Universe model without inflation

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Abstrakt

This article deals with possibility of finding an alternative model to the expanding universe model which can be in accordance with our astronomical observation. There is considered an easy but not usual model of closed universe with $k = 1$, $\Lambda = 0$ and $q = 0$ providing that mass of this universe is not constant but stepwise increasing.

Keywords: cosmology, universe, black hole, black matter, black energy

1 Constant speed expanding universe

Let's imagine a universe expanding with a constant speed. Let's consider that the speed of expanding of the universe determines the maximum of speed for particles inside. Let's suppose that particles with zero rest mass (photons) can move with the same speed as the universe is expanding. Let's postulate therefore:

$$\dot{a} \equiv c \tag{1}$$

Further, let's suppose that particles with nonzero rest mass have tendency to move with the speed of the light in vacuum too but due to its nonzero rest mass, they are not able to achieve the speed. The more their speed is near to the speed of light in vacuum, the higher their mass is and defends them to move speeder.

Let's have a model of the universe described by Fridman equations:

$$3\left(\frac{\dot{a}}{a}\right)^2 + \frac{3kc^2}{a^2} - \Lambda c^2 = 8\pi G\rho \tag{2}$$

$$\frac{\ddot{a}}{a} = -\frac{4\pi G}{3c^2}\left(\rho c^2 + 3p\right) + \frac{\Lambda c^2}{3} \tag{3}$$

G – gravitational constant

c – speed of light in vacuum

ρ – matter density in universe

p – pressure in the universe

a – expanse factor of the universe

$\dot{a}$ – speed of the universe expansion ($\dot{a} = c$ for the model)

$\ddot{a}$ – acceleration of the universe expansion ($\ddot{a} = 0$ for the model)

k – parameter of the universe curvature

Λ – Einstein constant

We can simplify the model by several premises:

1. Let's have Riemann space with positive curvature $k = 1$.
2. Let's have Einstein constant $\Lambda = 0$.

The Fridman equations simplifies to:

$$\dot{a}^2 + c^2 = \frac{8}{3}\pi G \rho a^2 = konst. \tag{4}$$

$$p = -\frac{1}{3}c^2\rho \tag{5}$$

The density of the universe is then inverse proportional to a square of the expansion factor a. It means that the linearly expanding universe is possible only on condition that its mass is not constant but it rises proportionally to a:

$$M = Ka \tag{6}$$

K – constant.

The standard model of the universe presumes that in time $t = 0$ all mass of our universe unreasonably appeared in some extremely small point which started to inflate and that way was created our present universe. However is it true?

Why should exist in time 0 such another amount mass which we observe around us? Is it necessary the all universe mass be here from the beginning or is it possible the universe mass has been increasing stepwise in context of the universe actual size? The easiest model of the variant is described by the equations (4) and (5).

Let us further imagine a universe where the more mass it contains the more it is larger and the larger it is the more mass it contains. The model like this evokes a black hole imagination. Its size is directly proportional to its mass.

$$a_\bullet = \frac{2GM_\bullet}{c^2} \tag{7}$$

$a_\bullet$ – radius of a black hole (Schwarzschild radius, horizon of events)
$M_\bullet$ – mass of a black hole.

Let's consider that the universe meets the Schwarzschild condition. The change of the internal energy of the universe corresponds with the change its energy in the model. The universe doesn't change heat with its surroundings. That is the first theorem of thermodynamics has easy form from which we can express a change of the universe energy as:

$$\mathrm{d}U = -p\mathrm{d}V = c^2\mathrm{d}M \tag{8}$$

From whence it follows that the pressure p is negative by positive density of energy. It is discrabed by the equation (5). Nevertheless, both matter and radiation creates positive pressure. As we will see, the value of negative pressure can be result of expansion of the universe and the current increase of its mass.

