The Arecibo Legacy fast ALFA Survey: The January 2008 Undergraduate Workshop

John Ayala[1], Guillermo Fontanez[1],Shawn Golley[2], Lisa Horne[3], Nancy Irizarry[1], Jose I. Lopez[1], Liza Piltz[4], Nathan Calabro[5], Patricia Carroll[6], Sara Ceran[7], Shelvean Kapita[8], Jessica Kellar[9], Scott Manglitz[10], Kim Nguyen[11], Lamarr Parsons[11], Kevin Risolo[6], Peter Shively[12], Arthur Sugden[9]

ABSTRACT

The Arecibo Legacy fast ALFA (ALFALFA) project is a blind HI survey that in the course of 4-5 years is expected to cover 7000 deg^2 of the sky detecting more than 25,000 HI sources. ALFALFA will expand our understanding of galaxy evolution in relation to their environments and address current issues in astronomy. Within the techniques and procedures of the general ALFALFA survey we plan to observe the region extending from Gemini to Bootes (RA range from 7h34m to 14h04m). The CFA Redshift Survey catalog (Huchra & Geller 1998) lists 67 galaxies in this region (between 25 and 27 degrees in declination). This region contains the Great Wall (Geller & Huchra 1989) and the Coma Cluster. We will contribute to the ongoing survey by providing data on a cluster-rich region in which we expect to find interacting systems of galaxies, such as the one found by Haynes et al. (2007), or isolated HI clouds (Kent et al. 2007).

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[1]University of Puerto Rico

[2]St. Lawrence University

[3]George Mason University

[4]University of Wisconsin

[5]Union College

[6]Siena College

[7]Georgia Southern University

[8]Lafayette College

[9]Wesleyan University

[10]Skidmore College

[11]Cornell University

[12]Colgate University

1. Introduction

The study of HI provides a significant amount of understanding about galaxy structure, content, as well as galaxy-galaxy interaction within groups and clusters. The ALFALFA survey aims to cover 7000 deg^2 of the sky out to a redshift of z $\sim$ 0.06, between 0 and 36 degrees in declination and from 07h30m to16h30m and 22h00m to 03h00m in right ascension (Giovanelli et. al. 2005). As a blind survey, it is unbiased to bright or previously detected galaxies. The survey is expected to detect more than 25000 extragalactic HI line sources, providing HI redshifts, masses, and rotational widths. As opposed to previous large HI surveys (such as HIPASS and HIJASS), the larger Arecibo diameter and ALFALFA's 3.5' beam provide significant improvements in spatial resolution and sensitivity respectively; this allows for fewer followup synthesis observations to be needed in order to adequately map the HI structures and identify their optical counterparts.

A catalog for the Virgo cluster has been published by Giovanelli et. al. (2007). This catalog covers the Northern Virgo cluster region (11h44m $<$ R.A $<$ 14h00m and +12deg $<$ DEC $<$ 16°) and has detected 730 objects. The Anti-Virgo Region has been studied by Saintonge et. al. (2007), who reported 488 objects over 135 degrees^2 within the region of the sky having 22h $< \alpha <$ 03h and $+26° < \delta < +28°$.

ALFALFA will also attempt to solve current issues in astronomy such as the missing satellite problem, i.e., the discrepancy between numerical simulations of cold dark matter (CDM), that predicts a higher number of dwarf satellite galaxies in the Local Group than the number observed (Kauffman et. al. 1993; Klypin et. al. 1999). The survey, by being unbiased to bright galaxies, also aims to provide a determination of the faint end of the HI mass function (HIMF).

In addition, ALFALFA will explore the evolution and dynamics of galaxies within local large scale structures such as the Virgo Cluster. By comparing regions of low, intermediate, and high galaxy density, we can obtain an increased understanding of the evolution of galaxies in relation to their environments and study galaxy-galaxy interactions. It will also allow for measurement of th HI diameter function, as well as searching for local HI tidal features.

This is the third undergraduate ALFALFA workshop which will allow students and their faculty mentors from 15 institutions the opportunity to operate the world's largest radiotelescope onsite. The amount of time assigned for this project (6 and a half hours) and the region that has been selected (Zwicky fields 117 to 132) will provide ample research opportunities for the students.

