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Astronomy

Space telescope glimpses the smallest distant galaxy

Alex Wilkins

THE James Webb Space Telescope (JWST) has spotted the smallest galaxy outside our local universe by using the heaviest known cluster of galaxies, called El Gordo, as a giant lens. The mini galaxy is a thousand times less massive than the Milky Way.

El Gordo was first discovered in 2011. Follow-up measurements found that it contained so much mass – the equivalent of 3 million billion suns – that it was at the very limit of what standard cosmological theory predicts.

This huge mass makes it useful as a gravitational lens, bending and magnifying the light from stars and galaxies on the other side of it that would otherwise be invisible to us.

Now, Jose Diego at the University of Cantabria in Santander, Spain, and his colleagues have used JWST to observe the infrared light from El Gordo and found 29 galaxies that hadn't been visible before, including a dwarf galaxy that is only a billion times heavier than our sun. Even dwarf galaxies typically contain a few billion stars.

The team identified the dwarf galaxy from a strange fluctuation of light from another galaxy, called La Flaca, that El Gordo had stretched into a pancake-like arc. "The only way to explain it is there is a small, tiny galaxy right there, which is probably a dwarf galaxy," says Diego.

The galaxy is believed to be a thousandth of the mass of the Milky Way. If this is confirmed, it would be the smallest galaxy seen outside our local universe – which includes the Milky Way and its associated galaxies.

Its existence could present problems for some physics models, says Diego. "The fact that you can see this galaxy is inconsistent with some models of dark matter that predict that dark matter could have a high temperature." Warm dark matter would have a velocity too high to form a galaxy this small, he says.

Diego's team also spotted a red supergiant star, a type of star that hadn't been seen outside our local universe, but that JWST could identify using its infrared sensors (arxiv.org/abs/2210.06514).

If stars that fluctuate in brightness – which also tend to be red like this supergiant – are found by JWST, then they could be used to accurately estimate distances for very distant objects and measure the expansion of the universe. Currently, we use supernovae for this, which can be inaccurate.

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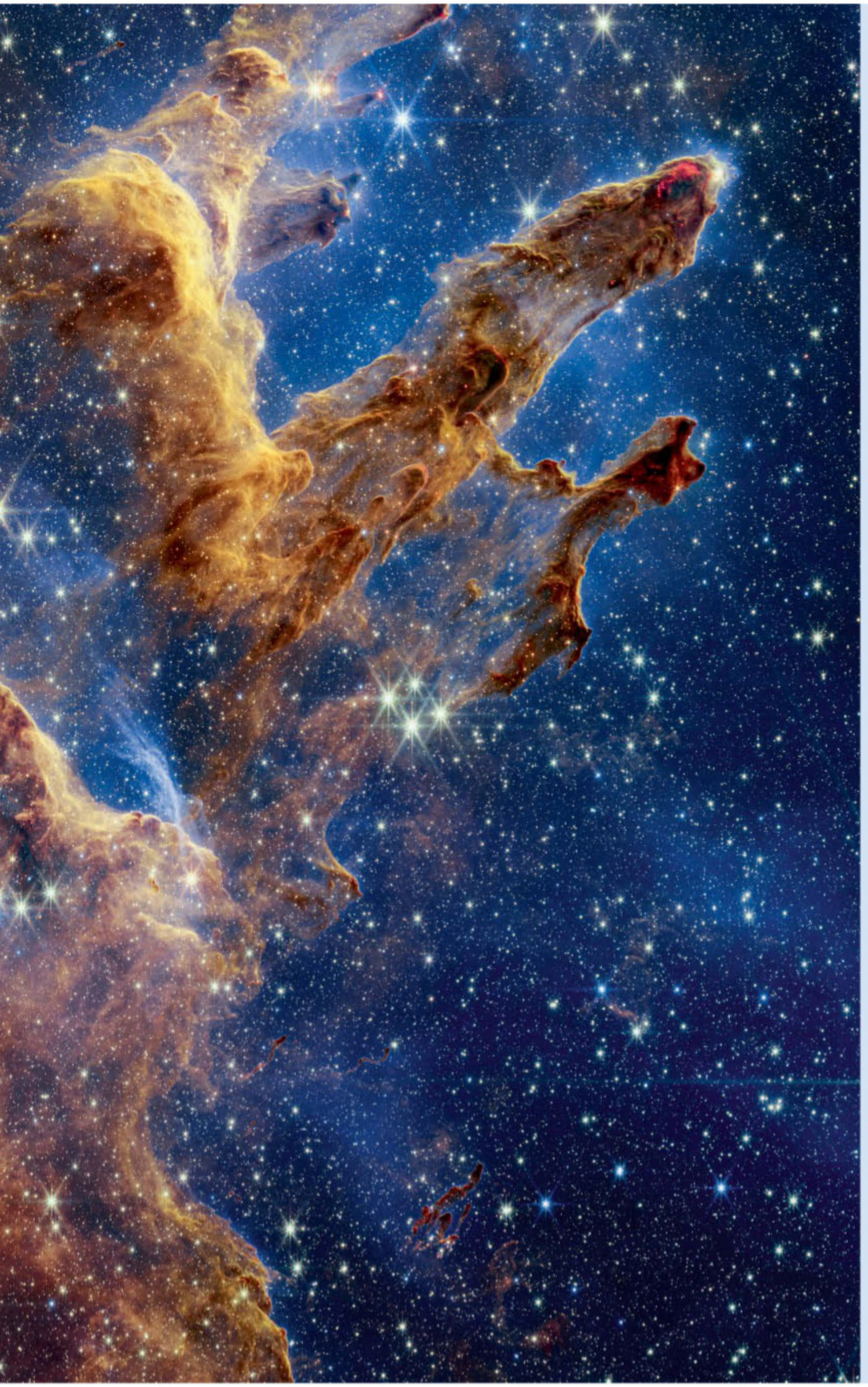
The number of newly observed galaxies detected by the team

