[12pt,aaspp4]article document **ACTION PRINCIPLE SOLUTIONS FOR GALAXY MOTIONS WITHIN 3000 KM S$^{-1}$**

Edward J. Shaya Department of Physics, University of Maryland, College Park, Maryland 20742

P.J.E. Peebles Physics Department, Princeton University, Princeton, NJ 08544

&

R. Brent Tully Institute for Astronomy, University of Hawaii, Honolulu, HI 96822

abstract

The numerical action variational principle is used to find fully nonlinear solutions for the orbits of the mass tracers given their present redshifts and angular positions and the cosmological boundary condition that the peculiar velocities are small at high redshift. A solution predicts the distances of the mass tracers, and is tested by a comparison with measured distances. The current numerical results use 289 luminosity-linewidth distance measurements designed to be close to unbiased. A catalog of 1138 tracers approximates the luminosity distribution of galaxies in the vicinity of the Local Supercluster, at redshifts $cz < 3000$ km s$^{-1}$. These mass tracers include groups with crossing times less than the Hubble time and isolated galaxies. In this preliminary computation, we assign each mass tracer the same mass-to-light ratio $M/L$. The tracer masses are fixed by apparent magnitudes and model distances. The only two free parameters in this model are $M/L$ and the expansion time $t_0$. The measure of merit of a solution is the sum of the mean square differences between the predicted and observed distance moduli. In the 3000 km s$^{-1}$ sample, this reduced $\chi^2$ statistic has a well-defined minimum value at $M/L = 175$ and $t_0 = 10.0$ Gyr, and $\chi^2$ at the minimum is about 1.29 times the value expected from just the standard deviation of the distance measurements. We have tested for the effect of the mass at greater distance by using the positions of Abell clusters as a model for the large-scale mass distribution. This external mass model reduces the minimum value of $\chi^2$ by about 10% ($\sim 1\sigma$). The value of the cosmological density parameter $\Omega_0$ is determined by the global mean mass-to-light ratio. Our preliminary analysis yields $\Omega_0 = 0.17 \pm 0.10$ at one standard deviation. A tighter bound is expected to come out of a larger sample of measured distances now available.