2 At the beginning

Let's think of existence only one quantum of energy with mass M_0 at the beginning of the universe. The time-space where the quantum occurred was limited by Schwarzschild radius. Its movement was limited by Heisenberg uncertainty principle.

Let the energy of the quantum starts growth. The space gets to be larger because Schwarzschild radius increases. Its speed will increase to value close to the expansion rate of the universe. It seems to be shorter in direction of its movement. If we consider that the quantum is 1-dimensional object (string) we can say that the quantum gets smaller generally. With increasing mass the primary quantum gets possibility to split on smaller quanta.

Particles with zero rest mass (photons) move from one point of space to another the shortest way (on a geodetic). They move with the speed of light in vacuum. Mass quanta (cold particles) move through space with little bit smaller instant speed. They move back and forth so that their average speed seems to be much smaller. That is big mass objects can move through space by speed much smaller then is their elementary parts instant speed.

How the universe expands, the speed of movement of all mass quanta will increase and limit near to the speed of light in vacuum. So there is an increase of matter in the universe without the universe received some energy from the outside. Mass of the universe (primary quantum) increases then by the relation:

$$M = \alpha_{v_m} M_0 = \frac{M_0}{\sqrt{1 - \frac{v_m^2}{\dot{a}^2}}} = \frac{M_0}{\sqrt{1 - \frac{v_m^2}{c^2}}} \tag{9}$$

v_m – instant speed of all mass quanta in the universe.

Size of quanta will seem smaller due to relativistic dilatation:

$$l = \frac{l_0}{\alpha_{v_m}} = l_0\sqrt{1 - \frac{v_m^2}{\dot{a}^2}} = l_0\sqrt{1 - \frac{v_m^2}{c^2}} \tag{10}$$

For the internal observer the mass of universe will then seem different than results from relation (9). If he considers his size and size of quanta which form him as a standard he won't consider that he or its parts gets smaller with time. If he stands on his planet surface and he doesn't know that the distance between him and the centre of the planet gravity gets smaller he will believe that the reason for the gravitational force increase is an increase of their mass.

Let's suppose further that mass and size of the universe doesn't change continuously but by quanta corresponding multiples of M_0 and a_0. For an internal observer then:

$$a = Na_0 = n^2 a_0 = \alpha_{v_m}^2 a_0 \tag{11}$$

$$M = NM_0 = n^2 M_0 = \alpha_{v_m}^2 M_0 \tag{12}$$

and time passages stepwise too:

$$t = Nt_0 = n^2 t_0 = \alpha_{v_m}^2 t_0 \tag{13}$$

n, N – natural numbers higher then zero.

The immediate speed of energy quanta has now the form:

$$v_m = \dot{a}\sqrt{1 - \frac{1}{n^2}} = c\sqrt{1 - \frac{1}{n^2}} \tag{14}$$

The universe is older the speed of light in vacuum is more close to the speed of the universe expansion

$$\lim_{n\to\infty} v_m = c$$

At present time the two values are not practically distinguishable.

3 The universe density

For closed universe ($k = 1$) we can call the expanse factor a as radius of the universe. Its volume is elementary inter-sphere with surfaces $4\pi a^2 \sin\psi^2$ and thickness $ad\psi$ ($0 \le \psi \le \pi$). We get it by integration:

$$V = a^3 4\pi \int_0^{\pi} \sin^2\psi \mathrm{d}\psi = 2\pi^2 a^3 \tag{15}$$

The volume of the universe represents the surface of a 4-dimensional sphere. The universe density we can express by means of relations (6) and (15) now:

$$\rho = \frac{M}{V} = \frac{K}{2\pi^2 a^2} \tag{16}$$

We can derive density from the equation (4) too but the equation can't be exact. Till now we haven't considered any relativistic effect related to the speed of universe expansion $\dot{a}$ but we should consider it as mass object speed too. That is we should use relativistic relation for superposition of two perpendicular speeds.

