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GROWING GALAXIES

Ken Tapping, 17th October, 2017

These evenings, if it is dark and clear, you should be able to see a fuzzy patch high in the eastern sky. If you manage to see it, you will be looking at the most distant thing you are ever likely to see without a telescope. That fuzzy patch is the core of the Andromeda Galaxy, a great spiral of stars, gas and planets, about 2.5 million light years away, where a light year is how far light travels in a year.

Light travels at just under 300,000 km/sec, so a light year will be a very large number of kilometres. To deal with this we have developed alternative ways of writing huge numbers. One of them is to write a number, followed by E, and then the number of zeroes. In this method, 1, 10, 100, 1000 and 1,000,000 can be written as 1E0, 1E1, 1E2, 1E3 and 1E6 respectively. We can write a huge number like 315 billion billion as just 315E18.This makes it easy to write really huge numbers. A light year is almost 1E13 km. The farthest galaxies we have seen lie 13 billion light years away, 13E22 km. Our Milky Way Galaxy is about 1E5 light years in diameter, and the Andromeda Galaxy is about twice as large, some 2E5 light years across.

With galaxies being separated by such distances it seems improbable that one galaxy will ever pass close enough to another for a collision or even to gravitationally tug at it. However, galactic collisions do happen; they are an important part of how galaxies grow. It's just that these things happen over timescales immensely larger than the span of a human life. We need to consider timespans of millions to billions of years. For example the Andromeda Galaxy is heading our way at about 110 kilometres a second. We will collide head-on in about four billion (4E9) years.

When we explore the depths of space with our telescopes, we find many examples of galaxies colliding or passing close enough to one another to gravitationally pull each other apart. However, this is not as disastrous as it sounds; this is how galaxies grow. We know that stars and planets grow by accretion: little bits of stuff sticking together to form bigger lumps. It looks as though galaxies grow the same way.

Soon after the Big Bang, just under 14 billion years ago, temperatures fell to where hydrogen atoms could form. Something disturbed the young universe, causing local concentrations of hydrogen to build up. These collapsed to form the first galaxies and stars. Over the billions of years since, these galaxies have moved through space, some of them colliding with one another.

A collision between galaxies sounds like a topic for the ultimate disaster movie. These collisions do look dramatic through our telescopes. However, galaxies are mostly extremely rarified clouds of hydrogen, with stars sparsely sprinkled in them. When galaxies collide, they usually pass through each other. A being on a planet orbiting a star in a galaxy that is hitting another is unlikely to notice anything other than over millions of years they would see their version of the Milky Way change. The main consequence of the collision is a bigger galaxy and a wave of formation of new stars due to the disturbance of the gas clouds.

Unless the collision is very fast, the dragging effect due to colliding gas clouds can be enough to slow the galaxies so that they become orbitally tied together. They then collide over and over again until eventually they merge into a single, larger galaxy. There is evidence that our own galaxy grew by colliding with and merging with other galaxies. The Large and Small Magellanic Clouds, two small galaxies only visible from the Southern Hemisphere, are likely to be its next two snacks.

Saturn lies low in the southwest, getting lost in the twilight. Brilliant Venus lies close to Mars in the dawn glow. Mars is much fainter because it is far away, on the other side of the Sun. The Moon will be New on the 19th.

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