Sloshing Galaxies in the Most Massive Gravitationally Bound Structures in the Universe

Janel G. Williams, Wellesley College, MIT, Kavli Institute,Class of 2019
Dr. Matthew B. Bayliss, Professor Michael McDonald, Kavli Institute

Galaxy clusters are the most massive objects in the universe. Brightest cluster galaxies (BCGs) are the dominant galaxy in each cluster and tend to reside near the center of the gravitational potential in galaxy clusters. Permeating galaxy clusters is hot gas called the intracluster medium (ICM). We detect and identify galaxy clusters via the Sunyaev Zel'Dovich (SZ) effect signature in the ICM from the South Pole Telescope (SPT) data. In this study, we measure the distance of BCGs relative to the centers of spectroscopically confirmed SPT clusters. The SPT clusters have a maximum redshift of z = 1.08 and a minimum redshift of z = 0.29. We identify BCGs by using SPT follow - up optical imaging data. We use BCG - SZ and BCG - X Ray peak separations to measure the positional offset between position of BCGs and the center of their host clusters. For clusters where we also have X - ray data (about 85% of the SZ cluster data) we measure separations with maximum of θ = 465.78 kiloparsecs (78.11 arcseconds) and the minimum offset value is θ = 1.57 kiloparsecs (0.29 arcseconds). The BCG - SZ separations are nearly identical, but with slightly less precision than that of BCG - X - ray separations. We also generated simulated measurements for the expected distribution of separations based on the SZ position errors for each cluster. According to the simulated measurements, we expect values that are mostly nonzeros, however we observe BCG - SZ and BCG - X - ray separations that extend past the expected SZ centroid errors. There is a significant fraction of BCGs that have verifiable, physical separations measured from the SZ data thus indicating that BCGs could be moving about the center of galaxy clusters to some degree.