ALFALFA: The Arecibo Legacy Fast ALFA Survey
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ABSTRACT

The Arecibo Legacy Fast ALFA (ALFALFA) survey is a blind extragalactic large area HI survey aiming to map 7,000 deg^2 of sky. The total survey is expected to detect 35,000 HI sources ranging from nearby dwarfs to massive spirals. The January 2010 Undergraduate Workshop will take place January 11th - 13th at the Arecibo Observatory giving undergraduate students and their mentors the opportunity to contribute to the ALFALFA survey while gaining research experience. The workshop will observe three drifts within the ALFALFA survey with right ascensions and declinations of 08h59m - 14h15m and +194954 (J2000), 08h55m - 14h11m and +201906 (J2000) and 09h03m - 14h19m and +200430, selected from the ALFALFA master drift list. These drifts are located in the northern region of the Virgo Cluster within the Coma Supercluster allowing for the study of a dense region of galaxy groups and clusters including a complete analysis of the NRGb 177 group.

1. Introduction

The ongoing study of neutral hydrogen (HI) provides the scientific community with a deeper understanding of galaxy formation and structures as well as galaxy interactions. The Arecibo Legacy Fast ALFA (ALFALFA) survey is a blind extragalactic HI survey which is mapping a large portion of the sky in order to allow

for a cataloging of extragalactic objects. The project covers an area of 7,000 deg^2 out to a redshift of z = 0.06, between 0 and 36 degrees in declination and from 07h30m to 16h30m and 22h00m to 03h00m in right ascension (Giovanelli et al. 2005). This unbiased analysis of such a vast region of sky allows for the detection of both known and unknown HI structures. Over 35,000 extragalactic HI sources are estimated to be discovered and cataloged, providing redshifts, rotational widths, HI fluxes, and (if the distance is known) HI masses. The large diameter of the Arecibo telescope along with the ALFA seven-pixel receiver improves on the sensitivity and resolution compared to previous HI surveys.

Proposed observations include the Virgo Cluster, containing roughly 2000 known objects, some of them currently interacting with other galaxies and/or the cluster. (Binggeli et al. 1985). Analysis of rich regions such as the Virgo Cluster in contrast to lower density regions allows for the study of galactic evolution in relation to their local surroundings. Many previously unidentified objects have been cataloged by the ALFALFA survey within and around the Virgo Cluster. Four catalogs have been produced, the first of the northern region includes a declination range of +12° to +16°, presents 730 HI sources (Giovanelli et al. 2007). The second catalog detected 488 HI sources between declination ranges +26° to +28° (Saintonge et al. 2008). A third catalog in declination range +8° to +12° reports 578 detections (Kent et al. 2008) and the fourth between declinations +24° to +26° reports 541 HI detections (Martin et al. 2009).

The third Undergraduate ALFALFA Workshop at Arecibo will allow for students from 15 different Universities to operate mankind's largest telescope, and learn about the inner workings of both the scientific community and the ALFALFA project as a whole. This provides research opportunities for undergraduates who are actively involved in the scientific community to learn about and be involved with a large scale research project.

2. Observations and Data Reduction

Observations by undergraduate students will be made using the existing ALFALFA techniques of two-pass strategy and fixed-azimuth drift mode, in which the telescope is fixed on the meridian as the sky drifts by. These techniques minimize changes in the beam parameters and follow the minimum intrusion principle (Giovanelli et al. 2005). By keeping the telescope fixed and using a two-pass strategy, the beam pattern is more easily removed and terrestrial interferences are minimized.

The three observing sessions are scheduled for January 11th, 12th and 13th between 02:00 and 07:15 AST. The drifts, selected from the ALFALFA master drift list, correspond to right ascension ranges of 08h55m-14h11m, 08h59m-14h15m and 09h03m-14h19m, centered on respective declinations of +201906 (J2000), +194954 (J2000) and +200430 (J2000). These observations will take place during the 2010 ALFALFA Undergraduate Workshop. Undergraduate students will be guided through the observation and data reduction process by experienced graduate students. Current ALFALFA software will be used during the data reduction process.

3. Focus of Observation

Our observations will complement the ALFALFA survey and aid in the understanding of galaxy evolution. Our assigned drifts selected from the master drift list cover a region north of the Virgo Cluster in the Coma Supercluster. This region is dense with galaxy groups and clusters allowing for the study of galaxy-galaxy interactions through tidal tails and galaxy mergers. Our drifts correspond to the first pass of the two pass strategy we use, allowing for new galaxies to be cataloged.

