Bump on a plot from Chandra X-ray observatory reveals excess of X-rays, hinting at dark matter

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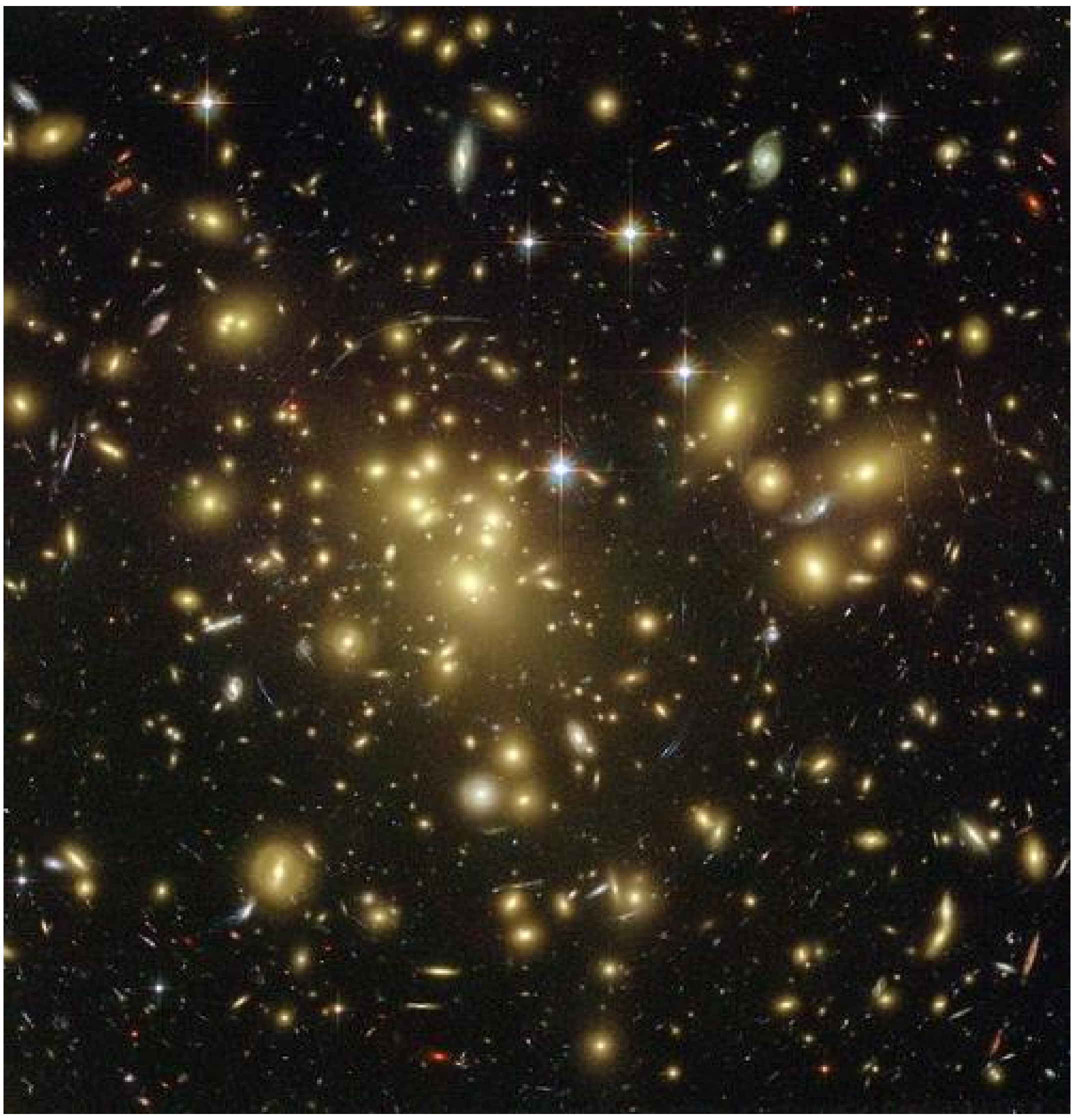

