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### **Plasma Physics in Clusters of Galaxies**

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Clusters of galaxies are the largest self-gravitating structures in the universe. Each cluster is filled with a large-scale plasma atmosphere, in which primordial matter is mixed with matter that has been processed inside stars. This magnetized cluster plasma contains both thermal and relativistic species, and is a wonderful laboratory for applying ideas and tools developed in other arenas of plasma physics. Although clusters formed many Gyr ago, the cluster plasma is still being energized today – but we are not sure by what. The plasma will clearly be affected by ongoing evolution of the gravitating matter in the cluster. Jets driven out from massive black holes in cluster-member galaxies will also impact the cluster plasma. Understanding the importance of these two drivers is one of today's major questions. Radio and X-ray observations have told us a great deal about the plasma atmosphere in the cluster, but the data alone cannot answer the big questions. We need to understand the physical and dynamic state of the cluster plasma; to get there from the data we must use tools and knowledge from MHD and plasma physics. Questions which need to be answered range from plasma mixing across magnetic surfaces, to acceleration of relativistic particles, to the nature of MHD turbulence and dynamos in the cluster environment.