Giant hydrogen cloud spotted around the Triangulum Galaxy

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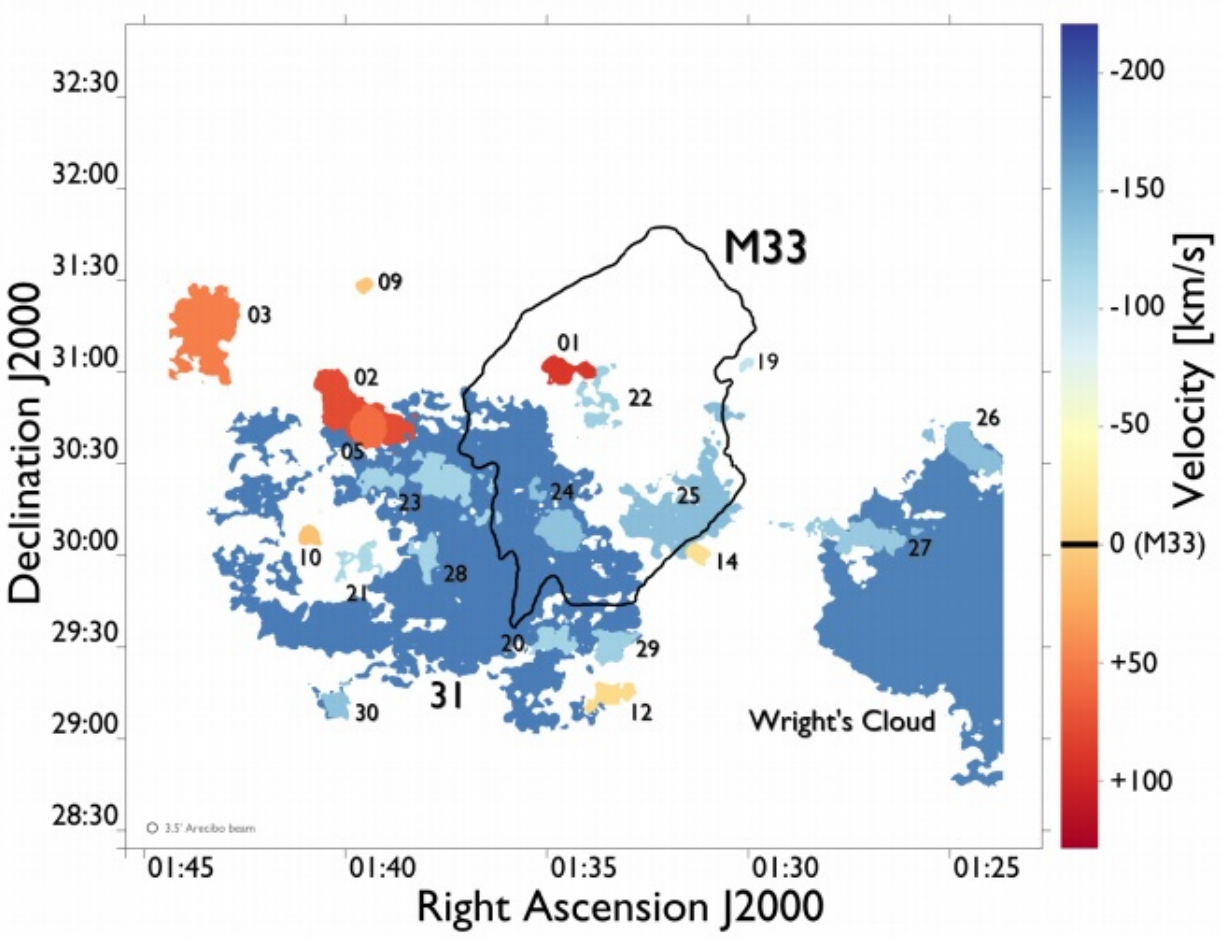

The outline of M33s neutral hydrogen disk is shown in black, with all of the discrete detected clouds overlaid. The figure was made by integrating the flux over the velocity range of each cloud, then filling in the lowest contour. The central velocity of each cloud was used so the colours are indicative of this velocity. Velocities shown are relative to M33. Credit: Keenan et al., 2016.

