

THE GALEX ARECIBO SDSS SURVEY (GASS)



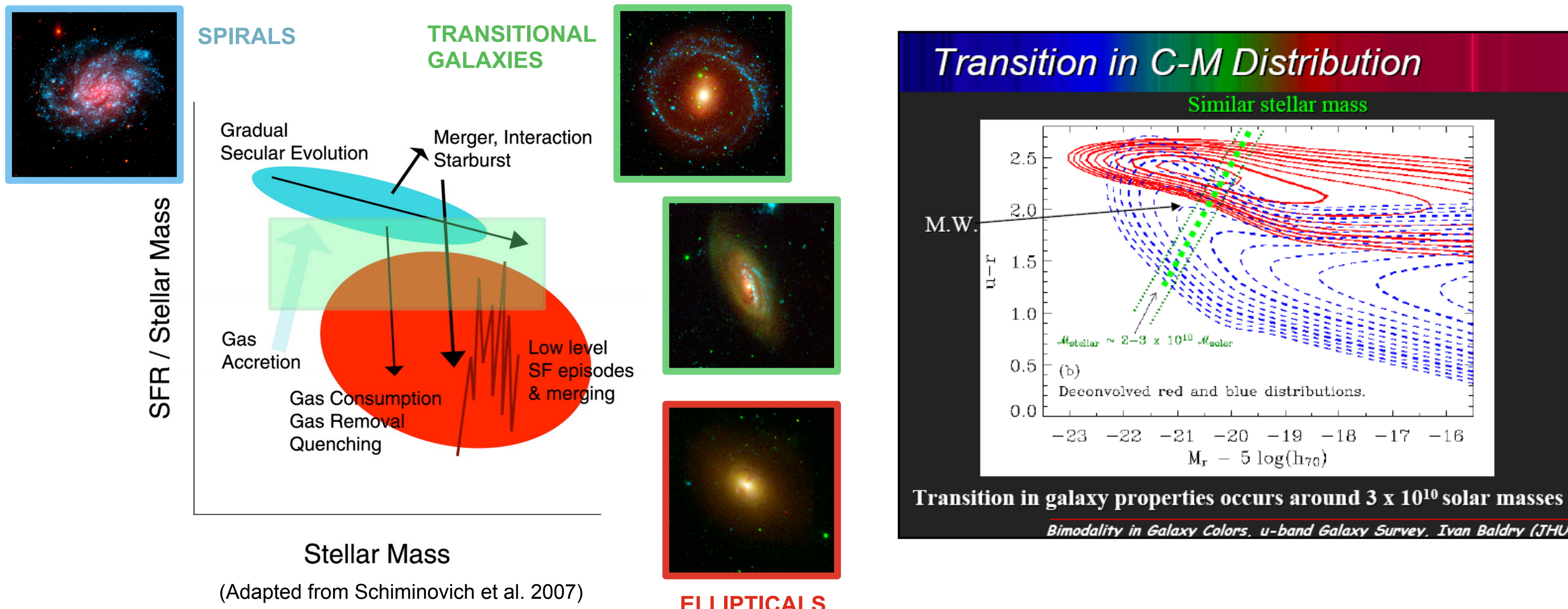
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INTRODUCTION

The GALEX Arecibo SDSS Survey (GASS) is a large targeted survey to be carried out at Arecibo. GASS is designed to measure the neutral hydrogen content of a representative sample of massive, transitional galaxies, uniformly selected from the SDSS spectroscopic and GALEX imaging surveys.

HI studies of transitional galaxies are currently not possible using existing HI surveys, which sample only shallow volumes: a specifically designed, targeted survey is required. GASS will produce the **first statistically significant sample of massive transitional galaxies with homogeneously measured stellar masses, star formation rates (SFR) and gas properties**. The final data base will include optical, UV and HI parameters for ~1000 galaxies with stellar mass $M_{\text{star}} > 10^{10} M_{\text{sun}}$ and gas mass fractions as low as 1.5%. This sample will allow us to investigate if and how the cold gas responds to a variety of different physical conditions in the galaxy, thus yielding important insights on the physical processes responsible for the transition between blue, star-forming and red, passively-evolving galaxies.



