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A HOLE IN THE MIDDLE

Ken Tapping, 28th April, 2015

In the hall of our observatory there is a radio image of the Andromeda Galaxy, the nearest spiral galaxy to ours. It lies nearby by cosmic standards, some 2.5 million light years away, and is a bit bigger than our galaxy, the Milky Way. The image shows the intensity of the radio emission that is the characteristic signature of hydrogen gas. Since hydrogen is by far the most common element in the universe and is the raw material for making new stars, we spend a lot of time mapping it.

That image is especially intriguing because although it shows clearly the spiral arms of the galaxy, there is nothing much in the middle; the whole central part of the galaxy is a blank. This indicates the spiral arms of the galaxy are loaded with hydrogen, but there is not much of it at all in the central regions, which tells us something important about how galaxies form and evolve.

Visible light images of other galaxies show something interesting too. Some galaxies lie more or less face-on to us; others edge on. When we see spiral galaxies edge on we see, standing out in silhouette against the bright central regions of the galaxies, great dark bands of gas and dust. The spiral arms are loaded with material not yet taken up in forming new stars, which is not the case in the core regions of the galaxies.

The advent of modern telescopes such as the Canada France Hawaii Telescope and of course the Hubble Space Telescope made it possible to obtain extremely high quality images of distant galaxies. These images are so beautiful in both the scientific and artistic senses that they are used in astronomical posters and calendars. One of the things that really stand out is the presence of many little pink blobs in the spiral arms of the galaxies but few if any in their cores. These are places where new stars are forming. The young stars are hot and blue, and the ultraviolet light they give off makes the surrounding hydrogen clouds fluoresce with a pinkish red colour (called hydrogen alpha). The dust and gas in the spiral arms is being used to form millions of new stars. Our Sun is a youthful spiral arm star.

In the central regions of the galaxies there are no little pink blobs, and no supply of new, young stars. However, those central regions do look yellower or redder than the spiral arms. That is because the stars are old or ageing with few if any young stars being formed to balance out the population.

Unless they blow themselves up beforehand, ageing stars swell up and cool, forming red giant stars. At some point in the past the rate at which new stars were born in the central regions declined dramatically or stopped. This happened long enough ago for most stars to become old, swollen red giants. This is so different from what we see in the spiral arms that we have to wonder what might be going on to give rise to this big disparity.

We know that stars and planets form from material aggregating into bigger and bigger lumps. Now it looks as though the same thing applies to galaxies; they grow by colliding, and big galaxies get even bigger by swallowing their smaller neighbours. One consequence of the arrival of a lot of new gas and dust in combination with some stirring up will be the birth of showers of new stars.

Since galaxies are mostly empty space, collisions between them are dramatic rather than catastrophic. They pull each other apart and coalesce into new shapes, but few if any stars collide and if there are astronomers on any of their planets, they will have grandstand seats on something really fascinating. That's good to know, because the Andromeda Galaxy is approaching us at about 110 kilometres a second, and we will collide in about four billion years.

Venus shines brilliantly in the west after sunset, like an escaped aircraft landing light, with Jupiter almost as bright, high in the south. Saturn rises around 11pm. The Moon will be Full on the 3rd.

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