ALFALFA Discovery of an HI Cloud Complex in the Virgo Cluster: Aperture Synthesis Observations

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We present aperture synthesis observations of the HI cloud complex in Virgo detected by the Arecibo Legacy Fast ALFA Survey (ALFALFA, Giovanelli et al. 2005; poster 179.22). We make two detections: the first is associated with the largest cloud in the complex, while the second coincides with an ALFALFA source near the LSB galaxy VCC 1357. In both cases, the ALFALFA clouds resolve into a network of HI clumps exhibiting no ordered velocity structure. An interpretation of the observations in terms of a galaxy harassment scenario is favored.

The ALFALFA HI Cloud Complex:

- A complex of HI clouds in Virgo - extending ~ 40' at a heliocentric radial velocity cz ~ 500 km/s, near the disturbed spiral NGC 4424 - was discovered from ALFALFA survey data.
- The single-dish data reveal a total HI mass of $5x10^8$ M_o (at a Virgo distance of 16 Mpc), distributed in several HI clumps.

See poster 179.22 for ALFALFA analysis

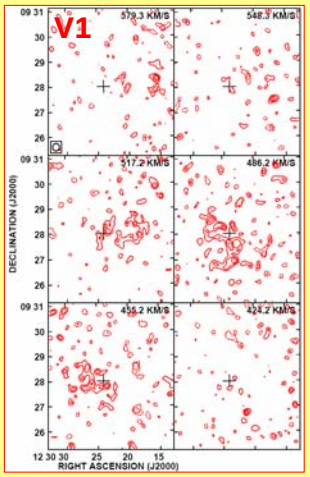
VLA Observations:

- C-configuration Very Large Array (VLA) observations were obtained near the ALFALFA complex center: sources A1, A2, A4, and A5 lie within the primary beam.
- The resulting maps are sensitive to 4 x 10^6 M_o at the Virgo distance (4σ over 2 21 km/s channels) on spatial scales accessible to the VLA.

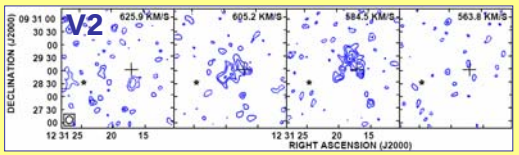
2 detections

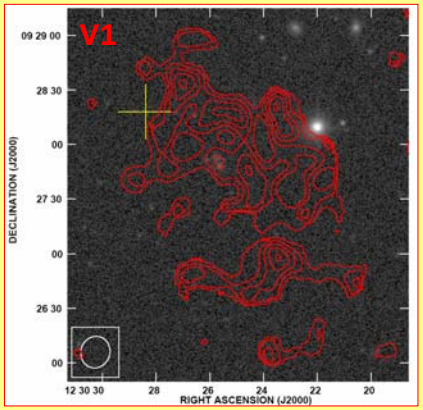
V1: associated with largest ALFALFA clump A1
V2: counterpart to ALFALFA cloud A2, near LSB galaxy VCC 1357

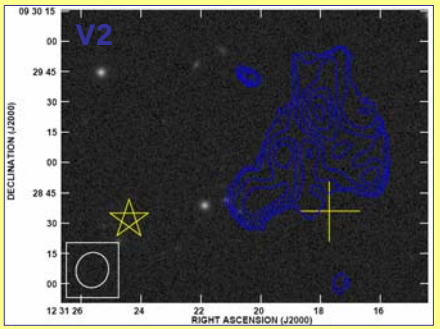
Naturally weighted channel maps for V1, counterpart to ALFALFA detection A1. Contours at 0.36 x (-3, -2, 2 [2σ], 3, 4, 5, 6) mJy/beam. Dashed contours are negative. In each panel, the cross shows A1 centroid and cz_l is at upper right. The synthesized beam is in the lower left corner of the first panel.



Naturally weighted channel maps for V2, counterpart to ALFALFA source A2. Contours at 0.48 x (-3, -2, 2 [2σ], 3, 4, 5, 6) mJy/beam. Dashed contours are negative. In each panel, the cross shows A2 centroid and cz_l is at upper right. The star denotes the optical position of VCC 1357 (Binggeli et al. 1985).





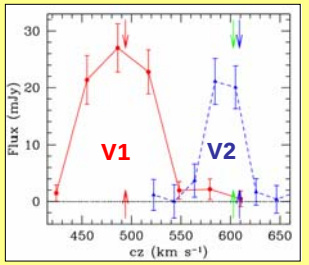


Total intensity maps of V1 (top) and V2 (bottom) superimposed on SDSS *r* images. In both plots, contours are at 10^{20} x (1, 1.5, 2, 2.5, 3, 3.5, 4) cm^{-2}. Yellow crosses show centroids of the ALFALFA sources A1 (top) and A2 (bottom). In the bottom panel, the star shows the optical position of the LSB galaxy VCC 1357 (Binggeli et al. 1985; not detected by SDSS).

Results:

- There is good agreement between the positions, cz of the ALFALFA clouds A1, A2 and the VLA detections V1, V2: *V1, V2 are clear counterparts to the single-dish detections.*
- All of the single-dish flux in the ALFALFA sources A1 and A2 is recovered by the VLA observations: *the complex clouds have a clumpy, disordered morphology on 18" (~1.4 kpc) scales.*

Feature	cz, km/s	$W_{1/2}$, km/s	∫SdV, Jy km/s	M_{HI}, 10^8 M_o
V1	500 +\- 5	41 +\- 22	3.3 +\- 0.4	2.0 +/- 0.2
V2	593 +\- 4	27 +\- 13	1.2 +\- 0.3	0.7 +/- 0.2



Global profiles for V1 (red) and V2 (blue). Red arrows show cz for the ALFALFA source A1, blue arrows show cz for the ALFALFA source A2, and green arrows show cz for VCC 1357 (Binggeli et al. 1993).

- We do not detect ALFALFA clouds A4 and A5: *this is expected given our detection limit, if the A4, A5 morphologies are similar to A1.*
- cz for A2 and V2 are in excellent agreement with that of the LSB galaxy Vcc 1357 (Binggeli et al. 1993): *the HI cloud and the galaxy are likely related.*
- BUT: the centroid of the V2 emission is displaced from the galaxy's optical center by 1.4', or ~7 kpc in projection at the Virgo distance: *if V2 is associated with VCC 1357, the system has a very disturbed HI morphology.*

The ALFALFA clouds A1 and A2 resolve into a network of clumps with no ordered velocity structure; their morphologies, kinematics and environments are similar to other Virgo HI complexes (e.g. NGC 4254, see poster 179.23). They are best interpreted as the relics of galaxy harassment processes in the Virgo cluster potential.

References:

- Binggeli, B., Popescu, C. C., & Tammann, G. A. 1993, A&AS, 98, 275
- Binggeli, B., Sandage, A., & Tammann, G. A. 1985, AJ, 90, 1681
- Giovanelli, R. et al. 2005, AJ, 130, 2598

For more information, visit http://egg.astro.cornell.edu/alfalfa/

Research partially supported by NSF/AST-0307661, NSF/AST-0435697 and a Brinson Foundation grant.