SURVEY GOALS

GASS will deliver catalogs of HI and value-added properties which will be used as the basis for a large number of studies. Initial science investigations will include:

- ◆ Distribution function of gas fraction as a function of stellar mass and SFR in local galaxies
- ◆ Relation between optical and UV indicators of star formation and the gas content of galaxies
- ◆ Baryonic scaling relations (in combination with ALFALFA data)
- ◆ Gas in and around nearby AGN
- ◆ Connection between gas content and dust attenuation
- ◆ Relationships among HI and the extended UV disk phenomenon
- ◆ Origin of the mass metallicity relation
- ◆ Environmental dependence of HI gas mass fraction

SAMPLE SELECTION

The selection criteria for the GASS targets are the following:

- ◆ location within the intersection of the footprints of the SDSS DR6 spectroscopic survey, the GALEX Medium Imaging Survey (MIS) and the Arecibo Legacy Fast ALFA (ALFALFA) survey
- ◆ redshift $0.025 < z < 0.05$
- ◆ stellar mass $10.0 < \log M_{\text{star}} < 11.5$
- ◆ ALFALFA will detect only the gas-richer systems
- ◆ the targets will be observed until either a gas fraction limit $F_{\text{gas}} = M_{\text{HI}}/M_{\text{star}} = 1.5\%$ or a minimum HI mass of $10^{8.5} M_{\text{sun}}$ is reached.

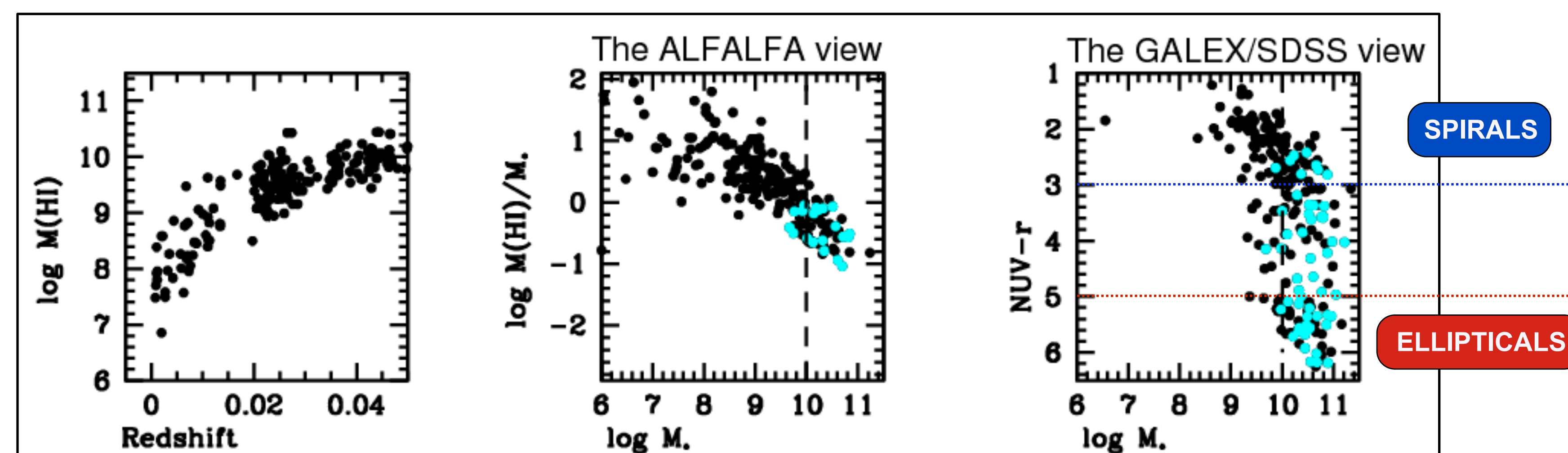
GAS MASS FRACTION/GAS MASS LIMIT

In order to obtain a *complete* sample of galaxies with $M_{\text{star}} > 10^{10} M_{\text{sun}}$, we need to observe the targets to an equivalent gas mass fraction limit. Practically, we have set the following limits:

