Optical Properties of the HI-selected Galaxies from the Arecibo Dual Beam Survey

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What will ALFALFA galaxies look like in the optical?

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- Overview of ADBS
- Optical follow-up of ADBS galaxies
- Properties of the ADBS galaxies

The ADBS Survey

- The Arecibo Dual Beam Survey (ADBS) was carried out by Rosenberg & Schneider (2000). It was a drift-scan survey taken in a series of declination strips with the Arecibo 305-m telescope. The velocity limit of the ADBS is 8000 km/s (it is volume limited!). The full ADBS sample includes 265 galaxies over ~420 sq. deg.

- Since it is a “blind” HI survey, it does not suffer from optical selection effects and therefore offers a unique, unbiased look at the gas-rich galaxy population in the local universe.

- Over 30% of the ADBS galaxies have never been included in any optical catalog, and ~50% are fainter than the Updated Zwicky Catalog (UZC) magnitude limit (B = 15.5).

- The ADBS sample provides an excellent means to investigate the environmental influences on gas-rich galaxies in low-to-intermediate densities, thereby permitting an assessment of how the local environment of a galaxy affects its evolution.

Arecibo Observatory

Arecibo, Puerto Rico

305-m Radio Telescope

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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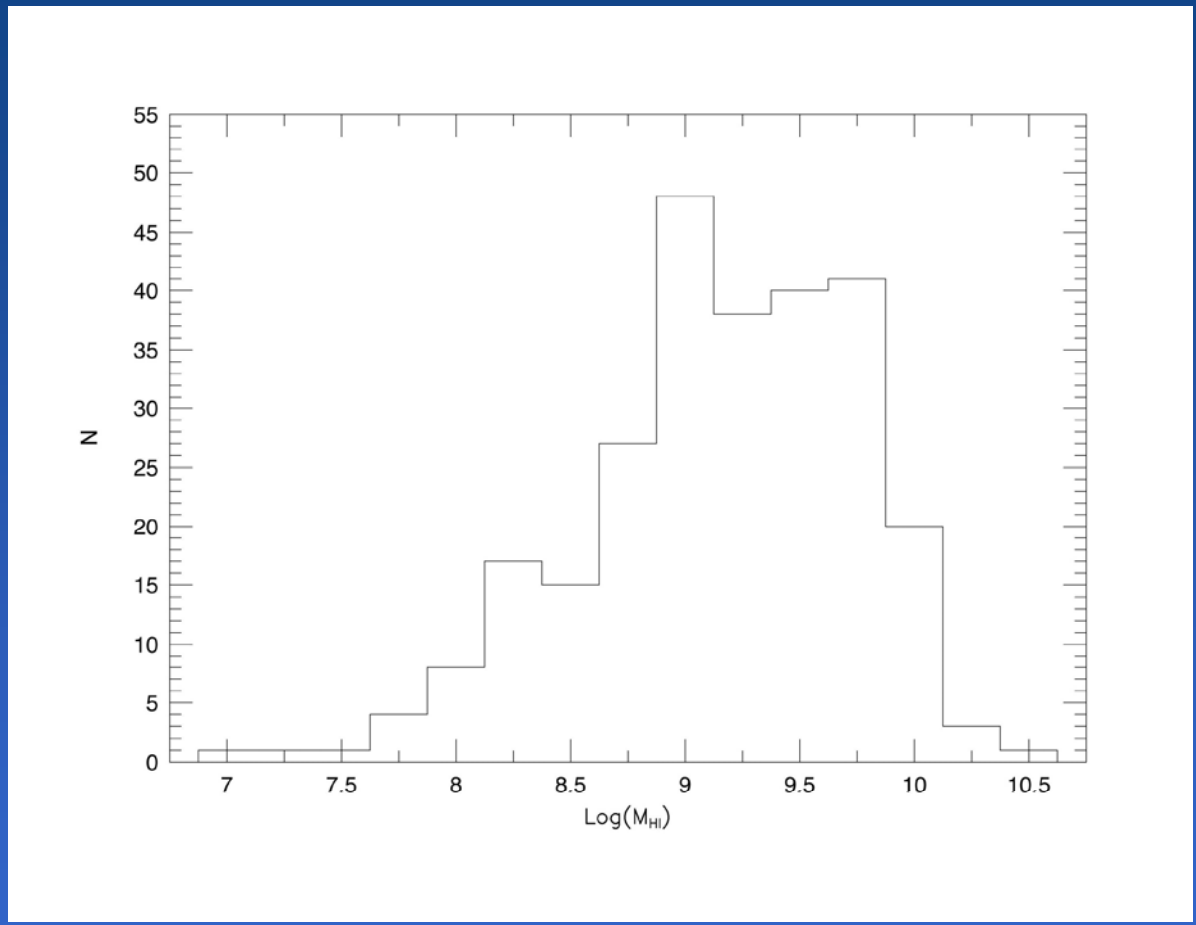
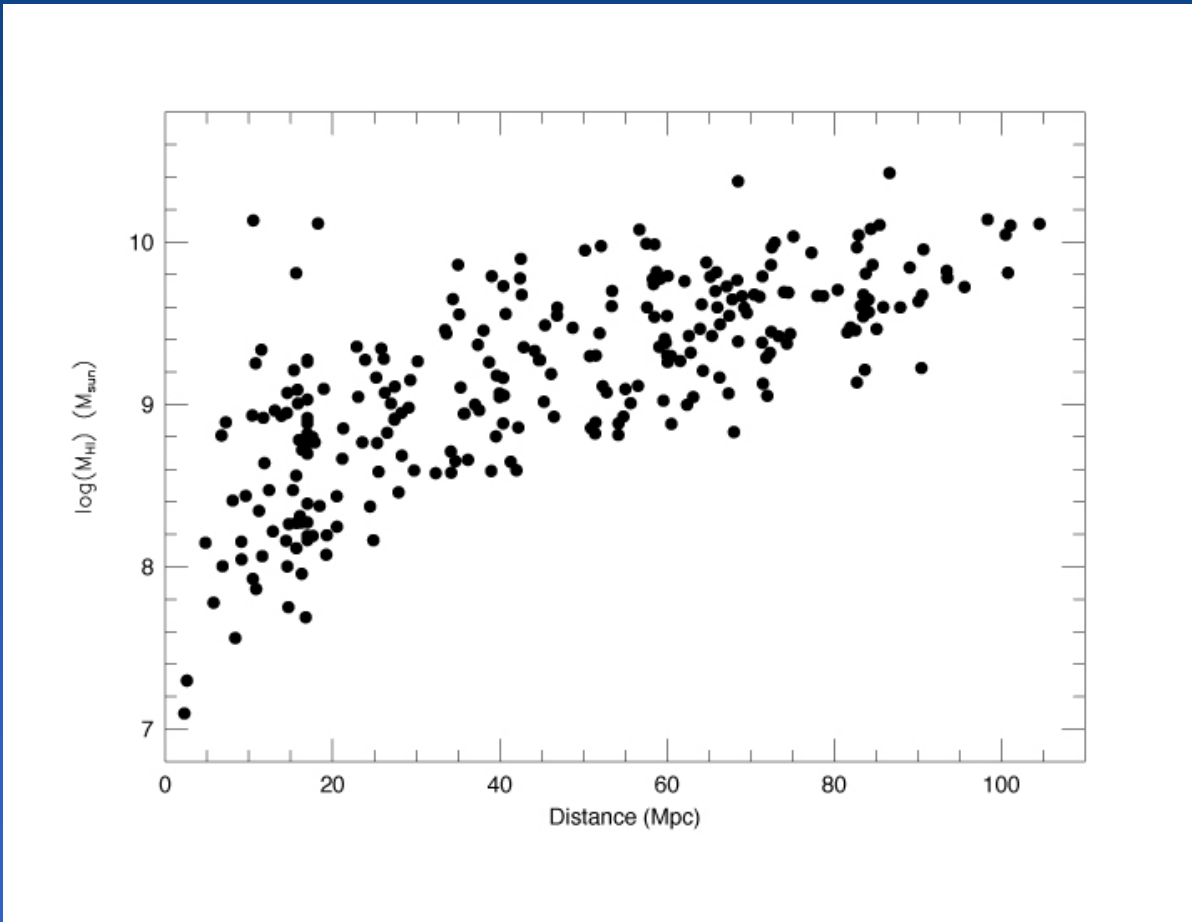
The ADBS Survey



