



The ALFA Zone of Avoidance Survey: Results from the Precursor Observations



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Introduction

The Arecibo L-band Feed Array Zone of Avoidance Survey (ALFA ZOA) will map 1350-1800 deg² at low Galactic latitude, providing HI spectra for galaxies in regions of the sky where our knowledge of local large scale structure remains incomplete, owing to obscuration from dust and high stellar confusion near the Galactic plane. Because of this extinction and stellar confusion, a substantial fraction of the galaxies detected in the survey will have no optical or infrared counterparts. However, near infrared follow up observations of ALFA ZOA sources found in regions of lowest obscuration could reveal whether some of these sources could be objects in which little or no star formation has taken place ("dark galaxies"). We present here the results of ALFA ZOA precursor observations on two patches of sky totaling 140 deg² (one near $l=40^\circ$, and the other near $l=192^\circ$). We have measured HI parameters for detections from these observations, and cross-correlated with the NASA/IPAC Extragalactic Database. A significant fraction of the objects are new, having never been detected at any wavelength. For those galaxies that have been previously detected, a significant fraction have no previously known redshift, and no previous HI detection.

Data Reduction

Data reduced using software originally developed for the Parkes Multibeam surveys (*LiveData*, *Gridzilla*), adapted for Arecibo. Data are gridded using a median filter, taking advantage of the re-observations of sky pointings afforded by the basketweave technique. Cubes are searched by eye, parameters fit in *Mirad*.

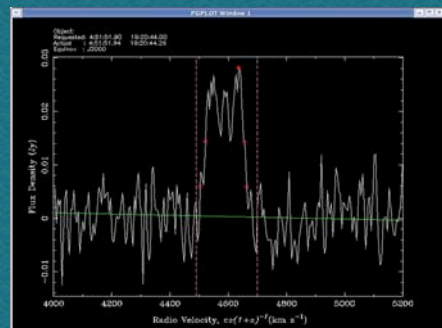


Figure 3 Spectrum of a previously unknown galaxy from the precursor observations.

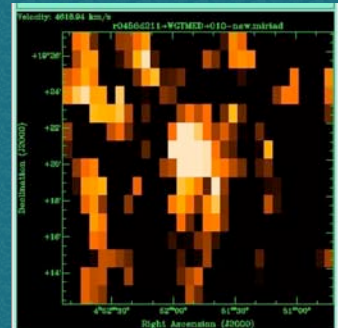


Figure 4 HI Image of the galaxy from Figure 3.

Why survey the ZOA in HI?

The ZOA has been narrowed by deep optical / IR searches, but both fail in regions of high extinction and stellar confusion. Galaxies which contain HI can be found in regions of thickest obscuration and worst IR confusion.

Scientific Goals:

- Reveal large scale structure in an unexplored region of the local universe
- Combine with HI detections of other ALFA surveys to produce HI parameter statistical measures such as the HI mass function
- Compute Tully-Fisher distances at low Galactic latitudes, to be incorporated into 2MASS Tully-Fisher Survey (Masters *et al.* 2005), to reveal extragalactic velocity field at low Galactic latitudes
- Because Galactic extinction is patchy, detection of dark galaxies (esp. at high $|b|$ and in Galactic anti-center direction) is possible, with IR followup observations: $A_B \sim 1.0$ in certain parts of the anti-center direction, so this should be possible.

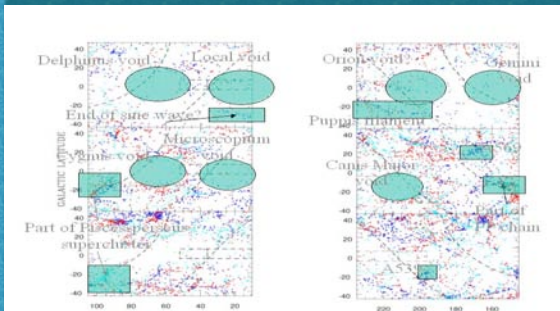


Figure 1 (From Henning *et al.* 2006) redshift slices of known galaxies in and near the inner and outer Galaxy regions accessible to Arecibo. Top panels show galaxies with $v_{hel} < 3500$ km/s, middle panels with $3500 < v_{hel} < 6500$ km/s, and bottom panels with $6500 < v_{hel} < 9500$ km/s. Known and suspected large-scale structures are labeled (Fairall 1998).

