Dark Energy – Needed?

The apparent acceleration of recent supernovae 1a is simply an evaluation result.

Dark Energy is the explanation of current physics for an accelerated expansion of the universe.

Observations of supernovae of type 1a are said to show an increasing expansion speed of the universe. However, this observation is questionable. The apparent acceleration of the observed objects can be explained as a measurement result.

The speed of stars is determined by its red shift, which refers to the speed of light. And Einstein's postulate that the speed of light was constant at all times leads to the result of an increasing recession speed. Alternatively, if we envision that c was higher in former times and is slowly decreasing now, the whole problem disappears.

We can express the essential point here in a short way: Einstein's *postulate* that the speed of light c was constant at all times in history is *the kernel of this problem*.

1   The apparent recent acceleration

The acceleration of the objects of our universe at recent times is concluded from the observations of several teams. The result of Riess et al. [1] from the observation of supernovae type *1a* is presented in figure 1 2.1.
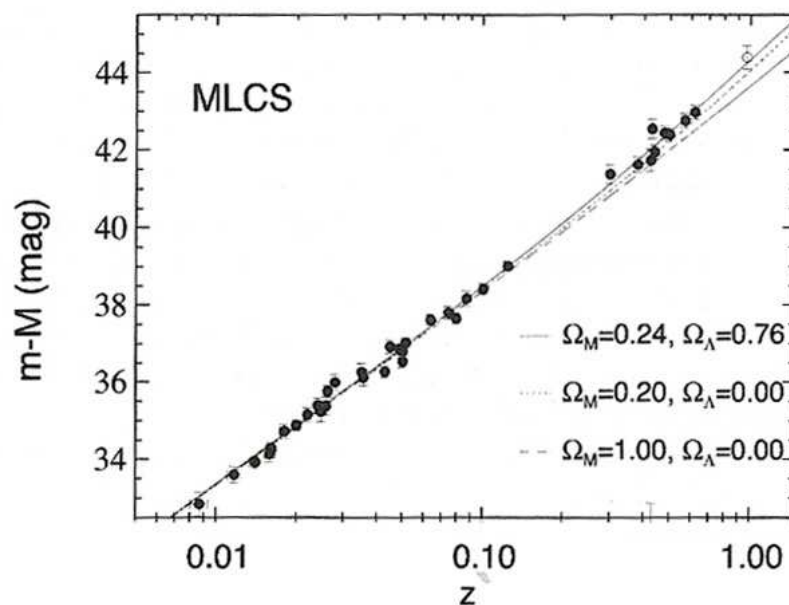

Figure 1.1: Supernova 1a Hubble diagram

Figure 1.1 shows the apparent magnitude of the observed supernovae (as the ordinate) versus the red shift z (the abscissa), which is identified with the escape recession speed of the star.

The red shift z is defined as

$$z = \frac{\Delta \nu}{\nu_{ob}}$$ (1.1)

where ν_{ob} is the *observed* frequency, $\Delta \nu$ is the frequency shift. From this follows for the speed v:

$$v = c \cdot \frac{z}{z+1}$$ (1.2)

which is used for the evaluation according to figure 1.1, but conventionally with the assumption that c is a constant at all times and the space is unchanged during the time investigated.

According to the Hubble Law, all stars and so also the investigated supernovae should be situated on a straight line, presented in figure 1.1 by the dotted line for the most probable situation / assumption. This means that the escape speed of these objects is proportional to their distance to the observer. However, the measurement points in the upper part can be understood as being too much to the left, which means that the red shift of the older supernovae is too small in comparison to the younger stars, being presented in the lower (left) part. This is commonly interpreted in the way that the younger supernovae are too fast in comparison to the older ones. They are assumed to be accelerated.

The lower - dashed - line would also be acceptable but assumes a higher matter density of the universe indicated by $\Omega_M = 1$. The lowest - straight - line which does fit to the data is characterized by $\Omega_\Lambda = 1$, which means the assumption of an acceleration, here indicated by the denotation of the cosmological constant Λ with reference to the original conception of Einstein.

