Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

Open Supernova Catalog objects subsample characteristics

To cite this article: E V Khyzhniak *et al* 2017 *J. Phys.: Conf. Ser.* **798** 012004

IOP Conf. Series: Journal of Physics: Conf. Series **798** (2017) 012004 doi:10.1088/1742-6596/798/1/012004

Open Supernova Catalog objects subsample characteristics

E V Khyzhniak[1,*], I V Arkhangelskaja[1,] and A R Lyapin[2]**

[1]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe highway 31, Moscow, 115409, Russia
[2]Moscow Institute of Physics and Technology (State University), Institutskiy pereulok 9, Dolgoprudny, Moscow Region, 141701, Russia

E-mail: [*]eugenia.sh.el@gmail.com, [**]irene.belousova@usa.net

Abstract. The homogeneous subsample characteristics understanding is necessary for the investigation of any astrophysical objects redshift distribution, for example, gamma-ray bursts. The type Ia supernovae considered as a homogeneous subsample because of suggestion that these luminous events might be used as standard candles for cosmological measurements occurs since the earliest studies of supernovae in 1938. The parameters of our Metagalaxy Ω and Λ were determine due sample of Ia supernovae from the Supernova Cosmology Project analysis in 1998. Since then more than 4000 supernovae were added. The results of the redshift distribution analysis for supernova from the two catalogues (Asiago Supernova Catalogue and Open Supernova Catalog) are presented in this work. The ability to use an analyzed dataset as homogeneous subsample also is discussed

1. Open Supernova Catalog

The Open Supernova Catalog (OSC) [1] contains data on 36488 supernovae. The purpose of this directory is to centralize all the data on registered supernovae. It collected data from 17 sources:

- Asiago Supernova Catalog;
- Caltech Core-Collapse Program (CCCP);
- Cambridge Photometry Calibration Server (CPCS);
- Carnegie Supernova Project (CSP);
- CfA Supernova Archive;
- Gaia Photometric Science Alerts;
- Latest Supernovae (Rochester Astronomy);
- Nearby Supernova Factory (SNF);
- OGLE-IV Transient Detection System;
- Panoramic Survey Telescope & Rapid Response System (Pan-STARRS);
- SDSS Supernova Survey;
- Sternberg Astronomical Institute Supernova Light Curve Catalogue;
- Supernova Hunt (SNHunt);
- Supernova Legacy Survey (SNLS);
- The Online Supernova Spectrum Archive (SUSPECT);
- UC Berkeley Filippenko Group's Supernova Database (SNDB);
- Weizmann Interactive Supernova data REPository (WISeREP).

Of all the supernovae have been selected for 7060 type Ia with a measured redshift and magnitude.

Table 1. Experiments in the Asiago Supernova Catalog

Experiment	Number SN	Min z	Max z	Min m	Max m
Adelmann-McCarthy	22	0.0141	0.322	17.2	21.5
Altavilla	13	0.0748	0.61	20.7	23.8
Antezana	15	0.0101	0.062	14	19
Arbour	15	0.0023	0.0423	14.7	17
Armstrong	65	0.0031	0.0781	12.36	18.9
BAOSS	34	0.0013	0.0346	12.2	18.4
Boles	90	0.0031	0.079	14	18.6
CFHT-LSSP	13	0.24	0.83	21.5	24
Chassagne	13	0.0075	0.0317	14.1	17
Chen	10	0.0143	0.0327	15.6	18.6
EROS	41	0.0101	0.3	18	22
ESCC	24	0.0514	0.493	18.3	24.1
ESSENCE	145	0.1	0.8	18.9	23.6
Gal-Yam, Maoz	15	0.0409	0.24	18	23
GOODS, HHZST	16	0.216	1.551	22.8	25.9
HZSST	115	0.0409	1.3	19.5	26
Itagaki	26	0.0027	0.03	11.2	17.8
LOSS	334	0.0021	0.0908	12.7	19.8
LOTOSS	233	0.0037	0.1	13.53	18.8
Madgwick	19	0.0555	0.1408	17.8	20.4
Martin	11	0.0036	0.0186	14.45	17.7
Miknaitis	30	0.0326	0.37	19.1	22
Monard	46	0.0024	0.0244	12.4	18.4
MSACSST	24	0.0239	0.16	16.2	21.2
Mueller	10	0.0073	0.0727	15.72	18.5
NGSST	20	0.0109	0.18	18.2	20.5
NSF	83	0.0101	0.14	15.6	20.3
Puckett	126	0.0022	0.0727	14.3	19.5
Quimby	16	0.0173	0.0835	14.2	18.7
Riello	13	0.0577	0.59	21.2	23.4
Schwartz	16	0.005	0.0517	14.2	18.3
SCP	117	0.0191	1.2	20.04	25.3
SDSS-II	378	0.0101	0.42	15.92	23.1
Wood-Vasey	44	0.0044	0.14	16.7	20.3

