Italian astronomers inspect galaxy Markarian 509 with ALMA

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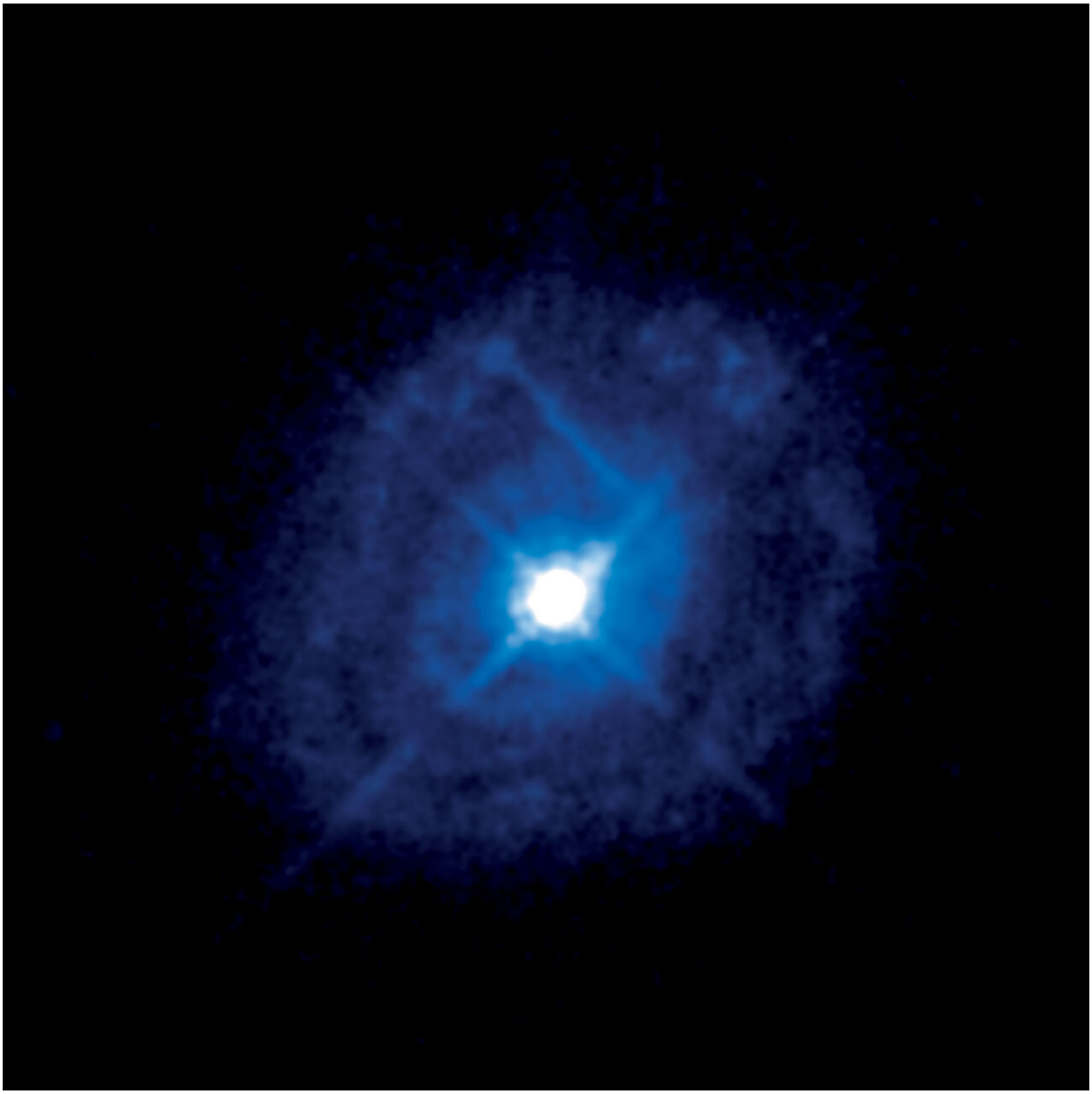

This image from the NASA/ESA Hubble Space Telescope shows the galaxy Markarian 509. Credit: NASA, ESA, J. Kriss (STScI) and J. de Plaa (SRON)

Using the Atacama Large Millimeter/submillimeter Array (ALMA), Italian astronomers have investigated an active galaxy known as Markarian 509. Results of the study, presented in a paper published July 14 on arXiv.org, deliver important insights into the distribution and kinematics of the galaxy's cold molecular gas.

At a distance of some 466 million light years, Markarian 509 (or Mrk 509 for short) is a Seyfert 1.5 galaxy hosting an active galactic nucleus (AGN). Observations show that Mrk 509 is a medium size galaxy resembling a bulge with an ionized gas disk and a starburst ring where star formation is currently ongoing at a rate of about five solar masses per year.

Mrk 509 is a complex system experiencing an ongoing minor merger and showing evidence of multiphase gas winds—from warm ionized gas wind to highly ionized ultra fast outflows (UFOs). In order to find more evidence of molecular winds, a team of astronomers led by Maria Vitttoria Zanchettin of the University of Trieste in Italy, has analyzed the data from ALMA as part of the IBISCO survey, focusing on the carbon monoxide (CO) emission line of Mrk 509.

"We presented an analysis of the CO(2-1) line and 1.2 mm continuum of Mrk 509, a Seyfert 1.5 galaxy drawn from the IBISCO sample of hard-X-ray selected local AGN," the researchers wrote in the paper.

The study found that Mrk 509 has a molecular gas reservoir at a level of 1.7 billion solar masses, located within a disk of about 17,000 light years in size that is inclined 44 degrees and has a mass of some 20 billion solar

masses. Within this disk, a molecular gas fraction was estimated to be approximately 5 percent, which is typical for local star-forming galaxies with similar stellar mass.

By investigating the disk further, the astronomers found that it is unstable across the starburst ring, and stable against fragmentation at nucleus. Moreover, the gas kinematics in the nuclear region of Mrk 509 within a radius of around 2,300 light years, suggest the presence of a warped nuclear disk.

"Both the presence of a molecular disk with ongoing star-formation in a starburst ring, and the signatures of a minor merger, are in agreement with the scenario where galaxy mergers produce gas destabilization, feeding both star-formation and AGN activity," the authors of the paper explained.

The research also found significant perturbations of the molecular gas kinematics at two different locations in the disk. In these two regions, the molecular gas exhibits deviations from the disk rotation, which was interpreted as molecular winds and received designations: wind A and wind B.

The astronomers noted that the wind A has a velocity of about 250 km/s and is located at a distance of some 980 light years from the AGN, in the same region where an ionized gas wind was detected. When it comes to the wind B, it was identified at a distance of about 4,600 light years from the AGN, and at a small projected distance from the tidal tail. However, its velocity at a level of 200 km/s indicates that this wind is not related to the tidal tail.

More information: The IBISCO survey: I. Multiphase discs and winds in the Seyfert galaxy Markarian 509, arXiv:2107.06756 [astro-ph.GA] arxiv.org/abs/2107.06756