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HOW COME WE'RE HERE?

Ken Tapping, 18th November, 2014

When, a long time ago I was reading astronomy books on the bus going to school, nobody seemed to be sure how the universe started. One theory was that the universe is eternal, and the other proposed that it started billions of years ago as something very dense and very small. One physicist called this object the "primaeval atom". At some point, now widely accepted to be just under 14 billion years ago, the primaeval atom started to expand very rapidly – an event now referred to as the Big Bang. The expansion and cooling decelerated to a slower rate, which continues today. Two big questions challenging us today is firstly, where did that primaeval atom come from, and what made it suddenly start to expand?

Our understanding of the universe rests upon three pillars: the physical and mathematical ideas of Isaac Newton, Albert Einstein's concept of "Relativity", and Quantum Physics. Einstein helps us to understand the world of the very large and massive, the fast moving and the very long-lived. Quantum physics deals with the very small, and Newton can be used with the intermediate – everyday universe. We have yet to successfully marry the physics of the very large and very small.

Newton would have described empty space as just that. Einstein saw it as a flat, multidimensional fabric that can be stretched, folded and twisted. Quantum physics says that empty space is far more bizarre than that, and definitely not empty. It suggests that empty space consists of tiny things flicking in and out of existence all the time. Because some of these things are particles and others their mirror images they cancel out on average, so that space is still "empty". This sounds odd, but there is an analogy – borrowing money.

Imagine you have no money. You go to the bank and borrow $100,000. You might now have a lot of money in your wallet, but since you also have a debt of $100,000, you still have nothing. However, you have the power to make things happen. You could start a small business, earn money and pay off the loan, ending up with a working investment, jobs for a few people and hopefully some profit.

The new idea is that out there is an "empty" multidimensional space in which primaeval atoms and their negative images are flicking in and out of existence (one primaeval atom plus its negative image cancel out, leaving nothing). Imagine a wave on the surface of the sea; water has formed a ridge, and alongside it there is a trough. There is enough water in the ridge to precisely fill the trough. However, wind or other things can make the wave grow, so the ridge gets bigger and the trough gets deeper. In just the same way a primaeval atom forms, with its negative counterpart. However in at least one case, instead of the two immediately cancelling, something makes them grow rapidly, to the point where they would continue to grow steadily under their own steam, becoming a universe. It is not clear what sort of cosmic "prod" pushes some primaeval atoms into becoming universes. Maybe it is just statistical, so that some small percentage of them become universes on a purely random basis; maybe something else is involved. This concept fits a recent idea, in which universes appear, grow and fade like bubbles in a multidimensional foam.

These new ideas are just another step in the expansion of human horizons that has taken place over thousands of years. Once we rarely considered things beyond our villages. Our world was the universe. Then we thought our galaxy, the Milky Way comprised all of creation. Over the last decades or two it was everything that formed following the Big Bang. Now our horizons may be expanding a whole lot more. Each question we ask yields a bigger answer, and more questions.

Jupiter rises around midnight. Mars lies very low in the sunset glow. Mercury lies very low in the dawn sky. The Moon will be New on the 22nd.

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