International Journal of Scientific and Innovative Mathematical Research (IJSIMR)
Volume 6, Issue 10, 2018, PP 28-42
ISSN No. (Print) 2347-307X & ISSN No. (Online) 2347-3142
DOI: http://dx.doi.org/10.20431/2347-3142.0610005
www.arcjournals.org

The Limit of the Acceleration and a Further Slowdown in the Expansion of the Universe According 7823 Type1a Supernova from Open Catalog for Supernova Data

P.M. Mazurkin

Dr. Sc.,Prof., Volga State University of Technology, Yoshkar-Ola, Russia.

Corresponding Author:** ***P.M. Mazurkin, *Dr. Sc.,Prof., Volga State University of Technology, Yoshkar-Ola, Russia.*

Abstract: *A set of 7823 Type 1a with 11672 pairs of redshift values and a visible stellar magnitude from the catalogue [1] proved the hypothesis of vibrational perturbation of the Universe, as well as the existence of the limit of expansion of the Universe to the maximum of the redshift 2.840 at the optimum of the visible stellar magnitude 33.0. The expansion of the Universe has a stronger effect on the supernova parameters than these objects themselves have on the expansion of the Universe. The Weibull law is the adequacy with correlation coefficient of 0.9345. Asymmetric wavelet gives proof of the wave hypothesis of the Universe. We need to look for supernovae with small values of visible stellar magnitude, but with large values of redshift. Within 0≤ z ≤3.83, a positive value of the oscillation period will be observed, that is, the wave perturbation with increasing amplitude occurs in our Universe. And under the condition of Z >3.83, the oscillation will move to a negative region, that is, the perturbation of the redshift begins to occur outside our Universe. At the same time, the complete sample receives a higher adequacy of 0.9348 compared to truncated sets.*

Keywords: *7823 SN 1a, the redshift, apparent magnitude, binary relations, a rank distribution, stable patterns*

1. Introduction

A group of scientists led by Adam G. Riess published a large article [2, Table 5] on their chosen set of 186 supernovae SNe Ia. After identification of Weibull's law we obtained the limit of achievement of the module of relative distance 92 from influence of the redshift aspiring to infinity. The introduction of two wavelets of the vibrational adaptation of the Universe to this set by us due to the influence of dark energy and dark matter gave the limit of the relative distance module 67.

Apparently, the universe will not break from the increase of the redshift, because with its increase the action of the vibrational adaptation forces should also increase. We believe that, at some level of redshift, there should be a dynamic balance between dark energy, dark matter and visible matter. This is evident from the fact that the limit $\mu_{0max}^{a} = 67.00$ according to the formula of the trend obtained is redshift 157710 just 881.5. This number is close to the redshift of relic radiation in ~1000, known for the recombination era.

Our analysis of the data [2, Table 5] showed that the redshift interval $z \leq 1.7550$ is still insufficient for the limit and deceleration judgments to slow down the acceleration of the Universe. So we turned to the catalogue [1] (as of 05.02.2010).

In the catalogue [1] we saw four new measurements in comparison with [2] three supernovae 1 a exceeding the redshift (Table 1): SCP-16C3 – 2.2216; SN1997ap – 2.07; UDS10Wil – 1.914 and repetition 1.914.

Of the 9840 catalog lines [1], we selected only those that have the values of the two most important parameters: m_{max} - maximum apparent AB magnitude; z - redschift. In addition, all objects that differ in some additional characters from the designation "1a"were excluded. After sorting, 7823 rows remained. Ranked them in descending order of redshift (Table1). Taking into account the repetition of measurements (from 2 to 10) there were 11672 lines, which were distributed by the number of repetitions as follows: 1 – 7823; 2 – 2916; 3 – 682; 4 – 160; 5 – 46; 6 – 20; 7 – 6; 8 – 3; 9 – 2; 10 – 2.

The seventh number in table 1 is the redshift value 1.32 (except for two values 1.755) for the supernova SN1997ff. We believe that measurement replays do not need to be averaged by calculating the arithmetic mean. All results of repeated measurements should be simulated by identification method [3-10]. This significantly increases the quality of the statistical sample, as the proposed method of identification [7-10] implies an arbitrary law of distribution of the initial data. As is known, the existing approximation method assumes the existence of a "normal" distribution by Gauss law.

Table1. *A fragment of the directory [1] supernova 1A by counting repetitions of measurements*

№ п/п	SN 1a	m_{max}	z	№ п/п	SN 1a	m_{max}	z
1	SCP-16C3	24.73	2.2216	11661	SN2012cg	11.7	0.001458
2	SN1997ap	23.5	2.07	11662	SN1895B	7.07	0.0014
3	UDS10Wil	27.13	1.914	11663	SN1972E	7.77	0.001358
4		27.13	1.914	11664	SN1971I	10.9	0.00131
5	SN1997ff	26.8	1.755	11665		10.9	0.00344
6		26.8	1.755	11666	SN1963I	13.93	0.0013
7		26.8	1.32	11667	SN1937C	8.4	0.001071
8	SN150G	25.2	1.713	11668	SN2011fe	9.48	0.000804
9	SN2003ak	24.1	1.551	11669	SN2014J	9.71	0.000677
10		24.1	1.551	11670		9.71	0.000739
11		24.1	1.551	11671		9.71	0.000841
…	…	…	…	11672	SN1985B	13	0.000617

Our study of the cosmological data on pulsars and other objects [3-5] showed that their parameters vary not only nonlinear, but also asymmetric wavelets. Method of identification according to statistics infinite-dimensional and finite-dimensional wavelets with variable amplitude and period of oscillation given in our publications [6-13].

After reaching the noise level in the residuals obtained patterns containing the trend (from one or two laws), and several wavelets. And finite-dimensional wavelets are solitons. And all components of the General patterns become signs, which must subsequently be explained.

Two factors of table 1, first consider the direct pattern $z = f(m_{max})$, and then the inverse $m_{max} = f(z)$, by exclusion from ranked in ascending order of the number of 11672 rows from zero (a complete range) to 1.5 at the interval of 0.1 redshift. At the end of the article the regularities of $z = f(R)$ and $m_{max} = f(R)$ rank distributions of increasing values of z and m_{max} supernovae at $R = 0,1,2,3,...$ ranks are given.

2. The Trend of Influence of the Apparent Magnitude on the Redshift

A significant amount of statistical sampling of 11672 values for SN1a allowed us to obtain the maximum redshift according to the law of P.M. Mazurkin [7] of the system stress excitation in the form of a simple trend equation (Figure 1)

$$z = am_{max}{}^{b} \exp(-cm_{max}{}^{d}), \tag{1}$$

where a - the activity of exponential growth and at the same time the exponential decline of the redshift depending on the visible stellar magnitude,

b - the growth intensity of the redshift by the exponential law,

c - activity of the decay redshift, according to the law of exponential death,

d - the intensity of exponential decay ($d = 1$ in the Laplace law in mathematics, Mandelbrot in physics, Pearl in biology, and Pareto in econometrics).

Coefficient Data (1): a =1.52244770584E-023; b = 1.87445828366E+001; c = 5.09060914366E-002; d = 1.56101170743E+000.

With these parameters, the model (1) obtains (in the upper right corner of figure 1) the variance $S = 0.10068$ and the correlation coefficient $r = 0.8935$.

Equation (1) contains two mathematical components by expression $z = z'z''$. In this case $z' = a'{m_{max}}^b$ and $z'' = a''\exp(-c{m_{max}}^d)$. Therefore, $a = a'a''$ and the parameter of the model (1) becomes a strange attractor. In the first approximation we will take $a' = a$ and $a'' = 1$.

