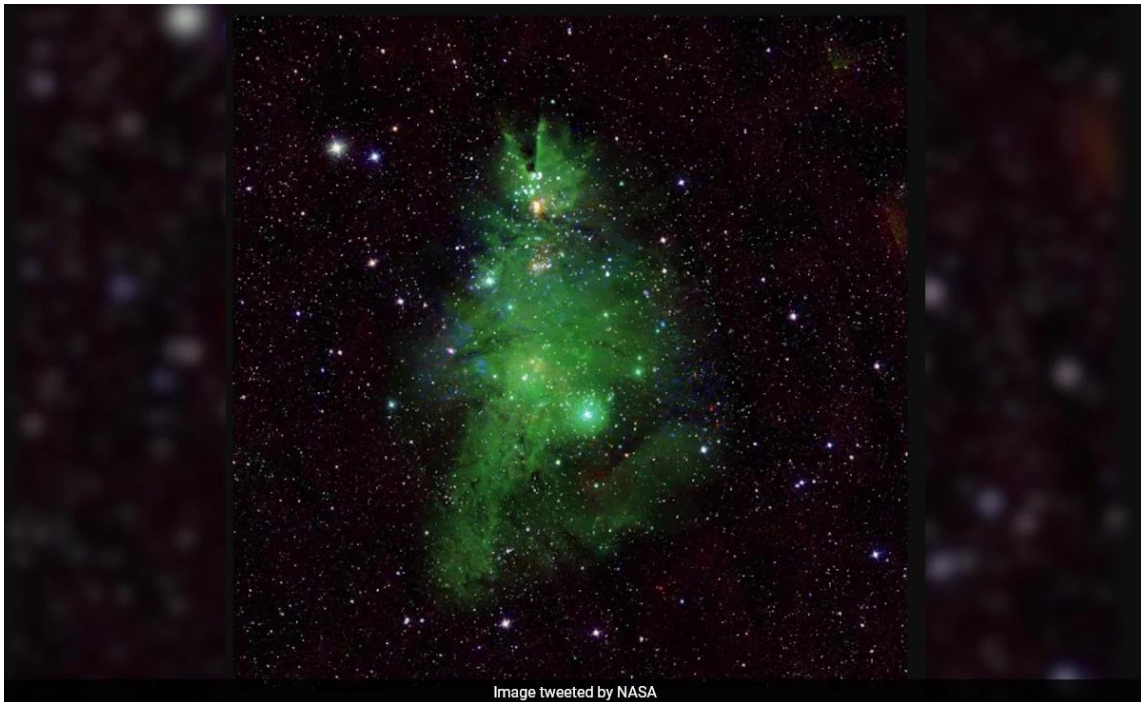
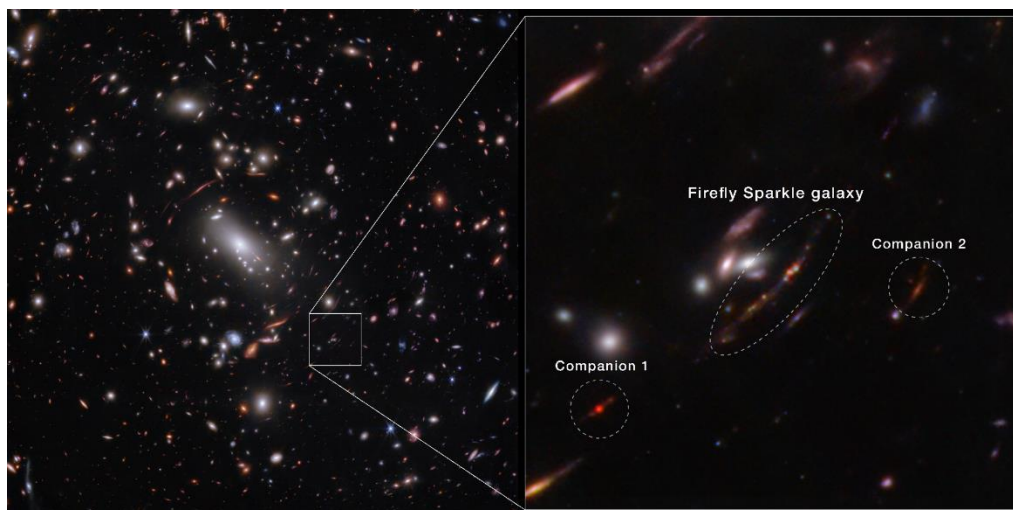


## A CHRISTMAS LIGHT GALAXY



Once again the James Webb Space Telescope has come up with a stunning and intriguing image. Taken with some major cosmic help, it shows one of the first galaxies to form after the beginning of the universe, almost 14 billion years ago. The image looks like a collection of old-style Christmas lights, where highly luminous stars of all colours are forming and starting to shine.

