INSTITUTE OF ASTRONOMY PUBLIC OPEN EVENING

— 14 December 2022 —

JWST breaks record for most distant galaxy observed

JWST has observed many galaxies that appear to be incredibly far away, such as GN-z11 which was observed to have a redshift greater than 12. Astronomers use redshift to measure how much the wavelength of light from a distant object has been stretched due to the expansion of the universe – a similar effect to the rise and fall in the pitch of a siren as it moves towards and away from the listener.

A redshift of 12 corresponds to around 30 billion light years. Objects at this distance will be seen as they appeared 13.4 billion years ago, as opposed to 30 billion years, due to space expanding faster than the speed of light for a brief period of time in the early universe.

Findings like these were viewed with scepticism by many as there wasn't enough data on the spectra of light coming from these galaxies to accurately measure their redshifts.

"It was crucial to prove that these galaxies do, indeed, inhabit the early universe. It's very possible for closer galaxies to masquerade as very distant galaxies," said astronomer Dr Emma Curtis-Lake of the University of Hertfordshire.

Recent spectroscopic results allowed Dr Curtis-Lake and her colleagues to confirm the redshifts of four distant galaxies, the most distant of which was found to have a redshift of 13.2. Which means it formed only 325 million years after the Big Bang, making it the most distant galaxy ever definitively confirmed.

"Seeing the spectrum revealed as we hoped, confirming these galaxies as being at the true edge of our view, some further away than Hubble could see! It is a tremendously exciting achievement for the mission" said Dr Curtis-Lake.

TONIGHT'S SPEAKER

Alexandra Amon

The dark Universe

Our weekly welcome

WELCOME to our weekly public open evenings for the 2022/23 season. Each night there will be a half-hour talk which begins promptly at 7.15pm. Please note that the talk will be recorded and archived for online streaming.

The talk is followed by an opportunity to observe if (and only if!) the weather is clear. The IoA's historical Northumberland and Thorrowgood telescopes, along with our modern 16-inch telescope, will be open for observations. In addition, the Cambridge Astronomical Association will provide a floorshow outdoors on the Observatory lawns, relaying live images from their telescopes and providing a commentary. If we're unlucky and it's cloudy, we'll offer you a conciliatory cup of tea after the talk (with perhaps some more astro-information in the lecture theatre for those who want to stay on).

If you have any questions, suggestions or comments about the IoA Open Evenings please contact Matt Bothwell at bothwell@ast.cam.ac.uk.

The talk schedule for this term can be viewed at: www.public.ast.cam.ac.uk

LIGO could detect alien warp drives

If aliens were to use spacecraft as large as Jupiter we may be able to detect them from the gravitational waves they produce. The Laser Interferometer Gravitational-Wave Observatory (LIGO), which first observed a pair of black holes merging in 2015, could potentially detect such waves.

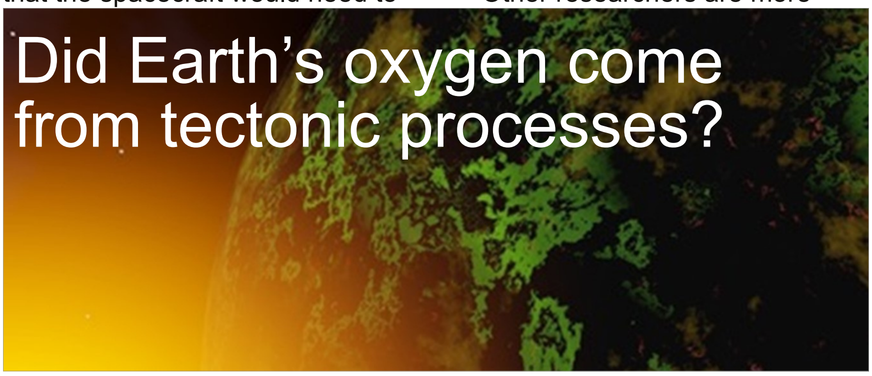
Gianni Martire of Applied Physics in New York and his colleagues calculated the minimum size and speed required for a spacecraft to produce a gravitational wave large enough for LIGO to detect. They found that the spacecraft would need to be at least as large as Jupiter, equivalent to a volume containing 1000 Earths, and travel at 10% of the speed of light – faster than any star discovered to date. A spacecraft like this would be unfeasible for humans, but perhaps not for aliens.

“With trillions of stars out there, you’re telling me that one doesn’t have aliens that haven’t done this? Just one? I think the odds are in our favour,” says Martire. “I wouldn’t want to be on the team figuring out how to build a Jupiter-sized spacecraft, but the odds aren’t zero”.

Other researchers are more sceptical of the idea that the waves produced by spacecraft would fall within the sensitivity range of LIGO.

“There is no downside in checking for an outlandishly enormous spacecraft in LIGO data” says Sabine Hossenfelder of the Munich Center for Mathematical Philosophy in Germany. “It’s there, it’s collected already and freely available, I don’t see why not. I’m just not that excited about the idea that they’ll actually find anything”.

Did Earth’s oxygen come from tectonic processes?



Oxygen is a crucial element for life on Earth and currently makes up 21% of our atmosphere. But around 2.5 billion years ago Earth hardly had any oxygen in its atmosphere. This raises the question – how did Earth’s atmosphere become so oxygenated?

A recent paper published in Nature Geoscience suggests that plate tectonics operating in the Archean era – from 2.5 billion years ago to 4 billion years ago – could be partially responsible. During tectonic activity the oceanic crust (the outermost layer of Earth under the oceans) sinks into the Earth’s mantle and forms magmas.

Modern subduction zones produce magmas with high oxygen and water contents known as oxidise magmas. In contrast, magmas formed in the Archean era were thought to be poorly oxidised. To test this theory researchers collected samples of 2.75- to 2.67-million-year-old rocks and measured their oxidation state.

They found that in spite of the lack of dissolved oxygen in oceans at the time, oxidised magmas were able to form 2.7 billion years ago. The oxygen must have come from a different source, ultimately being released into the atmosphere during volcanic eruptions.

These findings suggest that the process of subduction, in which oceanic crust is introduced into the mantle hundreds of kilometres below the surface, generates oxygen.

Earth being the only planet in the solar system known to have plate tectonics and active subduction could therefore explain the lack of oxygen found on the other planets.

Joke of the Week

Why did the chicken cross the road?

The answer is trivial and left as an exercise for the reader.