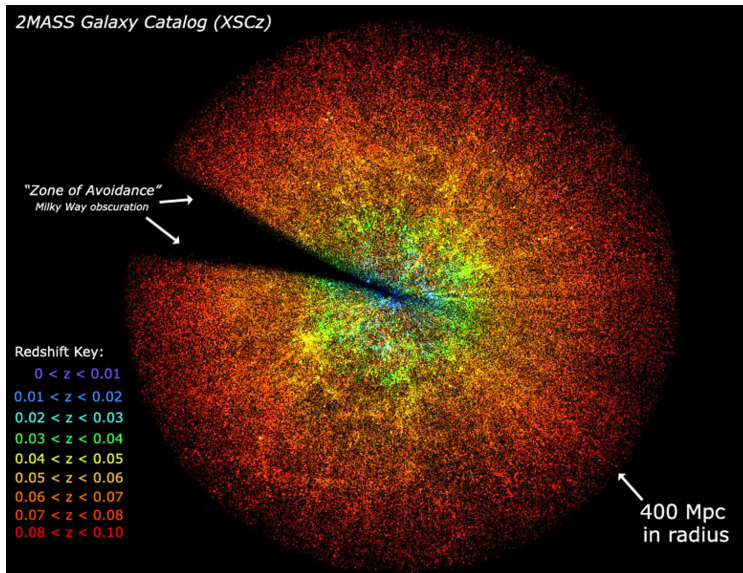


Hot Big Bang Theory

22 January 2020 15:30

This seems like a suitable point for me to go on a short rant about what a 'science theory' is as compared to 'science fact.' But, I will resist that temptation because I have a student in around 45 minutes.... Just note - this is a theory (albeit one with some good evidence, but a theory none the less....)



This is a map of galaxies. We are somewhere in the middle. The point is that as you get further away there is more redshift. Only a few, near galaxies appear to show any form of blue.

From this red shift we can work out how fast the galaxies are moving away from us - called their recessional velocity.

Edwin Hubble plotted a graph of recessional velocity against their distance and found they were proportional - this led to 'Hubble's Law'.

$$v = H_0 d$$

v = recessional velocity in km s^{-1}
 d = distance in Mpc
(Mega parsecs)
 $1 \text{ Mpc} = 3.09 \times 10^{22} \text{ m}$

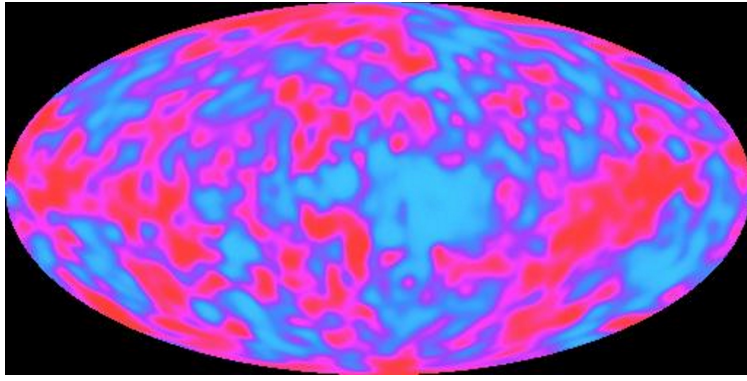
This shows that galaxies are moving apart from each other, and that the universe is therefore expanding. The rate of this expansion depends on H_0 . What will really do your head in is that it is not so much that the objects are moving apart from each other, but rather that space itself, in which the objects are found, is actually getting bigger - and therefore stretching the e/m waves too.

This is all very interesting...

- Assuming the universe has been expanding at the same rate since it began then we can use H_0 to get its age. So $1/H_0$ gives an age of around 13 billion years.
- Absolute size of the universe is unknown since we can only see out to the distance that light can travel in that 13 billion years. This gives us a figure of some 13 billion light years. Other considerations place it at 46 billion light years.

These ideas lead to another - that 'once upon a time' (though there wouldn't have been time then - probably If you wind the clock backwards you end up with all the matter at an infinitely dense point called a 'singularity' - which gave rise to a 'hot, big, bang' theory(HBB). Red shift seems to be good evidence that there was such a HBB.

Cosmic Background Radiation



If there was a HBB then there would have been a huge amount of e/m radiation created. This has been echoing around an expanding universe ever since, and theory predicts that the amount of red-shift that these photons (I know) would have experienced means they are now in the microwave part of the spectrum.

Indeed a satellite called COBE in the 80s took a very famous image (enhanced, naturally) which shows the background radiation which appears to be the same in all directions (isotropic). However, there are tiny fluctuations in the background radiation intensity, which look really obvious in the image, though really they are minute differences. These slight variations are thought to be the 'galaxy seeds'.

Lastly these cosmic microwaves background radiations are red shift too.