LARGE PECULIAR VELOCITIES IN THE HYDRA CENTAURUS SUPERCLUSTER

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ABSTRACT Six clusters forming part of the Hydra-Cen Supercluster and its extension on the opposite side of the galactic plane are under study at 21 cm with the Parkes radiotelescope. The infrared Tully-Fisher relation is used to determine the relative distances of the clusters. These clusters exhibit significant and generally positive peculiar velocities ranging from essentially zero for the Hydra cluster to as much as 1000 km/sec for the Pavo and Centaurus clusters. An upper limit of 500 km/sec was previously found in the study of clusters accessible from Arecibo. Data collection is not yet complete, however, and is further subject to unstudied systematic errors due to present reliance on photographic galaxy diameters. Nevertheless, these preliminary results support the notion of a large scale (and presumably gravitationally) disturbed velocity field in the second and third quadrants of the supergalactic plane.

1. INTRODUCTION

Comparison of the ratios of distances of galaxies with the ratios of their recession velocities allows one to learn something about the "noise" in the Hubble flow on various scales. One is subject to the limitation, however, that distance indicators are imprecise, and the 0.4 mag scatter in the infrared Tully-Fisher (IRTF) relation translates to an uncertainty of 1000 km/sec in an individual galaxy at $cz = 5000$ km/sec.

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J. Audouze et al. (eds.), Large Scale Structures of the Universe, 185–189.

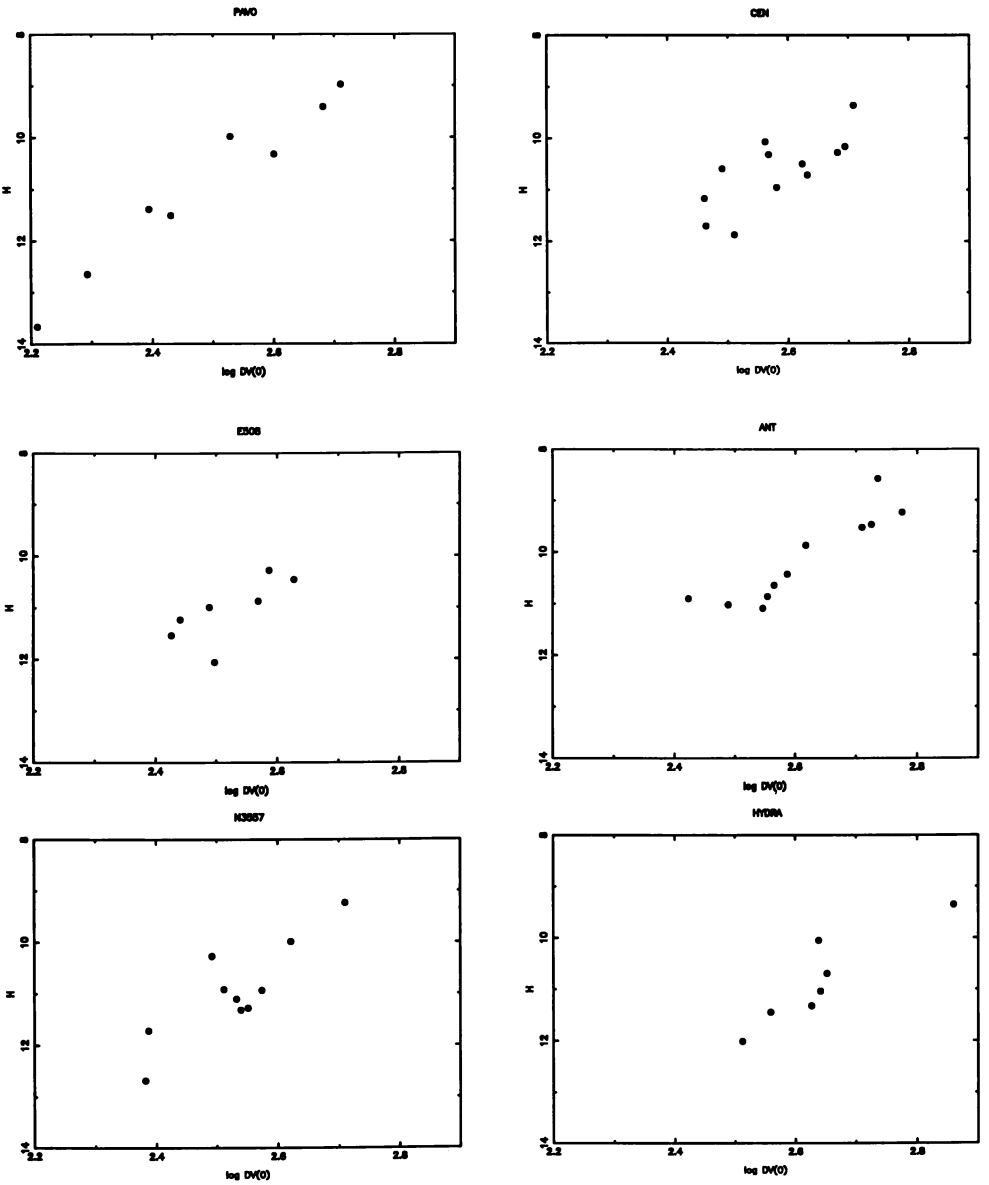

*Fig.*1. Tully Fisher relations for 55 galaxies in 6 clusters. $H^c_{-0.5}$ magnitudes are plotted against the log of the edge-on 20% 21cm profile width.