Each catalogue of local source consists of several experiments data. For example, table 1 summarizes the experiments presented in Asiago Supernova Catalog [2] which local catalogues contain more than 10 SN.

2. Data analysis

The plots of magnitude dependence on redshift for two supernovae catalogs were analyzed in the presented article. The parameters of our Metagalaxy Ω and Λ were determine due sample of Ia supernovae from the Supernova Cosmology Project now includes in both analyzed catalogues [3]. We compared the sample of supernovae (figures 2-4) supposed as homogeneous.

Unfortunately, the redshift data of several experiments (for example, ESSENCE - see figure 1) contain big errors. This effect leads to several "lines" looks to areas with z=const occurs in plots of dependence of magnitude on redshift. Such artifacts makes difficult to process these data.

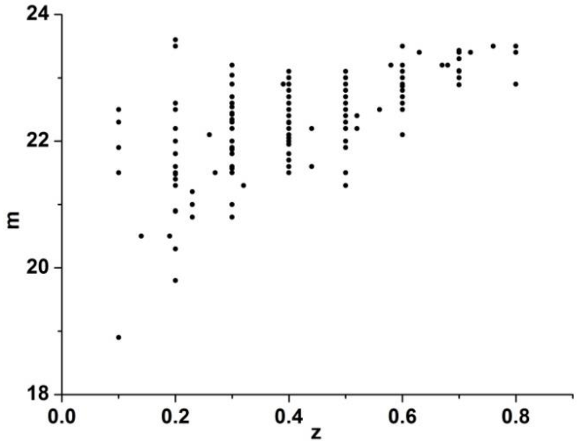

Figure 1. Plot of magnitude dependence on redshift for ESSENCE experiment.

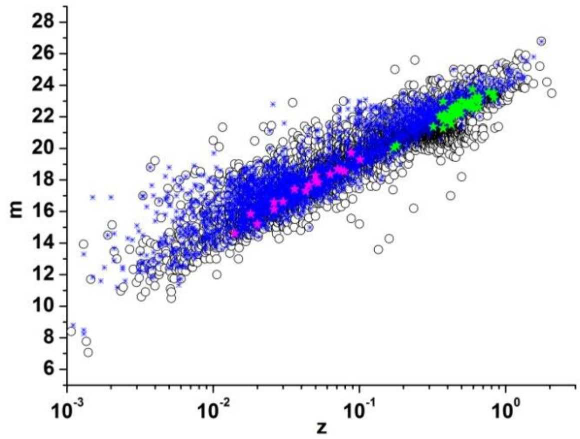

Figure 2. Plot of magnitude dependence on redshift (black - Open Supernova Catalog, blue - Asiago Supernova Catalog, green – Perlmutter data, magenta – Calan/Tololo).

