Hubbles Law in a New Light

1 Abstract

The redshift of distant objects in space with large relative velocities is caused by the Doppler Effect and by time dilation, which was described by Einsteins Special Relativity Theory. It slows down the frequency of the emitted light, because time runs slower in the fast moving system. Whereas the Doppler Effect is a function of the vertical component of the relative velocity, the time dilation is a function of its absolute value and therefore independent from the direction of the velocity.

Some example data of the Hubble law was transformed, with the assumption, that all the observed redshift could be caused, in the average, by time dilation redshift. The result was a constant value of the relative square velocities divided with the distances to all moving objects in space. This indicates an equilibrium of inertial and gravitational forces between all objects in the observed region of the visible universe.

2 Introduction

The american astronom Hubble observed a redshift of star light, whose values are increasing, proportional to their distance, in 1929. With more recent investigations, the presently widely accepted picture is, that all observed objects in space have, in average, an escape velocity relative to earth, which grows with their distance with the factor of 65 +/- 8 km/sec/Mpc.

The author [1] pointed out, that the redshift is not only caused by the Doppler Effect, but also by the time dilation effect, which was described by Einsteins Special Relativity Theory. With this effect, time runs slower in moving systems, relative to inertial systems. Due to the fact, that we can see objects in space with relative velocities with large fractions of the speed of light, the frequency of their radiated light will distinctively be shifted down by time dilation. This effect superimposes with blue- or redshift by Doppler-Effect. The time dilation is a function of the value of the relative velocity vector of the moving object, whereas the Doppler Effect is a function of the vertical velocity component of the relative velocity vector.

In the following calculations, the assumption of a steady, non-expanding universe was made. In this model, the continuity equation must be fulfilled and the integral of all vertical components of the vectors of relative velocities must be Zero. Consequently Doppler-effect caused red- and blueshifts of moving objects in space would compensate each other in the average. The observed mean values of redshift are then caused by the time dilation effect. In the following calculations the linear relationship of the Hubble law between vertical velocity and distance was used to calculate redshift data with Doppler Effect. These data were then used to calculate absolute velocities with the time dilation equation. The distance values were also transformed, to take the decreased flow of radiated photons by the time dilated moving object into account.

3 Transformation of Hubble Law data

Table 1 shows the results of some example data, where the linear relationship between the apparent distance of observed stars x', in Megaparsec [Mpc], which is an astronomic distance of 3.26 million light years, and its escape velocity, the vertical velocity component V_v, was transformed with simple calculations, based on the above considerations.

The relationship between V_v, the speed of light c and the frequency shift z of the observed light, is given with eq. (1) for the Doppler-Effect. The values of (1+z) were calculated and listed in Table 1.

$$1+z=\sqrt{\frac{1+\frac{V_v}{c}}{1-\frac{V_v}{c}}} \qquad (1)$$

Equation (2) expresses the frequency shift as the ratio between the observed time $\Delta t_{l,Doppler}$ of a measured wave length $\lambda_{observed}$ and the time $\Delta t_{l,i}$ of a non-shifted wave length $\lambda_{emitted}$.

$$1+z=\frac{\Delta t_{l,Doppler}}{\Delta t_{l,i}} \qquad (2)$$

Eq. (3), describes the time dilation effect, predicted by the Special Relativity Theory. V_{abs} is the value of the vektor *V*, with the velocity of a moving object, relative to the inertial system of the observer. Δt_m is the time experienced in the moving object, whereas Δt_i is the longer amount of time, which the observer in the inertial system will experience.

$$\frac{\Delta t_m}{\Delta t_i}=\sqrt{1-\left(\frac{V_{abs}}{c}\right)^2} \qquad (3)$$

With the above assumption, that blue- and redshifts by Doppler Effect are compensating each other, and only the redshifts by time dilation remains in the average, the frequency shift, which was calculated with the assumption of Doppler effect, leads to V_{abs} values with eq. (3) and (4), written as eq. (5). These values are listed in table 1.

$$\frac{\Delta t_i}{\Delta t_m}=\frac{\lambda_{observed}}{\lambda_{emitted}}=\frac{\Delta t_{l,Doppler}}{\Delta t_{l,i}} \qquad (4)$$

$$\frac{V_{abs}}{c}=\sqrt{1-\left(\frac{\Delta t_{l,Doppler}}{\Delta t_{l,i}}\right)^{-2}} \qquad (5)$$

The distance of very distant stars can only be calculated with a comparison of the brightness to nearer objects in space, which are assumed to be similar and whose distance was measured with Parallactic Shift. But due to the fact, that time dilation effects have not been considered, when observed data was plotted as escape velocity versus distance, the distance values are also to be transformed. Time dilated objects will not only radiate with lower frequency of the light, but also the frequency of emitted photons will be lower!

