

DISTANT GALAXIES AND COSMOLOGICAL MODELS

Edward J. Barlow Member of National Academy of

Engineering Recipient of NASA Public Service Award Previous member Report Review Committee of the National Research Council Retired Vice President, Research & Development, Varian Associates

Model III and IIIa - Critical Mass Density

Next, let us take into account the gravitational attraction of the mass in the universe which will act to slow down the expansion. It is tempting to think that the mass density now really is the critical density mentioned above. Remember the orbits of the planets being perfect circles to the astronomers of the Middle ages? Consider next a Model III with significant mass density, in fact with just the **critical density** giving us a flat space and being the dividing line between universes which expand forever (like Model II) and ones which stop and collapse again. For this model, the equations of general relativity take simple forms (and take the same form as Newtonian equations). This turns out to be a model which has been much used by cosmologists in interpreting their experimental results. It has an appeal, being the special case in which the mass density is exactly the critical value right after the big bang and stays the critical value always. This model is called the Einstein deSitter model after its authors. In this model, $R(t)$ is proportional to $t^{2/3}$. The results for this model are shown in [Figure III](#) for an age of the universe, t_r , of 15 billion years. Again, the curves are shown for various galaxies and for the light packets reaching us now. Since the galaxies are slowing down, their labeled velocities in Figure III are the velocity **now**, v_r . In addition, the proper distance D shown is how far away from us now a light packet is which was emitted from us at time t_e .

Many cosmologists use this Model III in reporting their results of

observations of very distant galaxies or supernovae. If, for example, the redshift, z , of a very distant galaxy is measured as 5.34 (recent paper using this model) **(5)** the model would say that the object was observed when the universe was a bit less than 1 billion years old.

For this model, since the galaxies are slowing down, the age of the universe is not $1/H_0$ but $2/3H_0$. Thus, **Figure IIIa** shows this model also for an age of the universe of 10 billion years to correspond with the 15 billion years of Model II, both having the same value of H_0 .

Figure IV shows the four concepts of distance discussed above for this Model III. It can be seen that, although at very low values of z the different distances are quite close, they diverge rapidly for larger values of z . Thus, it is interesting to know **which concept of distance** is being used in papers reporting observations of distant galaxies.

NEXT -->

© 2000-2002. **Ed Barlow** -- All rights reserved.

URL this site: <http://www.CosmologyModels.com>