One region of particular interest includes the NGC 4065 group also known as NRGb 177. The redshift of this group has been calculated to be 6995±48 km/s with a total of 74 group members and a velocity dispersion of 416±35 km/s (Mehdavi & Geller 2004). NRGb 177 has also been observed using the VLA and has additionally been shown to have X-ray emitting intragroup gas (Freeland et al. 2009). Freeland et

al. detected HI in several group members and found NGC 4068, a system of two interacting spiral galaxies. These spiral galaxies are then interacting with another pair of spiral galaxies, VV062a and VV062b (Freeland et al). Freeland et al. were limited to a velocity range from 6000 - 7200 km/s and surveyed a volume of 6.6 Mpc^3. An optical image of the group with HI contours overplotted is provided in Figure 1. ALFALFA will provide a better understanding of the larger environment of the group by probing the outer regions of this group. Galaxies that are in the process of falling into the group for the first time could be detected along with finding group structures not associated with NRGb 177 at higher redshifts.

The young, spiral-rich galaxy cluster A1367 is another region of particular interest. Also known as the Leo cluster, it makes up a large portion of the Coma Supercluster, which together with its neighbors, makes up a wall of clusters known as the Coma Great Wall. A prominent feature of this cluster for ongoing study is the long tail of trailing gas on several of its galaxies suggesting tidal interactions and ram pressure stripping by intracluster medium (Gavazzi et al. 2001). Figures 2 and 3 show example tails discovered by Gavazzi et al. using Hα imaging. Increased regions of star formation have been detected as these galaxies fall to the center of the cluster and much of their gas is pushed away. Observations of the Leo cluster, particularly in the X-ray, offer insight as to how the rate of star formation depends on the location of a galaxy in the cluster. Additionally, due to the intracluster gas temperature profile, A1367 is suggested to be a merger of two clusters (Donnelly et al. 1998) which makes this an ideal cluster to study gas and environmental effects.