Precursor Observations

While the full survey begins in Summer 2007, we conducted precursor observations in 2005-2006 on a 40 deg² patch of sky, in the vicinity of $l=40^\circ$, and a separate 100 deg² patch of sky near $l=192^\circ$. Each point on the sky is covered by two passes, reaching RMS sensitivities of 5-6 mJy per beam.

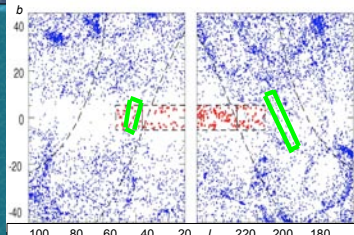


Figure 2 LEDA galaxies within 12,000 km/s in and near the two ZOA regions accessible to Arecibo, the inner (left) and outer Galaxy (right). Dashed curves show the regions of sky Arecibo can see. The rectangles containing the Galactic equator show the overlap with the HI Parkes ZOA survey, with galaxies detected by Parkes plotted with heavy dots. Green boxes indicate ALFA ZOA precursor regions.

Results

72 galaxies detected in the 140 deg² of sky covered by precursor observations.

Figure 5 Left heliocentric redshift and right HI flux distributions for the 72 detections.

Of the 72 detections:

- 15 have no known counterpart — observed here for the first time
- But only 32 of the 57 known objects have previously known redshifts (mostly radio)
- 23 objects with previously known HI fluxes and widths
- 10 gals are in the inner Galaxy region, where all but one of the counterparts have been detected in the radio only

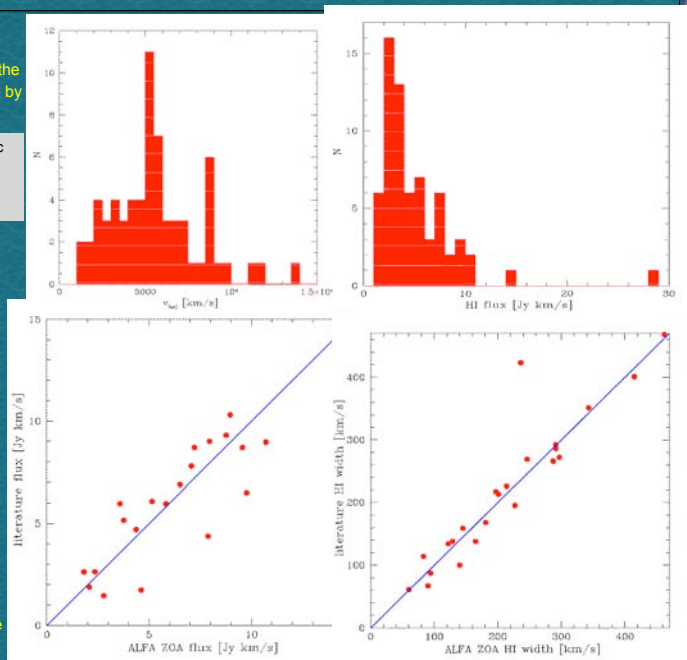


Figure 6 Left HI fluxes and right HI widths for galaxies with HI parameters in the literature—comparison between our values and literature values.

Our fluxes and widths are consistent with the values from the literature, given the typical errors associated with each quantity.

Summary

- We will map the ZOA behind the inner Galaxy in the Arecibo sky, within $|b| < 10^\circ$, to an RMS of $\sim 5-6$ mJy.
- Will also map both the inner and outer Galaxy Arecibo ZOA, within $|b| < 5^\circ$, with ~ 20 times longer integration time.
- The majority of our detections have known counterparts in the literature, but less than half have previously known redshifts—exploring new part of LSS.
- Only one of our detections in the inner Galaxy region has been observed in wavelengths other than radio; most of those in the outer Galaxy were detected by 2MASS.
- We find a strong correlation between our HI parameters and those from the literature.

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