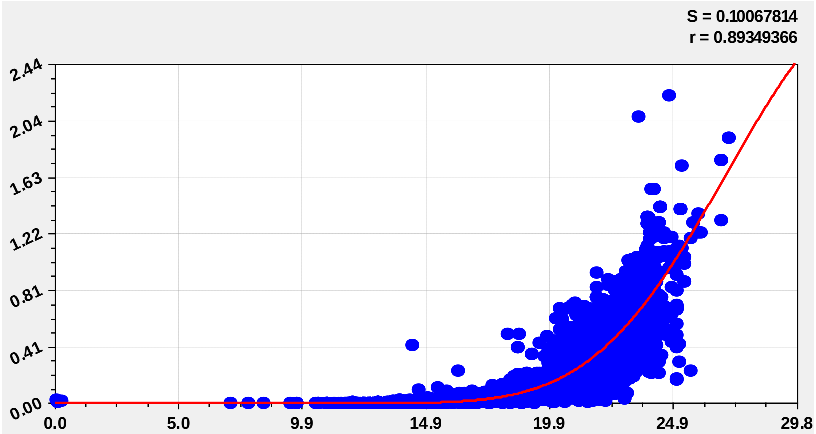


Fig1. *Graph of the trend by the formula (1) influence the apparent magnitude of the redshift*

According to the formula (1), the maximum $z_{\max} = 2.876$ is reached at the optimum of the visible stellar value $m^*_{\max} = 33$ (Figure 2). Then it turns out that we need new measurements of supernovae that exceed the achieved redshift level of 2.2216 by the value of 2.876 – 2.2216 = 0.654 according to table 1. Because of the astrophysical effect of the supernovae vibrational adaptation in the Universe, the apparent magnitude of the star may be between 28 and 38.

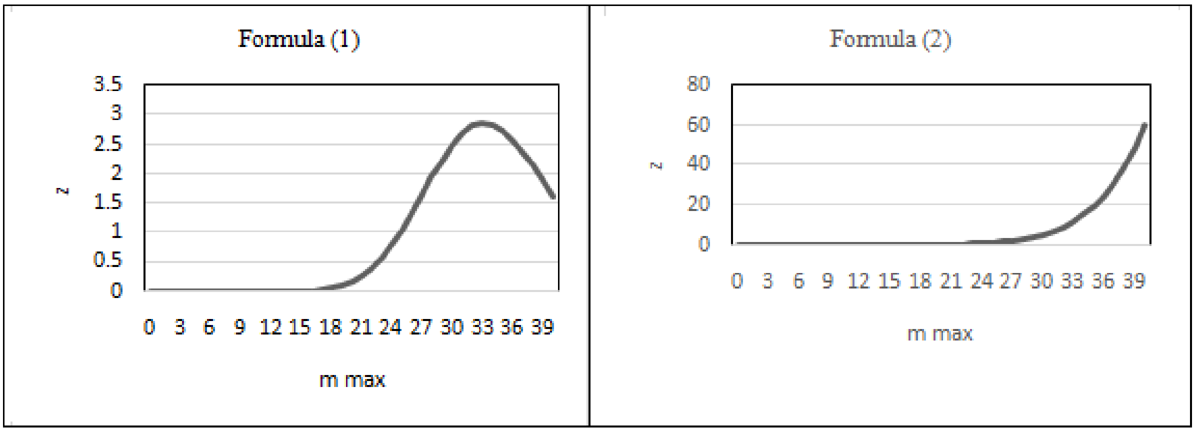


Fig2. *Formulas (1) and (2) calculated graphs of the effect of the apparent magnitude on the redshift*

By components of equation (1) $z' = a{m_{max}}^b$ and $z'' = \exp(-c{m_{max}}^d)$ were obtained at maximum $z_{\max} = 2.876$ values $z' = 443050.0$ and z''=6.49E-6.

In the absence of braking on the theory [2] accelerating expansion of the Universe the regularity (Figure 2) on the exponential law of the species was obtained

$$z = a{m_{max}}^b. \qquad (2)$$

Coefficient Data (2): a = 1.51599528840E-012; b = 8.48797550270E+000.

Comparison of formulas (1) and (2) for five supernovae (rows 5-7 of table 1 are excluded due to the strong difference in the redshift measurements) is given in table 2.

The following symbols are given in table 2:

ž – actual measured value of the parameter of the redshift supernova,

z – calculation according to the formulas (1) or (2) the values of the redshift,

ε - the absolute error or residual of the regularity, with $\varepsilon = \check{z} - z$,

Δ - relative error of formulas (1) or (2), $\Delta = 100\varepsilon/\check{z}$, %.

Table2. *Comparison of the redshift of distant supernovae SN 1a*

№ п/п	SN 1a	m_{max}	$\check{z}$	By formula (1)			By formula (2)		
				z	ε	Δ, %	z	ε	Δ, %
1	SCP-16C3	24.73	2.2216	0.980	1.242	55.88	1.015	1.207	54.32
2	SN1997ap	23.5	2.07	0.675	1.395	**67.41**	0.658	1.412	**68.21**
3	UDS10Wil	27.13	1.914	1.702	0.212	11.09	2.227	-0.313	-16.37
4		27.13	1.914	1.702	0.212	11.09	2.227	-0.313	-16.37
8	SN150G	25.2	1.713	1.111	0.602	35.12	1.191	0.522	30.50
9	SN2003ak	24.1	1.551	0.816	0.735	47.38	0.815	0.736	47.45
10		24.1	1.551	0.816	0.735	47.38	0.815	0.736	47.45
11		24.1	1.551	0.816	0.735	47.38	0.815	0.736	47.45

Calculations showed (Table2) that the maximum relative error of formulas (1) and (2) is approximately the same (67.41 and 68.21%).

3. THE TREND AND FLUCTUATION OF THE REDSHIFT

We accept the hypothesis of vibrational adaptation of the Universe, in this article on the set of 7823 supernovae SN 1 a, due to the influence of dark energy and dark matter on individual asymmetric supernovae explosions.

Because of the capabilities of the software environment CurveExpert-1.40 (http://www.Curve expert.net/) for 11672 points the trend equation with one oscillation (Figure 3) of the form was obtained

$$z = a m_{\max}{}^{b} \exp(-c m_{\max}{}^{d}) + A\cos(\pi m_{\max} / p + i), \quad \text{b} \qquad (3)$$

$$A = e\exp(f m_{\max}{}^{g}),\ p = h,$$

where a, b, c, …, i –parameters (2), A–amplitude (half) the fluctuations, p–half-period of oscillations. Coefficient Data (3):a =1.22564149509E-023; b =1.88181240604E+001; c =4.97851529829E-002; d=1.56863942269E+000;e=2.55505536822E-013; f =1.01337073669E+000; g =1.02036557030E+000; h =8.05856096051E-002; i =2.89537124852E+000.

