2388	PS15bqq		0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2389	SN1996bf	A021215+0127	0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%
2390	SN2002ls	A223740-0038	0.250000	66000	1300.00	4.24E+09	286.20	1586.20	974.31	3.04%	1249.36	3.90%

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	⊿T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdVto*dL(%)
3568	SNLS-05D2eb		0.534400	121000	3160.80	1.03E+10	1275.74	4436.54	1786.24	3.13%	2995.10	5.24%
3569	SDSS-II SN 15120	SDSS J23446.35-005956.9	0.534776	121107	3163.52	1.03E+10	1277.97	4441.49	1787.82	3.09%	2999.55	5.18%
3570	SDSS-II SN 4779	SDSS J11547.67+001548.6	0.535360	121200	3167.67	1.03E+10	1280.62	4448.29	1789.19	3.09%	3003.41	5.19%
3571	SDSS-II SN 14831	SDSS J20819.21-001951.9	0.536047	121315	3172.56	1.04E+10	1283.82	4456.38	1790.89	3.08%	3008.20	5.18%
3572	SDSS-II SN 14149	SDSS J24029.86+000304.6	0.536150	121330	3173.29	1.04E+10	1284.27	4457.56	1791.11	3.09%	3008.82	5.18%
3573	SDSS-II SN 14820		0.537555	121561	3183.30	1.04E+10	1290.78	4474.08	1794.52	3.08%	3018.46	5.18%
3574	SNLS-08D2aa		0.538000	122000	3186.00	1.04E+10	1296.54	4482.54	1801.00	2.78%	3036.84	4.68%
3575	SN1997eq	A045856-0359	0.538000	122000	3186.00	1.04E+10	1296.54	4482.54	1801.00	2.78%	3036.84	4.68%
3576	SN2003lh	A021019-0459	0.539000	122000	3194.00	1.04E+10	1299.79	4493.79	1801.00	2.92%	3036.84	4.92%
3577	SDSS-II SN 11370	SDSS J04552.20-004251.6	0.539000	122000	3194.00	1.04E+10	1299.79	4493.79	1801.00	2.92%	3036.84	4.92%
3578	SN2003li	A022747-0733	0.540300	122000	3202.90	1.05E+10	1303.41	4506.31	1801.00	3.07%	3036.84	5.18%
3579	DES14C2vnf		0.542100	122300	3215.70	1.05E+10	1311.84	4527.54	1805.43	3.06%	3049.45	5.17%
3580	SN2006si	A020951-0343	0.542400	122300	3217.80	1.05E+10	1312.70	4530.50	1805.43	3.10%	3049.45	5.23%
3581	SN in MACSJ1423		0.545000	123000	3236.00	1.06E+10	1327.68	4563.68	1815.77	2.86%	3079.05	4.85%
3582	SN Primo		0.545000	123000	3236.00	1.06E+10	1327.68	4563.68	1815.77	2.86%	3079.05	4.85%
3583	SNLS-03D1gt	[AGR2006] J022456.02-040737.1	0.548000	123000	3258.00	1.06E+10	1336.70	4594.70	1815.77	3.24%	3079.05	5.49%
3584	DES15C2nfs		0.551000	124000	3279.00	1.07E+10	1356.26	4635.26	1830.53	2.81%	3121.74	4.80%
3585	SDSS-II SN 18839	SDSS J22402.92-000255.0	0.551000	124000	3279.00	1.07E+10	1356.26	4635.26	1830.53	2.81%	3121.74	4.80%
3586	SNLS-04D3hn	[HSP2005] J142206.87+52	0.551600	123800	3283.70	1.07E+10	1356.01	4639.71	1827.58	3.05%	3113.16	5.19%
