Pioneering technique using powerful new radio telescope expands our understanding of chemical formation of stars

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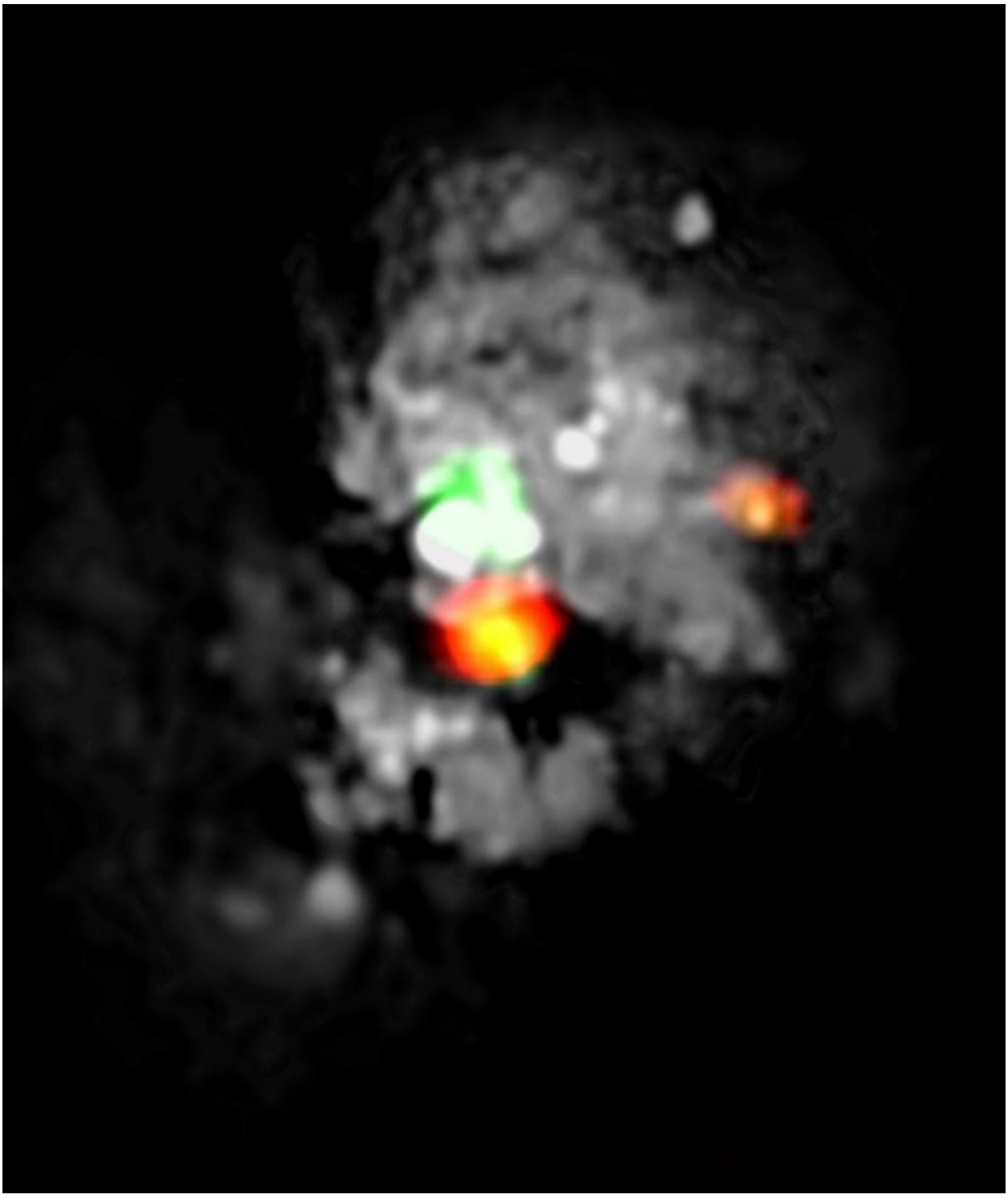


The multi-wavelength image shows the 'Eye of Medusa' (orange) located directly below the black hole at the center of NGC 4149 (white and green). Credit: Institut de Radioastronomie Millimetrique

NOEMA (Northern Extended Millimeter Array), the most powerful millimetre radio telescope of the Northern Hemisphere, has unveiled its first astronomical image: a unique and spectacular view of a previously unknown region of extreme star formation in the 'Medusa merger' - a luminous collision of two galaxies at more than 100 million light years from Earth.

The observations, conducted by IRAM using the new NOEMA observatory in the French Alps, reveal a giant region (about 500 light years across) of recently formed massive stars at the center of the 'Eye of Medusa', the central gas-rich region of the Medusa merger. The stars are still wrapped in their dusty birth clouds and completely hidden from view in visible light.