The speed of universe expansion $\dot{a}$ has a direction perpendicular to our 3-space dimensions and to all speed vectors in. We can express it by adding the imaginary mark before a value of the expansion speed (or before all speeds in our 3-dimensional space). Generally we can express speed of a mass object w this way:

$$w = v + \mathrm{i}\dot{a} \tag{17}$$

v – an object speed in our 3-dimensional space

The square of w can be expressed in the form:

$$w^2 = v^2 - \dot{a}^2(1 - \frac{v^2}{c^2}) \tag{18}$$

Now Einstein relativistic coefficient α gets more general form:

$$\alpha_w = \frac{1}{\sqrt{1 - \frac{w^2}{c^2}}} = \alpha_v \alpha_{\dot{a}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{1}{\sqrt{1 + \frac{\dot{a}^2}{c^2}}} = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \frac{1}{\sqrt{2}} \tag{19}$$

The first coefficient α_v in the relation (19) is the standard form of Einstein coefficient α. The second coefficient $\alpha_{\dot{a}}$ is related with speed of the universe expansion. If the speed of the universe expansion is constant then coefficient $\alpha_{\dot{a}}$ is constant too.

The wave packet related to the universe shows a dispersion which cause that it seems higher. Forasmuch that mass of universe increases linearly with time the dispersion is independent on time:

$$\Delta a_t = \sqrt{(\Delta a_0)^2 + (\frac{\Delta(m_0 \dot{a})}{m} t)^2} = \sqrt{a_0^2 + (\frac{m_0 \dot{a}}{N m_0} N t_0)^2} = a_0 \sqrt{2} \tag{20}$$

This result is in accordance with the value $\alpha_a = 1/\sqrt{2}$ from the relation (19). To get the density which corresponds to observation we must value a in the relation (4) to multiply by square root of 2. After correction:

$$\rho = \frac{3(\dot{a}^2 + \dot{a}^2)}{8\pi G(\sqrt{2}a)^2} = \frac{3\dot{a}^2}{8\pi G a^2} = \frac{3H^2}{8\pi G} = \rho_k \tag{21}$$

H – so-called Hubble constant:

$$H \equiv \frac{\dot{a}}{a} = \frac{c}{a} \tag{22}$$

The universe density seems so to be equal the critical density. It corresponds to our observation. In contrast to the inflation model it happens not only effectively.

By comparison the relations (21) and (16) results for K:

$$K = \frac{3\pi\dot{a}^2}{4G} = \frac{3\pi c^2}{4G} \cong 3.18 \times 10^{27}\, kgm^{-1} \tag{23}$$

The universe in the model is then not only closed but fulfills Schwarzschild relation for black holes too because everything contained inside the universe is placed under the horizon of events:

$$a_g = \frac{2GM_g}{c^2} = \frac{2GKa}{c^2} = \frac{3\pi}{2}a \tag{24}$$

a_g – Schwarzschild radius (horizon of events)

$M_g = M$ – the mass of the universe.

Mass movement in the direction of the expansion of the universe and its rise with time induce a force, which has size:

$$F = \mathrm{i}^2 \frac{\mathrm{d}M}{\mathrm{d}t} c = -Kc^2 \tag{25}$$

This force acts on the surface:

$$S = 6\pi^2 a^2 \tag{26}$$

This creates a pressure that is already known from the relation (5):

$$p = \frac{-Kc^2}{6\pi^2 a^2} = -\frac{1}{3}c^2\rho \tag{27}$$

The pressure in the universe is therefore negative. Positive pressure of particles and radiation is rather local phenomenon and can have on the universe as wholeness no effect.

