



Prof. Russell Stannard: The questions on everyone's minds

The Size of Universe

Russell: When one thinks about the great distances between the stars, between one galaxy and another, between one cluster of galaxies and another it prompts the question: How big is the universe? Here we have to make a distinction between 'the universe' and 'the observable universe'. We see stars by the light that they send us. It takes time for the light to get here. Light is fast. It travels at 300,000 kilometres per second. But the distances involved are immense, it takes four years for light to reach us from even the nearest star. As for crossing from one side of a galaxy like our Milky Way Galaxy to the other, that takes 100,000 years. The universe came into existence around 14 billion years ago in the big bang That means we can see only those galaxies for which the light from them could reach us in less than 14 billion years.

That's us okay, and these are the surrounding galaxies. So let's suppose it takes 14 billion years to get from here to where we are. Now that defines the observable universe. We can see everything inside this radius. And beyond the observable universe lies the rest of the universe, presumably. How far does that go on for? For ever. The universe is infinitely big. At least, that's what we assume. Why? Why do we assume that? Because we can't imagine what it would be like to come to the edge of the universe. If in our mind's eye we underwent a long-distance journey, and we did come to an edge, what would lie beyond the edge? Nothing? A stretch of emptiness, empty space. But wouldn't that empty space be part of the universe, it just has nothing in it? So we wouldn't have come to the end. There was one very ingenious attempt to get round this problem. Suppose the picture we have here is not the right one. Space isn't flat and it doesn't go on forever.

It's more like this. OK, that's us and we go on a long distance journey, going off into space and what happens? We carry on and on and on and on and oh... we get back to where we started. You don't go on for ever. The size of the universe? It's a nice measurable distance. No trouble with infinities. OK. With a 2-dimensional surface like this it's easy enough to see how it's curved, it curves in the third dimension. But with 3 dimensional space, how can that be curved in on itself? We don't see any additional spatial dimension to take up the curvature, it's not something we can form a mental picture of. Yet Einstein's theory of relativity does allow for 3 dimensional space to be curved. It's curved by the objects in it.

It's a bit like this, that's a flat 2 dimensional surface okay and if I put a heavy object in it, it curves the space. And the heavier the object, the greater the curvature. And Einstein's theory tells us that heavy objects such as this for example, it curves the space around it. And if there, the sheer amount of stuff in the universe as a whole is great enough, it will cause an overall curvature, sufficient to close the universe in on itself. Now what would, what would that mean? A closed up universe? Well, suppose, suppose this is a spacecraft okay. And here we have the earth. Spacecraft starts off at the north pole, it goes vertically upwards, up and up and up, always sticking to the same direction on and on and on and on and on and on and on and on and on and it lands up where it started only at the south pole.

No edge to the universe, no nasty infinite distances, what could be neater? The trouble is: it doesn't work. When you do the sums and you tot up everything in the universe, there just isn't enough stuff, not enough to curve space back in on itself. So that's the end of the finite, closed universe idea...

Which is a pity. Because that's a very good example of the kind of lateral thinking that is sometimes called for when dealing with very deep questions. No, we appear to be stuck, stuck with a universe that's infinite in size. But is that a satisfactory answer? What does it mean to say 'the universe is infinite'? Might that answer simply be a cop-out - a way of disguising the fact that we simply do not know how to answer the question: How big is the universe?

After piece

Tony: Okay everybody we need to try and get the ball in the waste paper basket this time. Okay so, it's fine Russell don't worry, never mind. Try again. Okay and Take 6, action! And take seven