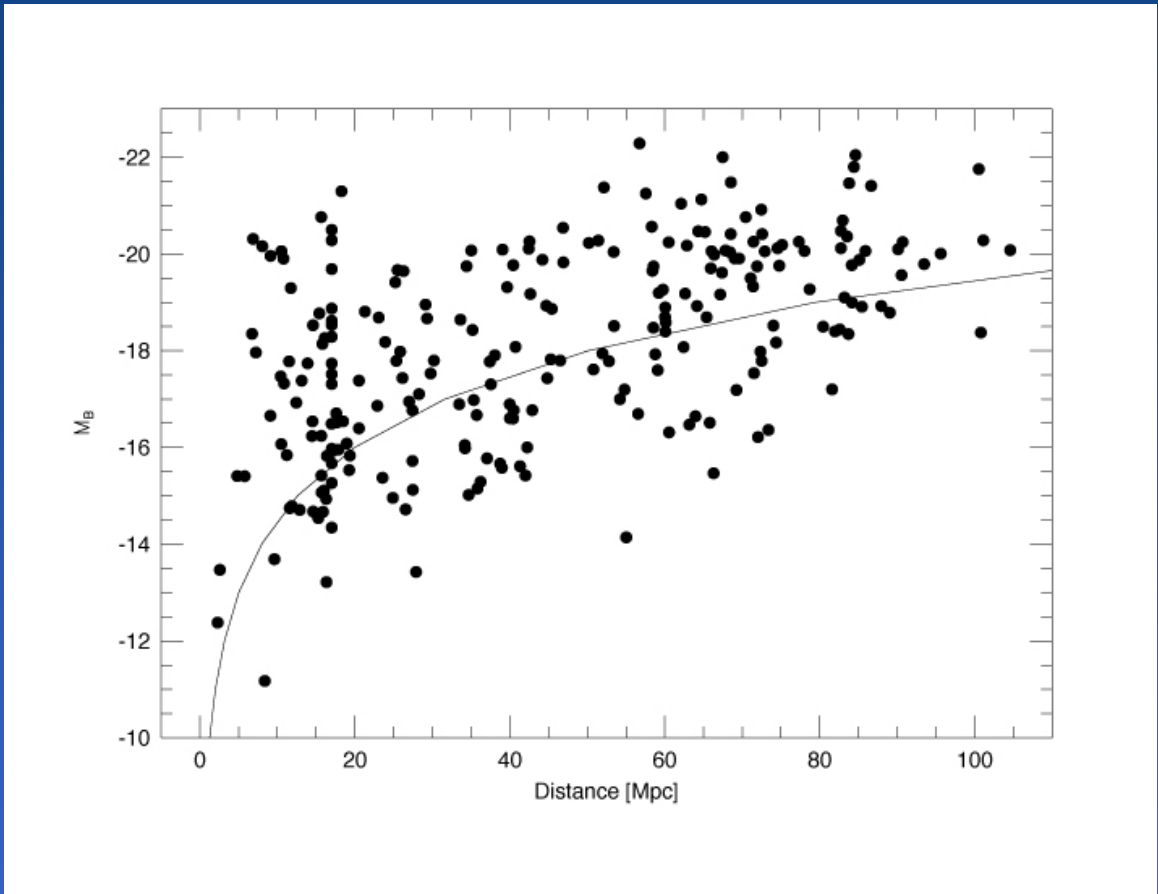
The galaxies detected in the ADBS exhibit a broad range of HI masses, with a median value of $\log(M_{HI}) = 9.21$ and a tail extending to values below 10^8 solar masses.

The Power of the ADBS



As one would expect from such a sample, lower HI mass galaxies are detected nearby, whereas high HI mass galaxies are detected at all distances covered by the survey.

The Power of the ADBS



When looked at in terms of its optical properties, the ADBS sample detects far lower luminosity galaxies than does the Zwicky Catalog magnitude-limited sample (B<15.5) at all distances.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Optical Observations of the ADBS Galaxies

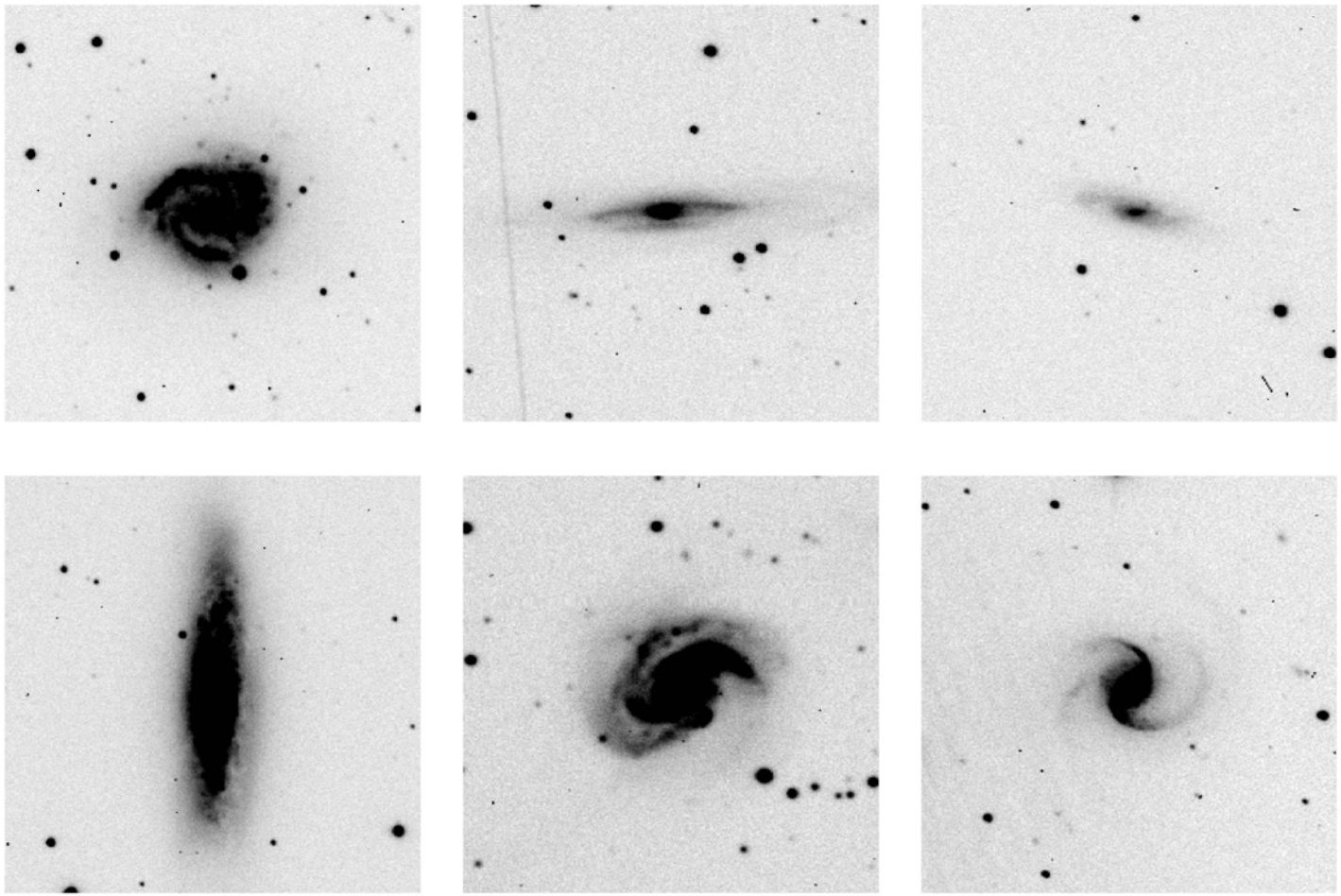
QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

