A possible signal from dark matter?

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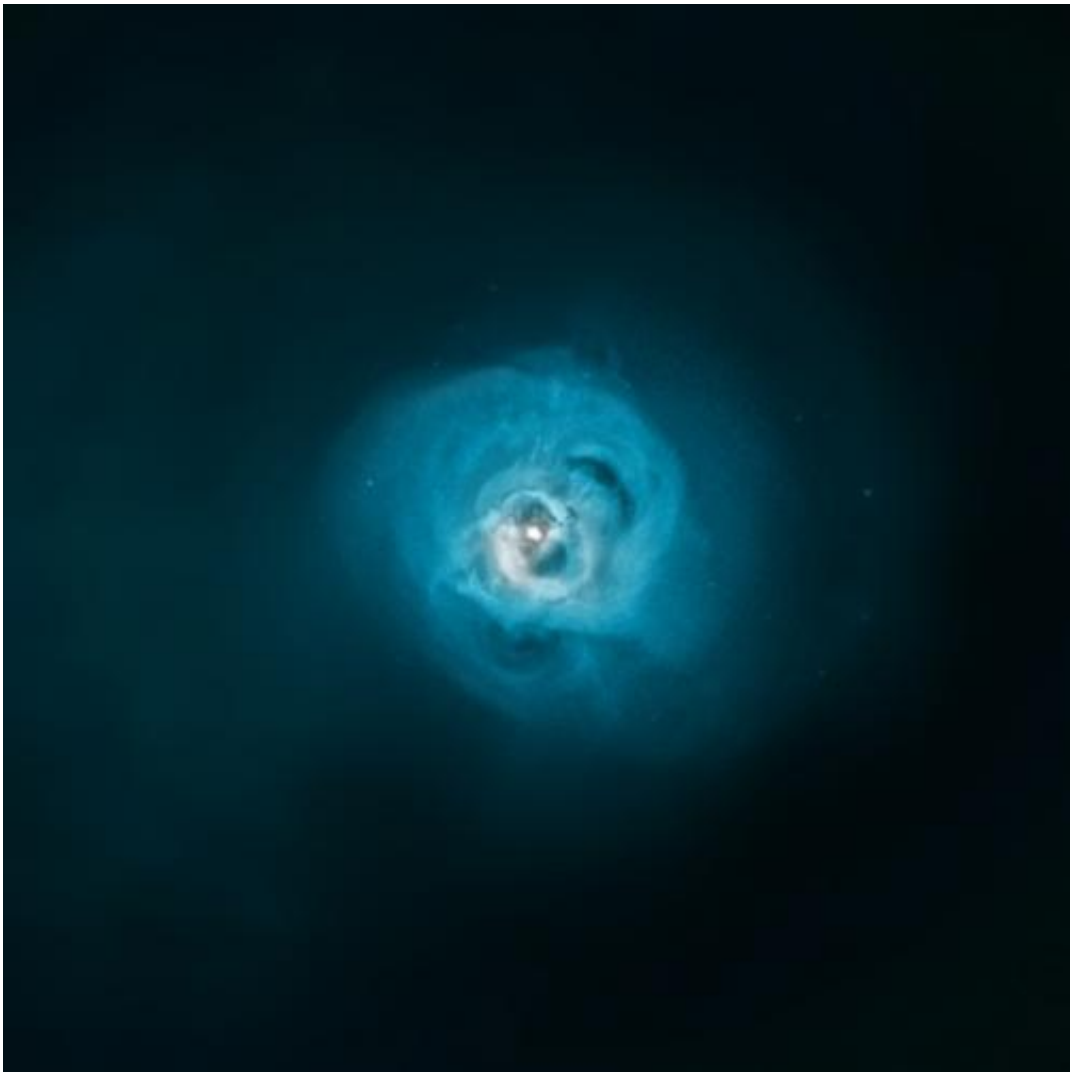

An X-ray image of the hot gas in the central region of the Perseus Cluster of galaxies, taken by the Chandra X-ray Observatory. The Perseus Cluster is one of the most massive objects in the Universe with thousands of galaxies immersed in an enormous cloud of superheated gas. The image shows enormous bright loops, ripples, and jet-like streaks throughout the cluster. Astronomers may have detected an emission line from a form of dark matter, the sterile neutrino, in the

spectrum of galaxy clusters like Perseus. Credit: Chandra/NASA/ESA

(Phys.org) —Galaxies are often found in groups or clusters, the largest known aggregations of matter and dark matter. The Milky Way, for example, is a member of the "Local Group" of about three dozen galaxies, including the Andromeda Galaxy located about 2 million light-years away. Very large clusters can contain thousands of galaxies, all bound together by gravity. The closest large cluster of galaxies to us, the Virgo Cluster with about 2000 members, is about 50 million light-years away.

The space between galaxies is not empty. It is filled with hot intergalactic gas whose temperature is of order ten million kelvin, or even higher. The gas is enriched with heavy elements that escape from the galaxies and accumulate in the intracluster medium over billions of years of galactic and stellar evolution. These intracluster gas elements can be detected from their emission lines in X-ray, and include oxygen, neon, magnesium, silicon, sulfur, argon, calcium, iron, nickel, and even chromium and manganese.

The relative abundances of these elements contain valuable information on the rate of supernovae in the different types of galaxies in the clusters since supernovae make and/or disburse them into the gas. Therefore it came as something of a surprise when CfA astronomers and their colleagues discovered a faint line corresponding to no known element. Esra Bulbul, Adam Foster, Randall Smith, Scott Randall and their team were studying the averaged X-ray spectrum of a set of seventy-three clusters (including Virgo) looking for emission lines too faint to be seen in any single one when they uncovered a line with no known match in a particular spectral interval not expected to have any features.

The scientists propose a tantalizing suggestion: the line is the result of the decay of a putative, long-sought-after dark matter particle, the so-called sterile neutrino. It had been suggested that the hot X-ray emitting gas in a galaxy cluster might be a good place to look for dark matter signatures, and if the sterile neutrino result is confirmed it would mark a breakthrough in dark matter research (it is of course possible that it is a statistical or other error). Recent unpublished results from another group tend to support the detection of this feature; the team suggests that observations with the planned Japanese Astro-H X-ray mission in 2015 will be critical to confirm and resolve the nature of this line.

More information: "Detection of an Unidentified Emission Line in the Stacked X-Ray Spectrum of Galaxy Clusters," Esra Bulbul, Maxim Markevitch, Adam Foster, Randall K. Smith, Michael Loewenstein, and Scott W. Randall, *ApJ* 789, 13, 2014.

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