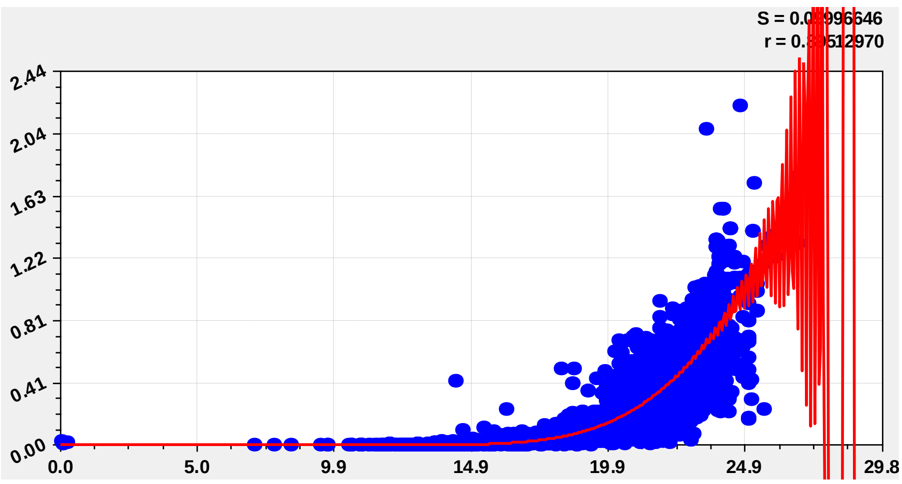


Fig3. *Pattern graph (3) the effect of the apparent magnitude on the redshift*

The constant oscillation period is 2A = 0.1612 of the apparent magnitude. The amplitude of the perturbation (Figure 4) increases sharply with the increase in the visible stellar magnitude.

The vibrational perturbation of the redshift begins markedly with the visible stellar value $m_{max} = 24$ and it lowers the maximum of the trend from $z_{\max} = 2.876$ by the formula (1) to 2.840 with the same optimum $m^*_{max} = 33$. In this case, the estimated amplitude of the fluctuations varies from -755.471 the apparent stellar magnitude 237.890 32.9 to 33.0 at the abscissa.

Then the negative amplitude, showing the change of the redshift outside our Universe, becomes very high. As a result, the oscillatory perturbation of the redshift (Figure 4) increases between at least two universes.

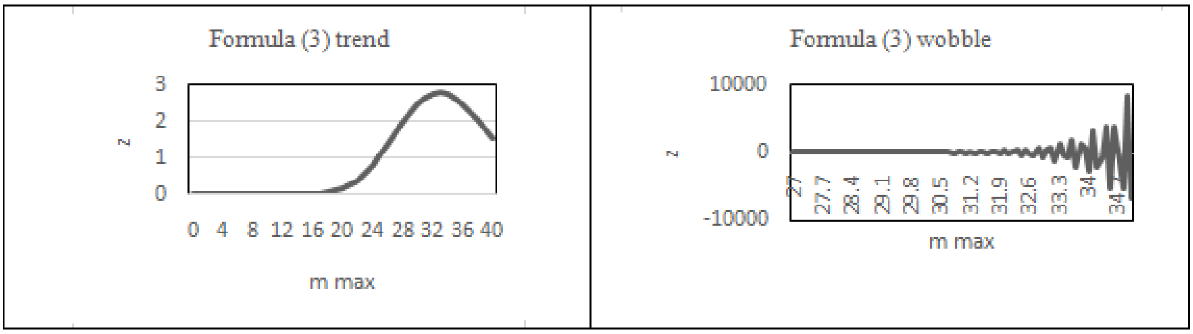


Fig4. *Calculated according to the formula (3) graphic effect in the apparent magnitude of the redshift*

Thus, the system of the set of supernovae, as well as the internal combustion engine, as it goes into dissimilarity, but only within our Universe. With the addition of the set studied by us with new measured supernovae at least up to redshift 2.840, an astrophysical effect of inhibition of the amplitude not only of the trend (trend is understood as oscillation with an infinite period), but also of the oscillating disturbances themselves can appear.

4. Truncated at the Lower Limit of the Redshift of the Sample

It was noticed that the sample of 7823 supernovae (repeated measurements 11672) contains an excessive number of very small values of redshift. Therefore, we introduce a new parameter z_0-the lower limit of the redshift, less of which the selection elements are excluded. With the step of 0.1 the resulting number lower limit 0.0, 0.1, 0.2, …, 1.4..

In table 3 the quantitative values of the statistical parameters of the samples.

Table3. *Selection parameters after truncation to the lower limit of redshift*

Lower limit	Total number	The number of repetitions of measurements				The parameters of the trend		Wave period		Correlation coefficient r
z_0	n	1	2	3	4	m^*_{max}	z_{max}	$2p_1$	$2p_2$	
0.0	11672	7823	2916	682	160	33.0	2.840	0.1612	-	0.8951
0.1	6052	3870	1587	491	91	31.2	2.116	0.1617	-	0.8153
0.2	4201	2573	1169	389	70	30.3	1.783	0.1738	-	0.7574
0.3	2559	1700	820	270	39	∞	∞	0.1609	0.4312	0.7162
0.4	1725	950	573	178	24	868.0	347454	0.1608	0.4309	0.7006
0.5	1120	578	409	115	18	346.0	4984.5	0.1607	0.4315	0.6975
0.6	715	355	270	74	16	121.0	53.671	0.1608	0.4311	0.6929
0.7	454	221	173	47	14	82.0	14.979	0.1610	0.4258	0.7164
0.8	324	149	121	40	14	55.0	4.641	0.1617	0.4262	0.7005
0.9	191	83	63	32	12	36.7	1.749	0.1617	0.4260	0.6554
1.0	127	53	36	27	11	26.0	1.196	0.1622	0.4048	0.6118
1.1	75	32	19	16	8	21.0	1.391	0.1629	0.3984	0.5945
1.2	53	22	14	12	5	16.5	2.521	0.1612	0.3551	0.7477
1.3	39	16	11	9	3	12.8	8.456	0.1595	0.3678	0.8285
1.4	18	9	5	3	1	8.1	8305.0	0.1593	0.3718	0.9983

The first three samples after identification were obtained with one oscillation due to difficulties with processing of more than 3300 pairs of values in the software environment CurveExpert-1.40 (http://www.curveexpert.net/). The first sample group includes lower limits of 0.0, 0.1, and 0.2. The correlation coefficient decreases as it is removed to the lower limit of the redshift from 0.8951 to 0.7574. Then it turns out that a large number of supernovae at low redshift allows us to improve the adequacy of the model (3). But the exception 11672 – 4201 = 7471 small values of redshift simultaneously shifts the optimum apparent magnitude from 30.3 to 33.0. At the same time, the maximum trend values of redshift 2.116 and 1.783 are already within the measurements in table 1 to 2.2216.

In the lower limit interval from 0.3 to 0.8, there was a strong difference in the trend parameters m_{max}^{*} and z_{max} . This fact indicates that the statistical sample of supernovae are found to be violated. Only to samples of 0.9 – 1.2 are formed, the most likely values of the parameters of the trend. The highest quality of truncated sets is a sample with a lower limit of 1.2, which shows that at the mean values of the visible star value, large values of redshift are possible. For example, from table 1, you can map supernovae SN1997ap ($m_{max} = 23.5$ and $z = 2.07$) and UDS10Wil ($m_{max} = 27.13$ and $z = 1.914$) to cross parameter values.

Lower limits 1.3 and 1.4 are highly adequate due to the small number of points.

Thus, two subgroups deserve attention from all samples except the lower limit 0.0: the first contains two samples 0.1 and 0.2, the second – 0.9, 1.0, 1.1 and 1.2.