https://doi.org/10.1017/S0074180900136010 Published online by Cambridge University Press

For this reason the program initiated by Aaronson, Huchra, and Mould (1979) has concentrated on studying clusters of galaxies, where the distance uncertainties could be reduced by the square root of the number of cluster members, and useful deviations from the ideal Hubble flow measured. Recent improvements in receiver sensitivity at Parkes have allowed our southern hemisphere program to make much more rapid progress, and preliminary results are reported here.

2. TULLY-FISHER DIAGRAMS

Clusters were chosen mainly from the southern survey of Sandage (1975) and the Hydra-Cen survey by Hopp & Materne (1985). Galaxies were selected from the ESO Catalog (Lauberts 1982) within 4 degrees of the cluster centres. An adequate signal to noise ratio was obtained at 21-cm on 75 galaxies in the Antlia, Centaurus, ESO 508, Hydra, NGC 3557 and Pavo clusters, giving a 60% detection rate. Of these, we have to date obtained 1.6μ photometry of 64 galaxies at Las Campanas Observatory. Full details of both the radio and IR data will be published at a later time. Figure 1 shows that after the standard corrections (Aaronson *et al.* 1980)

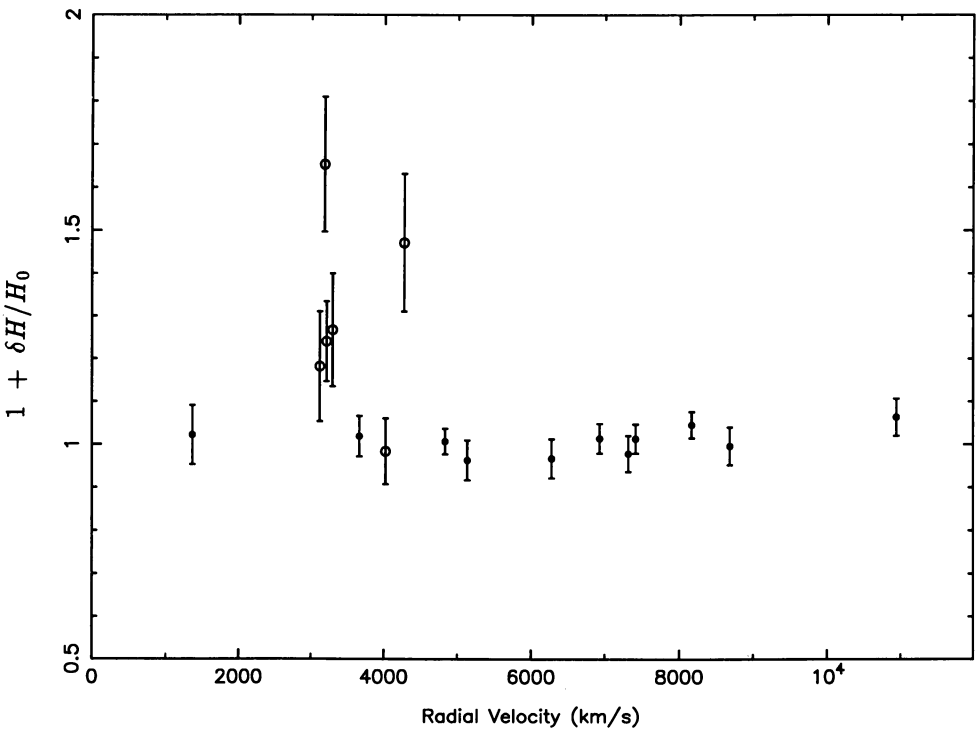

*Fig.*2. Deviations in the Hubble ratio ($1 + \delta H/H_0$) for the Parkes clusters (open circles) and Arecibo clusters (solid circles) are plotted against the redshift which would be seen by an observer at rest with respect to the microwave background.

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the clusters exhibit Tully-Fisher relations of the normal slope and dispersion. A bimodal velocity distribution has been demonstrated in the Centaurus cluster (Lucey *et al.* 1986). There is no clear separation in distance between Cen30 and Cen45 in the present data, in agreement with their findings.

