

Hanny's Voorwerp in the Radio

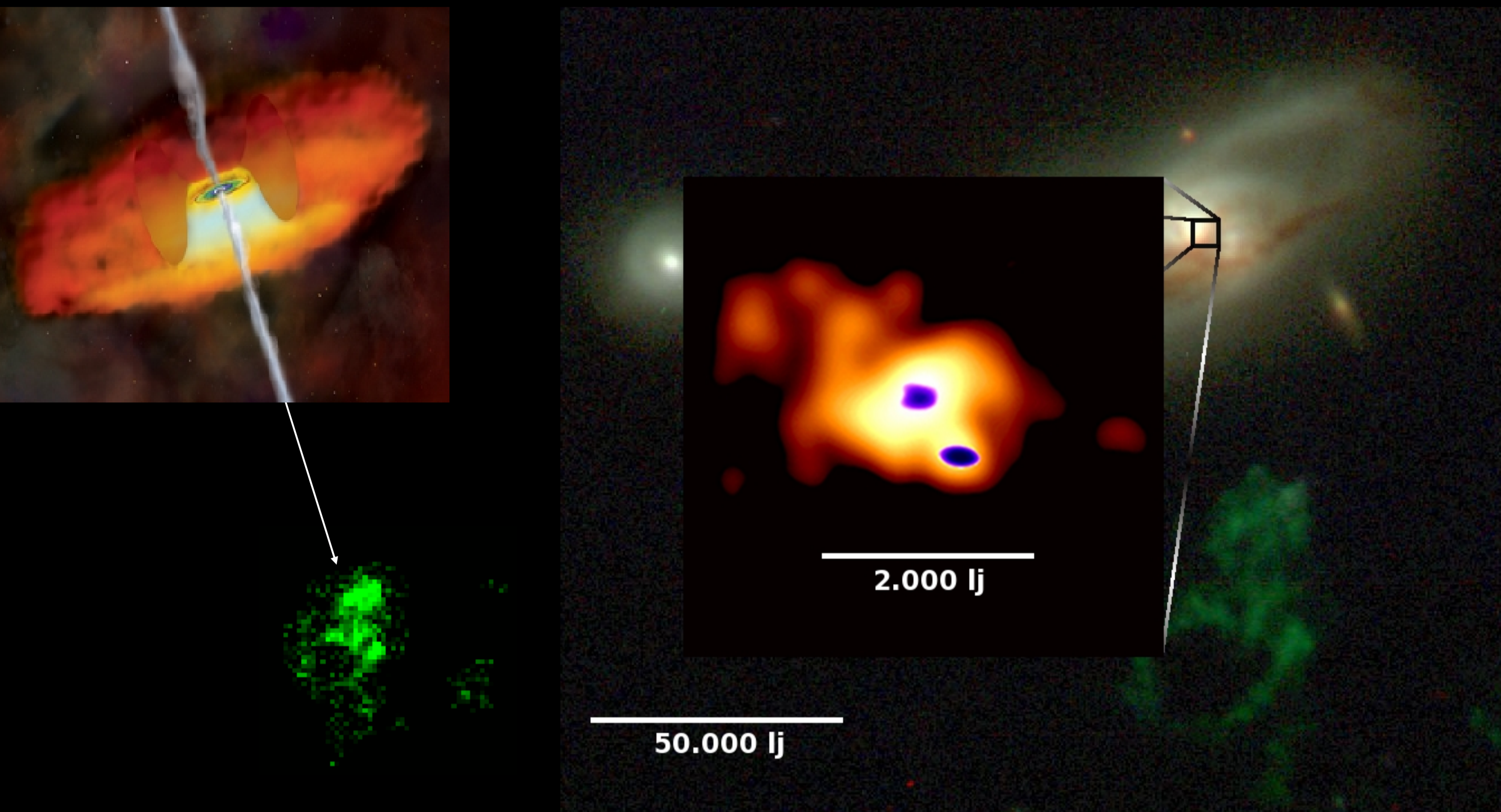
In 2007, a Dutch school teacher named Hanny van Arkel discovered something strange in the Universe. As an amateur astronomer she classified objects on the website of GalaxyZoo. The unidentifiable object she found was named "Hanny's Voorwerp" and made her world famous.

But what exactly is "Hanny's Voorwerp"? Hanny's Voorwerp is a luminous gas cloud in the vicinity of the giant galaxy IC 2497, at a distance of approximately 600 million light years from the earth.

The cloud has an extent of 80.000 light years and a temperature of more than 10.000°C, which is why it shines in a bright green colour.

