SENSITIVE SEARCH FOR HI IN E AND S0 GALAXIES

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ABSTRACT. Do elliptical and S0 galaxies in which type I supernovae (SNI) were detected contain more gas than those without SNI detections? Thirteen E and S0 galaxies in the Virgo and Pegasus I clusters, seven with SNI detections and six without, were mapped well beyond the optical image at the 21-cm neutral hydrogen line. No HI was detected. In Virgo, the upper limit to M_{HI}/L_B is between 0.0005 and 0.0024.

There are now many sensitive searches for 21-cm neutral hydrogen emission from elliptical galaxies, but still, less than one-tenth of the galaxies observed have been detected. As the HI content of E galaxies is almost three orders of magnitude less than that of Sc's, while the type I supernovae (SNI) rate is only a factor of four less, it had been assumed that the progenitor stars of SNI's were long lived stars. Oemler and Tinsley (1979), instead, have suggested that the progenitor stars for SNI's are short lived ($\sim 10^8$ yr) stars, implying that there should be sufficient gas to form them. My colleague, C.K. Kumar, noticed a hint (from a small number of published detections), that a detection of HI was more likely in those elliptical galaxies having had a SNI.

To test the hypothesis that E and S0 galaxies which produced SNI's have more gas than those that didn't, Kumar and I observed 13 galaxies in the Virgo and Pegasus I clusters at Arecibo. Six of the galaxies had not had SNI detections, but were otherwise identical to the SNI producing galaxies, and were included as controls. As recent observers have suggested that HI in E and S0 galaxies is extended, the detectability of HI was increased by mapping the galaxies over an area larger than the optical image. One to seven positions on each galaxy were observed. After smoothing to 42 km s^{-1} resolution, the individual profiles were examined for evidence of HI. To increase sensitivity to extended gas, the profiles (for each galaxy) were combined, yieling an RMS between 0.4 and 0.8 mJy. No neutral hydrogen was detected. Adopting H_o = 50 kms^{-1} Mpc^{-1} and an HI profile width of 400 kms^{-1}, the 3σ limit to the neutral hydrogen content of the Virgo galaxies is $\leq 4 \times 10^7$ $M_\odot$. We summarize the observations in Table I below.

E. Athanassoula (ed.), Internal Kinematics and Dynamics of Galaxies, 305–306.

TABLE I

Cluster	Distance adopted Mpc	Galaxies observed NGC	Diameter range arc min	$M_H/M_\odot$ mean (min-max)	M_H/L_B mean (min-max)
Virgo	20	4365,4382,4472 4526,4564,4578 4621,4636,4762	3.1-8.9	$\leq 4.5\times10^7$ (2.6-6.4)	$\leq$ 0.0015 (.0005-.0024)
Pegasus I	80	7619,7626,7634 7785	1.3-2.8	$\leq 8.3\times10^8$ (3.0-12)	$\leq$ 0.0043 (.0011-.0085)

We note that the HI content of NGC 4278, a "normal" E galaxy, is $\sim 4\times10^8$ $M_\odot$ (Knapp, Kerr and Williams, 1978), while for five isolated E's and S0's, Haynes and Giovanelli (1980) detected $\sim 8\times10^9$ $M_\odot$.

Of particular interest (Fig.1.), is NGC 4472, brightest E in Virgo, showing no HI except for emission from UGC 7636, 6' to the SW, and NGC 4636, earlier reported as detected (Knapp, Faber and Gallagher, 1978; Bottinelli and Gouguenheim, 1977,1978), also showing no HI at 1/20 the level of previous observations.

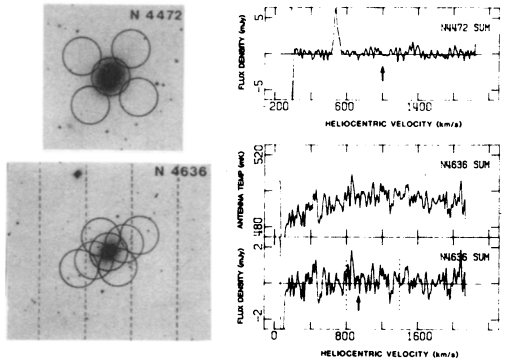

Fig.1. Left, reproduction of NGC 4472 and 4636 from the POSS (© 1957, National Geographic Society-Palomar Observatory Sky Survey). Solid circles indicate 3.'4 beam positions; dashed vertical lines, position of the Nancay observations. Right, the combined 21-cm profiles. For NGC 4636, we also show the unbaselined result, typical of the Virgo observations.

We have lowered the limit to the neutral hydrogen content of 13 E and S0 galaxies, and showed that HI is not "hiding" at the outskirts of these galaxies. No difference is seen (to our limit) in the HI content of those E and S0 galaxies having, and those not having had SNI's.

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