4 Minimum of length, time and mass

Let us further suppose that minimal value of the universe radius a_0 is given by the relation for the minimal quantum packet:

$$a_0 = \frac{\hbar}{2M_0 c} = \frac{\hbar}{2Ka_0 c} = \sqrt{\frac{2\hbar G}{3\pi c^3}} \cong 7.44 \times 10^{-36}\, m \tag{28}$$

The minimum time interval then:

$$t_0 = \frac{a_0}{c} = \sqrt{\frac{2\hbar G}{3\pi c^5}} \cong 2.48 \times 10^{-44}\, s \tag{29}$$

The minimum mass of the universe M_0 is given by the relation:

$$M_0 = K a_0 = \sqrt{\frac{3\pi\hbar c}{8G}} \cong 2.36 \times 10^{-8}\, kg \tag{30}$$

5 Non-local increasing of mass

As the universe expands, the speed of quanta increases. Their mass and the mass of whole universe increase too. While the universe dimension increases the size of quantum energy gets smaller because of length dilatation. At the same time dilatation happens too. Physical process taking a time in past will take shorter time in future.

We know how the mass and size of the universe will increase as a whole. Let's see now how mass and size of its parts change. Mass of all material structures has to change by the equation:

$$m_2 = m_1 \frac{t_2}{t_1} = m_1 \frac{N_2}{N_1} \tag{31}$$

m_1 – an object mass in time t_1

m_2 – an object mass in time t_2

If the mass of photons increases by relation (31) it would be mean in practice that energy of photons emitted in past will increase and not decrease with time. No red but blue shift would happen. If the relation (31) should be valid and red shift happens in the same time there has to be a decomposition of original energy quanta into smaller energy quanta.

If the number of quanta of energy increases, the number of by photons mediated electromagnetic interactions between them should increase too. Mass of the single photons doesn't increase, but increase their number in proportion to the number of quanta of energy particles with nonzero rest mass. The relation (31) for photons we can rewrite in form then:

$$m_{f2} = \frac{m_{f1}}{n_f} \frac{t_2}{t_1} = \frac{m_{f1}}{n_f} \frac{N_2}{N_1} \tag{32}$$

n_f – number of particles fragmented from an original particle

m_{f1} – photon mass in past in time t_1

m_{f2} – photon mass in past in time t_2

If the universe with temperature T_1 at time t_1 contains n_{f1} particles then it should have at time t_2 temperature T_2 and contain n_{f2} particles. Then:

$$\frac{n_{f2}}{n_{f1}} = \frac{p_2 V_2}{p_1 V_1}\frac{T_1}{T_2} = \frac{a_2}{a_1}\frac{T_1}{T_2} = \frac{N_2}{N_1}\frac{T_1}{T_2} \tag{33}$$

After insert in (31):

$$m_{f2} = m_{f1}\frac{T_2}{T_1} \tag{34}$$

and

$$\lambda_2 = \lambda_1 \frac{T_1}{T_2} \tag{35}$$

Regarding that the universe temperature decreases over time photon mass will decrease too. Radiation on the way through the universe gets colder. To the goal get more photons then was at the start - so much, as if the universe in the past contained the same amount of matter as today.

The particulate mass with nonzero rest mass will grow by (31) but simultaneously their wavelength will lengthen according to (35). Their mass is then given:

$$m_2 = N m_1 \frac{T_2}{T_1} \tag{36}$$

m_1 – the mass of a "cold" particle at time t_1

m_2 – the mass of a "cold" particle at time t_2

Relationships (34) and (36) describe observable mass. This is obviously lesser than the mass the mass objects should have by the equation (31). Mass corresponding to the difference we can't directly observe, but we can observe its gravitational-effect. The matter we name: "dark matter".

The non-local increasing of mass and energy already existing particles and mass objects can explain the existence so-called dark matter. If stars inside galaxies draw apart out of the galaxy centre in consequence of the universe expansion ($\sim N$) and increase their mass according (31) then the speed of their motion around the centre of galaxy gravity (which increases its mass too) should stay same what is in accordance with observation – its rotation curve is from some distance from the centre flat.

