ABSTRACT

Weak-Lensing Analysis of Low-Redshift Galaxy Clusters

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Mass determination of galaxy clusters is important, as they possess the most massive bound dark matter halos in the universe. Weak gravitational lensing is a method to measure the cluster mass. This method uses the distortion of the shapes of the background galaxies which occurs due to bending of the trajectory of light induced by the gravity of the foreground clusters to determine the mass of the cluster. This project uses this technique to present new mass measurements for nearby low-redshift (redshift < 0.15) galaxy clusters using data from the Sloan Digital Sky Survey (SDSS). The galaxy clusters are chosen from the MaxBCG catalog. To determine the individual masses of the galaxy clusters, each galaxy cluster is studied using a likelihood analysis, which fits the shear profile from the Navarro–Frenk–White (NFW) mass density profile to the shear map of the galaxies behind the cluster. The likelihood analysis provides best-fit estimates of M200 and C200. Here 200 refers to a radius inside of which the mass density is 200 times greater than the critical density of the universe. M200 is the mass inside that radius, and C200 is the concentration parameter, parameterizing how concentrated the NFW profile is. A prior is then applied to the fits to limit the estimates within the possible range of the concentration parameter. Using this technique we have determined masses of 3038 galaxy clusters. This is the largest set of weak lensing measurements of individual galaxy clusters to date. The median of the masses obtained from the analysis is 1.2×10^{14} h^{-1} solar masses. The weak lensing measurements are tested by analyzing simulated observations of clusters and then comparing input M200s and C200s with the output M200s and C200s to learn about the measurement transfer function. The simulations are carried by both varying the masses and the concentration parameter. We also made measurements of blank fields, centered on stars, where we would expect no mass. There will not be any measurable mass associated with the targets, the stars, so any mass that is measured is due to random structures projected along the line of sight. The statistics of this occurrence is needed to interpret our cluster measurements. As a result of this project, we have been able to increase the size of the sample by about ten times the sample studied in previous analysis.