Presently there are the following models used to explain the phenomenon:

> ➤ Dark Energy: This means that the whole universe is filled by some type of energy which causes all objects to accelerate. This energy can, with reference to Einstein's understanding of mass and energy, identified with matter. This leads to the conclusion that – together with the mysterious Dark Matter – only ca. 4% of the matter of the universe are known and described by present physics
> ➤ Quintessence: This would be some kind of a potential which can be related to a new type of matter which in turn could be understood as some modified type of an ether
> ➤ The recreation of the cosmological constant Λ, which was once introduced by Einstein in order to explain the fact that the universe does not collapse. This idea was lapsed at some later time, after Hubble detected that the universe was in a state of permanent expansion. Einstein called this idea later his worst stupidity.

2   Solutions related to the idea of inflation

For the explanation presented here it is first necessary to say some words about the so called 'inflation' of the universe.

2.1   The inflation of the universe - why is it needed?

From the temperature distribution of the Cold Microwave Background (CMB) it is concluded that there must have been a correlation between certain regions of the universe at a very short time after the Big Bang. On the other hand, those regions moved off each other at such a high

speed that, in the face of the limited speed of light, a causal connection cannot be understood. This question was given the name "Horizon Problem".

2.2 The understanding of inflation in present cosmology

For this causal conflict present cosmology offers a solution, which is based on a specific understanding of the spatial situation. According to this solution, the extension of the physical 'space' was at the start time of the universe smaller than at later times by a huge factor of around 10^{50}. Under these circumstances a logical connection is possible. Immediately after this time, an expansion happened by just this factor. This latter phenomenon has received the name 'inflation'. And up to now there is still some inflation (expansion) assumed, but at a much reduced rate.

This development is visualized by the commonly known figure 2 3.1.
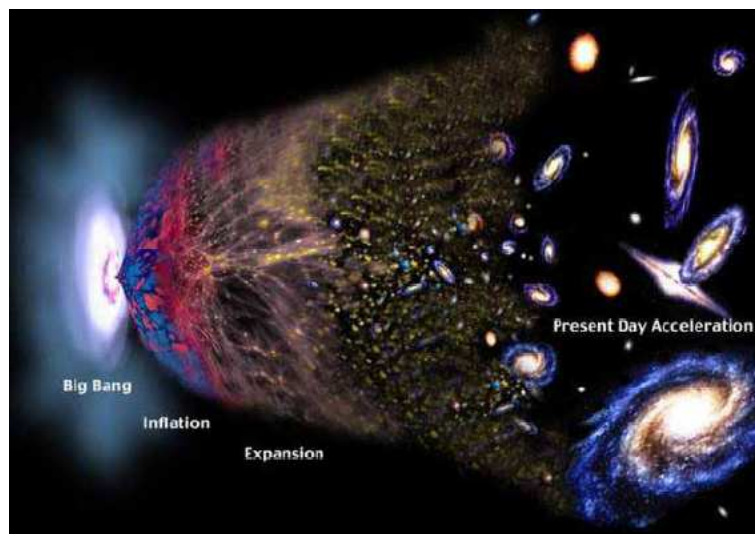

Figure 2 3.1: The spatial expansion after the Big Bang

Presently there is no understanding what the cause of the inflation could be.

The correlation problem can, however, be solved as well with reference to the other of the two conflicting parameters, the speed of light.

2.3 The alternative explanation to inflation

From a logical point, the problem of correlation is a conflict between the spatial extension and the speed of light.

So, as an alternative to an assumed change of the 'space', it can as well be assumed that the speed of light has changed in the way that it was extremely large in a short period after the Big Bang. Afterwards the speed of light decreased rapidly at first, and later in a slow manner until the present time as shown in figure 2.2.
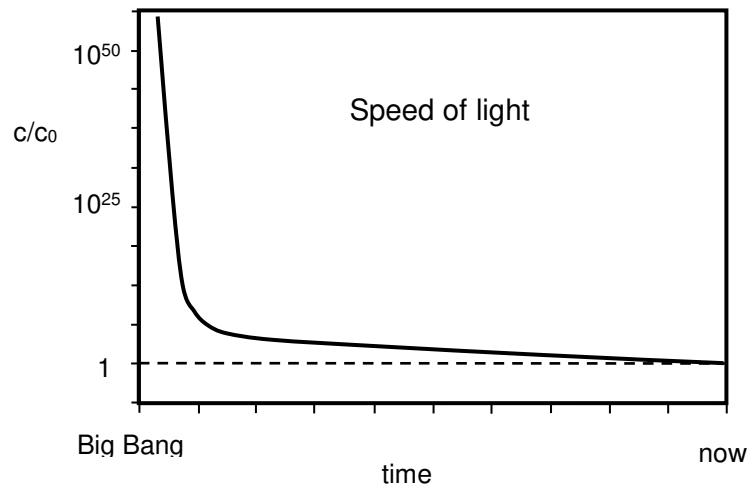
Figure 2.2: Possible development of *c* after the Big Bang