6 The universe temperature

If the universe is like a large four-dimensional black hole then it is characterized by the temperature which it should have in area of Schwarzschild diameter:

$$T_{Ng} = \frac{\hbar c^3}{8\pi k G n M_0} = \frac{T_{0g}}{n} \cong \frac{5.20 \times 10^{30}}{n}\,\mathrm{K} \tag{37}$$

In the relation ((34) the value n (instead N) is used because temperature of the black hole horizon and the universe is established by its real mass. The primal universe temperature was $T_{0g} \cong 5.20 \times 10^{30}\,\mathrm{K}$ then. The actual universe temperature is much lower and should correspond to the temperature of relict radiation $Tr = 2.726\,\mathrm{K}$. The relations (36) and (35) get then forms:

$$m_{f2} = m_{f1}\frac{n_1}{n_2} = m_{f1}\frac{\alpha_1}{\alpha_2} \tag{38}$$

$$\lambda_2 = \lambda_1\frac{n_2}{n_1} = \lambda_1\frac{\alpha_2}{\alpha_1} \tag{39}$$

If the wave length increases by the relation (39) and the radiation temperature decreases according to (37) then the radiation will have the character black body radiation.

The relation (36) for cold particles mass increase has now the form:

$$m_2 = m_1\frac{n_2}{n_1} = m_1\frac{\alpha_2}{\alpha_1} \tag{40}$$

From relation (33) results after substitution the number of energy quanta contained in our universe:

$$n_f = n^3 \tag{41}$$

The mass of universe increases during its expansion but the mass of the first quantum decreases. Elementary quantum has then energy:

$$E_{0f} = M_{0f}c^2 = \frac{n^2 M_0 c^2}{n^3} = \frac{M_0 c^2}{n} \tag{42}$$

The power radiated (by the Stefan-Boltzman low) from area of horizon is now independent on the value of N:

$$P = \sigma A_N T_{Ng}^4 = \sigma\left(\frac{\mathrm{d}V}{\mathrm{d}a}\right)_{a_g} T_{Ng}^4 = \sigma 6\pi^2\left(\frac{3\pi}{2}\right)^2\frac{N^2 a_0^2 T_{0g}^4}{n^4} \cong 3.01\times 10^{48}\,\mathrm{W} \tag{43}$$

σ – Stefan-Boltzman constant $\sigma = 5.6705 \times 10^{-8}\,\mathrm{Wm^{-2}K^{-4}}$

A_N – black hole surface (in horizon of events).

By multiplication of the power by the unit of time t_0, we should get the energy which the universe radiates analogously like a black hole radiates energy from its horizon. Question is where the universe should radiate it. Considering that our universe has the character of a surface of 4-dimensional sphere and light moving any direction is not able to escape from the surface the radiation from horizon will stay the part of the universe forever. The horizon of the black hole related with our universe is both everywhere and nowhere then. It produces radiation which transmits and heats whole universe.

The temperature of radiation which was radiated on the beginning of the universe is today same as the temperature originally from horizon of events. The universe seems like an interior of a black body where the density of temperature radiation is given by the relation:

$$U = \frac{\pi^2}{15} \frac{(kT)^4}{(\hbar c)^3} \tag{44}$$

For the temperature of relict radiation $Tr = 2.726\,\mathrm{K}$ results from the relation (44) the energy density $U \cong 4.18 \times 10^{-14}\,\mathrm{Jm}^3 \cong 0.26\,\mathrm{eVcm}^3$ what is a value well corresponding the measured value of density of relict radiation $0.25\,\mathrm{eVcm}^3$.

In first moment of the universe existence ($n = 1$) existed only one quantum of energy with mass M_0 and de Broglie wave length λ_0. In next moment ($n = 2$) existed already 8 energy quanta with mass $M_0/2$ and wave band $2\lambda_0$. De Broglie wave band of the original quantum but didn't dissolve. Despite it fragmented in smaller quanta the mass of whole increased.