Moreover, all samples from 0.3 to 1.4 have the same three-point pattern

$$z = am_{\max}{}^{b}\exp(-cm_{\max}{}^{d}) + A_1\cos(\pi m_{\max}/p_1 + i) + A_2\cos(\pi m_{\max}/p_2 - n)\,, \qquad (4)$$

$$A_1 = e\exp(fm_{\max}{}^{g}),\; p_1 = h\,, A_2 = j\exp(km_{\max}{}^{l}),\; p_2 = m\,.$$

For example, to fetch the redshift at the lower limit 1.2 identified (Figure 5), the following model parameters (4): a =3.21098639211E-006; b =8.18040929039E+000; c =8.06561356597E-001;d=8.74422361728E-001;e=1.51929678650E-014; f =2.17063016354E+000; g=8.21527693303E-001;h =8.06042703563E-002; i =3.76774798710E+000; j = 4.39941144140E-031; k =3.21625025629E+001; l =2.35709078562E-001; m =1.77555883547E-001; n =4.88222423560E+001.

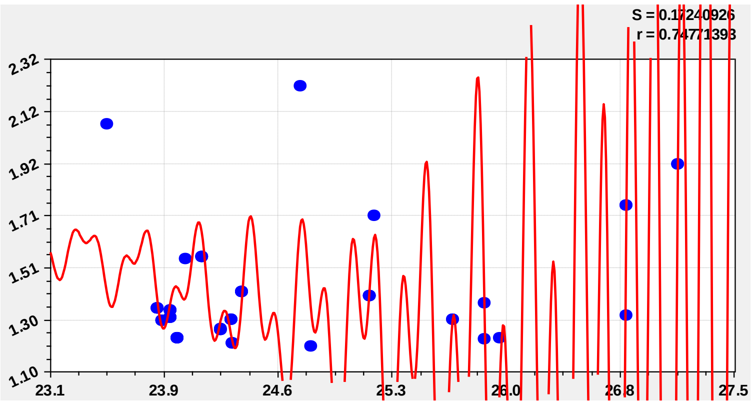


Fig5. *Graph of the influence of the visible star value on the redshift in the sample 1.2*

The two upper points in figure 5 show that high redshift can occur in supernovae at lower values of the apparent magnitude.

5. The Trend of Influence of the Redshift in the Maximum Apparent Magnitude

For a complete sample of 11672 points, consider the inverse effect of $m_{\max} = f(z)$ by the Weibull law formula (Figure 6) of the form

$$m_{max} = a - b\,exp(-cz^{d}). \qquad (5)$$

Coefficient Data:a = 2.87504142011E+001; b =3.29263833218E+001; c =1.85429921524E+000; d =1.67640407900E-001.

The parameters of the model (5) get the following astrophysical sense:

a - limit of apparent magnitude achievable under the condition of $z \to \infty$,

b - the interval of change of the visible star value from the influence of the redshift,

$a - b$ - the lowest value of apparent magnitude assuming $z \to 0$,

c- the exponential decay activity of the apparent magnitude,

d- the intensity of the decay of the visible star value exponentially.

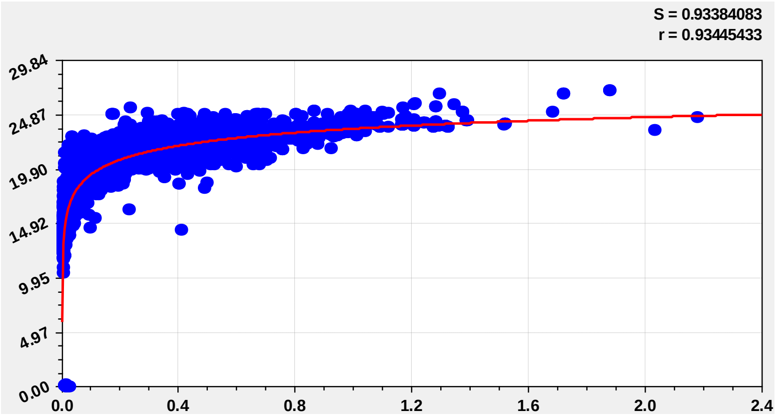


Fig6. *A graph of the effect of redshift on the apparent magnitude for the full sample*

The adequacy of the model (5) is high in correlation coefficient 0.9345. Thus we receive that $a = 28.75$, $b = 32.93$ and $a - b = -4.18$.

6. THE TREND AND FLUCTUATION EFFECT OF REDSHIFT

The addition of the trend by the asymmetric infinite-dimensional wavelet formula [3-10] significantly affects the change in the visible stellar magnitude (Figure 7) by the regularity of the form

$$m_{max} = a - b\, exp\left(-cz^d\right) + Acos(\pi z/p - k), \quad (6)$$

$$A = e\exp(fz^g), p = h - iz^j .$$

Coefficient Data: a = 3.17917369010E+001; b = 3.63150999335E+001; c =

1.50989830987E+000; d=1.52876628128E-001;e=2.05041217865E-001;f=2.29176302256E-001;g=3.40266252549E+000; h=6.02736478981E-001;i=4.31274588025E-

002;j=1.96377276763E+000;k=4.29914668107E-001.

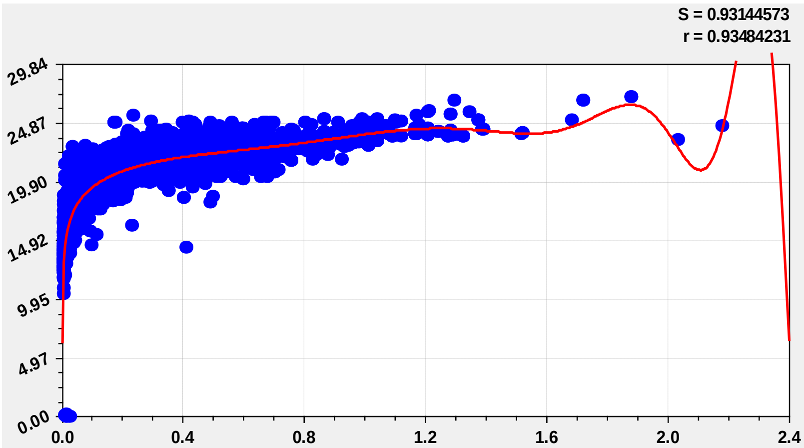


Fig7. *Pattern graph (6) the effect of the redshift on the apparent stellar value*

The correlation coefficient increased slightly from 0.9345 to 0.9348, but the application of the wave hypothesis of the Universe significantly increased the limits of the visible star value from 28.75 to 31.79. And the interval b apparent magnitude was equal to 36.32 instead of 32.93 have trend.

The lowest value of the apparent stellar value, provided $z \to 0$, was 31.79 – 36.32 = -4.53 instead of -4.18. Then it turns out that taking into account only one additional wave perturbation to the trend significantly increases the parameters of the Weibull law.

The graph in figure 7 shows that after a redshift of more than 2.4 there is a sharp decrease in the visible stellar magnitude. This means that you need to look for a supernova with small value of apparent magnitude, but with large value of redshift. This is evidenced by the first three supernovae from table 1, when UDS10Wil has a maximum of the visible star value 27.13, but it has a minimum of redshift 1.914, and the supernova SCP-16C3, on the contrary, receives the maximum value of the redshift at a lower value of the visible star value.

The equation (6) shows that the oscillation is an infinite dimensional wavelet due to the change of half of the amplitude according to the exponential growth law, so under the condition of $z \to 0$ the minimum $m_{\max \min}$ = 0.205 is observed. The half-period of oscillation on the redshift axis decreases from $p_{z \to 0}$ = 0.603 (parameter h of the model (6)) to $p_{z \to \infty} \to -\infty$. Of course, here the negative sign shows the influence of dark energy and/or dark matter.