2. Observations and Data Reduction

The observations are scheduled for January 14th between 00:30 and 07:00 AST, which corresponds to a Right Ascension range of 07h34m50s to 14h04m50s; our declination, chosen from the ALFALFA master drift list, is 26deg 1.5min (J2000). These observations will take place during the 2008 ALFALFA Undergraduate Workshop. Graduate students will aid the undergraduate students in the observation and data reduction process. The data will be reduced using current ALFALFA software and the same observation techniques will be employed. The student team will begin the data reduction process the following day during the undergraduate workshop.

The observations will be carried out in in Fixed-Azimuth Drift Mode, in which the telescope is pointed at a fixed declination as the sky drifts by. This follows the minimum intrusion principle (Giovanelli et al. 2005). By keeping the telescope fixed, the beam pattern is more easily retrieved and the data more easily reduced and of superior quality.

3. Focus of Observations

Our scientific interests blend with those of ALFALFA because they contribute to the survey as well as preparing us for future research in astronomy by providing us with an increased understanding of galaxy evolution and dynamics in the local universe and the scientific resources and protocols associated with it. The drift we chose contains numerous objects with a variety of redshifts for us to potentially observe as is illustrated in Figure 1 and Figure 2. In particular, our strip will include a portion of the Coma Cluster. This cluster is at a distance of 90 Mpc and contains about 10,000 galaxies with a majority of ellipticals and S0's with velocities of ∼6,900 km/s. We will contribute to the ongoing survey by providing data on a cluster-rich region in which we expect to find interacting systems of galaxies, as found by Haynes et al. (2007), in the Virgo ALFALFA Survey or HI clouds (Kent et al. 2007).

Three particular systems within our region, CGCG 129018, CGCG 129016, and CGCG 129015, are suspected to be interacting due to their similar positions in the sky, distances from Earth, and heliocentric recessional velocities. (See Figure 3). CGCG 129018 and CGCG 12015 both have heliocentric recessional velocities of 4716 km/s and CGCG 129016 has a heliocentric recessional velocity of 4979 km/s. These galaxies make up a galaxy cluster known as NGC 4615.

Also, using Goldmine, we have created a list of 12 previously observed galaxies that exist in our strip. (See Table 1). Using the NASA Extragalactic Database (NED), we have created

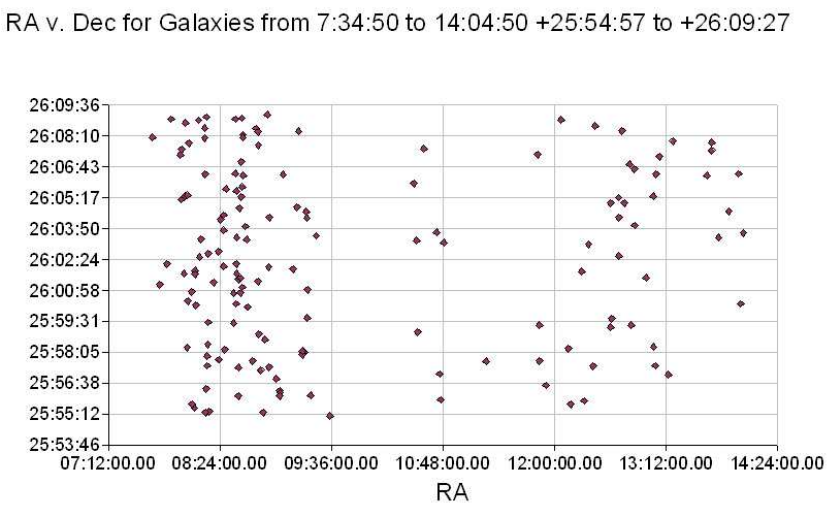

Fig. 1.— Galaxies in the region plotted as a function of RA and DEC.