3587	SNLS-08D2ad		0.554000	124000	3301.00	1.08E+10	1365.36	4666.36	1830.53	3.18%	3121.74	5.43%
3588	SDSS-II SN 8062	SDSS J31154.78+000438.0	0.554141	124237	3301.91	1.08E+10	1368.34	4670.25	1834.03	3.01%	3131.93	5.15%
3589	SN in MACSJ0717.5+3745		0.557000	125000	3322.00	1.08E+10	1385.12	4707.12	1845.29	2.76%	3164.92	4.73%
3590	SDSS-II SN 8662	SDSS J22946.41-002858.1	0.558160	124880	3330.79	1.09E+10	1387.46	4718.25	1843.52	3.00%	3159.71	5.14%
3591	SN2003le	A010808+0027	0.561000	125000	3351.00	1.09E+10	1397.22	4748.22	1845.29	3.24%	3164.92	5.55%
3592	SN2006sf	A020811-0351	0.561600	125400	3355.60	1.10E+10	1403.61	4759.21	1851.20	3.00%	3182.33	5.16%
3593	SDSS-II SN 13597	SDSS J04051.66-002512.2	0.562920	125630	3365.07	1.10E+10	1410.15	4775.22	1854.59	2.98%	3192.38	5.13%
3594	SDSS-II SN 8576	SDSS J05527.78-000942.3	0.564000	126000	3373.00	1.10E+10	1417.64	4790.64	1860.05	2.83%	3208.60	4.87%
3595	DES15X1ney		0.565000	126000	3380.00	1.10E+10	1420.58	4800.58	1860.05	2.94%	3208.60	5.07%
3596	DES15S2lam		0.565000	126000	3380.00	1.10E+10	1420.58	4800.58	1860.05	2.94%	3208.60	5.07%
3597	DES15E2uc		0.566000	126000	3387.00	1.11E+10	1423.52	4810.52	1860.05	3.05%	3208.60	5.27%
3598	SDSS-II SN 21388	SDSS J01233.30+000305.5	0.566650	126220	3391.99	1.11E+10	1428.11	4820.10	1863.30	2.97%	3218.27	5.12%
3599	HST04Patu	[RSC2007] J123809.00+62	0.571000	127000	3423.00	1.12E+10	1450.07	4873.07	1874.82	2.87%	3252.78	4.97%
3600	SNLS-03D4bc	[AGR2006] J221528.14-174	0.572000	127000	3431.00	1.12E+10	1453.46	4884.46	1874.82	2.99%	3252.78	5.19%
3601	SNLS-07D3hu		0.572000	127000	3431.00	1.12E+10	1453.46	4884.46	1874.82	2.99%	3252.78	5.19%
3602	SNLS-06D3et		0.575500	127600	3456.00	1.13E+10	1470.97	4926.97	1883.67	2.93%	3279.53	5.11%
3603	PS1-10ka		0.576000	128000	3460.00	1.13E+10	1477.29	4937.29	1889.58	2.69%	3297.47	4.70%
3604	SNLS-05D3jq	[NSB2006] J142145.46+53014	0.579000	128000	3481.00	1.14E+10	1486.25	4967.25	1889.58	3.02%	3297.47	5.27%
3605	SNLS-03D4gf	[AGR2006] J221422.90-174	0.581000	128000	3496.00	1.14E+10	1492.66	4988.66	1889.58	3.25%	3297.47	5.68%
3606	SN2004hn	A011332+0037	0.582000	129000	3503.00	1.14E+10	1507.33	5010.33	1904.34	2.61%	3342.69	4.58%
3607	SN2007ud	A023013-0915	0.582000	129000	3503.00	1.14E+10	1507.33	5010.33	1904.34	2.61%	3342.69	4.58%
3608	SN2003jj	A010758+0003	0.583900	128900	3517.10	1.15E+10	1512.23	5029.33	1902.86	2.90%	3338.15	5.09%
3609	SN2002iy	A023040-0811	0.587000	129000	3540.00	1.16E+10	1523.25	5063.25	1904.34	3.18%	3342.69	5.57%