That is in time $t = n^2 t_0$ exists already n^3 quanta of energy with mass M_0/n and a rank of de Broglie waves $\lambda_0, 2\lambda_0, 3\lambda_0, \ldots, n\lambda_0$.

Occurrence energy quanta are the most probable there where the amplitude of de Broglie waves is the highest. By composition of de Broglie wave rank with the same amplitude so that a complicated space pattern influencing mass density distribution and fluctuation of relic radiation temperature.

7 Cosmological shift of spectrum

Perception (measurement) of time flow was obviously different than it is today. Physical process lasting 1 s at present time lasted n_2/n_1 times longer time in past. Dimensions of mass objects were n_2/n_1 times bigger and photons radiated by them had n_2/n_1 times longer wave length then they have by the same process today.

Cosmological shift of spectrum cosmological objects is defined:

$$z \equiv \frac{\lambda_r - \lambda_e}{\lambda_e} \tag{45}$$

This relation presumes that the spectrum of cosmological source was the same in the past and today and the cosmological shift has happened during the way from the source to an observer in consequence the universe expansion. If in the past particles creating atoms had smaller mass then today then energy radiated radiation from them was equivalent smaller then today. We should write rather:

$$z = \frac{\lambda_r - \lambda_{e-today}}{\lambda_{e-today}} \tag{46}$$

In case that mass of elementary particles were smaller in past then:

$$\lambda_e = \lambda_{e-today} \frac{n_r}{n_e} \tag{47}$$

According (32), (46) and (47) results (as in classical theory):

$$z + 1 = \frac{\lambda_r}{\lambda_{e-today}} = \frac{\lambda_r}{\lambda_e}\frac{n_r}{n_e} = \frac{N_r}{N_e} = \frac{a_r}{a_e} \tag{48}$$

8 Size, age and mass of our universe

From the relation (37) results possibility to find out the actual value $N = n^2$ supposing that the temperature of relict radiation $T_r = 2.726\,\mathrm{K}$ corresponds both actual universe temperature and temperature of becoming cold radiation originally from early universe:

$$N = \left(\frac{T_{0g}}{T_{Ng}}\right)^2 = \frac{a_g}{a}\left(\frac{T_{0g}}{T_r}\right)^2 = \frac{3\pi}{2}\left(\frac{T_{0g}}{T_r}\right)^2 \cong 1.71 \times 10^{61} \tag{49}$$

From that:

$$n \cong 4.14 \times 10^{30} \tag{50}$$

The universe size (from point of view internal observer) is then:

$$a = N a_0 \cong 1.28 \times 10^{26}\,\mathrm{m} \tag{51}$$

Hubble constant H is then according (22):

$$H = \frac{\dot{a}}{a} \cong \frac{c}{N a_0} \cong 2.35 \times 10^{-18}\,\mathrm{s}^{-1} \cong 72.62\,\mathrm{kms}^{-1}\mathrm{Mpc}^{-1} \tag{52}$$

The actual age of our universe results:

$$t = N t_0 = N\frac{a_0}{c} = \frac{1}{H} \cong 13.5 \times 10^9\,\text{years} \tag{53}$$

The mass of our universe is (from point of view internal observer):

$$M = NM_0 \cong 4.05 \times 10^{53}\,\text{kg} \tag{54}$$

From the relation (42) results the actual mass of minimum free quantum of energy:

$$m_{0f} = \frac{M_0}{\sqrt{N}} \cong 5.71 \times 10^{-39}\,\text{kg} \tag{55}$$

9 Observable quantity of energy

Let's imagine that with the whole universe is related standardized wave packet which moves in direction of the universe expansion:

$$|\psi(a;t)|^2 = \frac{1}{\sqrt{2\pi}\Delta a_t} \exp\left[-\frac{(a-ct)^2}{2(\Delta a_t)^2}\right] \tag{56}$$

Δa_t – is given by relation (20).