The relationship between the observed brightness data H' and the distance *x* of objects of the same kind is given with eq. (6).

$$H_2' = H_1' \frac{x_1^2}{x_2^2} \qquad (6)$$

Values, which are proportional to the observed H' values are plotted in table 1. The redshift data, which was observed and led to the Hubble-Law diagram, was calculated with the Doppler-Effect equation (1) and listed in table 1. In the above arguments it was concluded, that the redshift is, in the average, a time dilation effect. This time dilation will slow down the flow of photons of the emitted light of the object with the same ratio as the frequency. Therefore the corrected values of the brightness of the observed object light was calculated and listed in table 1 with

$$H = H^{'}(1+z) \tag{7}$$

From eq. (6) it follows, that the apparent distance values can be corrected with

$$x = x^{'}\sqrt{\frac{H^{'}}{H}} \tag{8}$$

These values are also listed in table 1.

These transformed velocity and distance values are basing on well established observational data which was used to formulate the Hubble Law. The values can now be used to check the qualitative considerations of the author [1]. It was concluded that a non-expanding universe can only be stable, when gravitational forces can be counteracted by inertial forces. This condition can be fulfilled with constantly growing relative velocities with increasing distances.

A measure for the relative inertial forces is the quadratic value of the absolute relative velocity V_{abs} divided with the distance *x*. This value is listed in table 1. Within a range of apparent distances up to 500 Mpc[1] a mean value of $3.781 \cdot 10^7$ $km^2/s^2/Mpc$ was calculated. The standard deviation is $5.991 \cdot 10^5$, which is 1, 6%.

4 General Discussion and Conclusion

The frequency redshift of the light of far distant space objects was calculated with the Doppler Effect equation and some example Hubble Law data with distances and linear increasing escape velocities. This frequency shift was then used in the time dilation equation to calculate the resulting absolute velocity value, based on the assumption, that the redshift is, in the average, caused by time dilation. The distance values have been corrected, because time dilation on the frequency of radiated photons was not taken into account, when observation data of the brightness of compared space objects was used for the Hubble Law. Finally a measure for the relative inertial forces was calculated.

$$\frac{V_{abs}^2}{x} = K \tag{10}$$

The calculated values are quite constant with very good accuracy. With this result, the Hubble Law can be interpreted in a completely new manner. With the presented transformation process the observed data leads to a result, where the specific relative inertial forces on the observed objects in space are constant.

Eq. 10 is the well known relationship for the acceleration which results in the centrifugal force. This force keeps a rotating mass in balance with the gravitation force.

This relationship seems to be valid, also relative from all the observed objects within the investigated region in space. It expresses, that the specific inertial forces between the objects in space are constant, because there is no indication, that the constant K would vary in space. Increasing relative velocities with growing distances are ensuring, that the inertial forces do also act between very large regions, groups or clusters of galaxies, and keep the balance to the gravity forces. Without this condition, large regions on parallel tracks with the same mean velocity would slowly but ultimately be attracted by gravity. The result is an indication, that our universe is stable and infinite in space and time.

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1 The Hubble Law, which was set up with observation data with distances up to 2 Mpc, was recently confirmed by observations on type 1a supernovae (Riess, Press, Kirshner, 1996). They extended the investigated region to distances from 30 to 470 Mpc, see http://www.astro.ucla.edu/~wright/cosmoall.htm

5 Annex: Discussion of tangential and vertical relative velocity components

A remarkable point in table 1 is the large increase of the calculated absolute velocities in comparison to the apparent vertical velocities, which were calculated with the Doppler Effect equation (1). The problem can be seen with the following consideration: The Andromeda galaxy is our next neighbor with a distance of 2.2 Million Lightyears, which is about 0.7 Mpc. Table 1 gives a V_{abs}-value of 6196 km/s at 1 Mpc.

Vertical movement superimposes Doppler Effect, eq. (1), and Time Dilation effect, eq. (3), on the observed light:

$$1+z=\frac{\sqrt{\frac{1+\frac{V_v}{c}}{1-\frac{V_v}{c}}}}{\sqrt{1-\left(\frac{V_v}{c}\right)^2}} \qquad (11)$$

which is

$$1+z=\frac{1}{\left(1-\frac{V_v}{c}\right)} \qquad (12)$$

If the V_{abs}-value would be in the escape direction, then the redshift can be calculated with eq. 12. This supplies a redshift of 1,02. It alters the V_v component only by a few percentages. The next value for this is V_v = 6400 km/s in table 1.