All Observations for this project have been obtained on the WIYN 0.9m telescope on Kitt Peak, which is operated jointly by a consortium of universities that includes Wesleyan.

Galaxies imaged through B & V filters with 2k x 2k CCD with 0.6 arcsec pixels.

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Example Broad-Band Images of ADBS Galaxies



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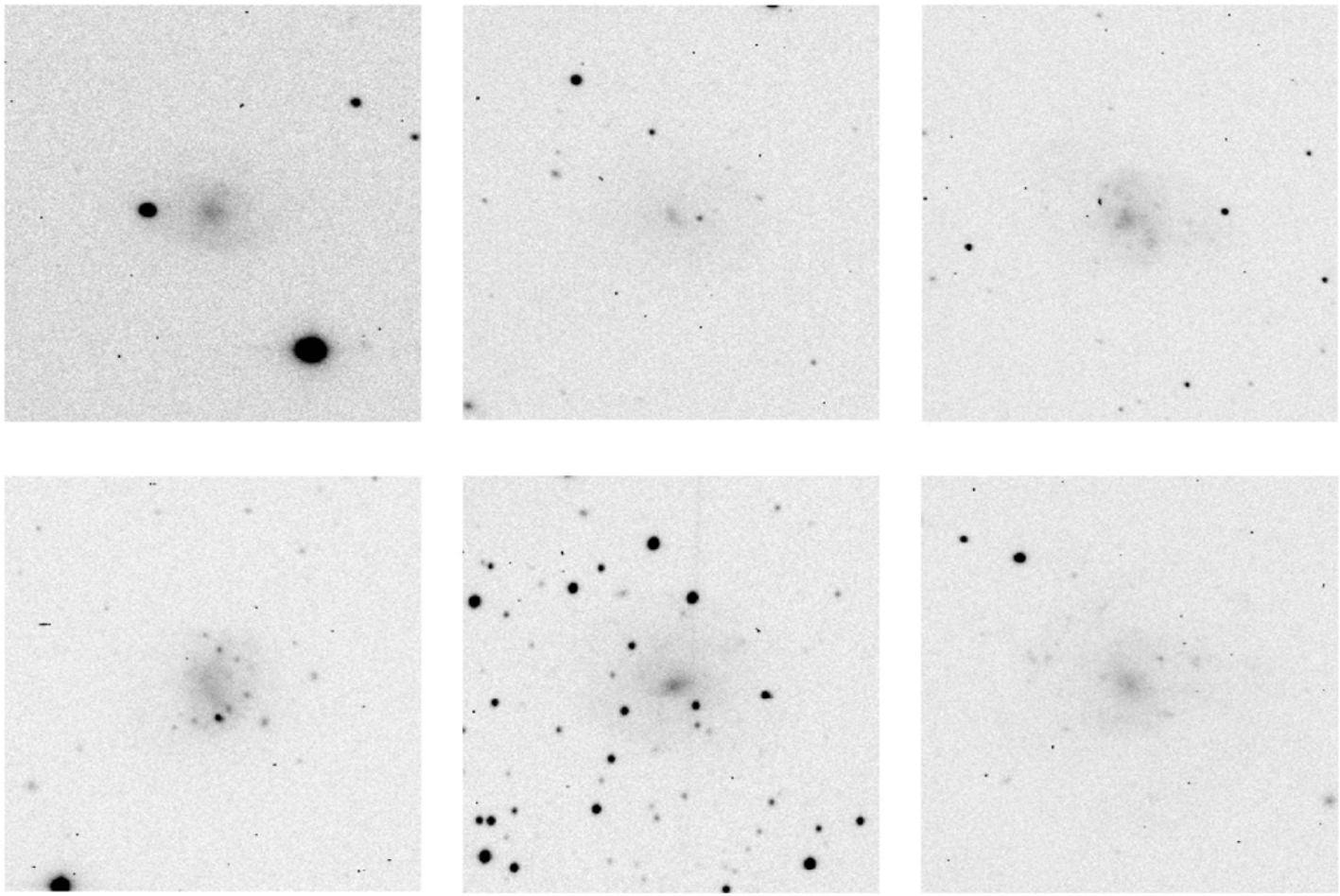
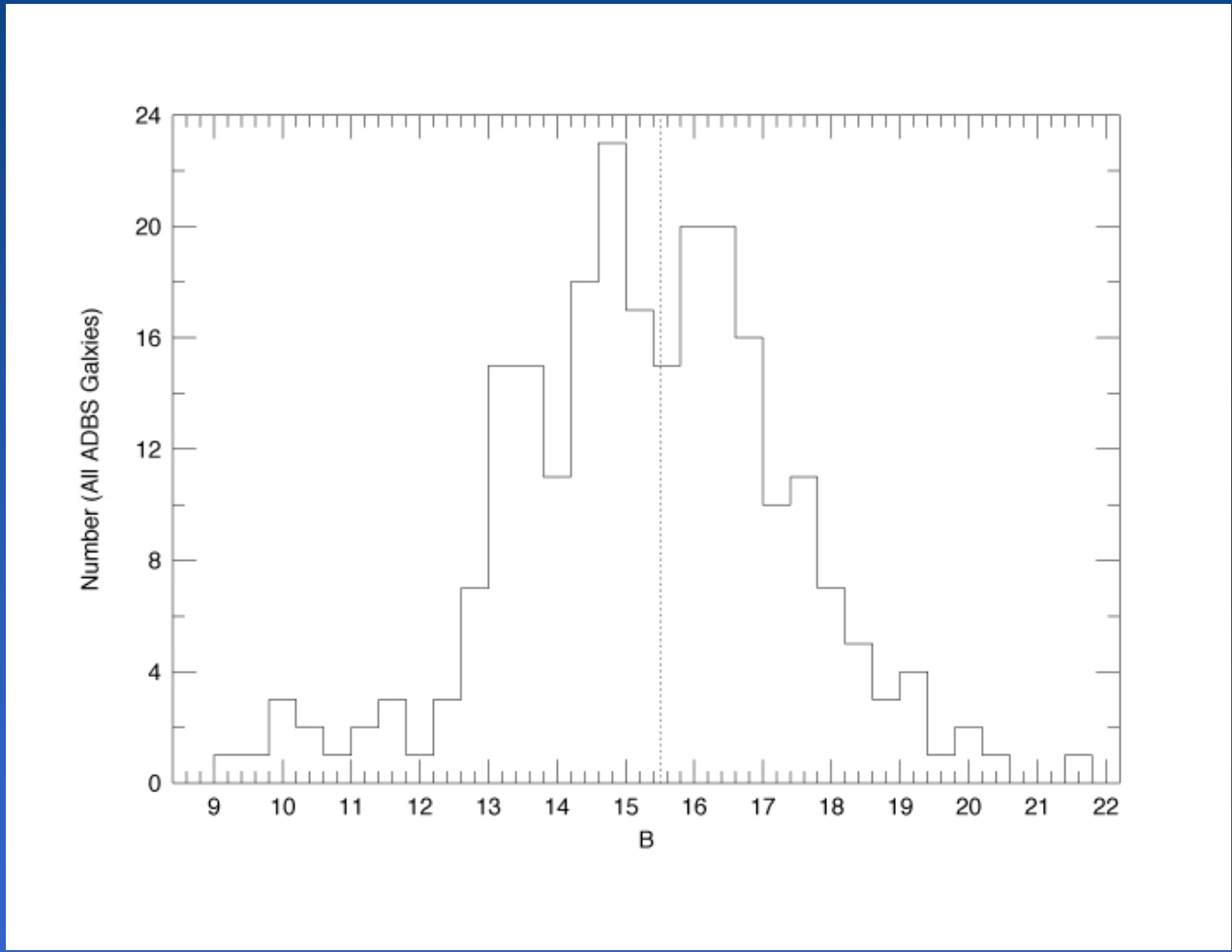
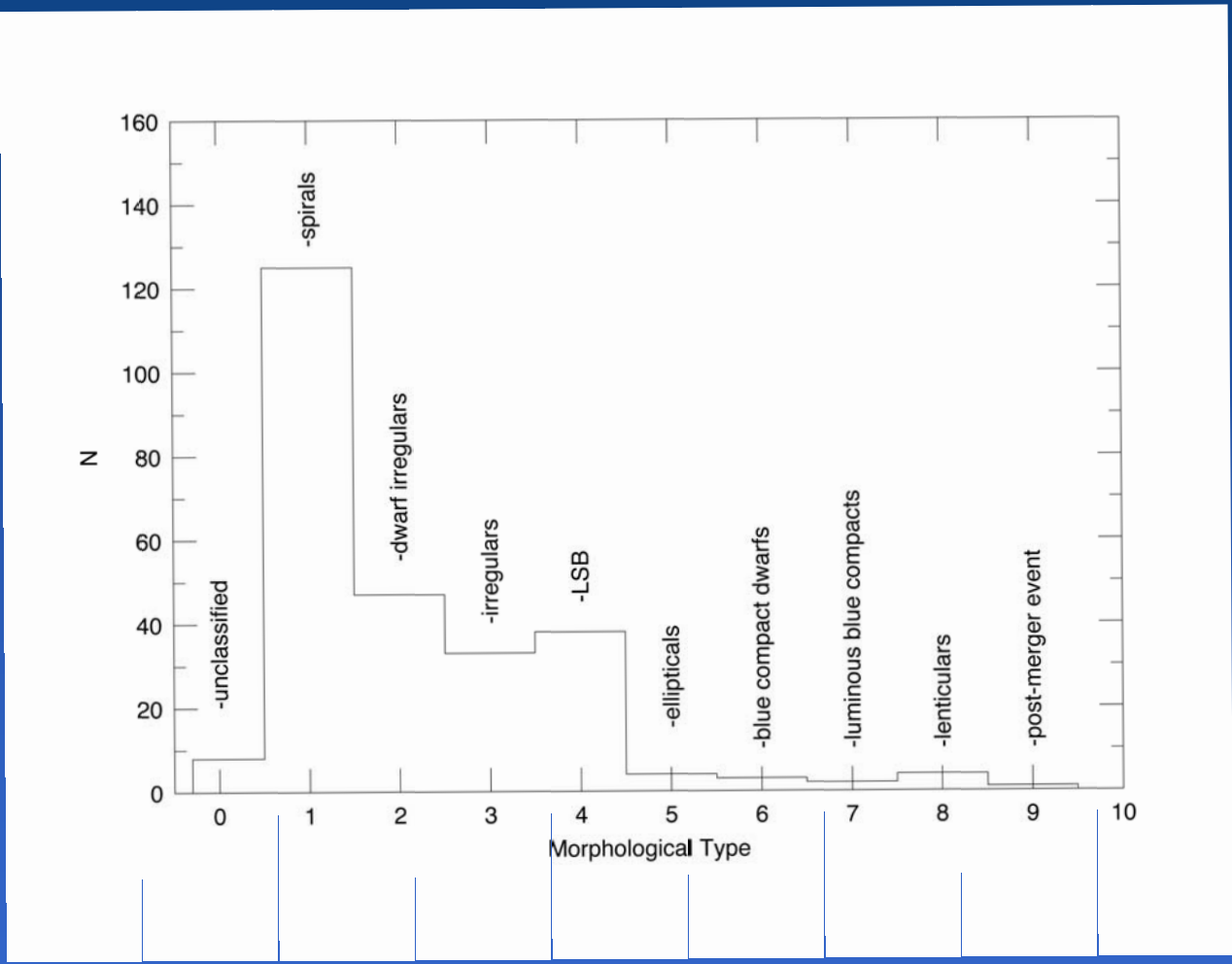


Properties of the ADBS



Apparent magnitudes. Nearly half of the ADBS galaxies have B > 15.5. These fainter galaxies are not included in magnitude-limited catalogs.

