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# Sky at Night

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# A starless galaxy?

A potentially all-dark-matter galaxy has put astronomers on Cloud-9

**A** mysterious blob of gas found in the vicinity of the spiral galaxy M94 is exciting astronomers. It might be the first example of a type of object that has long been predicted by our leading cosmological theory: a small galaxy with gas, dark matter... and no stars.

Our understanding of how gravity sculpts structure in the Universe says that from the tiny initial fluctuations in density that we see in the cosmic microwave background, objects of all masses will form. But only in the largest – those with a mass above a critical limit, which changes over time – is gravity expected to be strong enough to reach the density required for star formation to happen.

As a result, scattered all over the Universe there should be smaller, failed systems that didn't reach this limit, which have been given the convoluted but more positive name of REionization-Limited-HI Clouds (RELHICs for short) by the authors of this month's paper, Alejandro Benítez-Llambay and Julio F Navarro. Has the first of these failed, starless galaxies been found?

Maybe. A team of Chinese astronomers using the new Five-hundred-meter Aperture Spherical Radio Telescope (FAST) in southwest China – think a larger and more modern version of the recently collapsed famous Arecibo dish in Puerto Rico – detected radio waves at a wavelength of 21cm. These are associated with hydrogen, coming from a point in the sky just slightly less than a degree from M94, in the constellation of Canes Venatici. If the emission is indeed from hydrogen, it seems to be receding from us at about the same speed as the more massive galaxy, making it very likely to be part of the same cosmic group.

## Gas rich, star poor

This new discovery, charmingly called 'Cloud-9' by the discovery team, could be a satellite galaxy of M94, but if so it's a strange one. The deepest imaging we have so far shows no signs of any stellar light at a position corresponding to the radio source, though given the data we have in hand a small



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luminous galaxy might still be lurking, hidden at the cloud's centre.

The modelling done in this new paper about the discovery suggests that, assuming no stars are found, it could have a mass of perhaps five billion times that of the Sun – small for a galaxy, though not unprecedented. The material in it is slightly more spread out than predicted, a discrepancy Benítez-Llambay and Navarro explain by suggesting that these objects may have a different distribution of dark matter than a 'normal' galaxy of the same size does. The galaxy may also be a bit more massive than otherwise expected.

This is undoubtedly an exciting discovery, and I'm sure that telescopes will soon be swinging to observe Cloud-9. Top of the authors' wish list will be to get higher-resolution radio observations. A single dish like FAST cannot match the performance of an array, and the MeerKAT radio telescope in South Africa has the capability to give us a much sharper view of how the gas is distributed, and even that is just a precursor to the much larger Square Kilometer Array. Long-exposure imaging could show gas in the cloud's outskirts, and Hubble would be ideal to look for any stars that exist. Expect to hear more from Cloud-9 soon.

The oddball starless lump of dark matter dubbed Cloud-9 could be a satellite of spiral galaxy M94 (pictured)



**Chris Lintott** was reading... *Is a Recently Discovered HI Cloud near M94 a Starless Dark Matter Halo?* by Alejandro Benítez-Llambay and Julio F Navarro **Read it online at: [arxiv.org/abs/2309.03253](https://arxiv.org/abs/2309.03253)**