If the direction of movements of the observed galaxies are random, then the measured redshifts would have a severe scatter, due to the fact, that a certain percentage of the velocity vectors would have large radial components and consequently large Doppler effects. If this scatter is not observed, it could result in the consequence, that the large majority of the observed objects in space would have dominating tangential[2] velocity components - like a swarm of fishes, who are moving in the same direction. This picture is not as fantastic, as it sounds in the first moment, if we remember, that the solar system and the next large rotating system, the milky way galaxy, they are both flat and their objects are rotating with large tangential and very small radial velocity components. It is also possible that the galaxies of our visible universe are only a small fraction of the next huge flat and rotating system and we and our neighbor galaxies are all rotating with the same main direction, but with large relative tangential velocity differences. We do not know, whether this 'Super galaxy' exists, where our Galaxy and all our neighbor galaxies are moving on relatively parallel curves with dominating tangential velocity components. But we know, that the movements of the solar system and our neighbor stars in our galaxy are very much in the same direction within our galaxy and even the stars on the opposite side in our galaxy have dominating tangential velocity components, relative to us. In our flat rotating Galaxy are much less stars with large vertical components of the relative velocities, then it would be the case, if our galaxy would be spherical with random moving stars in every direction. This kind of universe kinetics would cause less scatter of measured redshifts plotted over the distance of observed space objects.

Finally we have to consider the possible size of a 'Super Galaxy' compared to our visible universe. The diameter of the solar system is about 0,001 light years. The diameter of our galaxy is about 100.000 light years. The ratio is 10^8. With this ratio, compared to the Galaxy-

[2] ...or transverse...

size, the next rotating 'Super-System' could have a diameter of 10^{13} light years. The edge of the presently visible universe is $1,2*10^{10}$ light years away. This is only a 10^{-3} fraction of the possible 'Super-System'. Therefore, the possibility, that all observed Galaxies are moving on relatively parallel curves in the same direction, but with increasing tangential velocities over their distances, is not unrealistic. It could explain, that the observed small scatter of the redshifts of galaxy movements was measured.

6 References

[1] K. Schmitt, View into dilated time, www.schmittk.de, 1999

apparent distance	apparent escape velocity	apparent escape velocity fraction of speed of light	red shift with Doppler-Effect	observed brightness	Time Dilation Effect, tangential movement only	Doppler- and Time Dilation Effect, radial movement only	corrected brightness	absolute velocity	corrected distance	kin. Energy per distance
e'	Vv	Vv/C	1+z	H'	Vabs/C	Vv/C	H	Vabs	e	V*V/e
Mpc	km/s							km/s	Mpc	c
1,00E+00	64	0,00021	1,000213	1,000E+00	0,020654	0,000213	1,000E+00	6196,11	1,00E+00	3,840E+07
2,00E+00	128	0,00043	1,000427	2,500E-01	0,029206	0,000427	2,501E-01	8761,69	2,00E+00	3,839E+07
1,00E+01	640	0,00213	1,002136	1,000E-02	0,065250	0,002131	1,002E-02	19575,05	9,99E+00	3,836E+07
3,00E+01	1920	0,00640	1,006421	1,111E-03	0,112777	0,006380	1,118E-03	33833,03	2,99E+01	3,828E+07
5,00E+01	3200	0,01067	1,010724	4,000E-04	0,145287	0,010610	4,043E-04	43585,96	4,97E+01	3,820E+07
1,00E+02	6400	0,02133	1,021566	1,000E-04	0,204390	0,021111	1,022E-04	61317,14	9,89E+01	3,800E+07
1,50E+02	9600	0,03200	1,032529	4,444E-05	0,249029	0,031504	4,589E-05	74708,74	1,48E+02	3,781E+07
2,00E+02	12800	0,04267	1,043617	2,500E-05	0,286079	0,041794	2,609E-05	85823,82	1,96E+02	3,762E+07
3,00E+02	19200	0,06400	1,066186	1,111E-05	0,346844	0,062077	1,185E-05	104053,20	2,91E+02	3,727E+07
4,00E+02	25600	0,08533	1,089307	6,250E-06	0,396545	0,081985	6,808E-06	118963,58	3,83E+02	3,693E+07
5,00E+02	32000	0,10667	1,113017	4,000E-06	0,439057	0,101541	4,452E-06	131717,11	4,74E+02	3,661E+07
1,00E+03	64000	0,21333	1,241923	1,000E-06	0,592999	0,194797	1,242E-06	177899,84	8,97E+02	3,527E+07
2,00E+03	128000	0,42667	1,577457	2,500E-07	0,773389	0,366068	3,944E-07	232016,76	1,59E+03	3,381E+07
4,00E+03	256000	0,85333	3,554766	6,250E-08	0,959616	0,718688	2,222E-07	287884,87	2,12E+03	3,906E+07
4,60E+03	294400	0,98133	10,302566	4,726E-08	0,995278	0,902937	4,869E-07	298583,47	1,43E+03	6,221E+07
4,67E+03	298880	0,99627	23,123890	4,585E-08	0,999064	0,956755	1,060E-06	299719,35	9,71E+02	9,250E+07

Table 1: Transformation of Hubble Law data