INTERGALACTIC NEUTRAL HYDROGEN

Yervant Terzian
NAIC Cornell University
Ithaca, New York 14853
U.S.A.

Here I would like to report on the HI intergalactic cloud in the Leo group of galaxies, which was first announced in 1983 by Schneider, Helou, Salpeter and Terzian (1983). This unexpected discovery was made accidentally by S. Schneider while calibrating the Arecibo λ21 cm system by looking at a part of the sky where no HI emission was expected at high velocities. These observations were made during a project of studying the HI distribution in binary galaxies and in small galaxy groups.

The HI emission was found mainly in a region 100 kpc long by 30 kpc wide midway between the galaxies M96 and M105. Fainter emission, extending North and South of the main cloud spans about 200 kpc and reaches the vicinity of M96. Schneider (1985) has interpreted the observed emission and kinematic structure of this cloud as a giant HI ring with a lifetime of several billion years.

Our original studies of this interesting HI cloud indicated high radial velocities of about 1000 km/s, which unambiguously distinguish this cloud from local high-velocity clouds. We also note that the isolation of the HI gas from the surrounding galaxies in Leo exceeds that of any previously studied HI feature in a group of galaxies. Also the lack of any optical tidal features to the nearby galaxies argues that this intergalactic cloud is not a recent tidal product. Furthermore, the mass of more than 2×10^9 $M_\odot$ in neutral hydrogen represents a substantial fraction of all the HI in the M96 group of galaxies.

Several attempts have been made recently to find any optical starlight emission from the HI cloud, but all these observations have given negative results (Skrutskie, Shure and Beckwith 1984; Pierce and Tully 1985; Kibblewhite et.al. 1985). Similarly no infrared radiation is detectable from the IRAS survey, and no diffuse X-ray emission appears in the direction or vicinity of this HI cloud.

Figure 1 shows the HI brightness distribution, which is concentrated primarily between M96 in the South and M105 in the North. The table below summarizes some of the physical properties of the HI cloud assuming that it is part of the M96 group of galaxies at a distance of 10 Mpc.

J.-P. Swings (ed.), Highlights of Astronomy, 341–344.

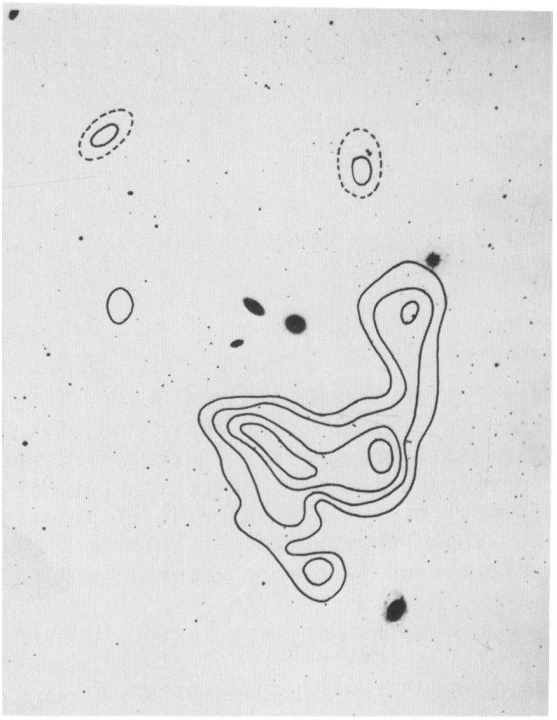

FIGURE 1. The HI brightness temperature distribution of the large cloud in Leo. The main part of the cloud is located between M96 in the South and M105 in the North. These observations were made with the Arecibo 1000 ft. radio telescope with a beam of ~ 3 arc minutes, as reported by Schneider et.al. (1983).

TABLE 1. HI CLOUD PARAMETERS

Systemic Velocity	960 km/s
Velocity Range	860 to 1060 km/s
Profile Width	20 to 60 km/s
Distance	10 Mpc
Main Size	30 x 100 kpc
Size with Extensions	200 x 500 kpc
HI Mass (detected)	2×10^9 $M_\odot$
HI Column Density	7×10^{19} cm^{-2}
HI Density	10^{-3} to 10^{-4} cm^{-3}
Optical Emission	$\leq$ 30 mag. arc sec^{-2}

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More recently Schneider, Salpeter and Terzian (1986) have made high resolution HI observations with the Very Large Array D-configuration (the VLA is part of the National Radio Astronomy Observatory, which is operated by Associated Universities, Inc., under contract with the National Science Foundation), and an HI VLA map of the main part of the cloud is shown in Figure 2. Some of the main results of these observations are shown in Table 2.

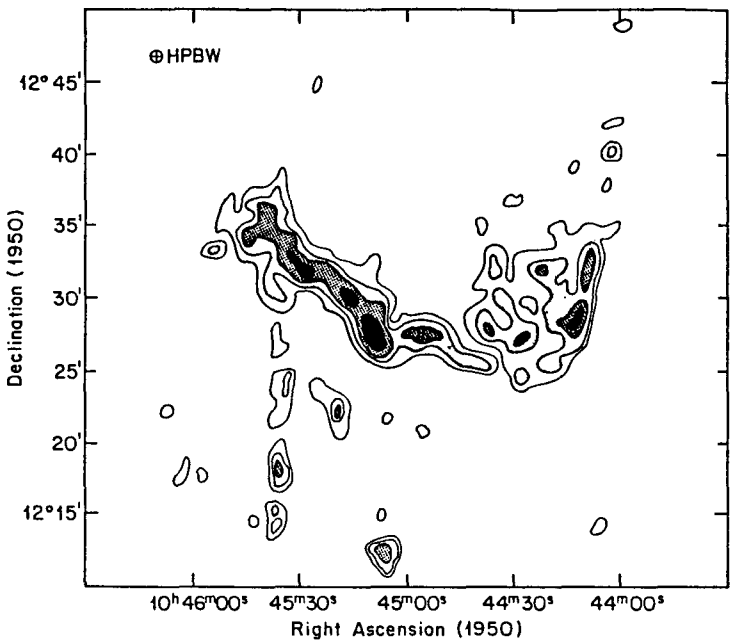

FIGURE 2. The VLA map of the main part of the Leo HI cloud showing significant fine structure. The galaxies M96 and M105 are respectively just outside the South and North boundaries of the map.

TABLE 2. VLA HI OBSERVATIONS

VLA Configuration	D-Array
Effective Resolution	45 arc sec
HI Morphology	Fine structure with many clumps
Clump Size	80 to 40 arc sec (2 to 4 kpc)
Mass Per Clump	1 to 4 x 10^7 $M_\odot$
Clump HI Density	10^{-1} to 10^{-2} cm^{-3}

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The HI clumps seen in the VLA observations have masses and sizes similar to small dwarf galaxies, and the mean densities are more typical of that of the interstellar medium. It is not yet clear how such clumps evolve, but further observations at higher resolution are planned to study these structures.

In conclusion, it seems possible that this HI cloud exists in the intergalactic space and it might even be primordial.

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