A massive cluster of yellowish galaxies, seemingly caught in a red and blue spider web of eerily distorted background galaxies, makes for a spellbinding picture from the new Advanced Camera for Surveys aboard NASA's Hubble Space Telescope. To make this unprecedented image of the cosmos, Hubble peered straight through the center of one of the most massive galaxy clusters known, called Abell 1689. The gravity of the cluster's trillion stars — plus dark matter — acts as a 2-million-light-year-wide lens in space. This gravitational lens bends and magnifies the light of the galaxies located far behind it. Some of the faintest objects in the picture are probably over 13 billion light-years away (redshift value 6). Strong gravitational lensing as observed by the Hubble Space Telescope in Abell 1689 indicates the presence of dark matter. Credit: NASA, N. Benitez (JHU), T. Broadhurst (Racah Institute of Physics/The Hebrew University), H. Ford (JHU), M. Clampin (STScI),G. Hartig (STScI), G. Illingworth (UCO/Lick Observatory), the ACS Science Team and ESA

(Phys.org)—A team of space researchers with members from Yale University, MIT and the Harvard-Smithsonian Center for Astrophysics has found a bump in X-ray readings from the Chandra-X-ray observatory that appears to be similar to bumps seen with X-rays from other telescopes. Such bumps have been theorized to represent the decay of dark matter, which could indirectly prove it exists. The team has written a paper describing their results and have posted it on the *arXiv* preprint server.

Physicists around the globe continue to be perplexed by dark matter and the dearth of evidence showing that it actually exists. In this new effort, the researchers were looking at data from a telescope orbiting the Earth—the Chandra X-ray observatory. The observatory was looking at X-ray signals from deep space when it came across an unexpected line of X-ray energy at approximately 3,500 electron volts. The team suggests that if the bump is due to dark matter, it would likely be caused by such material existing in a region surrounding the Milky Way galaxy. They note that the intensity of the bump is consistent with theories regarding dark matter in other parts of the galaxy such as at the center of the Milky Way—a source of signals that have been found to be stronger, which aligns with logic that suggests dark matter would be denser in places where there are more stars. Also, the bump was similar to readings found by researchers at several other observatories, which reduces the chances of the bump being an anomaly or system malfunction. Oddly, others looking at the same parts of sky have not observed any bump at all.

Unfortunately, the X-ray bump, despite being observed by multiple teams, is not proof of dark matter, because it is still possible that it is due to something else. The finding does, however, rule out some other theoretical sources, such as random sulfur ions seizing electrons from hydrogen atoms hanging around in otherwise empty space. It also seems very unlikely the bump came about due to the type of technology used to observe it. For some, that may leave dark matter as the only possible explanation—others will want something a little more concrete.

More information: Searching for the 3.5 keV Line in the Deep Fields with Chandra: the 10 Ms observations, arXiv:1701.07932 [astro-ph.CO] arxiv.org/abs/1701.07932

Abstract
In this paper we report a 3σ detection of an emission line at ~3.5 keV in the spectrum of the Cosmic X-ray Background using a total of ~10 Ms Chandra observations towards the COSMOS Legacy and CDFS survey fields. The line is detected with an intensity is $8.8\pm2.9\times10^{-7}$ ph $cm^{-2}s^{-1}$. Based on our knowledge of Chandra, and the reported detection of the line by other instruments, we can rule out an instrumental origin for the line. We cannot though rule out a background fluctuation, in that case, with the current data, we place a 3σ upper limit at 10^{-6} ph $cm^{-2}s^{-1}$. We discuss the interpretation of this observed line in terms of the iron line background, S XVI charge exchange, as well as arising from sterile neutrino decay. We note that our detection is consistent with previous

measurements of this line toward the Galactic center, and can be modeled as the result of sterile neutrino decay from the Milky Way when the dark matter distribution is modeled with an NFW profile. In this event, we estimate a mass ms~7.02 keV and a mixing angle sin2(2θ)= 0.69-2.29 $\times 10^{-10}$. These derived values of the neutrino mass are in agreement with independent measurements toward galaxy clusters, the Galactic center and M31.

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