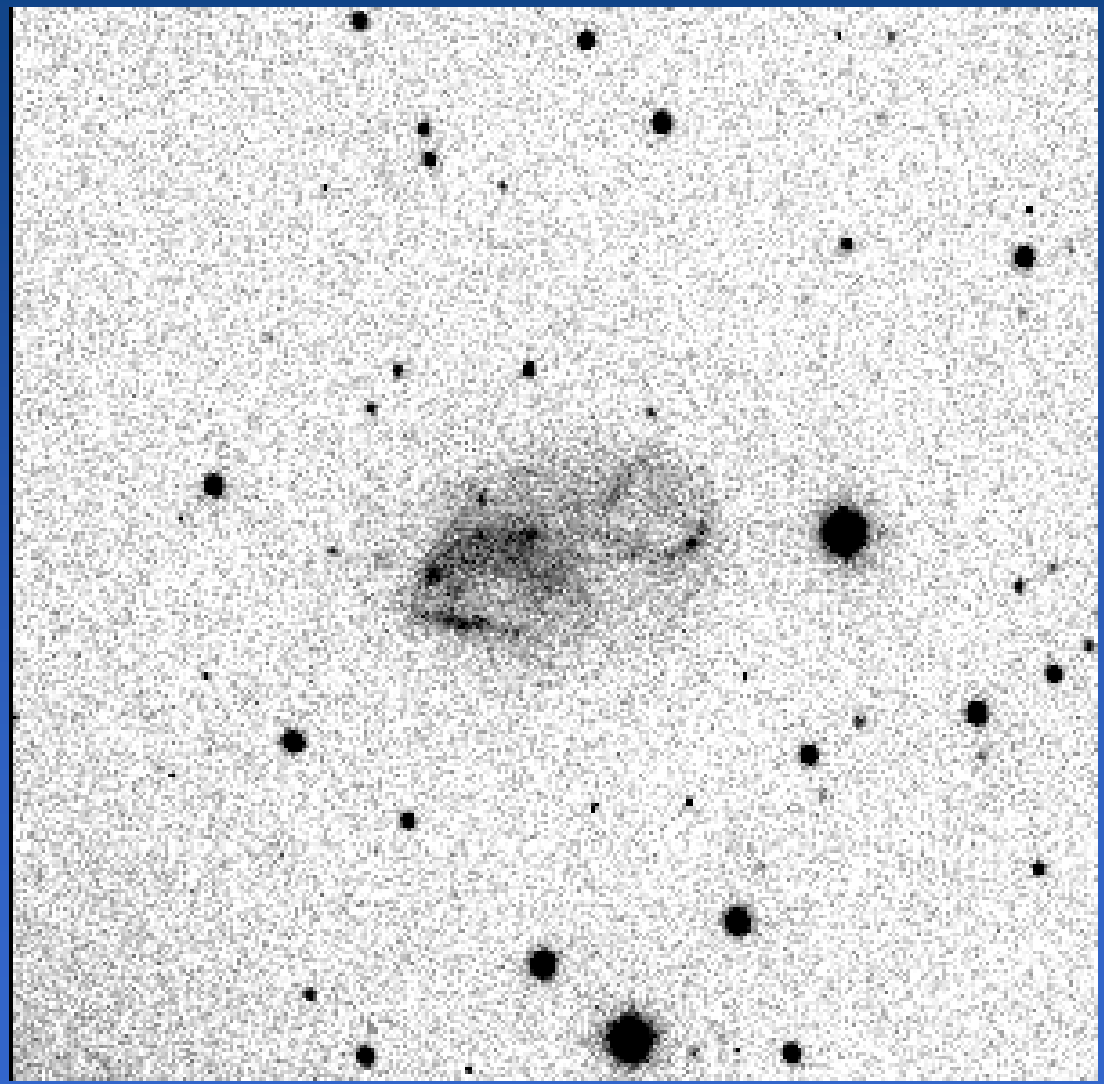
Properties of the ADBS



Morphological Classifications. The ADBS is a roughly equal mix of spirals and irregulars (including the LSB galaxies). There is a small number of early types and compact objects.

