THE PECULIAR VELOCITY OF THE LOCAL GROUP IN THE DIRECTION OF THE VIRGO CLUSTER

L. Staveley-Smith & R.D. Davies
Nuffield Radio Astronomy Laboratories, Jodrell Bank

The measurement of the amplitude of the Local Group infall velocity towards the Virgo Cluster is a crucial test for the value of the universal density parameter Ω_0 and the ratio of the universal Hubble constant to its local value. However, a very large discrepancy exists between total infall velocities derived from peculiar velocity field observations and those derived from "scaling" methods using standard candles in the Virgo and Coma clusters. The former have tended to produce high Virgocentric peculiar velocities (350 to 500 km s^{-1}) whilst the latter give much lower values (-70 to 100 km s^{-1}).

To resolve this apparent discrepancy, we applied the standard infall model to our sample of over 200 spiral galaxies recently observed in HI at Jodrell Bank and Parkes. We have used the HI Tully-Fisher relation and the diameter-linewidth relation as distance indicators and in both cases find that the 68% upper confidence limit for the systematic infall amplitude at the position of the Local Group is 110 km s^{-1}. The total peculiar velocity (systematic plus thermal) in the direction of the Virgo Cluster is much less dependent on input model parameters and is equal to 83 ± 46 km s^{-1} when the sample redshift is restricted to 3000 km s^{-1}. However, this velocity increases with the redshift of our reference frame and reaches a value of 420 ± 140 km s^{-1} at a mean redshift of 3700 km s^{-1}. This leads us to the conclusion that our local reference frame (defined in part by the Local Supercluster) has a very large peculiar velocity of its own. The obvious implication is that substantial density inhomogeneities must exist on very large scales ($\gtrsim$ 40 Mpc) in the Universe.

We have also confirmed that there is substantial evidence for a rotation field in the inner Local Supercluster which is centred on the Virgo Cluster. The rotational velocity appears to peak at an angle of 35° from the Virgo Cluster where it reaches a value of 230 ± 70 km s^{-1}. The direction is such that the Virgo II complex is rotating away from us whilst the Canes Venatici/Ursa Major complex is rotating towards us.

We propose 2 reasons why peculiar velocity field observations have previously yielded unrealistically high infall velocities. The first is the neglect of the distance dependence of the Local Group peculiar velocity. The second is due to the confusion between infall and clockwise rotation that exists where there is an asymmetric north/south distribution of galaxies.

Our observations therefore indicate that the Local Supercluster is not responsible for the large values of the Local Group peculiar velocity that are deduced from measurements of the dipole anisotropy in the microwave background. The inhomogeneities that give rise to this anisotropy must be much more massive (10^{16-17} $M_\odot$) and occur at redshifts beyond 3000 km s^{-1}.

J. Kormendy and G. R. Knapp (eds.), Dark Matter in the Universe, 115.