3. PECULIAR VELOCITIES

Distance moduli were calculated using the IRTF calibration by Aaronson *et al.* (1986). Mean redshifts were computed for present purposes from only the galaxies in Figure 1, and were corrected to those that would be measured by an observer at rest with respect to the microwave background. The quantity $1 + \delta H/H_0$, which

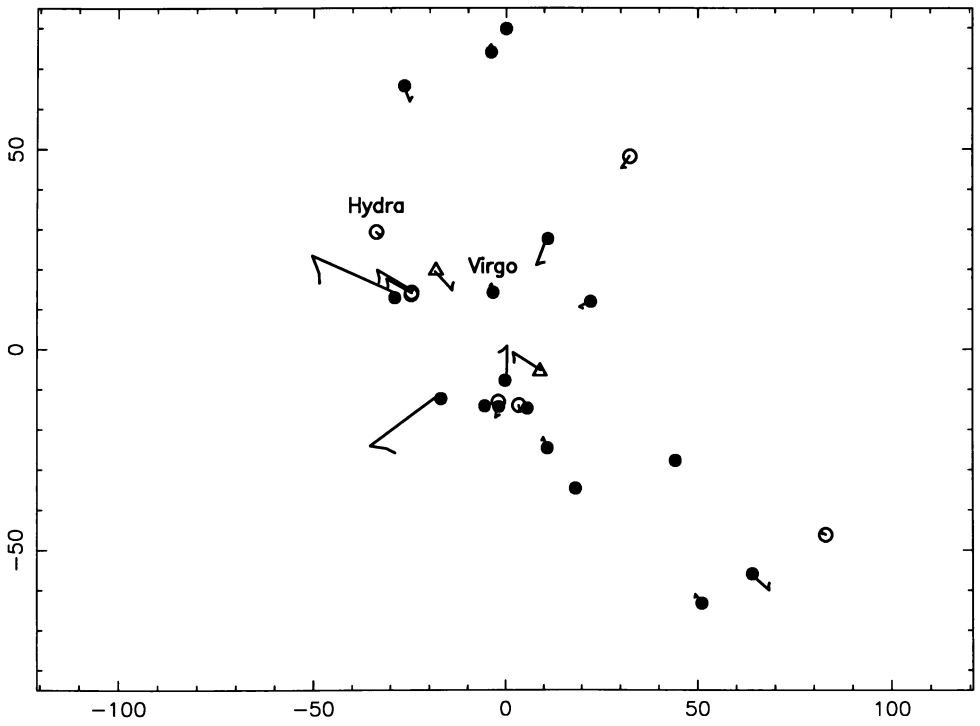

*Fig.*3. Peculiar velocities for clusters and groups are plotted in a spatial projection on the supergalactic plane. A half arrow of the same length as the diameter of the open symbols represents a peculiar velocity of 200 km/sec in a comoving frame in which the microwave anisotropy has been removed. Solid symbols denote clusters in the supergalactic plane; open circles: supergalactic latitude $< -30°$; open triangles: latitude $> 30°$. The Local Group is at the origin, and the arrows point radially, since that is the only measureable component. After correction for its motion towards Virgo the Local Group is moving to the left at 420 ± 80 km/sec.

https://doi.org/10.1017/S0074180900136010 Published online by Cambridge University Press

is thus independent of the zeropoint of the IRTF calibration, is plotted in Figure 2. In contrast to clusters observed from Arecibo by Aaronson *et al.* (1986), significant deviations from a uniform Hubble flow are apparent. The error bars are larger on the Parkes cluster data primarily because of the smaller number of galaxies per cluster now available, and secondarily because mean cluster redshifts have not been compiled from the literature. Arguably, the mean redshift of Centaurus (and hence its peculiar velocity) is 300 km/sec less than adopted here. Moreover, systematic errors as large as the current random errors may be present in the new data, because isophotal galaxy diameters have not yet been measured for the sample. Instead, we have employed ESO Catalog diameters, transformed following Mould & Ziebell (1982). Although these are in agreement with the alternative Fouque & Paturel (1985) transformations over the diameter range of interest, systematic field-to-field differences may be present in the catalog diameters, which can be eliminated by careful surface photometry. A tangible reason for suspicion of these provisional isophotal diameters is the divergence of some of these galaxies from the standard surface-brightness / line-width relation. The 9 worst offenders have actually been removed for the time being from the present sample. Alternatively, if these anomalous surface brightnesses are confirmed, Bothun & Mould (1987) have shown they can be used to tighten the Tully-Fisher relation. Another planned development is extension of the present sample by means of Fabry-Perot interferometry; some of the 21-cm line widths have already been confirmed at Hα in this way.

The direction and magnitude of the peculiar component of these cluster redshifts is shown in Figure 3, where the nearest Arecibo clusters are also included, as are groups within the Local Supercluster identified by Aaronson & Mould (1983). A large region around Virgo has been excised from this map. This figure bears a considerable resemblance to figure 2 of Dressler *et al.* (1987) and supports the notion that on average the Hydra-Centaurus supercluster shares the motion of the Local Supercluster both in direction and magnitude. This flow, which requires at least ten times the gravitational pull of the Virgocentric flow, will be challenging to map in full.

We acknowledge partial support from N.S.F. grants 86-11405 and 85-02518.

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