$$F_{\text{gas}} > 0.015 \quad \text{if } \log M_{\text{star}} > 10.35$$

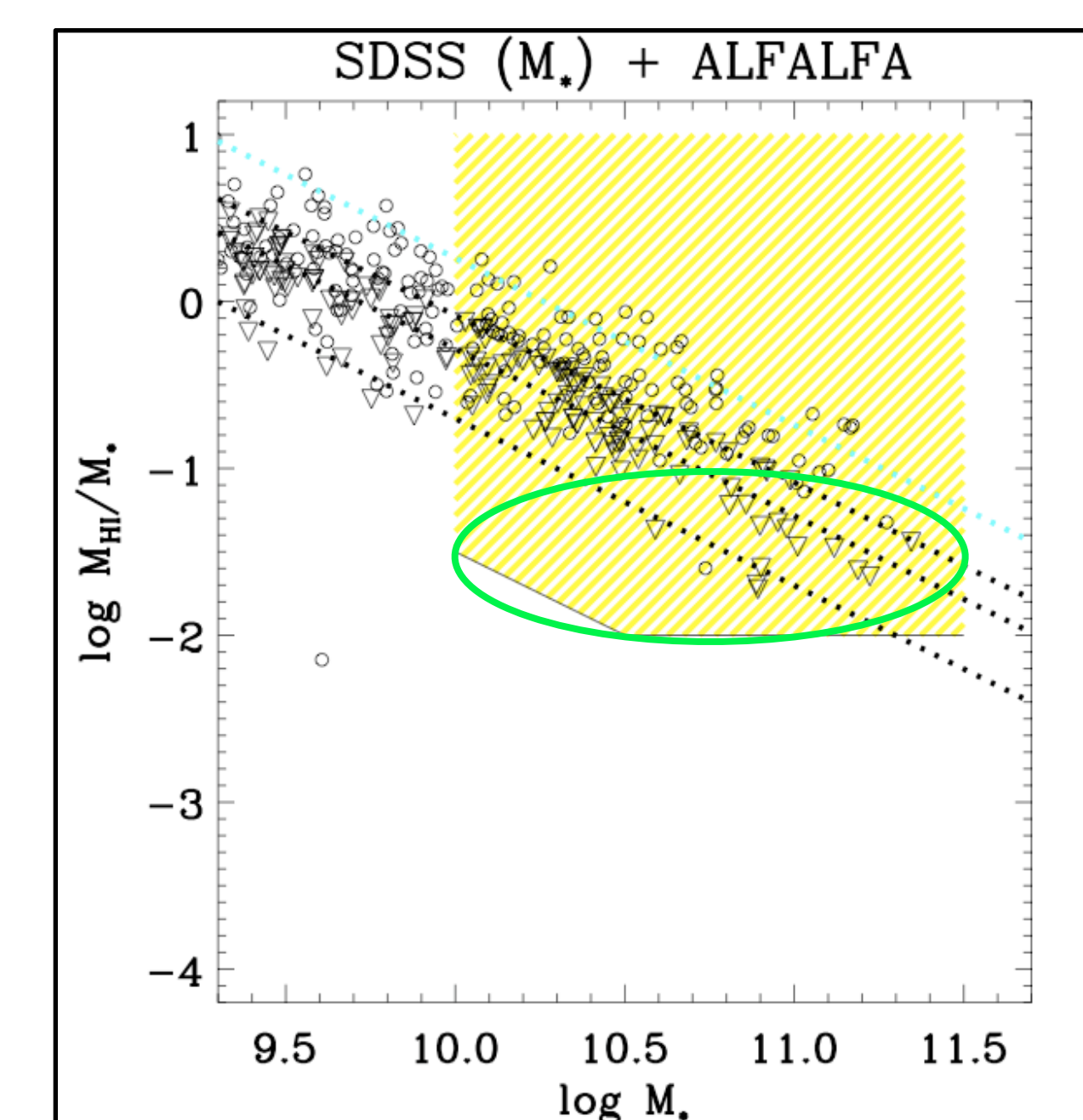
$$\log M_{\text{HI}} = 8.5 \quad \text{if } \log M_{\text{star}} < 10.35.$$

This corresponds to a limit $F_{\text{gas}} = 0.015-0.03$ for the whole sample. The figure below shows that GASS should detect galaxies with F_{gas} significantly below the gas-rich ALFALFA detections (as highlighted by a green ellipse), and consistent with those of early-type transition galaxies harboring significant reservoirs of gas.