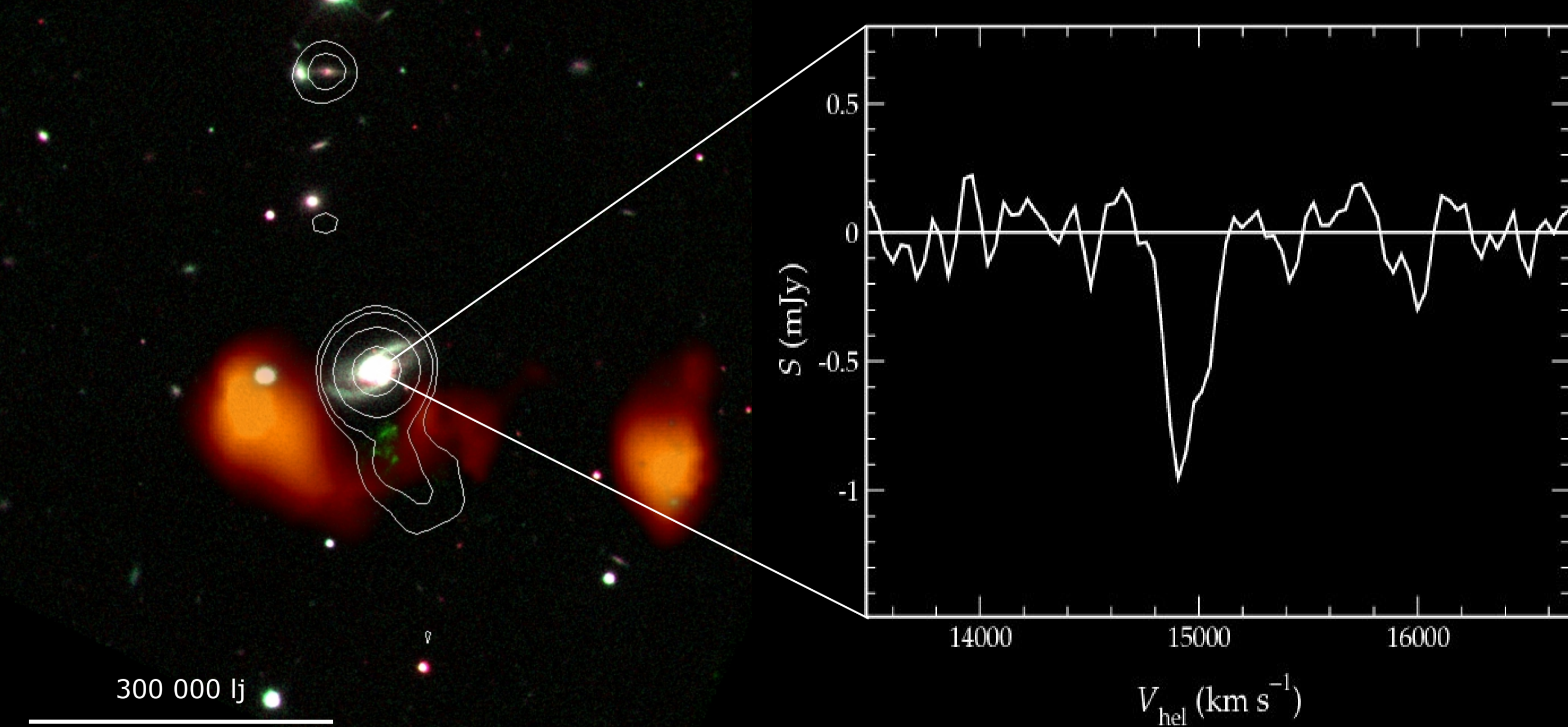
Since there are no hot stars in the vicinity of the cloud, the only possibility for heating it to that temperature is that the neighbouring galaxy IC 2497, approximately 60.000 light years away from Hanny's Voorwerp, contains an active galactic nucleus (AGN), a supermassive black hole which becomes extremely bright when swallowing gas.

However, looking at the galaxy with optical, ultraviolet, and X-ray telescopes, astronomers could not see such a black hole.



