

## MYSTERY IN THE PERSEUS CLUSTER

The Universe is a big place, full of unknowns. Astronomers using NASA's Chandra X-ray Observatory have just catalogued a new one. They have found something at the heart of the Perseus Cluster that seemingly could not be explained by known physics.

The Perseus Cluster is a swarm of galaxies approximately 250 million light years from Earth. Imagine a cloud of gas in which each atom is a whole galaxy— that's a bit what the Perseus cluster is like.

**It is one of the most massive known objects in the Universe.** The cluster itself is immersed in an

enormous 'atmosphere' of superheated plasma—and it is there that the mystery resides. The cluster's atmosphere is full of ions such as Fe XXV, Si XIV, and S XV. Each one produces a 'bump' or 'line' in the x-ray spectrum, which can be mapped using Chandra. These spectral lines are at well-known x-ray energies.

Yet, in 2012 when 17 day's worth of Chandra data was added together, **a new line popped up where no line should be.** The line appeared at 3.56 keV (kilo-electron volts) which does not correspond to any known atomic transition.

At first no one believed it, and it took a long time to make certain that this line was neither a detector artifact, nor a known atomic line. Careful checks and double checks; splitting the data set into different sub groups; and checking it from four other detectors on board two different observatories did not make the line disappear.

The reality of the line was further confirmed when the same spectral signature X-ray emissions was found in 73 other galaxy clusters. Those data were gathered by Europe's XMM-Newton, a completely independent X-ray telescope.

Moreover, about a week after the team posted their paper online, a different group at Leiden University in the Netherlands reported evidence for the same spectral line in XMM-Newton observations of the Andromeda galaxy. They also confirmed the line in the outskirts of the Perseus cluster.

The spectral line appears not to come from any known type of matter, **which shifts suspicion to the unknown: Dark Matter. Theoreticians came up with about 60 different dark matter types which could explain this line.**

The menagerie of dark matter candidates that might produce this kind of line include axions, sterile neutrinos, and "moduli dark matter" that may result from the curling up of extra dimensions in string theory.

**Solving the mystery could require a whole new observatory.** In 2015, the Japanese space agency is planning to launch an advanced X-ray telescope called "Astro-H." It has a new type of X-ray detector, developed collaboratively by NASA and University of Wisconsin scientists, which will be able to measure the mystery line with more precision than currently possible

AK from NASA Notes.