The dispersion of the wave packet doesn't increase due to the universe mass increase and stays same. The amplitude of the wave pocket related to a_0 is then:

$$|\psi(a=ct;t)|^2 = \frac{1}{2\sqrt{\pi}} \cong 0.282 \tag{57}$$

It means that if the universe size is a then on quantum level corresponding to this size is about 28.2 % of the whole universe energy. The rest of the universe energy 71.8 % occurs on near quantum levels.

If we are situated on quantum level at the size a from imaginary centre of our universe we are able to observe only the mass situated on the same quantum level. It means that rest of our universe mass is not observable for us even if it is gravitationally influences our universe as a unit.

10 Luminosity of cosmological sources

If the red shift doesn't exist the apparent luminosity l of a cosmological source would be given by relation:

$$l = \frac{L}{S} \tag{58}$$

L – absolute luminosity of a cosmological source

S – area on which photons from the cosmological source fall to.

The radiation energy from a cosmological source decreases three ways:

1. The energy of the detected photons is lower then their original energy due to red shift according to (48).
2. Photons radiated during time interval $t_{e-today}$ (time the process would last today) will reach target during time interval Δt_r too:

$$\frac{\Delta t_r}{\Delta t_{e-today}} = \frac{\lambda_r}{\lambda_{e-today}} = 1 + z \tag{59}$$

3. We can't forget influence of lesser particle mass in past:

$$\frac{\lambda_e}{\lambda_{e-today}} = \sqrt{\frac{a_r}{a_e}} = \sqrt{1+z} \tag{60}$$

The relative luminosity l of a typical cosmological source (cosmological candle) can be then written in form:

$$l = \frac{L}{4\pi d_L^2} = \frac{L}{4\pi r_e^2 a^2 (1+z)^{2.5}} \tag{61}$$

d_L – distance of a cosmological source.

$$d_L = r_e a (1+z)^{1.25} \tag{62}$$

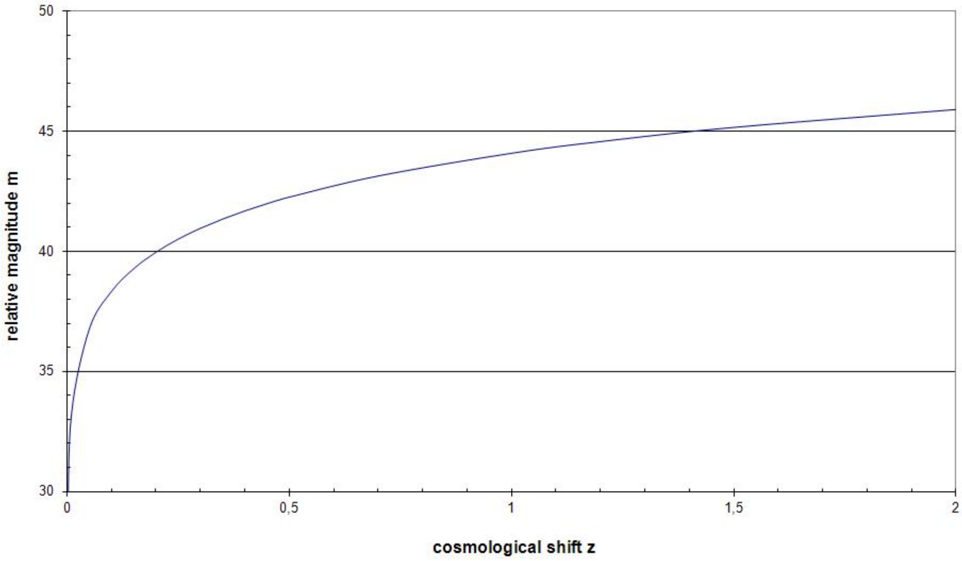
The variable r_e is given by [1] for $k = 1$ and $\ddot{a} = 0$ by the relation:

$$r_e = c \sin\left(\int_{t_e}^{t_r} \frac{\mathrm{d}t}{a}\right) = \sin\left(\ln \frac{t_r}{t_e}\right) = \sin\left[\ln\left(1+z\right)\right] \tag{63}$$