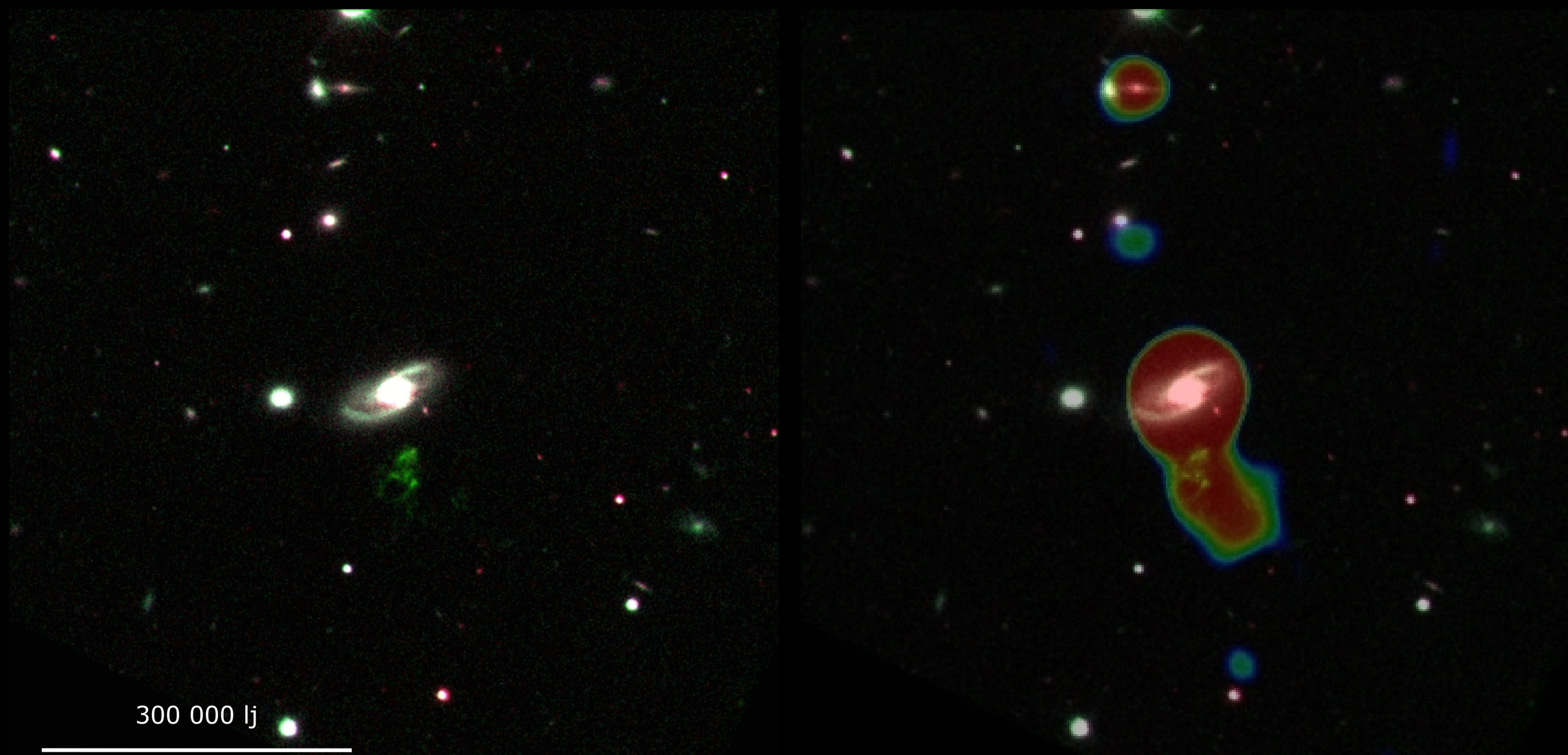
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Connecting several radio telescopes spread over Europe in the EVN network, and using the UK telescope network MERLIN, very sharp images of the centre of IC 2497 were taken. The image to the right shows the detection of two very compact sources (purple dots) with a diameter of less than 100 light years: there is still emission coming from the supermassive black hole (upper left purple dot), recently also detected in the X-ray regime, and a particle jet hitting the surrounding gas (lower right purple dot). In addition, a central extreme starburst region is detected (orange). In a region of 2000 light years across, IC 2497 is producing 70 suns per year, six times more than the famous extreme starburst galaxy M82!



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The radio data give also an indication why the AGN is only visible at radio wavelengths. Looking at the bright centre of IC 2497, the neutral hydrogen is detected in absorption (figure to the top): we see the shadow of the gas that is in the way looking towards the black hole. There might be enough material between us and the AGN to block the sight towards the black hole, except if we look at it with a radio telescope. Hanny's Voorwerp, however is fully illuminated (Figure to the right).