3610	SDSS-II SN 17835	SDSS J22753.23-003312.6	0.587383	129445	3542.46	1.16E+10	1529.57	5072.03	1910.91	2.88%	3362.99	5.07%
3611	ESSENCE m138		0.587700	129500	3544.80	1.16E+10	1531.23	5076.03	1911.72	2.87%	3365.50	5.06%

First, middle and last parts of the spreadsheet

#	Supernova Name	Host Name	z	v⊙(km/s)	dL(Mpc)	*Δ*T(year)	ΔD(Mpc)	Dr (Mpc)	*HL*Dfromv⊙	*RP*todL(%)	dV	*RPdVto*dL(%)
3612	SN1997eu	A082300+0408	0.590000	130000	3560.00	1.16E+10	1543.73	5103.73	1919.10	2.73%	3388.45	4.82%
3613	DES15S2myz		0.590000	130000	3560.00	1.16E+10	1543.73	5103.73	1919.10	2.73%	3388.45	4.82%
3614	SN1997ag	A095853-0020	0.590000	130000	3560.00	1.16E+10	1543.73	5103.73	1919.10	2.73%	3388.45	4.82%
3615	SNSDF0503-03		0.593000	130000	3583.00	1.17E+10	1553.71	5136.71	1919.10	3.08%	3388.45	5.43%
3616	SN2003ll	A023541-0806	0.595800	130700	3604.00	1.18E+10	1571.23	5175.23	1929.44	2.87%	3420.79	5.08%
3617	SN2004he	A022948-0820	0.597800	131000	3618.60	1.18E+10	1581.22	5199.82	1933.86	2.86%	3434.74	5.08%
3618	DES15X1mwg		0.603000	132000	3657.00	1.19E+10	1610.19	5267.19	1948.63	2.68%	3481.59	4.80%
3619	SNLS-03D4dy	[AGR2006] J221450.51-175723.2	0.604000	132000	3664.00	1.20E+10	1613.28	5277.28	1948.63	2.79%	3481.59	4.98%
3620	SN2004fn	A233020-0958	0.604500	132000	3667.80	1.20E+10	1614.95	5282.75	1948.63	2.84%	3481.59	5.08%
3621	DES15X2mey		0.609000	133000	3701.00	1.21E+10	1641.91	5342.91	1963.39	2.59%	3528.99	4.65%
3622	SN2006se	A011448+0006	0.610800	133000	3714.10	1.21E+10	1647.72	5361.82	1963.39	2.77%	3528.99	4.98%
3623	SN2003kt	A023347-0836	0.612000	133000	3723.00	1.22E+10	1651.67	5374.67	1963.39	2.90%	3528.99	5.21%
3624	SN1997S	A105751-0345	0.612000	133000	3723.00	1.22E+10	1651.67	5374.67	1963.39	2.90%	3528.99	5.21%
3625	SDSS-II SN 21405	SDSS J33434.16+000322.2	0.612000	133000	3723.00	1.22E+10	1651.67	5374.67	1963.39	2.90%	3528.99	5.21%
3626	DES14X3ajv		0.613000	133000	3730.00	1.22E+10	1654.78	5384.78	1963.39	3.00%	3528.99	5.39%
3627	PS1-10m		0.618000	134000	3767.00	1.23E+10	1683.76	5450.76	1978.15	2.79%	3576.97	5.04%
3628	SN2003ln	A233027-0835	0.619000	134000	3775.00	1.23E+10	1687.33	5462.33	1978.15	2.90%	3576.97	5.25%
3629	SN1997J	A074117+0933	0.619000	134000	3775.00	1.23E+10	1687.33	5462.33	1978.15	2.90%	3576.97	5.25%
3630	SN2007us	A022754-0800	0.620100	134400	3782.80	1.23E+10	1695.87	5478.67	1984.06	2.72%	3596.33	4.93%
3631	ESSENCE p534		0.620200	134400	3783.50	1.23E+10	1696.18	5479.68	1984.06	2.73%	3596.33	4.95%
