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HI CONTENT AND DYNAMICAL HISTORY OF THE VIRGO CLUSTER

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We conduct an investigation into the nature of and conditions within the 3D structure of the Virgo region, by adding to the analysis the HI content of its spiral population.

HI contents and quality distance estimates for a total of 161 spiral galaxies are obtained by averaging distance moduli based upon the Tully-Fisher relationship taken from eight published data sets previously homogenized, resulting in a relation with a dispersion of 0.41 mag.

Previous findings that the spiral distribution is substantially more elongated along the line-of-sight than in the plane of the sky are confirmed, but we detect, in addition, an important east-west disparity in this effect. The overall width-to-depth ratio of the Virgo cluster region is about $1:4$, with the most distant objects concentrated in the western half. The filamentary structure of the spiral population and its orientation are also reflected by the HI-deficient objects alone. The HI deficiency pattern shows a central enhancement extending from ~ 16 to 22 Mpc in line-of-sight distance; most of this enhancement arises from galaxies that belong to the Virgo cluster proper. However, significant gas deficiencies are also detected outside the main body of the cluster in a probable group of galaxies at line-of-sight distances of ~ 25–30 Mpc, lying in the region dominated by the southern edge of the M49 subcluster and clouds W′ and W, and in various foreground galaxies. In the Virgo region, the HI content of the galaxies is then not a straightforward indicator of cluster membership.

The presence on the Virgo cluster outskirts of spiral galaxies that exhibit gas deficiencies as strong as those of the inner galaxies stripped by the intracluster medium has led us to explore the possibility that some objects in the periphery of this cluster are not newcomers. A dynamical model for the collapse and rebound of spherical shells under the point mass and radial flow approximations has been developed to account for the amplitude of the observed motions of the spirals in the Virgo I cluster region. According to our analysis, it is not unfeasible that some galaxies far from the cluster, including those in a gas-deficient group well in the background, went through its core a few Gyr ago. The implications would be: (1) that a substantial fraction of the HI-deficient spirals in the Virgo region might have been deprived of their neutral hydrogen by interactions with the hot intracluster medium; and (2) that objects spending a long time outside the cluster cores might keep the gas deficient status without significantly altering their morphology.

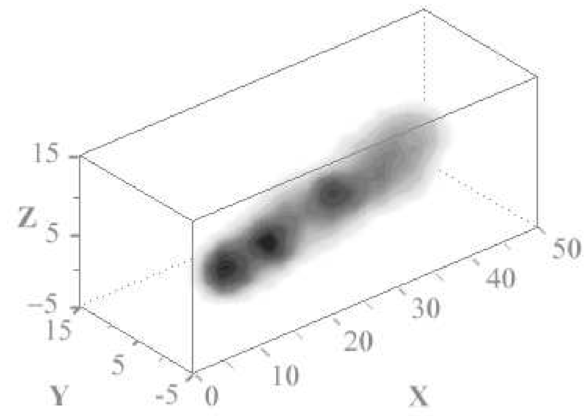

Fig. 1. Voxel projection of the 3D distribution of HI deficiency in the Virgo cluster region. The plot is in rectangular equatorial coordinates. Distances are in Mpc. The xy-plane corresponds to Decl. = 0°, the x- and y-axis point to R.A. = 12h and 18h, respectively, and the z-axis points to the north. The central enhancement is associated with the cluster (M87 is right at its center). We are at the origin of the coordinate system.

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