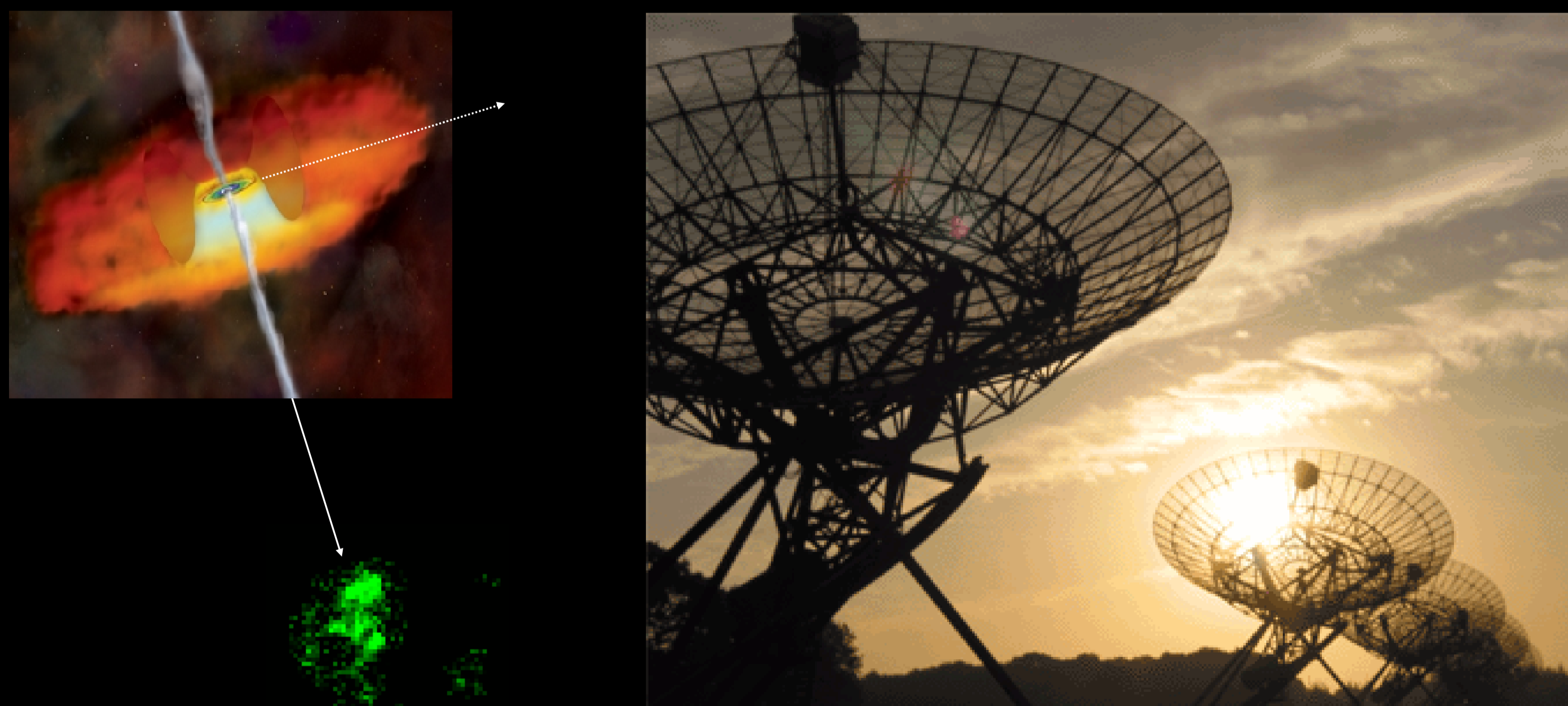
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IC 2497 (in the center of the left image) and Hanny's Voorwerp (green cloud below) were observed at radio wavelengths with the Westerbork Radio Synthesis Telescope (WSRT). And, in the radio regime, you can see a clear indication of an AGN. On the right, you see the radio image overplotted on the optical image. In the direction of the gas cloud there is an extension in the radio emission. To radio astronomers, this feature is well known.



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We now know that there is an active galactic nucleus illuminating the gas cloud. But still, we do not know where that gas comes from. Again, the system was observed with the Westerbork Synthesis Radio Telescope, this time tuned in such a way that one could see the emission coming from the neutral hydrogen. Two giant cloud complexes (left image) were detected, and a closer look into the data indicates that they are connected. The complete gas structure weighs as much as 8.5 billion suns! And it has a size of more than 300.000 light years across. Hanny's Voorwerp is only a small part of the cloud that is illuminated by the AGN (sketch to the right). The gas does not belong to IC 2497. It probably belongs to a galaxy group that is visible on optical images.



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