Constraints on Cosmological Models from the Large-Scale Velocity Field

Jean Gyung Doh[1], Changbom Park[2], and Mun-Suk Chun[1]
[1]Dept. of Astronomy and Atmospheric Science, Yonsei University
[2]Dept. of Astronomy, Seoul National University

Abstract

The Cosmic Mach number M is the ratio of the bulk flow velocity of the galaxy velocity field on some scale R to the small scale velocity dispersion within regions of scale R. Because M is the ratio of two velocities, it is non-dimensional, and therfore, independent of the amplitude of the power spectrum and of the bias parameter in the linear theory. We have measured the Mach number for two observational samples: a spiral galaxy sample(AHM) of Aaronson and his collaborators with absolute distances measured by the infrared Tully-Fisher relation, and an elliptical galaxy sample(EGALS) of Faber *et al.* with distances determined by the $D_n-\sigma$ relation. The effective depths(rms distances of galaxies from the Local Group) of these samples are 1639 km/s and 2862 km/s, respectively. The Mach numbers from these observed peculiar velocity fields are found as M=0.95 for AHM and M=0.59 for EGALS. We compare these calculated Mach numbers with those from mock surveys drawn from three cosmological models: the standard biased Ω h=0.5 CDM model, an open CDM model with Ωh=0.2, and a model with the power-law power spectrum $P(k)\sim k^{-1}$ and Ω=1. The Mach number test can give robust constraints on these cosmological models whose power spectra have very different shapes at large scales.