The assumption that the speed of light has changed during the development of the universe is anyway attractive, as it would not only solve this causal problem. As a further benefit, it would also solve the presently not understood fine-tuning of basic physical parameters. (Refer e.g. to the work of A. Albrecht and J. Magueijo [2].) And so it avoids besides of other problems the necessity of a 'landscape' of 10^{100} uni-(multi-)verses.

The assumption that the speed of light *c* has changed as indicated in figure 2 3.2 is able to explain the acceleration as an evaluation effect.

The abscissa in figure 1.1 is in reality the factor of the red shift *z* of the observed supernovae. From this factor z the speed v is related to the red shift Δv according to eq. (1.1) as

$$z = \frac{\Delta v}{v_{ob}}$$

From this follows for the escape speed *v*:

$$v = c \cdot \frac{z}{z+1} \tag{2 3.1}$$

However, with reference to figure 1.2, the speed of light *c* has been higher at early times. So, if *c* is to be replaced by a larger value, then the resulting *v* will be larger.

In figure 2.3 the – corrected – speed is added to the abscissa scale. That means that in reference to the speed scale the supernovae are to be repositioned to the right to reflect the correction. They can be positioned on the dotted line now without any conflict to the observation.
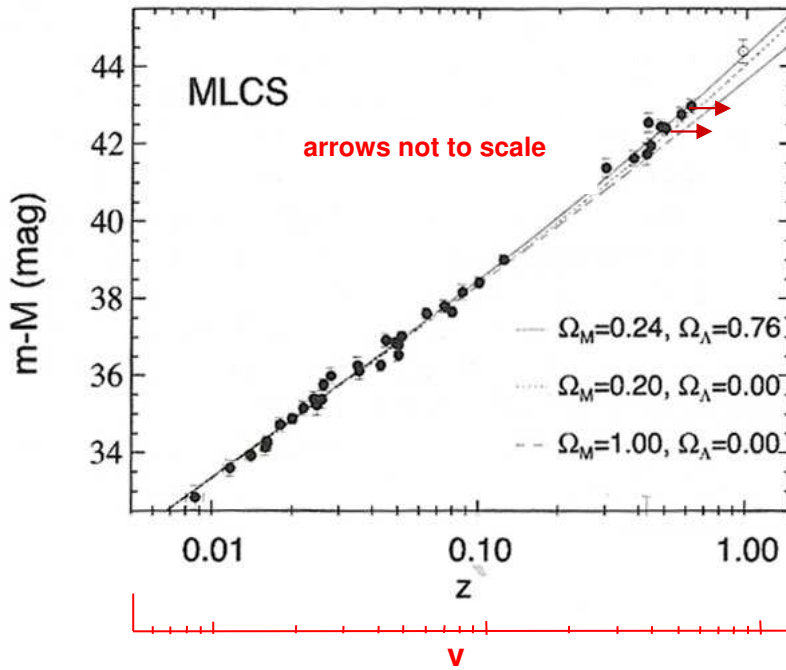
Figure 2.3: Supernova 1a Hubble diagram - corrected

This means physically that the resulting acceleration vanishes.

3   Conclusion

The apparent acceleration of the universe at recent time can be explained as a measurement result based on incorrect assumptions. If we accept a variable *c* as assumed by a number of physicists at all times, it turns out to be a misinterpretation.

NOTE:
The concept of the Basic Model of matter was initially presented at the Spring Conference of the German Physical Society (Deutsche Physikalische Gesellschaft) on 24 March 2000 in Dresden by Albrecht Giese.

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[1] A.G.Riess et al 1998 Ap. J. 116:1009 ; Adam G. Riess *et al.* (Supernova Search Team) (1998). "Observational evidence from supernovae for an accelerating universe and a cosmological constant" *Astronomical J.* **116**: 1009–38. doi:10.1086/300499. http://www.arxiv.org/abs/astro-ph/9805201.

[2] A. Albrecht and J. Magueijo, Phys. Rev. D 59, 043516 (1999); "A time varying speed of light as a solution to cosmological puzzles" http://arxiv.org/abs/astro-ph/9811018