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HOW WILL IT ALL END?

Ken Tapping, 23rd December, 2014

The universe started just under 14 billion years ago, with some sort of tweak of the fabric of space-time. At that moment the conditions leading to the universe we live in today were established. If it had a beginning, it is logical to think it could have an end. What are we finding out about that?

In the beginning the universe was tiny, unbelievably dense and extremely hot. It then started to expand, became less dense, and the temperature fell. Eventually atoms could exist, and then galaxies, stars, planets and us. The expansion is the result of a push outwards. This is being opposed by every object in the universe tugging gravitationally at every other object. The future of the universe will be determined by which wins: the force driving the expansion, or the gravitational force pulling everything back together.

If the expansion of the universe was not initially fast enough, the expansion will gradually slow, stop and then everything will start falling back, until at some time in the distant future, everything would be back in one lump. Maybe that lump will start to expand again. However, if the expansion began fast enough, the universe will expand forever. Gravity would gradually slow it, but never stop it.

To test this idea requires totalling up all the mass in the universe, and then seeing if its combined gravity is enough to stop the expansion. Scientists have gone through this process several times, and each time they got the same answer. There is not enough matter to stop the expansion. The universe will continue to expand indefinitely. Recent discoveries have underlined this conclusion. There is something in the universe called "dark energy", which helps drive the expansion, and as the universe gets more spread out, weakening its collective gravity, the dark energy is becoming increasingly dominant and is speeding up the expansion. So what lies ahead for us?

Over billions of years the other galaxies will get more distant, as they get carried away by the

expansion. Our Sun will run out of fuel, sneeze off its outer layers and end up as a slowly-cooling white dwarf star. New stars will continue to be born in the great gas clouds in the spiral arms of galaxies for some time yet, but eventually there will be no material left and star formation will cease.

However, white dwarf stars cool very slowly and red dwarf stars are so niggardly in their use of fuel that they will smoulder on for tens of billions of years. So eventually the universe will consist of cooling white dwarf stars and dim red dwarfs. When they eventually go out all will become dark. Eventually even the elementary particles making up all matter will themselves decay, leaving the universe as an increasingly rarified miasma of decayed particles. Given enough time even black holes will decay.

Actually, the tale is not quite as dark as it might seem. An idea attracting a lot of scientific attention is that there may be a sort of multidimensional cosmic foam, in which universes form as bubbles, which expand and then eventually dissipate. New universes are forming all the time. Some researchers report evidence of contact points between our universe and others.

With accumulating knowledge and ever-improving research tools, we have reached a position that would have been hard to predict even a few decades ago. However, it is also clear that we are uncovering ever bigger and more subtle questions. There is no danger of our learning everything, or even of understanding more than a tiny bit of what is going on. This is a book we've hardly begun to read. We're at the best place, near the beginning, with the end of the book nowhere in sight. Have a Great Christmas and a Happy New Year.

Jupiter rises around 9pm. Mars still lurks low in the sunset glow. Saturn lies low in the low in the dawn sky. The Moon will reach First Quarter on the 28th.

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