1-7-1999

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AUSTIN, Texas -- Today, at the American Astronomical Society meeting in Austin, Texas, astronomers David Batuski and Chris Miller of the University of Maine, presented evidence of two relatively rare types of galaxy superclusters in a single colossal complex in the southern part of the constellation Aquarius. The complex consists of two long filaments, one of which is the longest such object yet seen, and a dense knot of clusters.

These findings add significantly to the emerging picture of large-scale structure in the present-day universe and provide some well-defined examples of structure that must be explained by processes in the fireball of the Big Bang. Future analysis of the knot of clusters, when studied in detail with three other similar clumps of clusters, may prove that some vast objects may be collapsing within our otherwise expanding universe.

Batuski and Miller conducted their observations at the European Southern Observatory in Chile with Kurt Slinglend, also at Maine, and colleagues from Meudon Observatory near Paris. In 1997, this research team announced their initial finding of the Aquarius supercluster. This filament of clusters appears to extend about one billion light-years in length, making it the longest structure yet seen in the universe.

Since that time, the team has re-analyzed their observational data on the Aquarius clusters. They have also nearly completed observations of a large sample of clusters scattered over much of the rest of the sky and compared structure in Aquarius with that seen elsewhere. They limited their study to the richest of galaxy clusters, those with 50 or more bright member galaxies (the earlier finding had included some poorer clusters). They also focused on dense aggregations of clusters, ones with more than eight times the average space density of such clusters. The work has been supported by the National Science Foundation and the National Aeronautics and Space Administration.

TWO MAJOR RESULTS

Two major results have emerged. One has been confirmation of the existence and significance of the Aquarius supercluster. “Although the dense portion of this previously identified filament extends only about 400 million light-years, it is still the longest supercluster of such rich clusters yet seen,” says Batuski.

The study identified a second example of a long (300 million light-years), dense filament of eight clusters, which appears to be loosely connected to the Aquarius supercluster. The finding of two long filaments of rich clusters in close proximity was surprising, since among the 350 observed clusters in the rest of the sky only two other such filaments were found.

The study also confirmed that a particularly dense subset of clusters within the Aquarius supercluster (nicknamed the `Aquarius knot') has general properties similar to three other exceedingly dense superclusters and leads to the conclusion that a genuine class of such objects can now be studied.

Other astronomers have thoroughly studied a dense supercluster of this new class in Corona Borealis and another called the Shapley Concentration in Hydra and Centaurus. Some of their results suggest that these structures may be on the verge of collapsing under the force of gravity or may already be collapsing. Another supercluster in Microscopium has a similar density of rich clusters, and further detailed observations of all four of these unusual objects should allow for the determination of whether such large regions of space are indeed under general gravitational collapse.

light spectra from several of the galaxies that make up each observed cluster. They then analyzed these spectra to determine the cluster redshifts. The term redshift refers to a change in the spectra of light received from galaxies which are speeding away from Earth. Because of the high velocities involved, light from those galaxies is shifted to longer, redder wavelengths. Greater redshift corresponds to greater distances from Earth.

The Aquarius supercluster consists of a string of 14 rich clusters of galaxies running roughly along the line of sight from Earth. They feature a range of redshifts corresponding to distances between 1 billion and 1.4 billion light-years from earth. Poorer clusters (less than 50 galaxies per cluster) appear to fill in and extend the filament to a maximum distance that could be as much as 2 billion light-years.

Previous supercluster discoveries of similar scale include the Perseus-Pegasus supercluster, which is also in the shape of a filament, and the "Great Wall," which is actually a gigantic sheet of galaxies. Structures of this size match up nicely with the smaller features observed in the findings from NASA's Cosmic Background Explorer (COBE) survey of the remnant microwave radiation from the Big Bang.

The researchers at the University of Maine and Meudon Observatory hope to continue studying this region of unusual superclustering in greater detail. “Eventually,” Batuski says, “astronomers will be able to describe the structure in the universe on large scales with confidence. This is important because we think that these scales have been relatively undisturbed since very early times and have much to tell us about conditions in the Big Bang.”