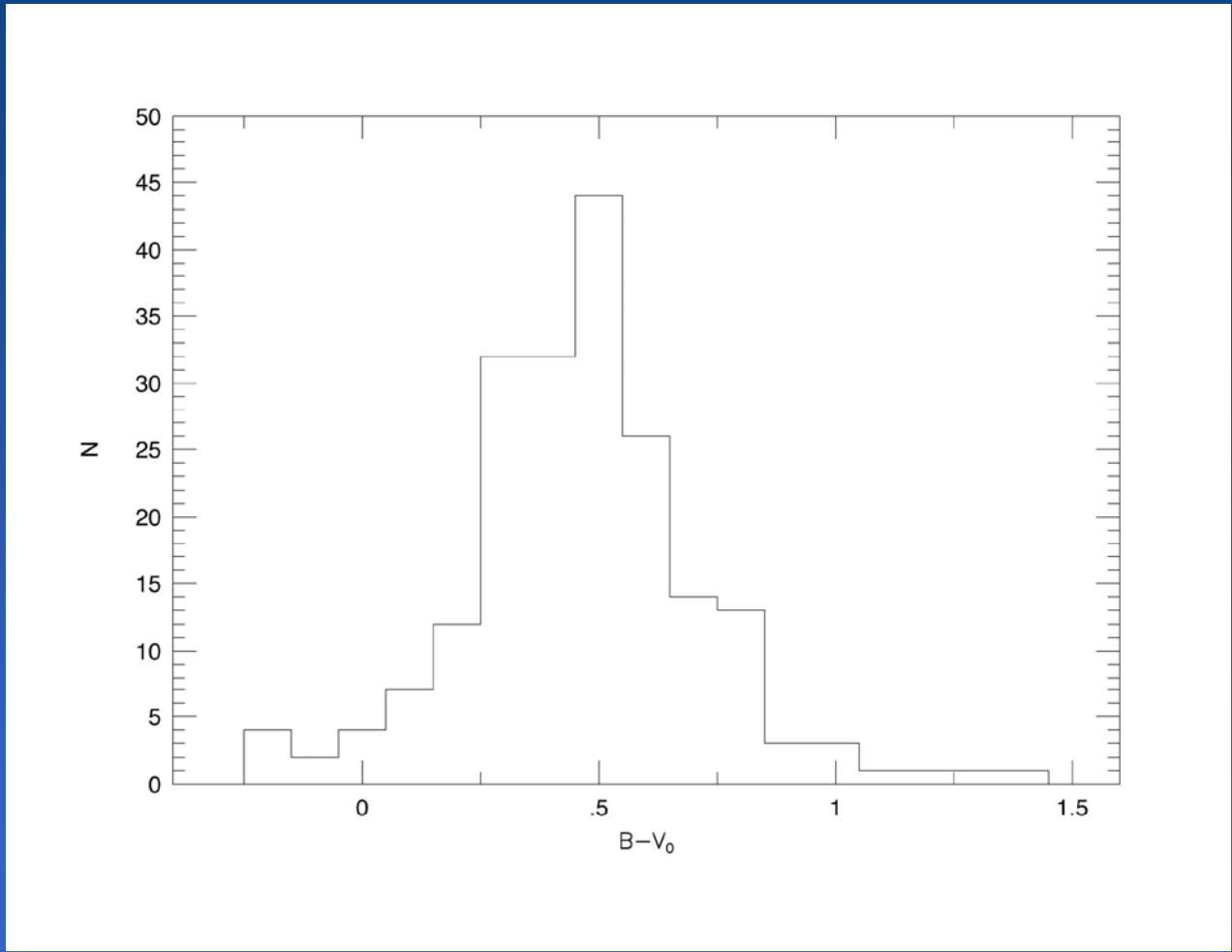
Properties of the ADBS

Example LSB dwarf galaxy in the ADBS



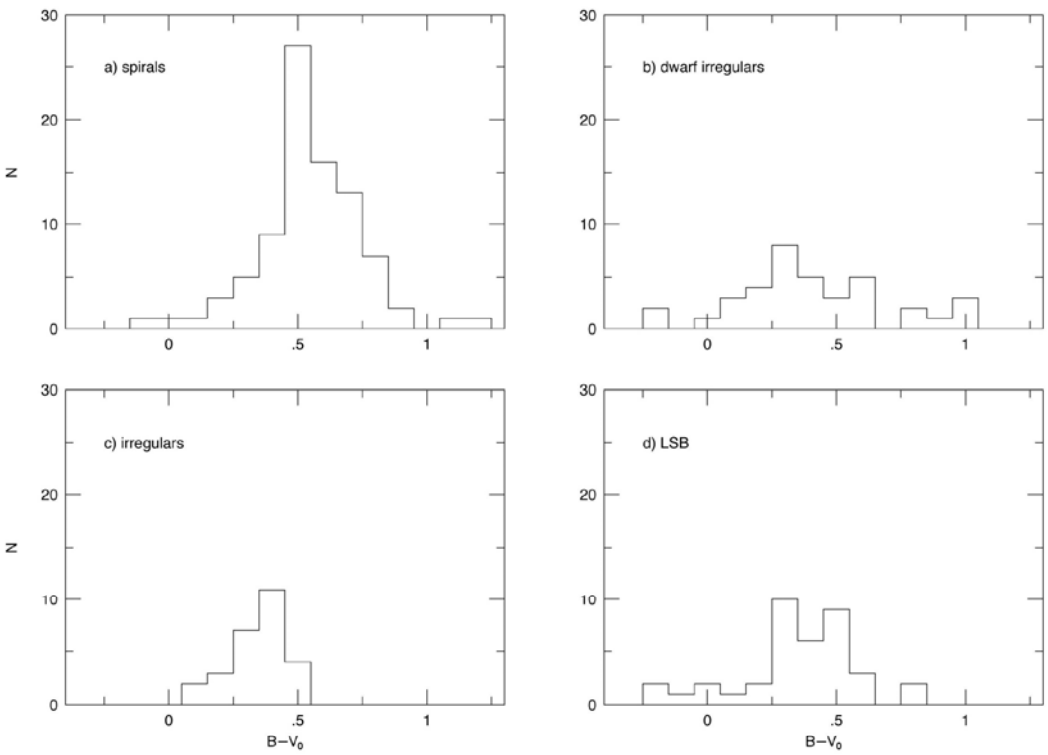
045254+2310
(a.k.a. the fish)

Properties of the ADBS



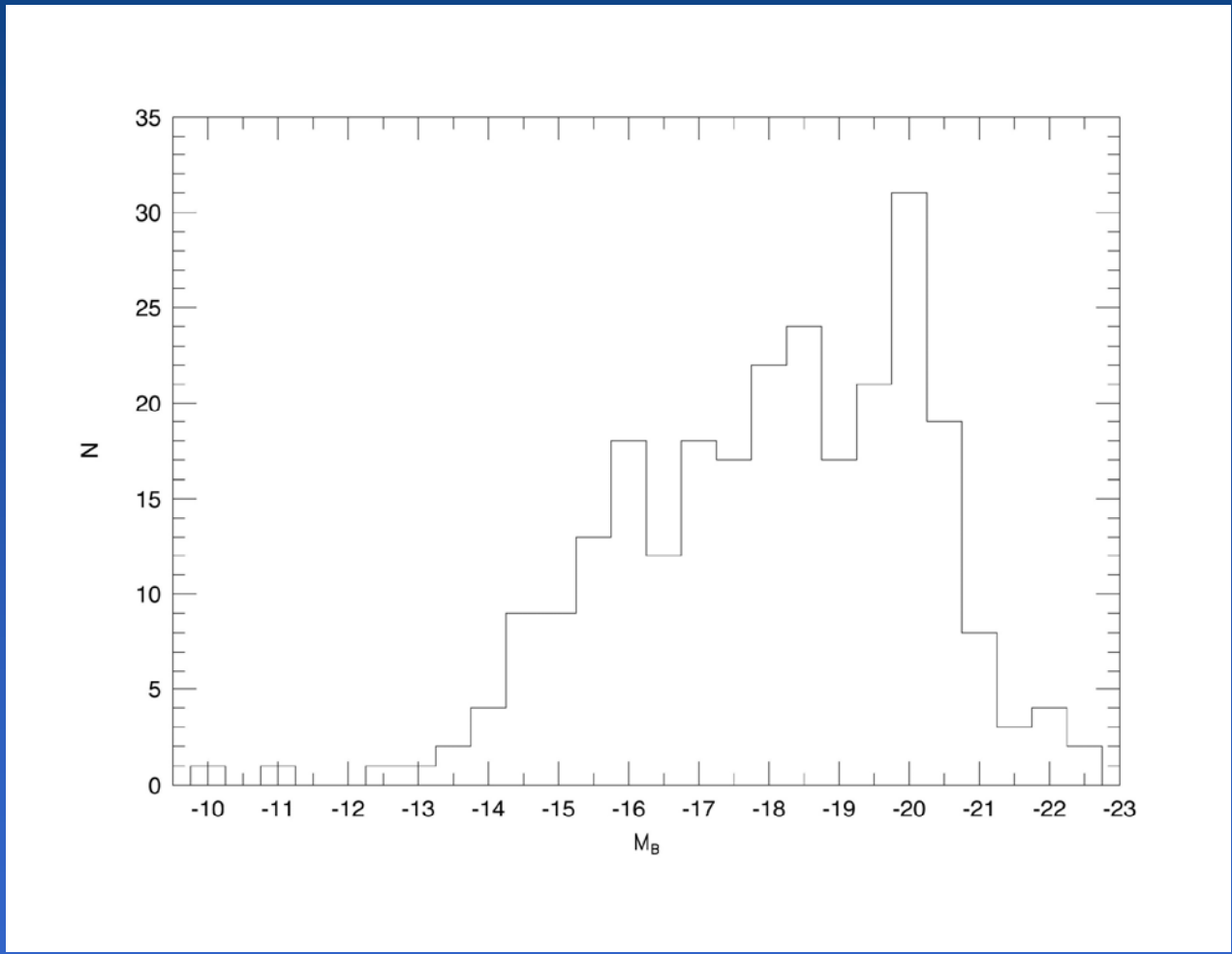
B-V colors. The median color is B-V = 0.47, far bluer than in typical magnitude-limited samples. The dwarf galaxies are particularly blue.