Seeing such distant dwarf galaxies and red supergiant stars for the first time is "pretty amazing", says Felipe Menanteau at the University of Illinois at Urbana-Champaign. However, on their own, these objects won't be enough to help inform our models of the universe's formation; more data is needed for that, he says.

Diego and his team also found fewer very distant galaxies than expected behind El Gordo. These correspond to an era in the history of the universe called reionisation when the first stars began to form. This is strange given El Gordo's unique size and strength as a lens, says Menanteau, and hints that there might be something missing in our understanding of the formation of the first galaxies. ▮

Read Chanda Prescod-Weinstein on the contradictions of the James Webb Space Telescope on page 28

NASA, ESA, CSA, STScI; J. DEPASQUALE, A. KOEKEMOER, A. PAGAN (STSCI)



Space

Pillars of Creation look even starrier in new JWST image

OUR view of the iconic Pillars of Creation has been transformed by the James Webb Space Telescope (JWST). While these towering clouds of dust and gas, which are 6500 light years away in the Eagle Nebula, look like solid cosmic stalagmites in the classic images from the Hubble Space Telescope, JWST images reveal the stars forming within them.

JWST is able to see through the dust because it observes in infrared wavelengths of light, as opposed to visible light that Hubble mostly uses. Infrared light pierces through the clouds of dust and gas to show the young stars that have just formed or are still forming in this stellar nursery.

Many of the brightest stars in this image have only recently formed within the pillars and then blown away their surrounding gas. Some of these bright stars are surrounded by eight spikes of light, which are simply caused by the extremely bright starlight bouncing off the edges of JWST's mirrors.

The dark lines at the edges of the clouds come from even younger stars, which formed only a few hundred thousand years ago. When these kinds of stars are still forming, they blast out jets of plasma. The jets slam into the gas and dust around them and create shock waves, which pick up more material as they propagate through the cloud.

Observing these young stars may help us learn more about the process of star formation – how dust and gas form tight knots that then collapse into stars. It could also help us track what happens once the stars form in a region like this and how they emerge from their pillar-like cocoons.

Leah Crane