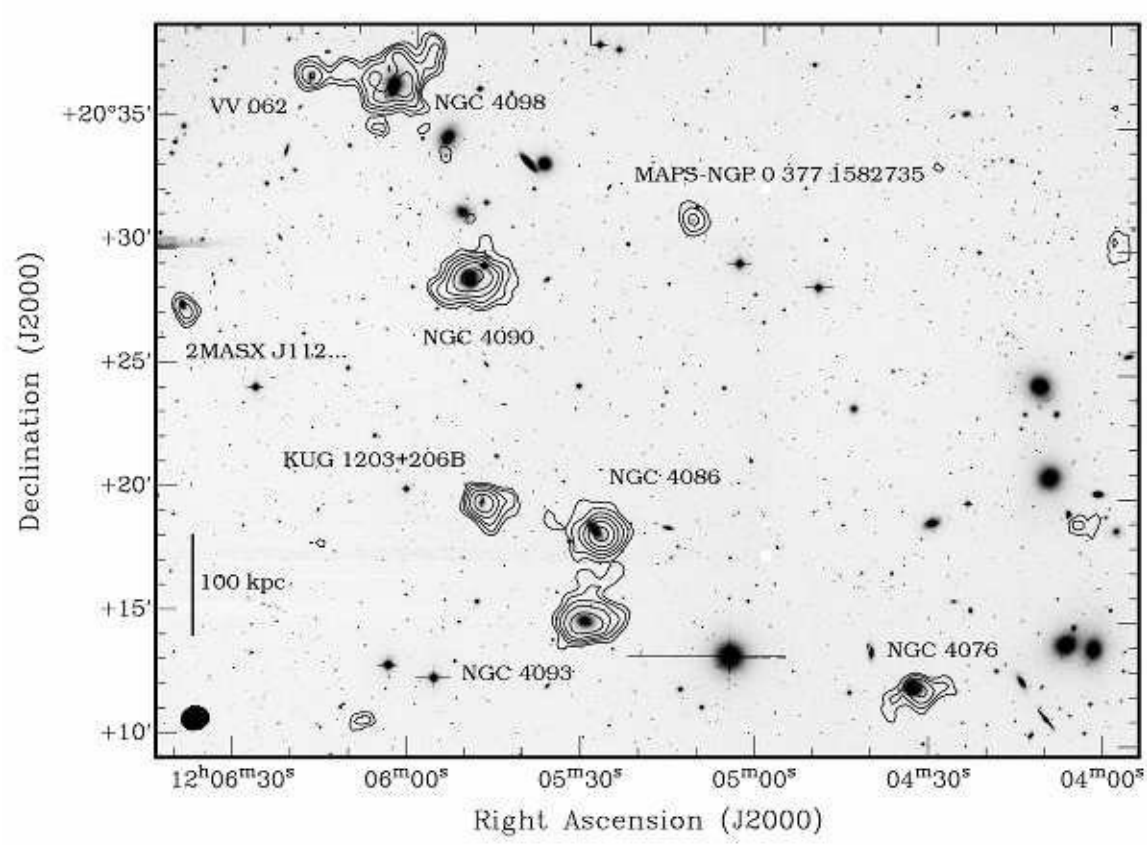

Figure 1: Total intensity HI contours overlaid on an R band optical image taken at the WIYN 0.9m (Freeland et al.).

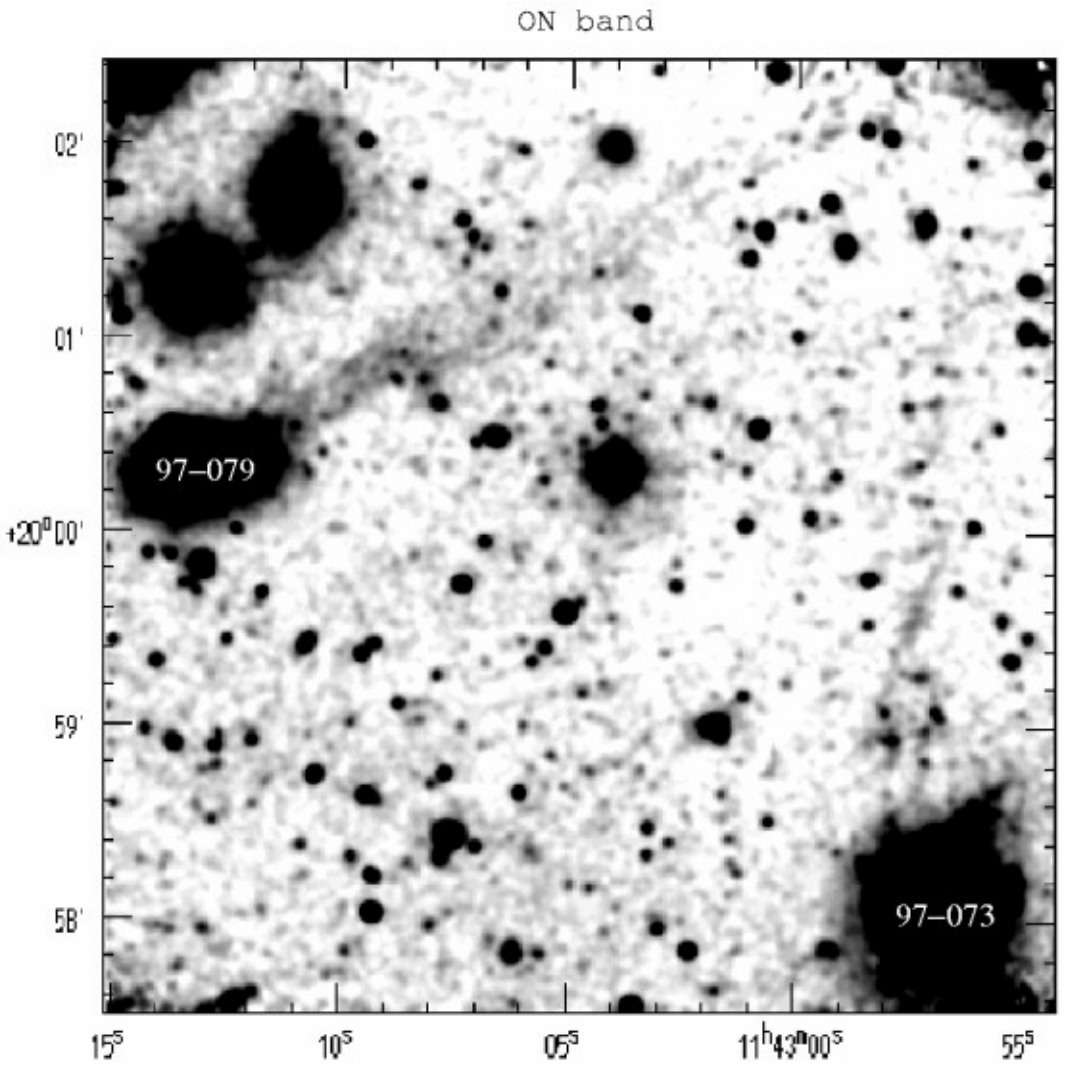

Figure 2: Stacked 6 hr Hα +[NII] ON band of the Leo cluster shown at high contrast to enhance the extended tails. The upper corner suffers from filter vignetting (Gavazzi et al. 2001).