Properties of the ADBS



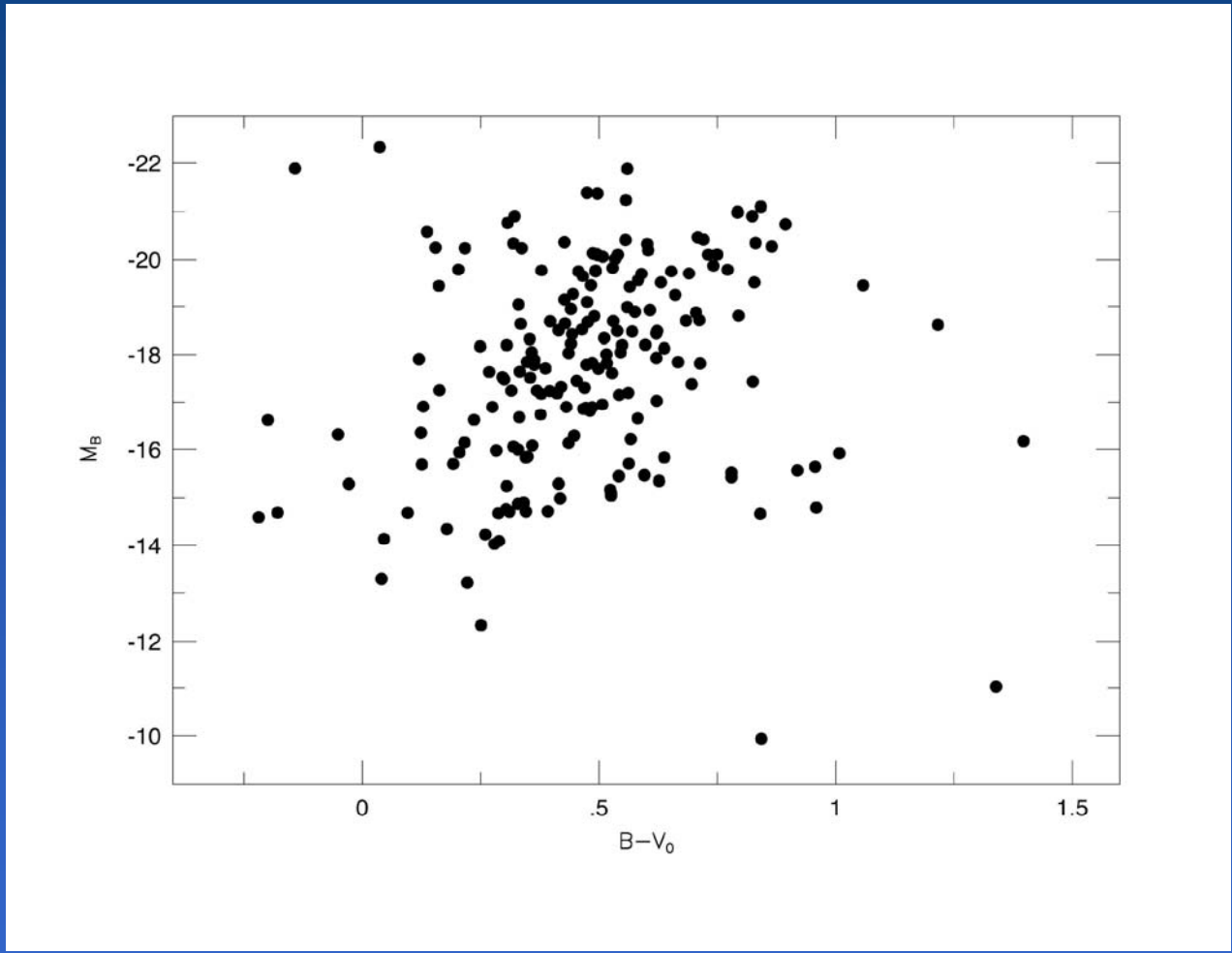
Color vs. Galaxy type. We can investigate the properties of the ADBS galaxies as a function of their galaxy class - in this case B-V color.

Properties of the ADBS



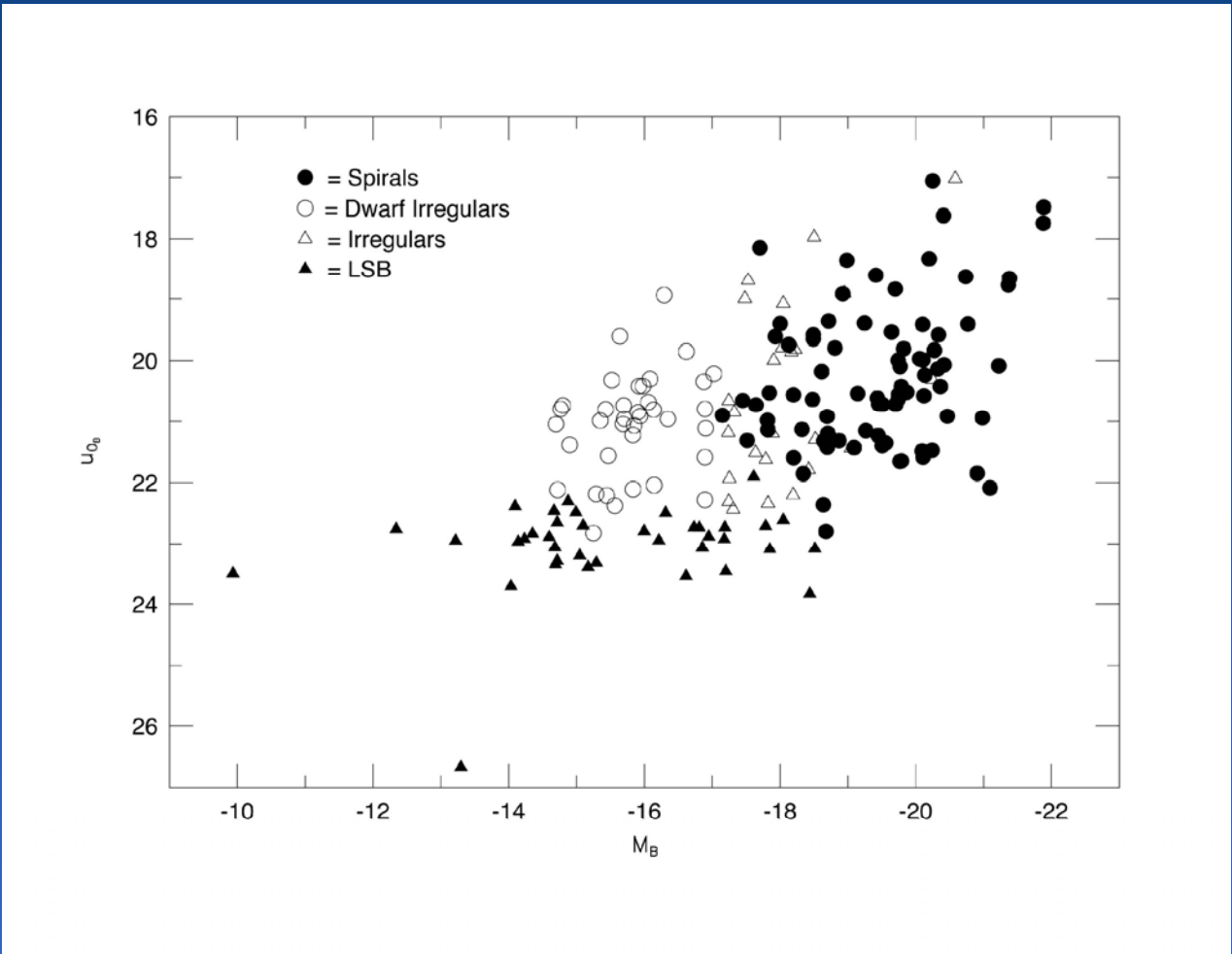
Absolute magnitudes. There is a solid component of luminous galaxies included in the ADBS, as well as a large contingent of dwarf systems. The median M_B is -18.29.