Left: HI mass vs. z for a sample of 227 galaxies from ALFALFA DR1 (Giovanelli et al. 2007) with matches in the SDSS spectroscopic sample. Center: HI gas mass fraction vs. stellar mass. Right: Properties of a random sample of 227 galaxies from GALEX/MIS with matches in SDSS and $0.01 < z < 0.05$. Cyan points denote AGN. Dashed line: GASS stellar mass limit.

A *complete* sample of galaxies with $M_{\text{star}} > 10^{10} M_{\text{sun}}$ spans an extremely wide range in NUV/optical colors. The spread is much more dramatic than that seen in optical colors alone. Galaxies with $\text{NUV-r} < 3$ are typically star-forming spirals and are likely to have reasonably high gas fractions. Colors $\text{NUV-r} > 5$ correspond to passive ellipticals. The intermediate color regime, where the transitional galaxies are found, is consistent with ongoing SFR at a level of a few percent of M_{star} over the past Gyr and moderate gas fractions (1–10%). Over this stellar mass regime, ALFALFA detects only systems with $F_{\text{gas}} > 10\%$. Thus it is clear that, in order to systematically quantify the HI properties of these objects, a significantly deeper, targeted HI survey is required.



Gas mass fraction vs. stellar mass for ALFALFA DR1 detections and upper limits (shown as upside down triangles, with only 1 in 5 points plotted). ALFALFA data are restricted to $0.025 < z < 0.05$. Black solid line: GASS F_{gas} and M_{HI} limit. Yellow shaded area: GASS survey coverage. Black dotted lines: ALFALFA detection limits at $z=0.025$, 0.04 and 0.05 (bottom to top). Cyan dotted line: HIPASS detection limit at $z=0.025$.

SURVEY STATUS & PLANS

- ◆ The proposal for GASS was submitted in June 2007 and later approved by the skeptical review (observing time requested to complete the project: 840 hours). The Arecibo observations are expected to start in early 2008.
- ◆ The construction of the GASS data base is underway. The GASS *parent sample* of galaxies in the ALFALFA and SDSS DR6 spectroscopic survey footprints, meeting GASS stellar mass and redshift cuts, includes 12008 objects. Of these, 2078 have already been observed by GALEX to MIS depth. A subset of 285 galaxies lies in the sky region where ALFALFA data have already been processed (as of Feb. 2008). ALFALFA detected 50 galaxies out of 208 that have been cataloged in this region to date.
- ◆ As ALFALFA proceeds and more GALEX/MIS observations become available, the list of potential GASS targets will grow. The final sample for Arecibo observations will include ~1000 galaxies, chosen by randomly selecting a subset which balances the distribution across stellar mass and RA and which maximizes existing GALEX exposure time.
- ◆ In order to make the most use of the data that are already available, we will stack ALFALFA observations of GASS candidates with similar optical and/or UV properties. This will allow us to place upper limits on the HI content of different classes of objects and carry out preliminary science investigations.
- ◆ For more information visit the GASS web site: <http://www.mpa-garching.mpg.de/GASS>

GASS DATA ACCESS

The GASS HI spectral data products will be incorporated into the Cornell-NAIC Extragalactic HI Digital Archive (<http://arecibo.tc.cornell.edu/hiarchive>), a registered VO node that contains the ALFALFA data releases as well as other HI data sets. The archive is SQL and cone searchable and spectra can be downloaded in VOTable, FITS and ASCII formats. Through VO tools already developed for ALFALFA, ancillary datasets from GALEX, SDSS, 2MASS etc. will also be accessible.

GASS TEAM

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