Galaxy Clusters Inside and Out

Dr. Mark Bautz/MIT Kavli Inst. For Astrophysics and Space Research

Abstract: I discuss recent observational results on the both the innermost and outermost regions of the X-ray emitting plasma pervading clusters of galaxies. The canonical picture of the very centers of clusters is that they often harbor cosmic feedback loops in which gravitational potential energy released as the plasma falls toward a central, supermassive black hole (on scales of ~<0.01 pc) almost precisely balances radiative (X-ray) energy losses throughout a much larger volume (100 kpc in radius), maintaining some 10^12 solar masses of intracluster plasma in a nearly steady state. Chandra X-ray follow-up of clusters discovered in the South Pole Telescope's Sunyaev-Zeldovich effect cluster survey has turned up at least one relatively distant object in which cooling and heating are spectacularly out of balance. In this cluster rapid cooling (and very rapid star formation) is taking place. I discuss some possible implications of the existence of this object for the physics and evolution of plasma cooling and star formation in clusters.

My second topic concerns what we and others have learned about the outermost edges of the virialized regions of clusters from low-background observations made with the Suzaku satellite. While still far from conclusive, these data show that conditions at large radii can vary considerably within a given cluster, as well as from cluster to cluster. The observations provide qualitative support for the general picture that we are observing ongoing mass accretion and cluster growth in these regions. I briefly compare these results to numerical simulations performed by others and aimed at testing this picture quantitaively. I also discuss future observations that might lead to greater insight into the physics governing cluster growth.