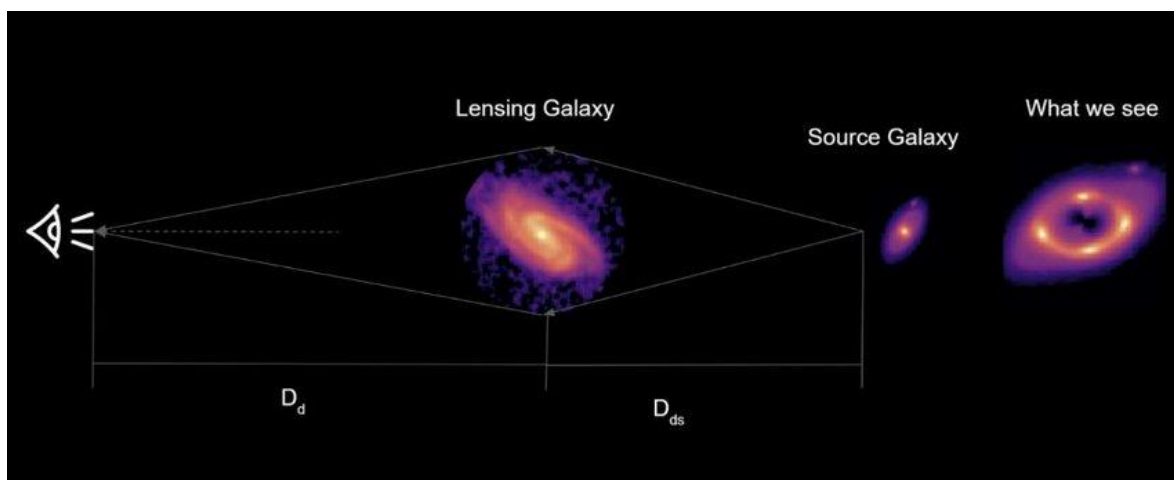
About 380,000 years after the Big Bang, the universe had cooled to the point where the primordial "quark soup" could condense into atoms. At this point the universe changed from an incredibly hot, opaque, glowing fog, to more or less the way it looks today. At the point of transition we see the beginnings of the condensations of matter that were the embryos of the first galaxies. A mere 220,000 years later, we had galaxies, like the one in the image (see the NASA link below).



<https://science.nasa.gov/missions/webb/found-first-actively-forming-galaxy-as-lightweight-as-young-milky-way/>.

This ability to look back in time is a consequence of the universe being so large that light from the more distant objects, despite travelling at almost 300,000 kilometres a second, can take billions of years to reach us. That Christmas Light galaxy is so far away its light is reaching us now. However, without a huge piece of cosmic help, the light from that and other objects that far away would be too faint for our telescopes. What makes it visible is a process known as gravitational lensing.

Imagine a bowling ball sitting in the middle of a trampoline, its weight stretching the fabric, forming a depression. If you roll marbles across the trampoline, passing over the edges of the depression, the marbles will have their paths bent inwards, towards a point behind the bowling ball. They have been focussed. The distorted fabric is acting like a crude lens.



Precisely in line between us and that distant galaxy there happens to be a cluster of galaxies. Just like the bowling ball, the colossal mass of the galaxy cluster is stretching the fabric of space-time. As in the case of the bowling ball and trampoline, the stretched space-time acts as a lens, fortuitously collecting and focussing light in our direction. Imagine a light collector millions of light years across, unimaginably larger than any telescope we can build. Understandably, the "lens" is not perfect. However, thanks to Einstein, and images of that galaxy cluster, it has been possible to largely correct for those imperfections, enabling us to look more than 13 billion years back in time.

The evidence we have collected so far suggests that the first galaxies formed surprisingly early in the history of the universe. There were functioning galaxies a mere 500,000 years after the Big Bang. As yet we cannot explain this. Understandably we are trying hard to figure out what is going on.

As that quark soup cooled after the Big Bang, the first atoms to form were the ones most able to tolerate the intense heat and density. There were hydrogen and helium. Nothing was left over for other atoms to form as the cooling continued. Without all the other elements, planets and life as we know it is impossible. However, these two elements are enough to make stars, and back then, star formation was very vigorous, producing extremely bright, supergiant stars. These lived short, active lives and exploded, distributing the waste products of their energy production: all the other elements. These first stars started to build up the concentration of ingredients necessary for making planets, us, and any other living things who almost certainly share the universe with us.

After sunset, Venus shines low in the southwest with Saturn nearby. Jupiter shines high in the southeast. At the same time Mars is rising in the northeast. Mercury lies in the southeast just before dawn. The Moon will reach First Quarter on 6 January, 2025.

Here's to 2025 being scientifically exciting but otherwise quiet and peaceful. Happy New Year.

Ken Tapping, 31st December, 2024

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