Sloshing cold front detected in a massive galaxy cluster

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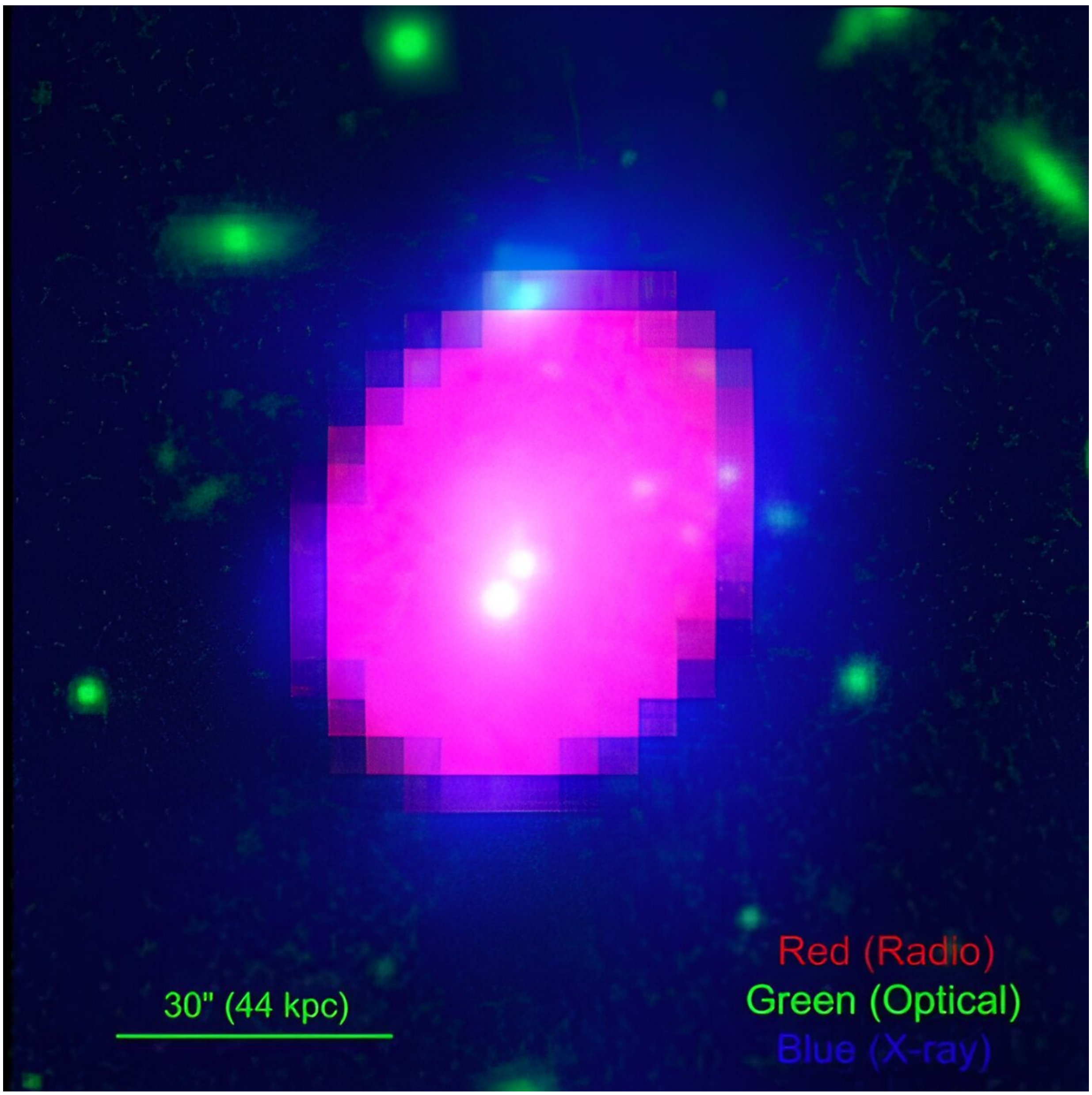

RGB (tricolor) image of Abell 2566 obtained by proper combination of emission measured at 1.4 GHz with VLA C-configuration (red), Pan-STARRS r-band (green), and Chandra X-ray soft band (blue). Credit: Kadam et al, 2024

By analyzing the data from NASA's Chandra X-ray observatory, astronomers from India and South Africa have investigated a massive galaxy cluster known as Abell 2566. They detected sloshing cold fronts in the intracluster medium (ICM) of this cluster. The finding was reported in a research paper published May 17 on the preprint server *arXiv*.

Galaxy clusters contain up to thousands of galaxies bound together by gravity. They are the largest known gravitationally bound structures in the universe, and could serve as excellent laboratories for studying galaxy evolution and cosmology.

In general, the so-called cold fronts are sharp surface brightness discontinuities observed in X-ray images, where the drop of the surface brightness and gas density is accompanied by a jump in the gas temperature, with the denser region colder than the more rarefied region.

Now, a team of astronomers led by Sonali K. Kadam of the Swami Ramanand Teerth Marathwada University in India has identified such features in Abell 2566—a cool core galaxy cluster at a redshift of 0.08, with an estimated mass of about 217 trillion solar masses.

By analyzing Chandra images and archival radio data, Kadam's team found evidence of gas sloshing in the core of Abell 2566 along with a pair of cold fronts in its environment.

First of all, the collected images unveiled an unusual morphology of

ICM distribution—in the form of spiral-shaped gas sloshing along with edges in the surface brightness distribution. Spectral analysis conducted by the astronomers then confirmed an association of these morphological discontinuities with the cold fronts.

"A detailed analysis of the sectorial brightness profiles along these edges confirm their origin due to sloshing of gas, referred to as the sloshing cold fronts," the researchers explained.

Furthermore, the observations identified an offset of about 22,200 light years between the brightest cluster galaxy (BCG) and the X-ray emission peak, as well as close association of the BCG with a neighboring system. The authors of the paper suppose that this offset might have yielded the sloshing structure in Abell 2566.

Based on the collected data, the astronomers assume that the observed features and complex morphology of plasma distribution in Abell 2566 share a common origin—as they may be due to a minor merger. The team noted that a sub-cluster may have disturbed the main cluster by displacing its gravitational potential well.

"Such a displacement further results in the formation of cold fronts, the concentrically shaped borders in the surface brightness produced by the core's gas as it moves around the potential well. These cold fronts further develop spiral patterns in the plasma distribution provided the sloshing direction is close to the plane of sky," the scientists concluded.

More information: S. K. Kadam et al, Sloshing Cold Fronts in Galaxy Cluster Abell 2566, *arXiv* (2024). DOI: 10.48550/arxiv.2405.10475