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CANNIBAL GALAXIES

Ken Tapping, 15th November, 2016

If you look high in the eastern sky these evenings, and it is clear enough, you will see an elusive fuzzy blob. The blob is the nucleus of the nearest spiral galaxy, the Andromeda Galaxy. The rest of it is too faint to see with the unaided eye, but covers a patch of the sky about twelve times the size of the Full Moon. It contains some million million stars. Our galaxy, the Milky Way, is a bit smaller, home to some 300,000 million. The Andromeda Galaxy lies about 2.5 million light years away, is heading straight for us at 110 kilometres a second, and will hit us in about 4 billion years. This sounds like a good subject for the ultimate disaster movie. However, this event is not cosmically unusual; these collisions are how galaxies grow.

About 380,000 years after the Big Bang, the universe changed from being uniform to having little concentrations of material. A disturbance of some kind was needed to get this started. However, from then on things proceeded unaided. Those concentrations attracted each other and surrounding material, and got bigger and denser. Eventually, between 100 and 200 million years after the Big Bang, our universe's first stars started to form. These formed groups, and then clusters, and finally, together with a lot of gravitationally trapped gas and dust, the first galaxies. As these galaxies moved through space, collisions occurred and a large number of small galaxies became a smaller number of larger ones. This story has not ended, galaxy collisions are still happening.

Even though galaxies contain many stars, they are also huge, and those stars lie far apart. In a collision it is very unlikely that stars will hit each other. The galaxies would tear each other apart, but the stars would be more or less unaffected. However, they also contain a lot of other material, mainly gas and dust, and also magnetic fields. These things do collide, and may slow the galaxies enough to prevent them moving apart again. They orbit around each other, colliding over and over again until they merge into a single, larger galaxy.

This process is still going on; our telescopes reveal many of these collisions, showing galaxies at all stages of merging. Both the Andromeda Galaxy and ours grew big by cannibalizing other galaxies, and in four billion years will make their joint contributions to an even bigger one. Our remote descendants will be unlikely to notice much other than the shape of the Milky Way in the sky very slowly changing, and the gas and dust cloud collisions driving the birth of lots of new stars as the disrupted clouds collapse.

Most galaxies, including the Andromeda Galaxy and ours, have black holes in their cores. These objects are millions of times the mass of the Sun, very compact and exert an extremely strong gravitational pull on their immediate surroundings. What will happen to them?

It's not really clear what would happen if these black holes collide head-on. However, it is more likely they will pass close by one another. Such encounters between stars or planets won't produce much drama, but for black holes the story is different. These things distort space-time so intensely that as they move past one another they will lose energy by making bow-waves in space-time: - gravity waves. They could lose enough energy to leave them trapped in orbit around one another, radiating ever more intense gravity waves and eventually spiralling into one another and merging. We have successfully detected the gravity waves from two small colliding black holes. The merging of these galactic black holes will be a far more dramatic event. We have to hope that someone or something out there will observe it.

Venus is very low in the southwest after sunset. Mars is low in the south in the evening. Jupiter rises in the early hours. The Moon will be Full on the 14th and Last Quarter on the 20th.

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