The relative magnitude of stars m is defined by relation:

$$m = -2.5 \log\left(l\right) + 2.5 \log(2.52 \times 10^{-8}) \tag{64}$$

Now we can calculate value l (for suitable L) in the relation (61) and calculate curve $m = m(z)$ using the relation (64) (See Fig.1). The best fit with real measured values of relative magnitude of supernovas type Ia [3] we get for $L \cong 2.765 \times 10^{28}$ W. It acknowledges that the model above can correspond with our reality.

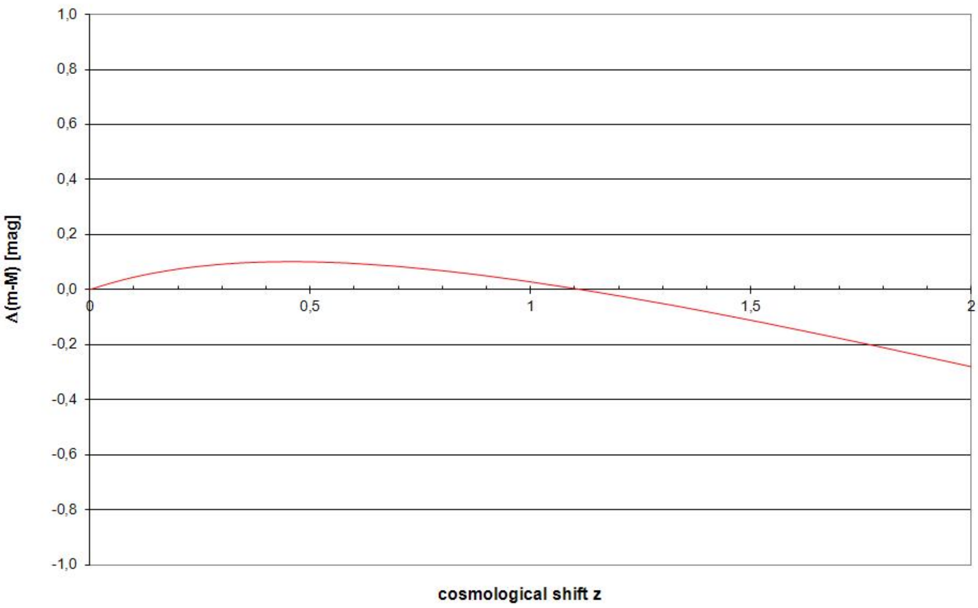


Obrázek 1: Relative supernova magnitude – calculated for $L = 2.765 \times 10^{28}$ W

We can construct the so called residual Hubble diagram – relative luminosity of supernovas related to the case of empty universe $(\Omega = 0, k = -1, q = 0)$ too (See Fig.2).

$$\Delta(m - M) = 5 \log \left(\frac{r_e}{r_{e0}} \right) \tag{65}$$

$$r_{e0} = \sinh[\ln(1 + z)] \tag{66}$$



Obrázek 2: Residual Hubble diagram – without consideration of dust influence

Conclusion

Our universe can't be necessarily open and accelerating its expansion to be in accordance with our present observation and knowledge. In the article I tried to show that our universe can be closed and uniformly expanding supposing that its mass increases proportionally its size (or better its size increases proportionally to its mass similarly like black holes do).

Reference

[1] Misner Ch. W., Thorne K. S., Wheeler J. A.: Gravitation, W. H. Freeman and Co., San Francisko USA 1973.

[2] Horský J., Novotný J., Štefaník M.: Úvod do fyzikální kosmologie. Academia, Praha 2004.

[3] http://www.astro.ucla.edu/~wright/sne_cosmology.html [18.4.2008].

[4] http://aldebaran.cz/bulletin/2004_33_dma.html [18.4.2008].