Dynamical Models for our Virgocentric Deviation from Hubble Flow

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Spherically symmetric models for the dynamic development of a galaxy cluster from an initial overdensity have been carried out numerically, without dissipation or 2-body relaxation but with shell crossings included. The deviation ΔV from pure Hubble Flow of the Local Group, due to the retardation effect of the Virgo cluster and supercluster, has been calculated from a number of different models by Hoffman and Salpeter (Astrophys. J. 263, 1982, in press). The results are somewhat surprising if one takes the point of view of (a) insisting that the dynamic model fit the observed dispersion of galaxy systemic velocities in the core of the Virgo cluster, but (b) allowing the mass to light ratio M/L to be an arbitrary (but smoothly varying) function of distance from the Virgo cluster center. Point (a) essentially fixes the mass density and M/L in the core, but (b) still allows a wide range of values for the cosmological density parameters Ω (proportional to the average M/L far from the Virgo cluster). With this point of view ΔV actually decreases with increasing Ω: If M/L is constant, $\Omega \approx 0.3$ and $\Delta V \approx 250$ km s^{-1} (Hoffman, Olson and Salpeter, Ap. J. 242, 861, 1980); for $\Omega \sim 0.05$, ΔV would exceed 350 km s^{-1}; for $\Omega = 1$, ΔV could be less than 150 km s^{-1}.

Such variations in M/L could arise in at least two possible explanations for the large amount of "invisible mass" in rich galaxy clusters: (1) If the dark matter is contributed by "stellar population III" such stars might (or might not) form preferentially in regions of high density and low turbulent velocity. After star formation, most of the dark matter (and hence most of the total mass of the universe) would reside in cores of rich clusters whereas these regions account for only about 10% of the total luminosity. In this case ΔV must exceed 350 km s^{-1} and point accurately towards the Virgo center. (2) If the dark matter is in the form of massive neutrinos, the "neutrino cluster" (with thermal velocities and without dissipation) has a larger radius than the "luminous cluster" and Ω could be as large as unity. The simplest models then give a small ΔV, but the actual distribution of the dark matter could be quite complex and ΔV could be "almost anything", not necesarily pointing in the direction of the Virgo center. Observational

Richard M. West (ed.), Highlights of Astronomy, Vol. 6, 751–752.

https://doi.org/10.1017/S1539299600005979 Published online by Cambridge University Press

hints at this session that ΔV may itself depend on position relative to Virgo could be a clue in favor of this possibility. The effects on V of the flattening of the Local Supercluster are also very different for cases (1) and (2): For case (1) most of the mass is centrally concentrated and there is essentially no effect. For case (2) there may be lots of mass near our location where the flattening is prominent, so there may be a strong effect but we do not even know its sign at the moment!

https://doi.org/10.1017/S1539299600005979 Published online by Cambridge University Press