IDENTIFYING ASSOCIATED SOURCES

Wing & Blanton (2011) searched SDSS for optical sources within 5” of the radio source’s central component. Using the closest optical source, we determined a 95% reliability separation cut-off for each sample compared to a sample of random positions on the sky. Radio source ids that have blue colors and high-likely quasars) were removed from the samples. We measured cluster richness by searching SDSS for sources within a radius of 1 Mpc around each radio/optical source and brighter than M_r=-18. Background galaxy counts were subtracted and a richness was calculated. A count above 40 corresponds to a cluster.

DETERMINING OPTICAL SUBSTRUCTURE

We searched SDSS for sources with spectroscopically measured redshifts within a radius of 3 Mpc around each radio/optical source in our samples. We determined the average redshift of all galaxies in this area and within 10,000 km s^{-1} of the radio source after iteratively excluding all galaxies with peculiar velocity gaps of more than 1000 km s^{-1}. We used the shifting gapper method of Owers et al. (2009) to determine cluster members for potential clusters with more than 40 spectroscopically measured members in this velocity range. Using these cluster members we ran several substructure tests, as described in Pinkney et al. (1996) and below. The results described here are from three different 3D tests, each of which have their own strengths and weaknesses.

SUBSTRUCTURE TESTS

The first test is the ξ test, finding the local average velocity and standard deviation for each galaxy in the cluster. The difference between these values compared to global values are calculated for each galaxy. The sum of these values becomes the overall statistic is the average local mass around each galaxy. Clusters with substructure will have lower ξ values. The last test is the η (centroid shift) test. The center of the cluster in x and y coordinates is found and compared to the cluster. The overall statistic is the average of all weighted and un-weighted centers. Each test was normalized using 500 Monte Carlo simulations with randomized velocities.