



Press Release
Max-Planck-Institut für extraterrestrische
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Missing piece of cosmological puzzle found

Astronomers detect a part of long-searched baryonic matter in a filament connecting two clusters of galaxies

The composition of the Universe still puzzles the astronomers: Over 90 percent consist of unknown matter – three quarters of the mysterious Dark Energy which causes an accelerated expansion of the Universe and about 21 percent of Dark Matter, the components of which the physicists have not yet figured out. Just four percent are composed of the normal material of which we ourselves are made, the so-called baryonic matter. Even this minor part however has not yet been comprehended completely: all discovered stars, galaxies and gases in the Universe amount to less than a half of these four percent. Now a team of astrophysicists from the Max Planck Institute for extraterrestrial Physics (MPE) and the ESO, both in Garching, Germany, and of two institutes in the Netherlands has found evidence of a part of the missing baryons in a bridge-like filament connecting two clusters of galaxies (*Astronomy & Astrophysics Letters*, May 2008).

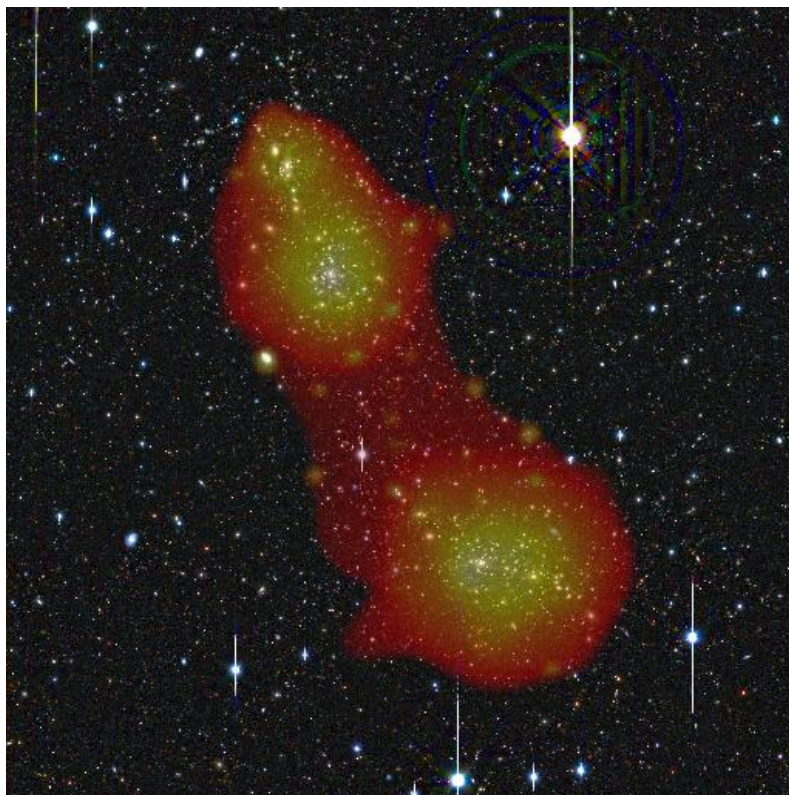


Image Credits: ESA/XMM-Newton/ EPIC/ ESO (J. Dietrich)/ SRON (N. Werner)/ MPE (A. Finoguenov)

A bridge of hot gas is connecting two clusters of galaxies. Composite optical and X-ray image of the cluster pair Abell 222 and Abell 223.

The Universe is constructed like an oversized spider web: All visible material is arranged along the filamentary structure of the Dark Matter. On its threads and knots this web holds gigantic chunks of baryonic matter which are made of quarks and leptons. Studies of the Big Bang and the fluctuations of cosmic background radiation yield quite exact figures on the existence of baryons in the Universe. So from the calculations astronomers knew for a long time that the vanished pieces of the cosmological puzzle must be hidden somewhere. To trace and apprehend this solely observable component in the Universe is the precondition to learn more about the web of Dark Material and to test the quality of different cosmological models.

The missing part of the baryonic matter is imagined since nine years as hot, ultra-thin gas haze of very low density between larger structures. Due to its high temperature this gas is expected to emit primarily in the far-ultraviolet and X-ray band. Scientists around Norbert Werner from SRON Netherlands Institute for Space Research therefore used the X-ray space observatory XMM-Newton to observe the two clusters of galaxies Abell 222 and Abell 223 which are connected by a filament. This structure was chosen because of its fortunate geometry: The astronomers could look directly into the bridge instead of looking at it from the side.

The hot gas they found there is probably the hottest and densest part of the diffuse gas which constitutes half of the missing baryons in the Universe. The properties of the gas, for example its density and temperature, are consistent with the results of simulations. “Having discovered the hottest of the missing baryons is of particular importance as various models, while all predicting the lost matter in some kind of warm gas, tend to disagree about the extremes”, explains Alexis Finoguenov, Max Planck Institute for extraterrestrial Physics.

This is the first time that scientists see the bridge of gas connecting two clusters of galaxies in X-rays. “So far we could only see the clusters, the dense knots of the web. Now we are starting to see the connecting wires of the immense cosmic spider web”, says MPE astrophysicist Aurora Simionescu, co-author of the publication.

The discovery of the gas is a significant step forward on the way to a complete understanding of the cosmic evolution. The distribution and composition of the baryonic matter gives information about what happened after the Big Bang and which forces are dominating the Universe today and in the future. The astronomers now want to trace comparable galactic systems in further space missions. To this end it will be necessary in the long term to launch a dedicated space observatory to study the cosmos with a much higher sensitivity than possible with the current satellites.

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