It turns out that with the increase of the redshift from zero, we obtain (6) from the formula

$$p^* = h - iz^j = 0, \; p^* = 0.60274 - 0.043127 z^{*1.96377} = 0. \qquad (7)$$

Next we have $z^{*1.96377} = 13.97593$. Then we get $z^* = 3.83051$. Within $0 \le z \le 3.83$ there will be a positive value of the half-period of oscillation, that is, perturbation occurs in our Universe. And under condition $z > 3.83$, the oscillation will move to a negative region, that is, the perturbation of the redshift occurs outside our Universe.

In table 1 the maximum measured value of the redshift is equal to 2.2216. Therefore, the design limit 3.83 is 1.724 times higher. In the range from 0, as it approaches 3.83, the redshift is increasingly influenced by dark matter and dark energy.

7. The Effect of Redshift in the Truncation of the Sample

Table 4 and table 5 provide the results of pattern identification (6).

Table4. *Model trend parameters (6) after truncating the sample to the lower limit of the redshift*

Lower limit z_0	Total number n	The parameters of the trend model (6)				Correlation coefficient r
		a	b	c	d	
0.0	11672	31.79174	36.31510	1.50990	0.15288	0.9348
0.1	6052	32.49163	36.00437	1.41500	0.14616	0.8326
0.2	4201	37.80822	18.77164	0.29105	0.60533	0.7451
0.3	2559	38.30508	17.86502	0.20625	0.89634	0.6919
0.4	1725	36.93933	24.29851	0.61663	0.28631	0.6652
0.5	1120	37.02142	24.01165	0.59717	0.28266	0.6699
0.6	715	32.49089	36.04250	1.42363	0.18365	0.6700
0.7	454	32.48936	36.05188	1.42338	0.18763	0.7125
0.8	324	32.48629	36.07409	1.42290	0.20541	0.7232
0.9	191	32.48193	36.09869	1.42233	0.21387	0.6787
1.0	127	32.49133	36.05641	1.42343	0.21485	0.5792
1.1	75	32.47643	36.13273	1.42158	0.21646	0.6525
1.2	53	65.97676	44.79205	0.056707	1	0.7111
1.3	39	43.37638	24.58723	0.18189	1	0.7711
1.4	18	93.09832	72.12072	0.037731	1	0.9758
1.5	11	92.28288	73.57688	0.056226	1	0.9996

Model (6) proved to be suitable for all clip on redshift from sampling 11672 to 11 pairs of values. For group $z_0 = 15$ the total number $n = 11$, which coincides with the number of model parameters (6). The software environment does not perceive a smaller number of points.

With the exception of small redshift values from level $z_0 = 0.1$ to 0.3, the limit of the visible star value increases from 31.79 to 38.31, provided $z \to \infty$. With further truncation of the sample to $z_0 = 0.9$, the limit decreases. The subsequent sharp increase in model a (6) is due to a decrease in sample size. The interval b is almost the same if $z \to 0$.

In truncations 0.2 to 1.3, the correlation coefficient of formula (6) is much lower than 0.9348 for a full sample at $z_0 = 0$. The increase in the correlation coefficient at levels 1.4 and 1.5 is associated with a sharp decrease in the number of pairs of values in statistical samples. Therefore, we can accept that the full sample receives a higher value in comparison with truncated sets.

Graphs with lower limit levels of redshift 0.3, 0.9, 1.2, and 1.5 are shown in figures 8, 9, 10, and 11.

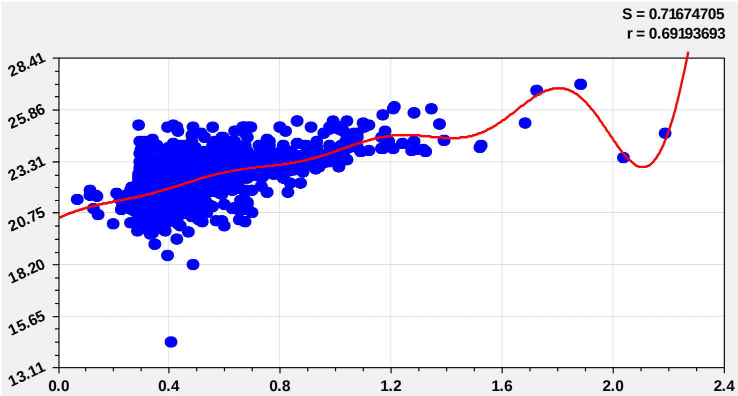


Fig8. *Pattern graph (6) the effect of the redshift on the apparent stellar value at* $z_0 = 0.3$

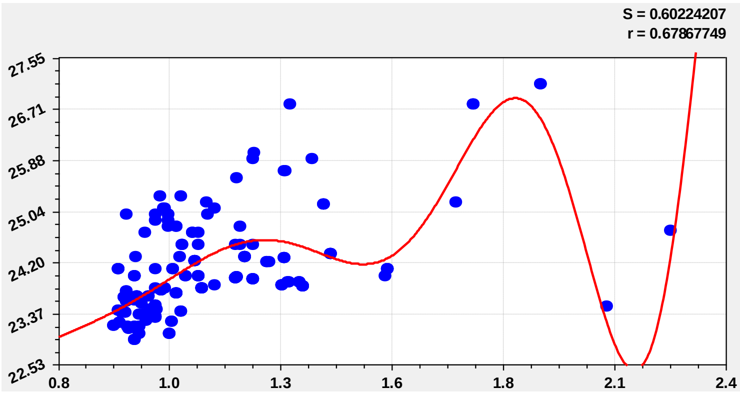


Fig9. *Graph of the model (6) the effect of the redshift on the apparent stellar value at* $z_0 = 0.9$

Figure 10 shows that on the left there is a beautiful figure of a cluster of supernovae in the form of a leaf of a tree with an average main vein. At the level of the lower limit 1.3 the left side of this conditional sheet is removed. And at level 1.5, the whole cluster is excluded. Apparently, such a figure arrangement of the values of the visible stellar magnitude is not accidental: it can have some effect for a particular set of supernovae SN 1a.

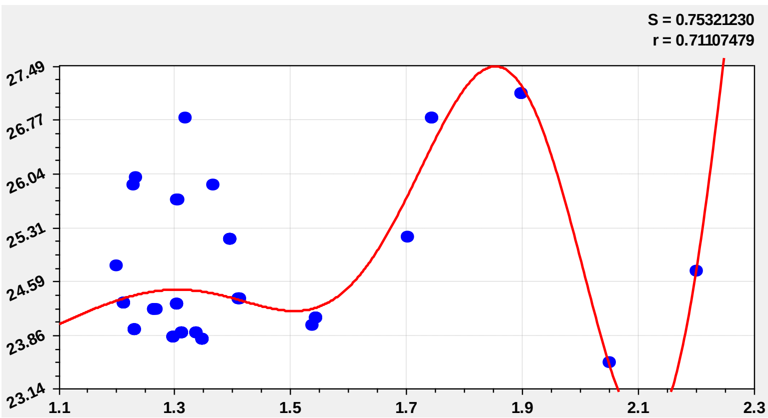


Fig10. *Model graph (6) the effect of the redshift on the apparent stellar value at* $z_0 = 1.2$

Thus, only those supernovae remain at the lower level 1.5 (Figure 11), which clearly determine the oscillation of the visible stellar magnitude from the change of the redshift under the condition of $z \geq 1.5$.

