The Peculiar Velocities of Rich Clusters in the Hot and Cold Dark Matter Scenarios

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We present the results of a study of the peculiar velocities of rich clusters of galaxies. The peculiar motion of rich clusters in various cosmological scenarios is of interest for a number of reasons. Observationally one can measure the peculiar motion of clusters to greater distances than galaxies because cluster peculiar motions can be determined to greater accuracy. One can also test the slope of distance indicator relations using clusters to see if galaxy properties vary with environment. We have used N-body simulations to measure the amplitude and rms cluster peculiar velocity as a function of bias parameter in the hot and cold dark matter scenarios. In addition to measuring the mean and rms peculiar velocity of clusters in the two models we determine whether the peculiar velocity vector of a given cluster is well aligned with a)the gravity vector due to all the particles in the simulation and b)the gravity vector due to the particles present only in the clusters.

We have investigated the peculiar velocities of rich clusters of galaxies in the cold dark matter and hot dark matter galaxy formation scenarios. We have derived peculiar velocties and associated errors for the scenarios using four values of the bias parameter b ranging from $b = 1$ to $b = 2.5$. The growth of the mean peculiar velocity with scale factor has been determined and compared to that predicted by linear theory; we find a larger growth rate for clusters over that predicted by linear theory. In addition we have compared the orientation of force and velocity in these simulations to see if a program such as that proposed by Bertschinger and Dekel (1989) for elliptical galaxy peculiar motions can be applied to clusters. The method they describe enables one to recover the density field from large scale redshift distance samples. The method makes it possible to do this when only radial velocities are known by assuming that the velocity field is curl free. Our analysis suggests that this program if applied to clusters is only realizable for models with a low value of the bias parameter i.e. models in which the peculiar velocities of clusters are large enough that the errors do not render the analysis impracticable.