Astrophysics Seminar

Cooling and AGN heating in cool-core galaxy clusters

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The feedback from active galactic nuclei (AGNs) is widely considered to be the major heating source in cool-core galaxy clusters, preventing a classical cooling flow where the intra-cluster medium (ICM) cools at hundreds to a thousand solar masses per year. We perform adaptive mesh simulations using Enzo including both momentum-driven AGN feedback and star formation to study the interplay between ICM cooling, AGN heating and star formation over 6.5 Gyr in an isolated cool-core cluster. We find that AGN jets globally heat up the ICM via weak shock waves and turbulence. Locally, cold clumps can cool out of the ICM due to the non-linear perturbation driven by the AGN jets. These cold clumps feed both star formation and the supermassive black hole (SMBH), triggering an AGN outburst which increases the entropy of the ICM and reduces its cooling rate. When star formation completely consumes the cold gas, leading to a brief shutoff of the AGN, the ICM quickly cools and develops multiphase gas again, followed by another cycle of star formation/AGN outburst. The simulation reproduces a wide range of observed properties and naturally explain the variety of star forming clouds observed in the center of cool-core clusters.