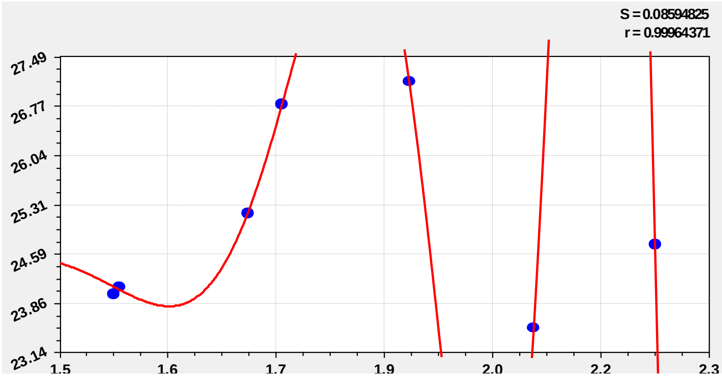


Fig11. *Graph of the model (6) the effect of the redshift on the apparent stellar value at* $z_0 = 1.5$

Table5. *Oscillation parameters after truncating the sample to the lower limit of the redshift*

Lower limit	The amplitude (half) the fluctuations of the model (6)			Half-period of oscillation of visible stellar magnitude			Shear wave
z_0	e	f	g	h	i	j	k
0.0	0.20504	0.22918	3.40266	0.60274	0.043127	1.56377	0.42991
0.1	0.17401	0.38713	2.75034	0.77889	0.14834	1.14022	-0.17948
0.2	0.00061610	5.79789	0.49345	0.34758	0.0085074	1.07941	4.57460
0.3	0.077939	0.84567	1.98279	0.19988	-0.061359	0.43677	1.25306
0.4	0.10694	0.74305	2.01929	0.49154	0.099817	0.49961	-2.88296
0.5	0.036530	1.74775	1.24079	0.49533	0.086131	0.65879	-3.27096
0.6	0.0083917	3.13285	0.85430	0.34009	5.69644e-5	7.12627	4.57975
0.7	0.0082933	3.12836	0.85725	0.33979	4.97245e-5	7.21882	4.54906
0.8	0.0076198	3.11601	0.88648	0.33921	3.58326e-5	7.40099	4.46816
0.9	0.0075394	3.11488	0.88284	0.33885	2.94464e-5	7.50421	4.43645
1.0	0.0074844	3.11269	0.88294	0.33852	2.47201e-5	7.56898	4.40588
1.1	0.0073873	3.10806	0.88239	0.33838	2.06004e-5	7.63625	4.39922
1.2	2.15594e-33	72.81072	0.065960	1.40661	0.86683	0.19272	0.74941
1.3	9.28202e-36	78.20268	0.063193	0.10315	-0.035341	1	2.76332
1.4	6.66527e-34	73.87171	0.079494	1.18261	0.37132	1	-1.11048
1.5	2.40067e-34	73.81968	0.10612	0.88463	0.25269	1	1.03099

According to the table 5 the parameters of the oscillations from the model (6) changes in a complicated way. Under condition $z \to 0$, parameter e gets the maximum on the full sample of 11672 pairs of values. With further truncation of the sample at the lower limit of the redshift, this model parameter (6) decreases dramatically. And the activity f of the exponential growth of the amplitude of the apparent magnitude increases sharply, but the growth intensity of the amplitude g decreases significantly.

Under condition $z \to 0$, the half-period of oscillation $\hbar$ of the apparent stellar magnitude becomes less than 6 times (for the lower limit level 1.3) and more than 2.3 times (for the truncation level 1.2). At the same time, for the level 1.3, the activity of half-period variation changes the sign and therefore the half-period increases here by the exponential law.

This fact also indicates that the [1] directory needs to be updated with new data.

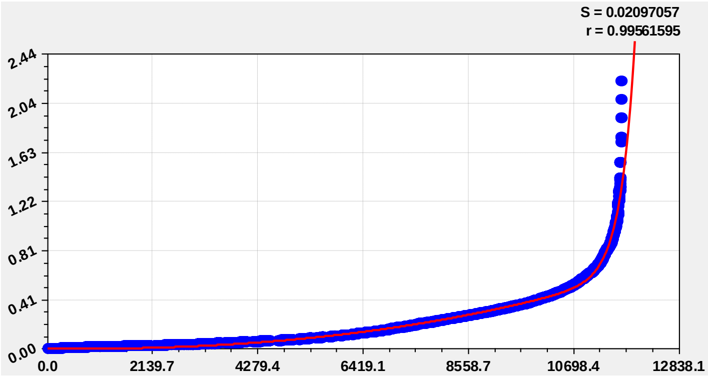
8. Ranking Distribution of the Redshift

The distribution of the factor values by ranks $R = 0,1,2,3, \ldots$ basically shows the quality of the measured data, in our case, the measurements of the parameters in 7823 supernovae.

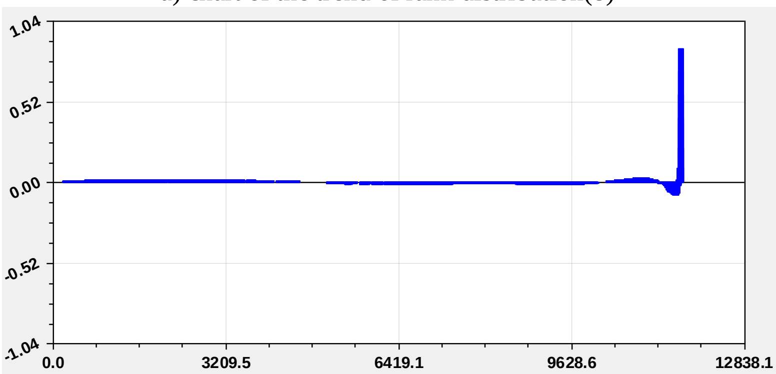
Figure 12 shows the graphs of two members of the trend by the formula

$$z = a\exp(bR^c) + dR^e \,. \tag{8}$$

Coefficient Data:a =4.84361301928E-018; b = 2.40244577795E-003; c=1.03684250866E+000; d =1.14477498484E-010; e =2.38895660293E+000.



a) chart of the trend of rank distribution(8)



b) residues after a trend (8)

Fig12. *Model graphics (8) the ranking 11672 values of redshift*

The graph in figure 12b shows that the absolute error of the model (8), including the law of exponential growth and the law of exponential growth, will increase sharply at the end of a series of values of redshift. At the same time, the wave pattern is not identified. This fact indicates that the measurements of the redshift at high values are performed with some (maybe unconscious scientists) excess. This seems to be due to the psychological desire in measurement experiments to obtain higher values of redshift.

Subsequent repetition of the measurements significantly reduce the value of redshift. For example, the values of the redshift 1.755, 1.755 and 1.32 for the supernova SN1997ff at the same visible stellar value of 26.8 were obtained from table 1 in three multipliers. The last dimension may be more reliable, but then the first two values are overestimated by 100 (1.755 – 1.32) / 1.32 = 75.50%.

Then it turns out that the test of our hypothesis about the limit of acceleration of the Universe will need to be checked on a sample containing SN 1a with small errors in measurements.

9. Rank Distribution of the Visible Magnitude Maximum

A similar situation is observed with the desire to overestimate the highest values in the visible stellar magnitude.

