

A dark matter mystery

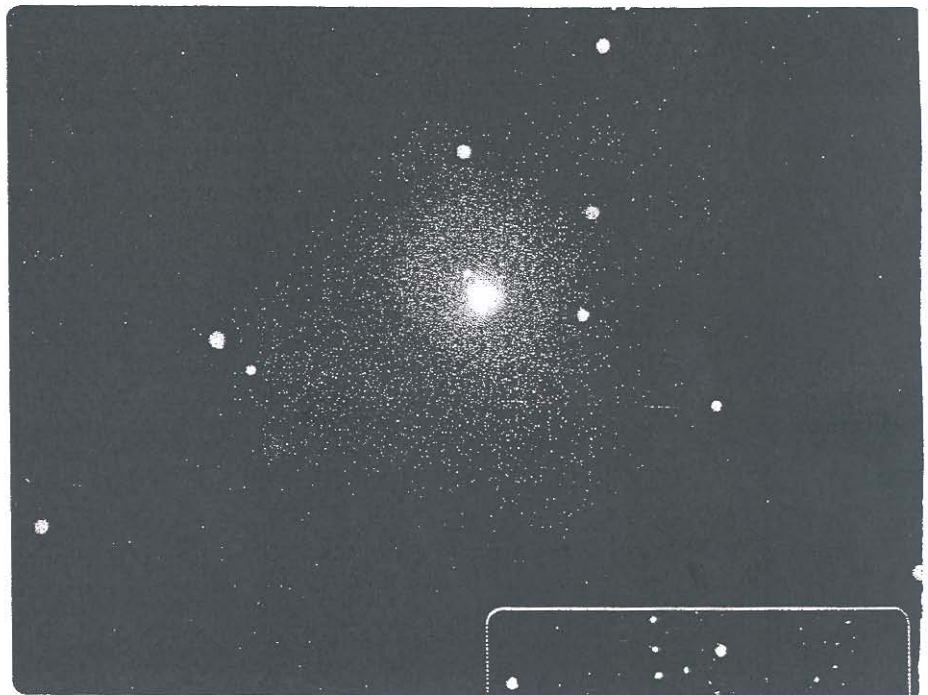
The detection of a halo of hot gas surrounding an elliptical galaxy, but none around others, has raised new questions about how much dark matter exists around such galaxies, and in the Universe in general.

Astronomers in the US and UK used NASA's Chandra X-Ray Observatory to study NGC 4555, an elliptical galaxy 300 million light-years away. Unlike most large elliptical galaxies, NGC 4555 is not part of a larger group of galaxies, and provides astronomers with a platform for studying how much dark matter might surround such galaxies.

Using Chandra, the astronomers detected a large halo of hot gas, 400,000 light-years across, surrounding the galaxy. Keeping that halo of gas confined around the galaxy required a mass of dark matter about ten times the mass of the visible matter in the galaxy itself and 300 times the mass of the gas in the halo.

"The observed properties of NGC 4555 confirm that elliptical galaxies can possess dark matter halos of their own, regardless of their environment," said Ewan O'Sullivan of the Harvard-Smithsonian Center for Astrophysics. "This raises an important question: what determines whether elliptical galaxies have dark matter halos?" The observations by O'Sullivan and Trevor Ponman of the University of Birmingham were published in the November 1 issue of the *Monthly Notices of the Royal Astronomical Society*.

The question has puzzled astronomers because in most cases elliptical galaxies are located in clusters, where interaction among its members can strip dark matter from their members. While the work of O'Sullivan and Ponman offers one answer, work by another team has come up with a conflicting result.



Chandra's image of NGC 4555 (above) reveals this large, isolated, elliptical galaxy is embedded in a cloud of 10 million-degree Celsius gas. The hot gas cloud has a diameter of about 400,000 light years, roughly twice that of the visible galaxy (right). Images: NASA/CXC/SAO/E. O'Sullivan *et al.*



Aaron Romanowsky and colleagues at the University of Nottingham used the 4.2-metre William Herschel Telescope in La Palma to study three nearby elliptical galaxies, looking for optical evidence of dark matter surrounding them. They could not find any evidence of dark matter surrounding the three, two of which are in loose clusters of galaxies and one which is isolated, like NGC 4555. This suggests that the galaxies have much more extended dark matter halos, or none at all, either of which would

force astronomers to revise their dark matter models. NGC 4555 itself was too far away to be studied by Romanowsky's group.

"This is clearly a question which deserves further consideration," said O'Sullivan. "It seems likely that much more theoretical and observational work on elliptical galaxies will be required before this issue can be resolved."

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