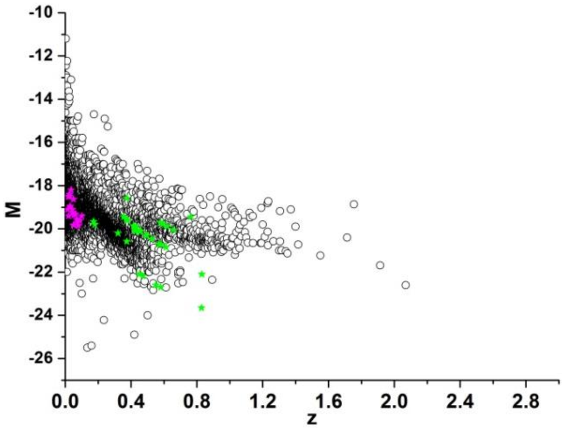

Figure 3. Plot of absolute magnitude dependence on redshift (black - Open Supernova Catalog, green – Perlmutter data, magenta – Calan/Tololo).

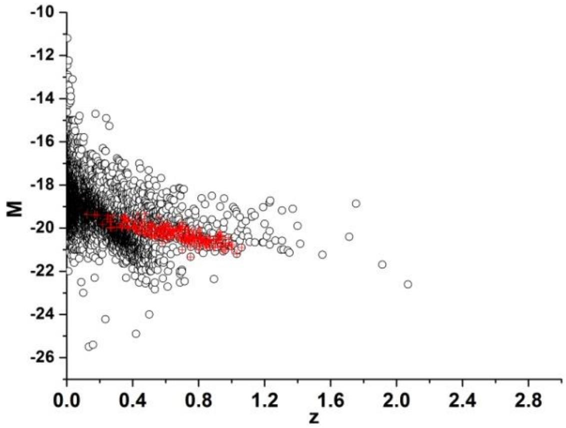

Figure 4. Plot of absolute magnitude dependence on redshift (black - Open Supernova Catalog, red – SNLS catalog).

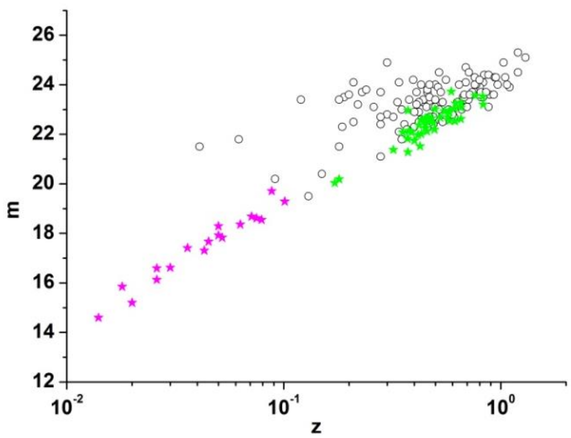

Figure 5. Plot of magnitude dependence on redshift for HZSST experiment (green – Perlmutter data, magenta – Calan/Tololo).

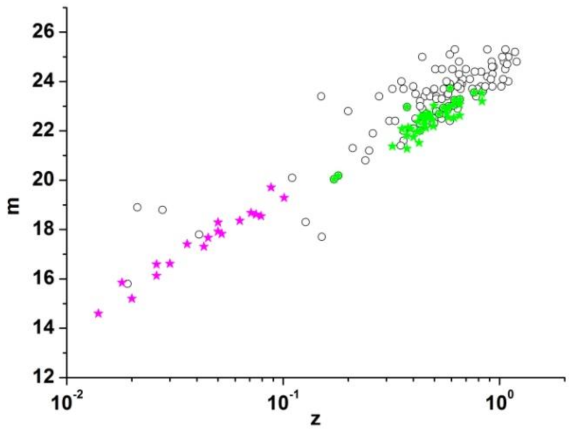

Figure 6. Plot of magnitude dependence on redshift for SCP experiment (green – Perlmutter data, magenta – Calan/Tololo).

Also distributions for each separate experiment, part of the catalogs (examples shown in figures 5, 6) were considered.

Figure 2 shows the plot of magnitude dependence on redshift for OSC. Most supernovae presented in Asiago Supernova Catalog. This graph shows that the sample OSC has a branch in the field of z ~ 0.2-0.4.