But for this supernova parameter, except for the maximum values (Figure 13), a sharp deviation of the complex four-point trend

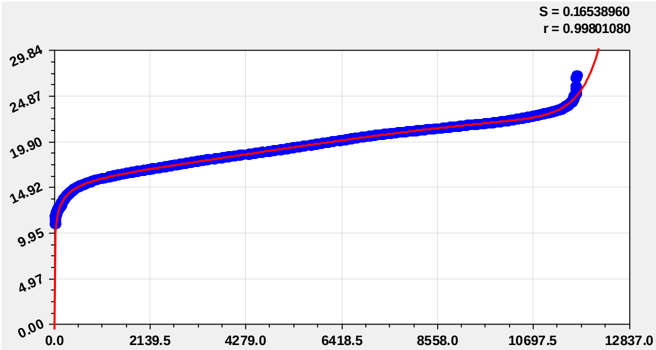
$$m_{\max} = a\exp(bR^{c}) + dR^{e}\exp(-fR^{g}) + hR^{i} - j\exp(kR^{l}) \qquad (9)$$

from the actually measured values occurs at the beginning of the ranking series.

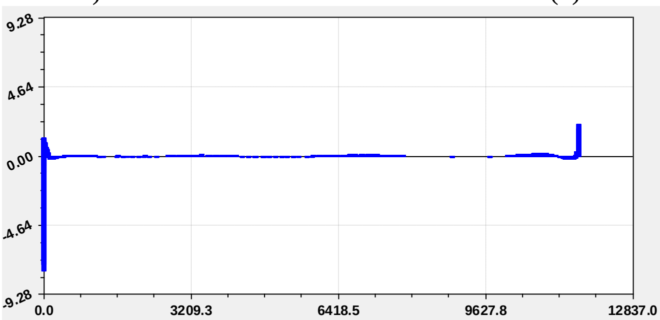
Coefficient Data:a = 1.33466288037E-011; b =1.69103794914E-003; c =1.02927476082E+000;

d=6.51966875914E+000;e=1.89661303724E-001;f=2.99002466139E-002;g=3.92065510175E-001; h=6.24513140566E-004;i=1.08779100891E+000;j=6.23768220560E-001;k=.92421484637E-004;

l =1.00067495809E+000.



a) chart of the trend of the rank distribution (9)



b) residues after a trend (9)

Fig13. *Model graphics (9) of the ranking 11672 values of apparent magnitude*

From the graph in figure 13b it can be seen that at the beginning of a series of ranking there is a strong wave perturbation. This fact means that it seems that the first 14 values of the apparent magnitude less than 10 will need to be deleted.

However, the first 104 values of apparent magnitude with grades from 0 to 97 in the beginning of the series given the model (Figure 14) with a correlation coefficient of 0.9558 according to the formula of the truncated (with the model parameter $d = 1$) of the Weibull law of the form

$$m_{\max} = a - b\exp(-cR) . \qquad (10)$$

Coefficient Data:a = 1.22579129549E+001; b =1.37676014640E+001; c =1.12454690620E-001.

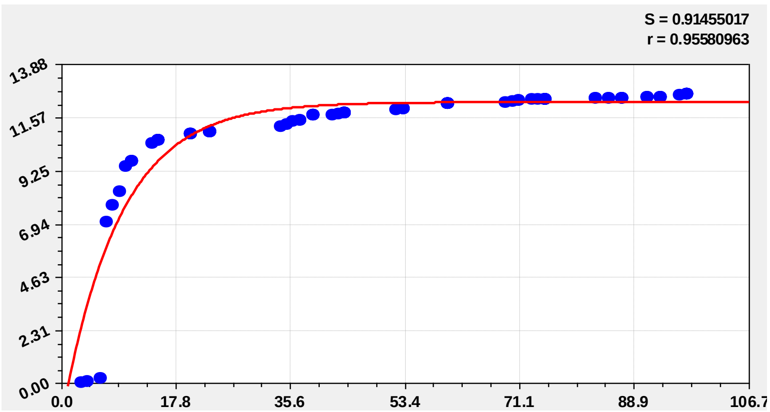


Fig14. *Graph of Weibull's law (10) for initial 104 values of visible stellar magnitude*

Thus, the regularity of the ranking allows to evaluate not only the quality of different versions of the sets SN 1a for the simulation the identification of stable laws and laws, but also to identify astrophysical effects on different parts of the ranked series. Thus there is an opportunity of the analysis and other parameters at supernovae from the catalog [1].

10. Conclusion

The redshift and visible stellar magnitude are unique parameters of the system consisting of 7823 supernovae Type 1a in the catalogue [1]. This uniqueness is proved by the presence, in the revealed regularity of influence of the visible stellar magnitude on the redshift, of the limit of expansion of the Universe to the expected maximum of the redshift 2.840 at the optimum of the visible stellar magnitude 33.0.

The limit of the redshift change is obtained both by the stress excitation trend (according to P.M. Mazurkin's law) and by this trend with the addition of an asymmetric wavelet with infinitely increasing amplitude and a constant oscillation period equal to 0.1612 of the visible stellar magnitude. The adequacy of the trend with the wave on the correlation coefficient is equal to 0.8951.

Truncation of the sample at the lower limit of the redshift from 0.1 to 1.4 in increments of 0.1 gives lower values of the correlation coefficient. Level lower limit on the redshift of 0.3 of the second oscillation similar design with the period of oscillations from 0.4312 to 0.3718 apparent magnitude. This difference is due to the computational capabilities of the CurveExpert-1.40 software environment, which allows you to effectively work with arrays of only up to 3300 pairs of values. At the same time, without taking into account the residues, it is possible to work with 32 thousand pairs of values.

To identify together all possible components with arrays of more than 32000 pairs of numbers, we need a special software environment created according to our scenarios of structural and parametric identification of stable laws and laws. This will improve the adequacy of polynomial models and at the same time significantly clarify the values of their parameters. Modeling many parameters of space objects will allow to identify new astrophysical effects.

In the future, it is necessary to re-identify the regularities given in the article from the catalogue [1] with additional supernovae measured again. For other columns of this catalog you need to perform parameterization, that is, to give them a computer-friendly quantitative values. Increasing the power of statistical sampling will give adequate regularities with a correlation coefficient greater than 0.95. Search new instances SN 1a, with a lot more in comparison with 2.2216 [1] values of redshift, you need to enter at lower values of apparent magnitude, when it theoretically possible for large values of redshift. For example, from table 1, you can compare supernovae SN1997ap ($m_{max} = 23.5$ and $z = 2.07$) and UDS10Wil ($m_{max} = 27.13$ and $z = 1.914$) with such cross parameter values.

The rank distribution of 11672 values of the redshift revealed a regularity consisting of two laws – exponential and exponential growth. Moreover, the analysis of the residues after these two laws showed that there is some overestimation of the measurements of the largest values of redshift at values of 1.5. However, it may turn out that such an overestimation in comparison with the regularity of the rank distribution is connected with the fundamental properties of dark energy and dark matter through the oscillation of the Universe at its long distances, and not with the psychological desires to show the best results of measurements by scientists. To identify such patterns, a factor analysis of at least 10 parameters in supernovae stars should be carried out. To do this, it is necessary to make the catalogue [1] convenient to create binary quantitative relations between factors.

The inverse effect of the redshift on the apparent stellar value, even at one oscillation, was the correlation coefficient 0.9348 (for direct influence 0.8951) adequate. This fact seems to mean that the expansion of the Universe has a greater influence on the supernova parameters than these objects themselves have on the expansion of the Universe. At the same time, the two-point trend according to the Weibull law has a correlation coefficient of 0.9345. But a small influence on 0.9348-0.9345 = 0.0003 of an asymmetric wavelet with a variable oscillation period gives a strong proof of the wave hypothesis of the Universe. This wavelet significantly increased the limits of the visible stellar magnitude from 28.75 to 31.79. And the interval of apparent magnitude was equal to 36.32 instead of 32.93 have trend. The lowest value of the visible star value under the condition $z \to 0$ became equal to 31.79 - 36.32 = -4.53 instead of -4.18 on the trend. Then it turns out that taking into account even one wave of perturbation to the trend significantly increases the parameters of the Weibull law.

