Diffuse hot gas detected around a potential super-star cluster

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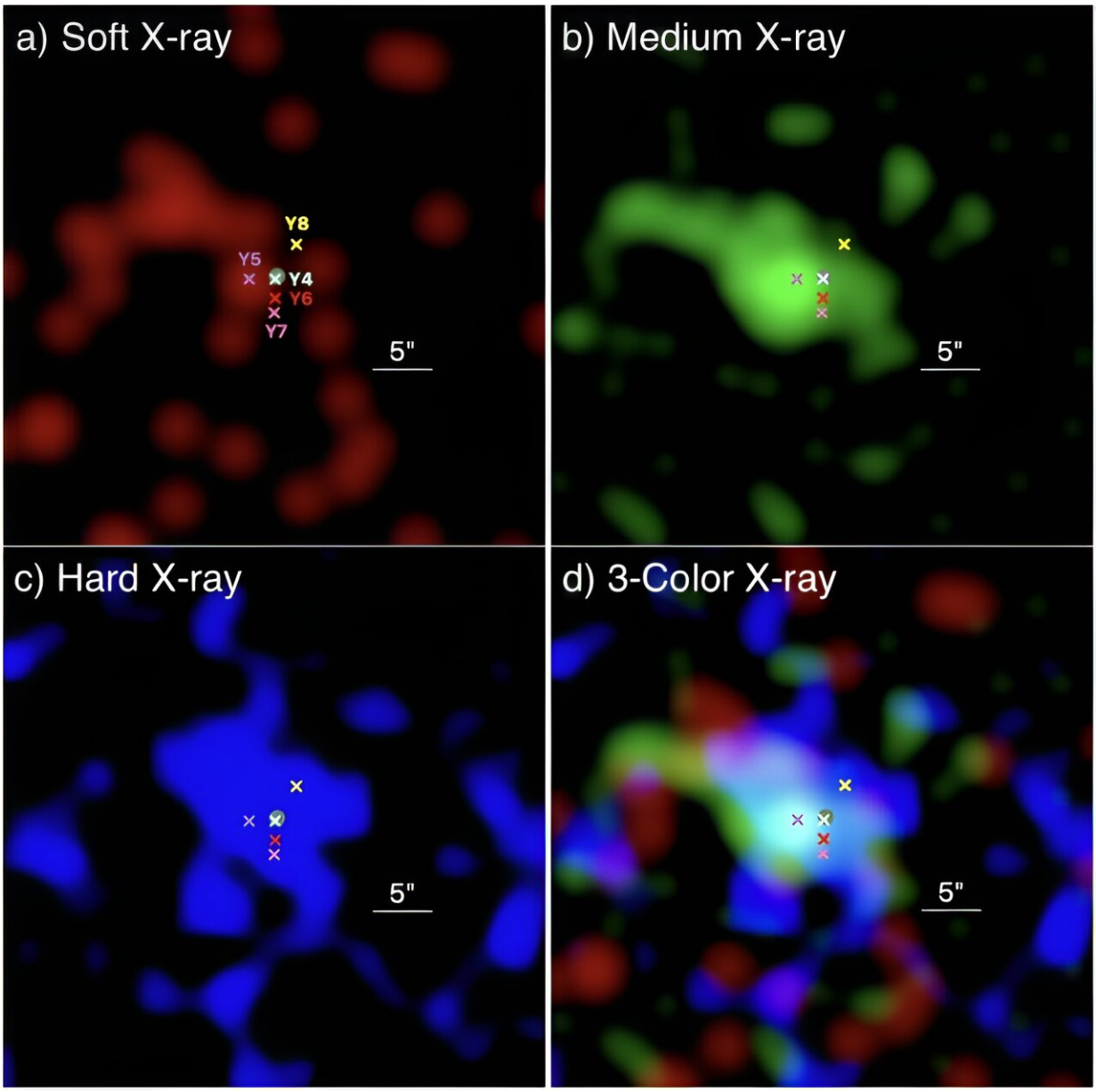

X-ray images of H72.97−69.39 in soft [0.5 – 1.2 keV] (a), medium [1.2 – 2.0 keV] (b), hard [2.0 – 7.0 keV](c), and all bands (d). Credit: Webb et al., 2024.

Using NASA's Chandra X-ray spacecraft, astronomers have inspected a potential super-star cluster, designated HSO BMHERICC J72.971176-69.391112, or H72.97−69.39 for short. The new observations resulted in the detection of a diffuse hot gas around this cluster. The finding was reported in a paper published February 21 on the pre-print server *arXiv*.

Super-star clusters (SSCs) are very massive young open clusters (OCs) that eventually evolve into globular clusters (GCs). They usually contain a very large number of young, massive stars that ionize a surrounding region of interstellar atomic hydrogen (HII region). Observations of SSCs are important for astronomers seeking to improve our understanding of formation and evolution of GCs and their host galaxies.

Located some 160,000 light years away, H72.97−69.39 is a highly-embedded, potential SSC in the star-forming complex N79 of the Large Magellanic Cloud (LMC). With an estimated age of less than 500,000 years, H72.97−69.39 is in the earliest stages of formation, exhibits an accelerating star-formation rate and has a bolometric luminosity at a level of two million solar luminosities.

Although H72.97−69.39 has been investigated in optical, infrared, and submillimeter wavelengths, it has not been comprehensively studied in X-rays. That is why a team of astronomers led by Trinity Webb of the Ohio State University (OSU) in Columbus, Ohio, decided to employ Chandra to take a closer look at the X-ray emission from this cluster.

"Here we study the X-ray emission of H72.97−69.39 with the Chandra

X-ray Observatory, and we explore stellar-wind feedback at an early stage in star formation," the researchers wrote in the paper.

Chandra observations detected diffuse X-ray emission around H72.97−69.39. The identified X-ray emission is extended about 10 arcseconds in radius, which suggests that the hot gas is produced by stellar-wind feedback in the earliest stages of formation.

The astronomers found that the X-ray emission is especially hard, dominated by photons above 1.2 keV. This points to a high hot gas temperature, a large absorbing column in the region, or a contribution from a non-thermal/power-law component. Furthermore, X-rays appear to be spatially anti-coincident with the dense carbon monoxide gas, which may indicate that the hot gas is preferentially occupying the lower-density cavities.

The study also found that the X-ray luminosity of H72.97−69.39 is one order of magnitude below expected if the shock-heated gas is confined by a cool shell. In this case, the shell heats up via thermal conduction and evaporates. This result indicates that even in such an early stage of a massive star cluster formation process, significant amounts of wind energy are being lost.

More information: Trinity L. Webb et al, Detection of Diffuse Hot Gas Around the Young, Potential Superstar Cluster H72.97-69.39, *arXiv* (2024). DOI: 10.48550/arxiv.2402.14056