(Phys.org)—While peering into the nearby Triangulum Galaxy known as M33, astronomers have detected what appears to be a giant cloud of hydrogen around it. According to research published online on May 5 on the arXiv pre-print server, the cloud is extremely large, even bigger than the galaxy itself. The discovery could improve our knowledge about the distribution of gas in and around galaxies.

The detection was made by a team of astronomers led by Olivia C. Keenan of the Cardiff University, U.K. The researchers used a set of data provided by the Arecibo Galaxy Environment Survey (AGES) that utilizes the Arecibo Telescope in Puerto Rico. AGES is a neutral atomic hydrogen survey aimed at searching for galaxies in different areas of the local universe.

The scientists have analyzed the data from AGES to look at the neutral hydrogen distribution around M33. Investigating this area, they were searching for any hydrogen clouds that could be starless dwarf satellites of the galaxy. Due to the proximity of M33 and the high quality of AGES data, the team could easily detect new clouds around this galaxy.

"It wasn't too difficult to detect clouds around M33. What was more difficult was working out whether the clouds were part of the disk of M33, near M33 but unattached, or whether they were, in fact, related to our Milky Way galaxy. This meant we had to study each cloud in a lot of detail to work out if it was associated with M33," Keenan told *Phys.org*.

The team managed to detect 11 new clouds. They also found out that many previously detected clouds are actually part of the low neutral hydrogen disk of M33. However, they were not able to identify any stars associated with these clouds.

"We now know a lot about where the gas is around M33 and what it looks like. M33 has an extended neutral hydrogen gas disk which is larger than the optical galaxy as it extends further than the stars. This disk is warped and has lots of clumpy dense regions, which may hint towards a past close encounter with the Andromeda galaxy. M33 also has a population of gas clouds which don't have any stars associated with them. This is interesting, as we don't know how these clouds of gas got there, or why they don't have stars," Keenan said.

According to the study, the largest cloud found by the researchers, designated AGESM33-31, is the most intriguing one. It has a diameter of nearly 60,000 light years and a neutral hydrogen mass of about 12 million solar masses. If the cloud is at the distance of M33, it is larger in size than the galaxy.

"We have found a large ring-shaped cloud which appears to be about as big as M33 itself," Keenan noted.

The origin of AGESM33-31 is yet to be determined. One of the hypotheses proposed by the team is that this cloud is the further extension of the Magellanic Stream. The researchers also suppose that the cloud could be the remnants of a dark galaxy that has been disrupted. However, these explanations do not account for the hole observed in this ring-shaped feature.

"We have investigated the possibility that this hole may have been formed by a supernova, but found it to be around an order of magnitude too large for this to be a satisfactory explanation. AGESM33-31 remains an interesting and intriguing object, we would need additional observations to allow us to make further comment on its nature," the scientists wrote in a paper.

Keenan concluded that although the Arecibo Telescope is excellent to

look for gas around nearby galaxies, a more powerful observatory, like the Square Kilometer Array (SKA), would be needed to continue the search in more remote locations.

"We hope that as telescopes improve we will be able to detect more gas around galaxies, and see gas around galaxies which are further away. When the Square Kilometer Array telescope is complete it will be great for this kind of work," she said.

SKA is an international project to built a network of radio telescopes in Australia and South Africa. These telescopes will be tens of times more sensitive and hundreds of times faster at mapping the sky than today's best radio astronomy facilities. First observations are currently scheduled for 2020.

More information: The Structure of Halo Gas Around M33, arXiv:1605.01628 [astro-ph.GA] arxiv.org/abs/1605.01628

Abstract
Understanding the distribution of gas in and around galaxies is vital for our interpretation of galaxy formation and evolution. As part of the Arecibo Galaxy Environment Survey (AGES) we have observed the neutral hydrogen (HI) gas in and around the nearby Local Group galaxy M33 to a greater depth than previous observations. As part of this project we investigated the absence of optically detected dwarf galaxies in its neighbourhood, which is contrary to predictions of galaxy formation models. We observed 22 discrete clouds, 11 of which were previously undetected and none of which have optically detected counterparts. We find one particularly interesting hydrogen cloud, which has many similar characteristics to hydrogen distributed in the disk of a galaxy. This cloud, if it is at the distance of M33, has a HI mass of around 10^7 Msun and a diameter of 18 kpc, making it larger in size than M33 itself.