3632	SN2006mi	A020555-0400	0.623100	134800	3805.00	1.24E+10	1710.90	5515.90	1989.96	2.74%	3615.77	4.97%
3633	SNLS-03D4dh	[AGR2006] J221731.04-173746.9	0.626800	135400	3832.40	1.25E+10	1730.89	5563.29	1998.82	2.68%	3645.12	4.89%
3634	DES15C3lza		0.628000	136000	3841.00	1.25E+10	1742.46	5583.46	2007.68	2.37%	3674.69	4.33%
3635	SNLS-05D2ci	SDSS J100001.97+021256.3	0.630300	135900	3858.40	1.26E+10	1749.07	5607.47	2006.20	2.67%	3669.75	4.89%
3636	ESSENCE n256		0.631000	136000	3864.00	1.26E+10	1752.89	5616.89	2007.68	2.68%	3674.69	4.90%
3637	SN2007to	A022942-0902	0.634500	136500	3889.70	1.27E+10	1771.04	5660.74	2015.06	2.66%	3699.49	4.89%
3638	PS1-10ahl		0.635000	137000	3893.00	1.27E+10	1779.03	5672.03	2022.44	2.35%	3724.45	4.33%
3639	SN1998ay	A105721-0314	0.638000	137000	3916.00	1.28E+10	1789.54	5705.54	2022.44	2.66%	3724.45	4.89%
3640	HST05Dic		0.638000	137000	3916.00	1.28E+10	1789.54	5705.54	2022.44	2.66%	3724.45	4.89%
3641	DES15S1oeh		0.639000	137000	3923.00	1.28E+10	1792.74	5715.74	2022.44	2.75%	3724.45	5.06%
3642	SNLS-05D2ec	SDSS J095926.14+020048.3	0.642000	138000	3946.00	1.29E+10	1816.42	5762.42	2037.20	2.34%	3774.82	4.34%
3643	SN1998be	A134620+0202	0.644000	138000	3961.00	1.29E+10	1823.32	5784.32	2037.20	2.54%	3774.82	4.70%
3644	SN2003kp	A023102-0839	0.645000	138000	3968.00	1.30E+10	1826.54	5794.54	2037.20	2.63%	3774.82	4.87%
3645	SNLS-05D3kt	DEEP2 12027456	0.647341	138342	3985.49	1.30E+10	1839.14	5824.63	2042.25	2.61%	3792.19	4.85%
3646	DES15X1mzz		0.649000	139000	3998.00	1.30E+10	1853.69	5851.69	2051.96	2.31%	3825.82	4.31%
3647	SN1997es	A081840+0313	0.650000	140000	4010.00	1.31E+10	1872.63	5882.63	2066.73	1.76%	3877.46	3.31%
3648	SNLS-08D2dz		0.650000	140000	4010.00	1.31E+10	1872.63	5882.63	2066.73	1.76%	3877.46	3.31%
3649	SN2006sj	A021022-0333	0.653500	139200	4031.60	1.32E+10	1871.96	5903.56	2054.92	2.60%	3836.10	4.85%
3650	ESSENCE m026		0.654800	139400	4041.40	1.32E+10	1879.20	5920.60	2057.87	2.58%	3846.40	4.83%
3651	SN1996ba	A010839-0056	0.660000	140000	4080.00	1.33E+10	1905.32	5985.32	2066.73	2.65%	3877.46	4.96%
3652	SN2007ue	A010909-0014	0.661400	140300	4091.00	1.34E+10	1914.55	6005.55	2071.15	2.57%	3893.08	4.84%
3653	SN2007tw	A020532-0502	0.665400	140900	4121.10	1.35E+10	1936.88	6057.98	2080.01	2.53%	3924.49	4.77%
3654	SN2006tn	A020536-0508	0.673400	142000	4181.50	1.36E+10	1980.61	6162.11	2096.25	2.50%	3982.70	4.75%
3655	ESSENCE m226		0.673900	142100	4185.30	1.37E+10	1983.81	6169.11	2097.73	2.48%	3988.03	4.71%