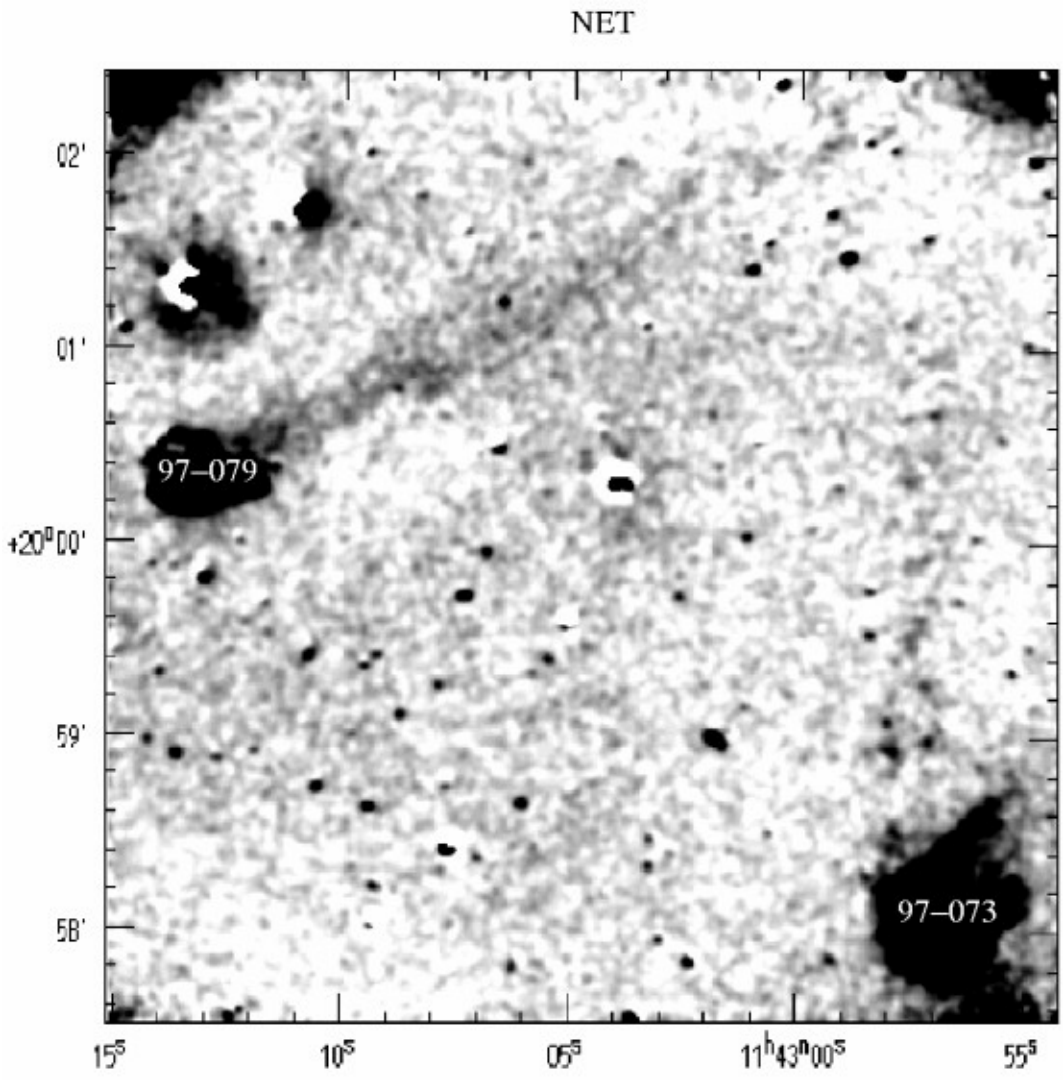

Figure 3: Stacked 6 hr Hα +[NII] NET exposures of the Leo cluster shown at high contrast to enhance the extended tails. The upper corner suffers from filter vignetting (Gavazzi et al. 2001).

4. References Cited

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