According to the three-term equation of the regularity of the effect of the redshift on the visible stellar magnitude after the redshift of more than 2.4, a sharp decrease in the visible stellar magnitude occurs. This means that you need to look for a supernova with small value of apparent magnitude, but with large value of redshift. This is evidenced by the first three supernovae from table 1 in the catalogue [1], when UDS10Wil has a maximum of the visible star value 27.13, but it has a minimum of redshift

1.914. and the supernova SCP-16C3, on the contrary, receives the maximum value of the redshift at a lower value of the visible star value.

Within $0 \le z \le 3.83$ there will be a positive value of the oscillation period, that is, perturbation occurs in our Universe. And under the condition $z > 3.83$ the oscillation will go into a negative region, that is, the perturbation of the redshift begins to occur outside our Universe. According to table 1, the maximum measured value of the redshift is 2.2216, so the calculated limit is 3.83 more than the measured value of 1.724 times. In the range from 0, as it approaches 3.83, the redshift is increasingly influenced by dark matter and dark energy. At the same time, the complete sample receives a higher adequacy of 0.9348 compared to truncated sets.

Table 6 shows the correlation coefficients of rank distributions (in diagonal cells) and binary relationships after modeling all 11672 pairs of values.

The whole system of 7823 SN 1a is estimated by the coefficient of correlation variation 3.8235 / 4 = 0.9559. At the same time, according to [2], this index was 0.9966 for the system of 186 supernovae.

Table6. *Correlation matrix with rank distributions on trends and binary relations with wave components and rating of the strongest factors*

Influencing parameters x	Indicators y		Amount Σr	A place I_x
	z	m_{max}		
z	0.9956	0.9348	1.9304	1
m_{max}	0.8951	0.9980	1.8931	2
Amount Σr	1.8907	1.9328	3.8235	-
A place I_y	2	1	-	0.9559

Thus, for various reasons, sampling elements showed a slight difference between the two systems. Even sorting the entire catalog and selecting all SN 1a gave a correlative variation of more than 0.95. As a result, it is possible to compare a variety of different space objects, for example galaxies, pulsars and supernovae, by the coefficient of correlation variation. Further studies should increase the number of sample members. It was 11672 members instead of 186, and even with repetitions of measurements (in the future in the catalog [1] it is necessary to give the opportunity to print a sample with only one repetition, but having the lowest measurement error) and with a redshift of more than 1,755 allowed us to prove the existence of the limit of Universe expansion.

In table 6, the redshift came out to the first place among the influencing variables, and the visible stellar value is in the first place among the indicators. In the new software environment, which can accommodate up to 100 members, up to 1,000 parameters and up to 10^6 lines, the correlation coefficient of the space object system would be closer to 1.

Our experience of statistical modeling [3-10] has shown that in order to improve the quality of meaningful identification of the studied phenomenon or process, it is first necessary to take the primary parameters of the system of factors, and derived (calculated) indicators should be simulated in the second place. The redshift and the magnitude of the stellar magnitude will be considered conditionally for the primary factors, although they are calculated by the known formulas.

Table 6 shows that the first place with a correlation coefficient of 0.9980 was obtained by the model of the rank distribution of the visible star value, and the second place with a correlation coefficient of 0.9956 was the rank distribution of the redshift. This fact shows that the measurements of the apparent magnitude are slightly more accurate than the measurements of the redshift. The third place was taken by the binary regularity of the inverse influence of the redshift on the visible stellar magnitude, and the fourth place by the direct influence of the visible stellar magnitude on the redshift.

The regularity of the ranking allows to evaluate not only the quality of different versions of the sets SN 1a catalog [1] for the simulation the identification of stable laws and regularities, but also to identify astrophysical effects on different parts of the various ranks of the ranked. So you need to change the contents of a directory [1] for ease of identification of steady laws and regularities in the quantitative values of many parameters of the supernova.

REFERENCES

[1] J. Guillochan, J. Parrent, L.Z. Kelley, R. Margutti. Open Catalog for Supernova Data.https:// sne.space/. The Astrophysical Journal, Volume 835, Issue 1, article id. 64, 15 pp. (2017). Doi: 10.3847/1538-4357/835/1/64.

[2] Telescope: Evidence for Past Deceleration and Constraints on Dark Energy Evolution. To Appear in the Astrophysical Journal, June 2004. 0402512v2.pdf. Reiss_etal-Hiz-SneIa.pdf. 2004_Type Ia Supernova Discov... on Dark Energy Evolution_web.pdf.

[3] P.M. Mazurkin, Asymmetric Wavelet Signal of Gravitational Waves. *Applied Mathematics and Physics*, vol. 2, no. 4 (2014): 128-134. doi: 10.12691/amp-2-4-2.

[4] P.M. Mazurkin. Identification of wave regularities according to statistical data of parameters of 24 pulsars. 2016. 15 p. Doi 10.18411/d-2016-156.

[5] P.M. Mazurkin. Bubbles apparent magnitudes Messier objects. 2016. 6 p. Doi 10.18411/d-2016-157.

[6] P.M. Mazurkin. Stable Laws and the Number of Ordinary. *Applied Mathematics and Physics*, vol. 2, no. 2 (2014): 27-32. doi: 10.12691/amp-2-2-1.

[7] P.M. Mazurkin. Method of identification. *International Multidisciplinary Scientific GeoConference, Geology and Mining Ecology Management*, SGEM, 2014, 1(6), pp. 427-434. https://www.scopus.com/ inward/record.uri?eid=2-s2.0-84946541076&partnerID=40&md5=72a3fcce31b20f2e63e4f23e9a8a40e3

[8] P.M. Mazurkin. Wavelet Analysis Statistical Data. *Advances in Sciences and Humanities*. Vol. 1, No. 2, 2015, pp. 30-44. doi: 10.11648/j.ash.20150102.11.

[9] P.M. Mazurkin. Invariants of the Hilbert Transform for 23-Hilbert Problem, *Advances in Sciences and Humanities.* Vol. 1, No. 1, 2015, pp. 1-12. doi: 10.11648/j.ash.20150101.11.

[10] P.M. Mazurkin. The Invariants of the Hilbert Transformation for Wavelet Analysis of Tabular Data. *American Journal of Data Mining and Knowledge Discovery*. Vol. 1, N. 1, 12, 2016. http://www. Science publishinggroup.com/journal/paperinfo?journalid=603&doi=10.11648/j.ajdmkd.20160101.14.

[11] P.M. Mazurkin. (2018) Asymmetric wavelet signals of the cosmological redshift. *SF J Astrophyzics* 1:4. 8 p.

[12] P.M. Mazurkin. (2018) Oscillatory adaptation of redshift and module of distance in group of 186 supernew MLCS2k2. *SF J Astrophyzics* 1:4. 19 p.

[13] P.M. Mazurkin. (2018) Standing Wave Angular Height of the Location Of 17088 Supernovae from Azimuth according to Open Catalog for Supernova Data as a Result of the Influence of Visible and Dark Matter, Dark Energy. SF J Astrophysics 1:3. 32 p.

Citation: *Mazurkin. P.M. (2018). The Limit of the Acceleration and a Further Slowdown in the Expansion of the Universe According 7823 Type 1a Supernova from Open Catalog for Supernova Data. International Journal of Scientific and Innovative Mathematical Research (IJSIMR), 6(10), pp.28-42. http://dx.doi.org/ 10.20431/2347-3142.0610005*