To study this branch we are plotted the absolute magnitude dependence of the redshift. In this dependence data from the Perlmutter, Calan/Tololo catalogues (figure 3) and SNLS catalog (figure 4) were imposed. We see that the OSC sample is divided into three branches. This agrees with Perlmutter data [3]. Figure 7 shows the dependence of the magnitude from the redshift for Perlmutter and Calan / Tololo data. Figure 8 shows the dependence of the corrected magnitude ($\mu = m - (M - \alpha \times X_1 + \beta \times C)$, where m – magnitude; M – absolute magnitude; α, β - nuisance parameters in the distance estimate; X_1, C - SALT2 parameter) [5] for SDSS, SNLS and HST experiments. In these graphs, we can see that since z ~ 0.1 fit begins to deviate from the straight line, which is evidence of the transition to the Λ-dominant model. This may explain the existence of a branch in the field of z ~ 0.2-1 in figures 2-4.

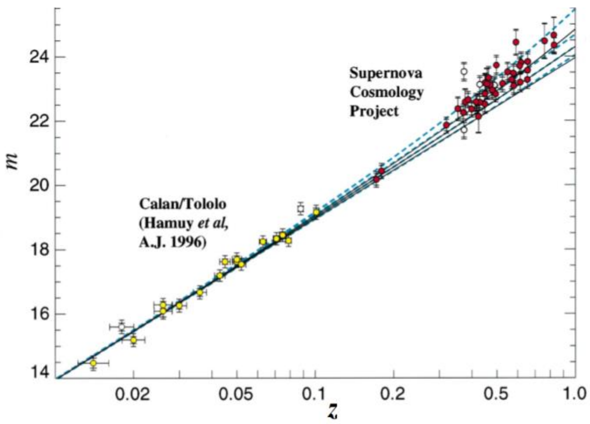

Figure 7. Plot of magnitude dependence on redshift for Perlmutter and Calan/Tololo data [3]

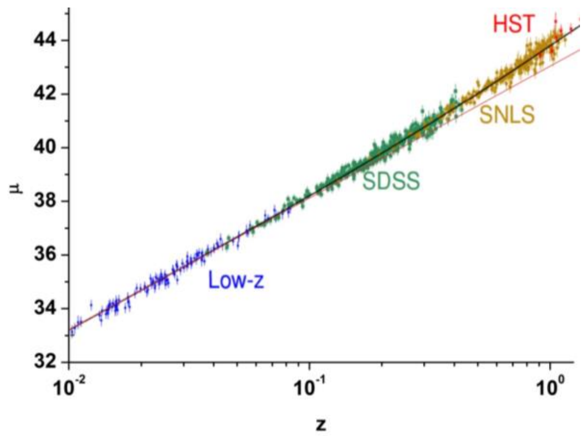

Figure 8. Plot of μ dependence on redshift for SDSS, SNLS and HST experiments.

3. Conclusion

The paper explored Open Supernova Catalog. We analyze dependences of the redshift from the magnitude for the OSC and for the experiments included in this catalog. It was concluded that not all experiments from the catalog could be analyzed (small statistics or big errors in the determination of z caused difficulties in data representation and analysis).

The data analysis shows that the sample of OSC can be divided into three parts. Area z ~ 0.2-1 with a smaller magnitude, as compared to the total sample, can be explained by the transition to the Λ-dominant model.

Acknowledgements
Authors thank for the support from National Research Nuclear University MEPhI in the framework of the Russian Academic Excellence Project (contract No. 02.a03.21.0005, 27.08.2013).

References

[1] Barbon R *et al.* 1999 *AAS* **139** 531-36
[2] Guillochon J *et al.* 2016 *arXiv:1605.01054*
[3] Perlmutter S *et al.* 1999 *Astroph. J.* **517**(2) 565-86.
[4] Riess A *et al.* 1998 *Astroph. J.* **473** 88
[5] Betoule M *et al.* 2014 *AA* **568** 32