# The Age and Size of the Universe.

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**Abstract.**
The possible implications of some reported high-valued red-shifts for both the age and size of the Universe are examined on the basis of presently accepted theory.

The possible age of the Universe is something to which reference is often made and, frequently, the figure quoted is around 13.5 billion years[1], where billion refers to the American definition of the term and is $10^9$. However, is such a figure consistent with all other astrophysical data quoted?

In the issue of the National Geographic of February 2003, a galaxy with a red-shift value of 6.56 was reported. Although there are claims for the existence of even larger values of red-shift, this one will suffice for the present discussion. Using

$$1 + z = \sqrt{\frac{c+v}{c-v}},$$

where $c$ is the speed of light and $v$ the speed of the galaxy in question. It follows that

$$v = 0.9656c.$$

Then, using

$$v = Hd,$$

where $H$ is the Hubble constant, it follows that, if the value of $H$ is taken to be 75,

$$d = 3.86\times10^3 \text{ mpc} = 12.6\times10^9 \text{ light years};$$

that is, the relevant galaxy is at a distance of 12.6 billion light years from the Earth.

The discussion often seems to stop at this point but it must be noted that what this result means is that, when the light being viewed left the said galaxy, the galaxy was then at a distance of 12.6 billion light years from the Earth. While that light was travelling towards the Earth, the galaxy itself would have continued to move away from the Earth at a speed of the order of $0.9656c$; at least this is a not unreasonable assumption to make. Hence, at the time the measurements were made, the galaxy would have been at a distance of approximately 24.8 billion light years from the Earth. This would seem to indicate a Universe of minimum size much greater than popularly believed. Of course, the commonly accepted figure might refer to the size of the actual *visible* Universe, whereas this figure of 24.8 billion light years refers to an actual minimum size of the Universe. However, if that is the case, it should always be stated quite clearly.

It might be noted that the value of the Hubble constant used here is merely an average value of those advanced but, in any case, it is strictly only the value of the time dependent Hubble parameter at the present point in time. If the Hubble parameter is, in fact, time dependent as presently thought, its value would obviously have changed during the time taken for the light from a distant galaxy to reach the Earth. However, that is not something which can be taken into account on the basis of our present knowledge. Once again this indicates that the above is merely a very rough examination of a situation. Nevertheless, it does raise questions concerning popular statements concerning the age of the Universe.

These presently accepted figures also give rise to a further problem since, if the age of the Universe is taken to be 13.5 billion years and the galaxy referred to above emitted light towards the Earth 12.6 billion years ago, it follows that that galaxy was at most 0.9 billion years old when its light began its journey. As the age of the Milky Way is of the same order, it follows that there were two galaxies in existence of the order of 13 billion light years apart when the age of the Universe was a mere one billion years. For even larger redshifts, the

separation distance would, of course, be even greater. One explanation of this point, within the Big Bang scenario, is provided by the inflationary models. Alternatively, a consideration of models involving a variable speed[2] of light might also furnish an explanation. Again, it must be remembered that all of this discussion is based on the presently accepted interpretation of redshift, which is another factor which must remain open to question.

All this indicates that great care must be exercised when discussing both the age and size of the Universe and, where relevant, it is important to draw attention to the fact that, in many cases at least, only the visible Universe is being considered. It also raises possible queries concerning the presently accepted ideas for interpreting some observational data. Indeed, it seems that the general area of astrophysics/cosmology is becoming more and more intriguing for investigation and contemplation by anyone with an open mind. The example considered here seems to assume more relevance with the announcement in the edition of Science Daily dated 24th November 2010 in which some researchers have revealed that some of the most massive galaxies in our Universe appear to have formed billions of years earlier than current theory predicts. In fact, this new research seems to match in quite well with the above mentioned figures for the Earth and the galaxy taken as an illustrative example.

**References.**


1. B. Ryden, 2003, *Introduction to Cosmology*, (Addison-Wesley, New York)
2. D. J. Farrell & J. Dunning-Davies in *Astrophysics, Neutron Stars and Galaxy Clusters*, ed. Louis V. Ross, pp. 67 – 85,(Nova Science Publishers Inc., New York)