APR10-2009-000117

Abstract for an Invited Paper
for the APR10 Meeting of
the American Physical Society

Global Structures of Radio Galaxies – Theory and Simulations Meet Observations[1]

HUI LI, Los Alamos National Laboratory

X-ray and radio observations of galaxy clusters have revealed a wealth of structure in their hot halos associated with extragalactic radio sources. Structures in the form of large scale cavities and weak shocks provide a reliable gauge of the mechanical output of extragalactic radio jets launched by AGNs. The energies involved range between 1E57 to 1E62 ergs. Furthermore, the morphology and properties of cavities have given strong constraints on the nature of AGN outflows, especially on large scales. We will present 3-D magnetohydrodynamic (MHD) simulations to study these large scale structures of radio galaxies, emphasizing the roles of magnetic fields and kinetic energy flow. The important effects of background environment on the radio galaxies will be discussed. In addition, we will present self-consistent cosmological MHD simulations of cluster formation with AGN feedback, emphasizing the important role of magnetic fields in carrying the AGN energy and in the cavity formation. Such simulations are compared with cluster radio halo and relic observations, as well as extensive Faraday rotation measurements. These results are sheding light on the origin and energetics of the cluster-wide magnetic fields. We demonstrate that the intracluster medium turbulence can be excited and sustained by the frequent mergers during the cluster formation. This turbulence then excites a small-scale dynamo process that transports, spreads, and amplifies the fields originated from the radio jet/lobe system. This process could be the primary process of populating the whole cluster with magnetic fields at observed levels.

[1]Supported by LDRD program at LANL and DOE/OFES.