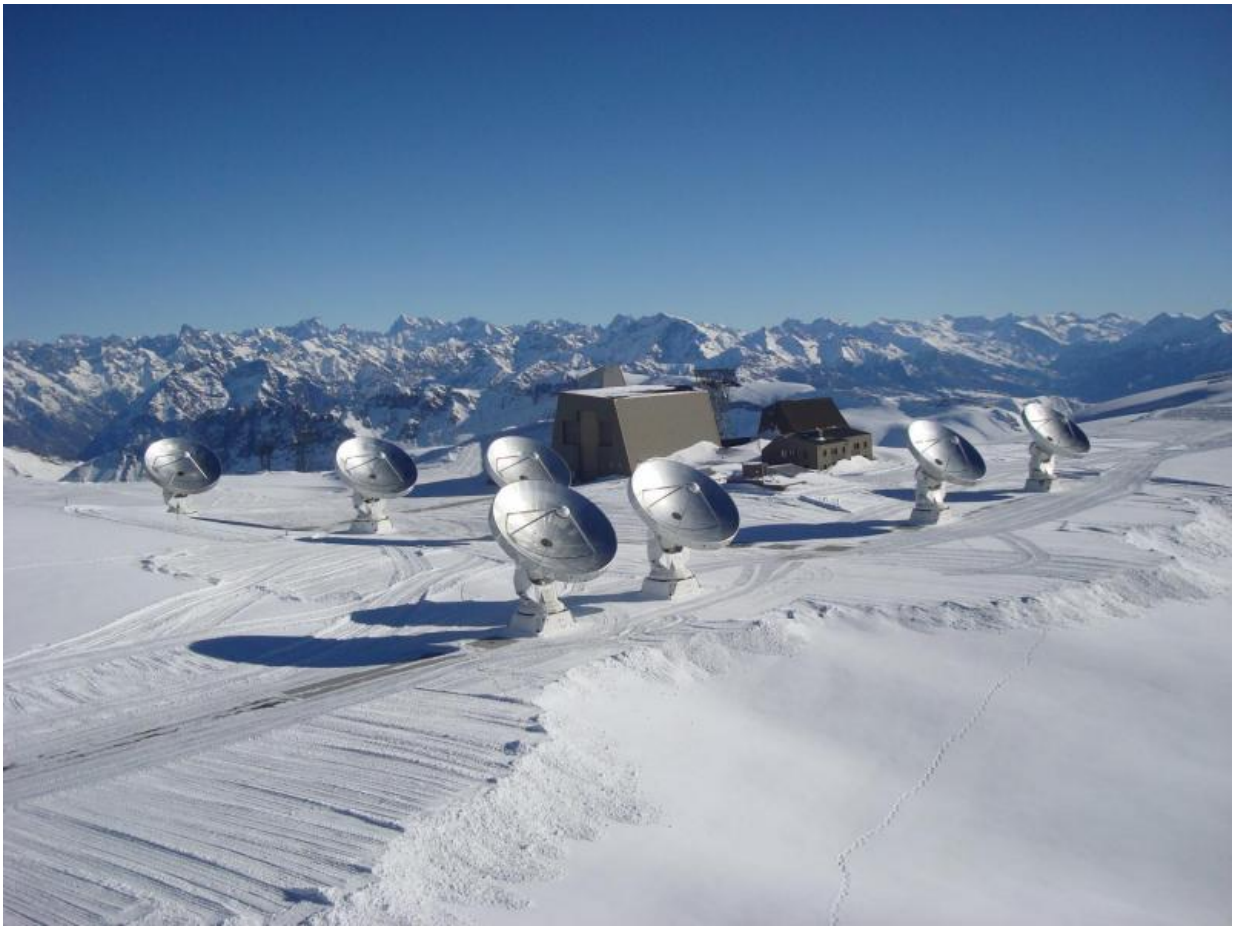
Other observatories have previously mapped the Medusa merger but none had detected the existence of this region of high-density gas in the 'Eye' until now. The new discovery has not only proven its existence, but also has implications for our understanding of the origins of the Universe and will influence future investigative techniques.

Previous exploration of the Medusa merger had involved carbon monoxide (CO) - the most common molecule used in radio observations at millimeter wavelengths.

Observations of this molecule had never before revealed any detail of a potential 'Eye' region. The IRAM team, led by Sabine Koenig, tried a new way in, tuning the NOEMA antennas to detect hydrogen cyanide (HCN) and formylium (HCO+) molecules.

The discovery demonstrates that star development can be probed in stages of formation, which are currently not detectable by tracing carbon monoxide. By successfully detecting other molecules, the extreme star formation observed in the 'Eye' demonstrates the existence of more

complex chemical formulations than previously thought. This discovery means our understanding of the chemical formation of stars can be hugely expanded upon.



NOEMA -- the most powerful millimeter radio telescope of the Northern Hemisphere, is located in the French Hautes-Alpes on the Plateau de Bure. Credit: Institut de Radioastronomie Millimetrique

Studies on galaxy collisions and their impact on star formation are fundamental to understanding how galaxies have assembled throughout the history of the Universe.

Sabine Koenig of IRAM, who led the team of researchers in the discovery, said, "It was a great surprise to see this region brightly illuminated all of a sudden, and see it shine with the light of thousands of recently formed stars. This region turns out to be the site of the most extreme stellar nursery in this galactic collision!"

Roberto Neri, Scientific Director of the NOEMA observatory, said, "These observations clearly show that we have perfectly mastered the new instrument and that NOEMA will allow us to uncover and explore the complex process of star formation in the most hidden places of our Universe in the coming years".

NOEMA is the result of an international effort and will operate in synergy with the largest and most important astronomical instruments on Earth and in space. It can probe the cold universe (around -250 degrees Celsius) and detect the cold interstellar matter (gas and dust), which is responsible for the formation of new stars and planets. It is part of a new generation of radio telescopes employing the most advanced technologies available. Although still under construction, this instrument is already the most powerful millimeter wave interferometer in the Northern Hemisphere.

NOEMA is the result of considerable development of the previous Plateau de Bure observatory, which became NOEMA when the first of six new antennas was inaugurated in September 2014. It is currently operating with seven antennas of 15 metres diameter, each equipped with a unique and ultra-sensitive receiver system, approaching the quantum limit. It will ultimately be equipped with 12 antennas, giving the international scientific community an exceptional look into the depths of our Universe through hundreds of scientific research projects each year.

NOEMA will be one of the leading instruments in the hunt for

astronomical discoveries in the most remote regions of our Universe and its capabilities will ultimately contribute to human understanding of the evolution of the universe.

Provided by Institut de Radioastronomie Millimetrique