# A Neutral Hydrogen Survey of the Hydra I Cluster

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## Introduction

We are undertaking a project to image the entire volume of the Hydra I cluster of galaxies in neutral hydrogen using the VLA. This involves making a series of pointings spaced 30′ (the half power beam width) apart, each observed at three velocity settings in order to span the whole velocity range of the cluster. The purpose of this survey is to determine the true distribution, both in space and velocity, of gas-rich systems and hence, to deduce what effects a dense environment may have on the evolution of these systems. Most HI surveys of clusters to date have been performed on optically selected samples. However, optically selected samples may provide misleading views of the distribution of gas-rich systems, since many low surface brightness galaxies have an abundance of neutral gas (Bothun et al. 1987, Giovanelli & Haynes 1989). The Hydra project is providing the first unbiased view of the HI distribution in a cluster of galaxies.

Our $5\sigma$ sensitivity is $4.1 \times 10^7$ M$\odot$/beam, (assuming $H_o = 75$ km s$^{-1}$ Mpc$^{-1}$) and our velocity resolution is 42 km s$^{-1}$. We have a spatial resolution of 45″, which means that only the largest galaxies are spatially resolved enough to determine HI disk size. Our coverage is about 50% of the central region plus eight other fields centered on bright spirals within about 2° of the center.

## Results

The survey observations to date consist of four central fields having full velocity coverage and the eight other bright spiral fields. We have detected 41 galaxies in total. Using Richter's (1989) catalogue to determine the optical counterparts to these detections and counting only those late type galaxies with measured optical velocities, we find an overall detection rate of 75%, with no dependence on distance from cluster center. Many more spirals are catalogued with no measured optical velocities, of which we detect 10%.

HI images of the bright spirals reveal gas disks that in general show no evidence for severe stripping. Even the largest and central-most spiral, NGC 3312, displays a gas disk that is nearly as large as its optical. This is in contrast to images of central Virgo spirals, whose HI disks are as small as 25% of their optical disk diameters (Cayatte et al. 1990). In addition, the Virgo spirals show a decrease in stripping with distance from cluster center. Ram pressure stripping by the hot ICM is generally believed to be the cause of the effects seen in Virgo. It is then puzzling that spirals in Hydra, also an X-ray cluster, do not display these same effects.

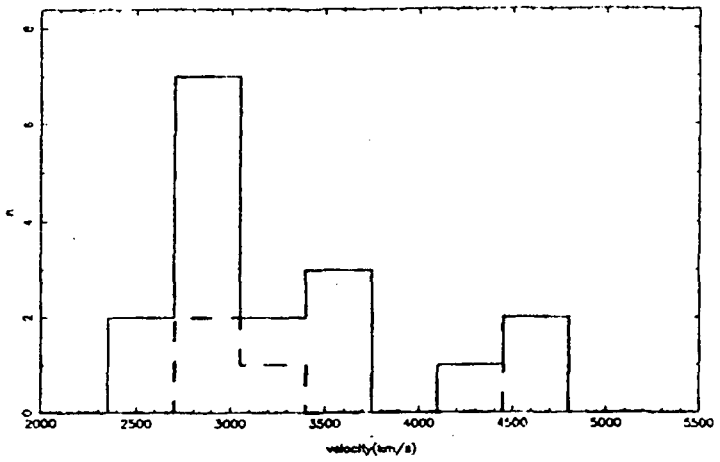
The galaxies in Hydra are however systematically HI deficient. Taking only those galaxies for which we have photometric diameters, we determined the HI content using the parameter $\log(M_{HI}/D^2)$, and calculated the deficiency in units of the $1\sigma$ scatter of Haynes & Giovanelli (1984) field galaxies. The average deficiency is $1\sigma$ with a scatter of $1\sigma$. We look for correlations between the deficiency and distance from the cluster center, relative velocity, and local surface density as defined by the ten nearest neighbors. We find a slight trend of increasing deficiency with local density only.

We have detected seven uncatalogued dwarf galaxies, five of which reside in the central fields. Careful examination of the ESO plates reveals small faint blue smudges at the locations of these detections. It is surprising to find gas-rich dwarfs in the central regions of an X-ray cluster and indeed the optical surveys of Virgo by Bingelli et al. (1987) and Fornax by Ferguson (1989) have shown that Im's tend to avoid cluster centers, while dE's are concentrated toward cluster centers. The usual reasoning used to explain centrally located dwarf galaxies is that they perhaps have circular orbits and never actually pass through the X-ray emitting hot gas. However, all the central dwarfs have large relative velocities (> 600 km s$^{-1}$ both higher and lower) with respect to the cluster systemic.

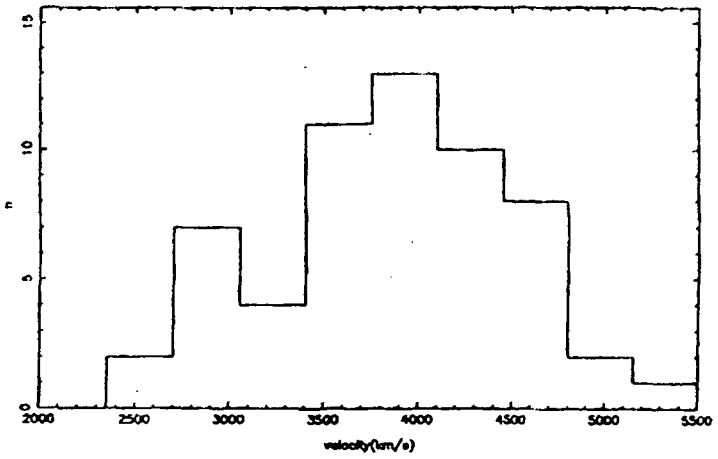
The velocity histogram of all detections in the central fields, i.e., in the fields with full velocity coverage, reveals a bimodal distribution, one group centered at 3000 km s$^{-1}$, the other at 4500 km s$^{-1}$ (see figure). This was also found by Fitchett & Merritt (1988) in their search for subclustering in Hydra. Plotting the velocity histrogram of all galaxies within 100′ of the center, they found a "hint of bimodality" for those

galaxies within 40′. and a gaussian distribution for those outside 40′. Although the number of galaxies with measured velocities is still quite small, we find that the bimodality is much more pronounced for the gas rich galaxies than for the ellipticals. This may be evidence that the ellipticals form a relaxed system while the spirals (and dwarfs) are more clumped and may be a clue to why the stripping is not very severe but is very constant.

**Number of Central Gas-Rich Galaxies per Velocity Bin**




**Number of Central Ellipticals and S0s per Velocity Bin**




## References


Binggeli, B., Tammann, G.A., and Sandage, A. 1987, AJ, 94, 251

Bothun, G.D., Impey, C.D., Malin, D.F., and Mould J.R. 1987, AJ, 94, 23

Cayatte, V., van Gorkom, J.H., Balkowski, C., and Kotanyi, C. 1990, AJ, 100, 604

Ferguson, H. 1989, AJ, 98, 367

Fitchett, M., and Merritt, D. 1988, ApJ, 335, 18

Giovanelli, R and Haynes, M.P. 1989, ApJ, 346, L5

Haynes, M.P., and Giovanelli, R. 1984, AJ, 89, 758

Richter, O.-G. 1989, A&AS, 77, 237