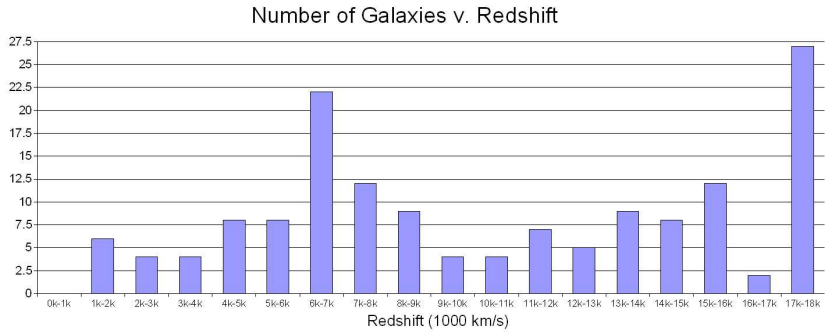

Fig. 2.— Galaxies in the region plotted as a function of redshift.

a list of 10 galaxies within our strip that have measured redshifts. (See Table 2). In addition, searches within the Sloan Digital Sky Survey and the Center for Astrophysics Redshift Survey yielded 21 and 67 galaxy candidates respectively within the strip of observation.

4. References

Geller & Huchra 1989, Science 246, 897

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Kent, B. R. et al. 2008, ApJL, in press

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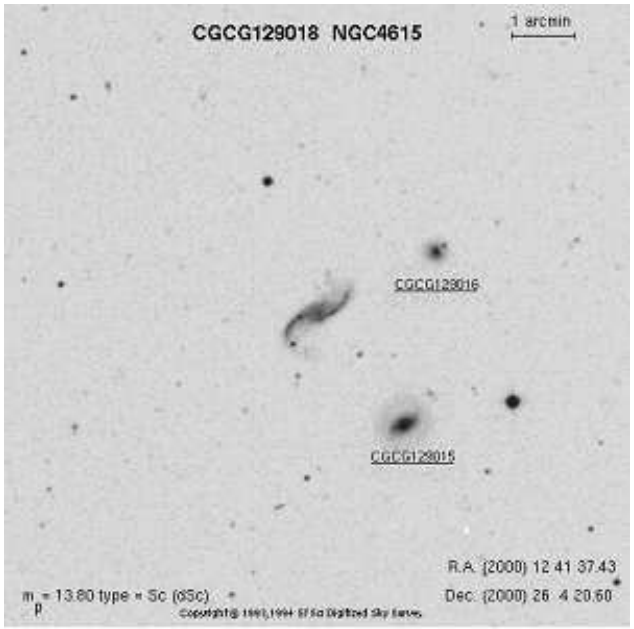

Fig. 3.— The regions around CGCG 129018 and CGCG 12015 which have similar enough recession velocities that they may be interacting.

Table 1. Corresponding Galaxies found in Goldmine Database

Name	RA J2000	Dec J2000
CGCG 127060	11:49:18.72	26:07:14.70
CGCG 127065	11:50:20.16	25:57:41.50
CGCG 128049	12:10:34.71	25:55:40.60
CGCG 128071	12:17:48.61	26:01:48.50
CGCG 128084	12:22:10.04	26:03:07.20
CGCG 128087	12:25:04.64	25:57:28.80
CGCG 129010	12:36:20.72	25:59:16.20
CGCG 129015	12:41:31.32	26:02:31.50
CGCG 129016	12:41:29.67	26:05:17.90
CGCG 129018	12:41:37.43	26:04:20.60
CGCG 130004	13:03:48.49	26:05:22.50
CGCG 130006	13:05:15.95	25:57:27.20

Table 2. Corresponding Galaxies found in NED:

Name	RA J2000	Dec J2000	Velocity km/s
SDSS J082628.81+26042	08h26m28.81s	+26d04m29.1s	1960
NGC 2592	08h27m08.07s	+25d58m13.2s	2046
NGC 2735	09h02m38.64s	+25d56m04.3s	2450
NGC 2735A	09h02m41.84s	+25d56m17.8s	2560
SDSS J090253.00+25561	09h02m53.00s	+25d56m12.5s	2503
CGCG 124-041	10h35m42.07s	+26d07m33.7s	1392
IC 3215	12h22m10.38s	+26d03m07.0s	1019
IC 3571	12h36m20.10s	+26d05m03.2s	1260
NGC 4565	12h36m20.78s	+25d59m15.6s	1230
KUG 1249+263	12h51m44.45s	+26d06m37.8s	1225