Properties of the ADBS



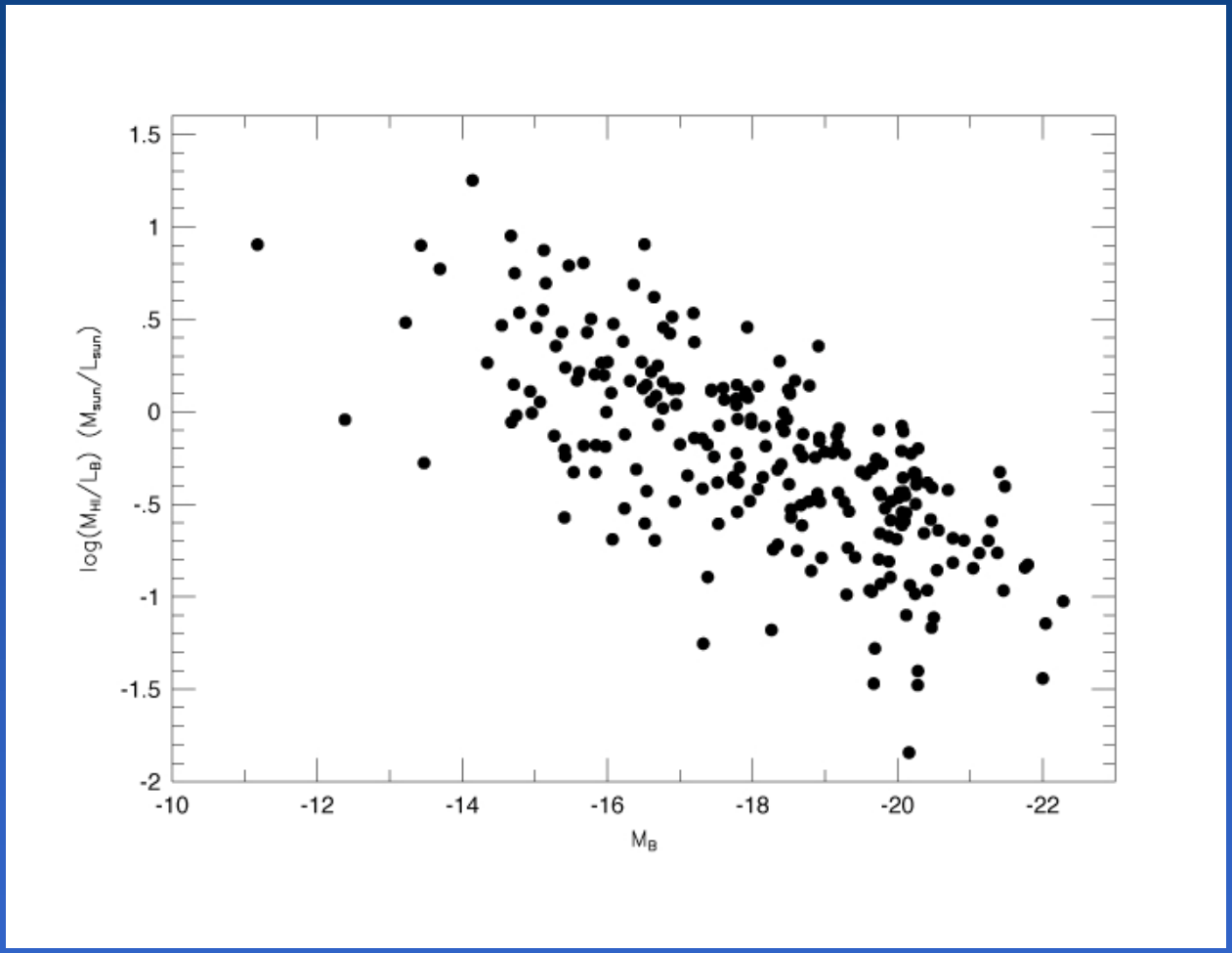
Luminosity - Color Diagram. The ADBS galaxies display a weak relationship between M_B and color, in the sense that dwarfier galaxies tend to be bluer. There are many outliers, however.

Properties of the ADBS



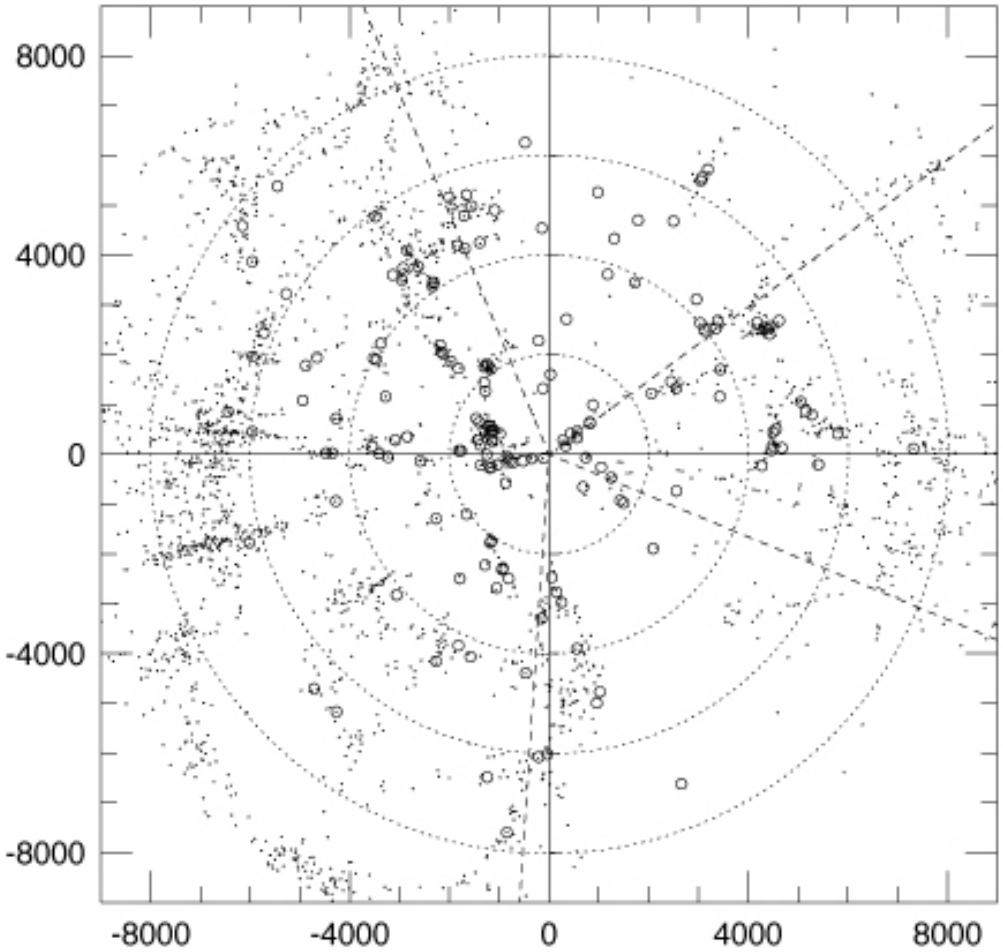
Central Surface Brightness vs. Luminosity. The major galaxy types are indicated by the plot symbols. There is a clear trend, but with much scatter.

Properties of the ADBS



HI mass-to-light ratio vs Luminosity. We see an inverse relationship between the fractional HI mass (HI mass-to-light ratio) and absolute magnitude such that the more luminous an object the lower the fractional gas content it will have.

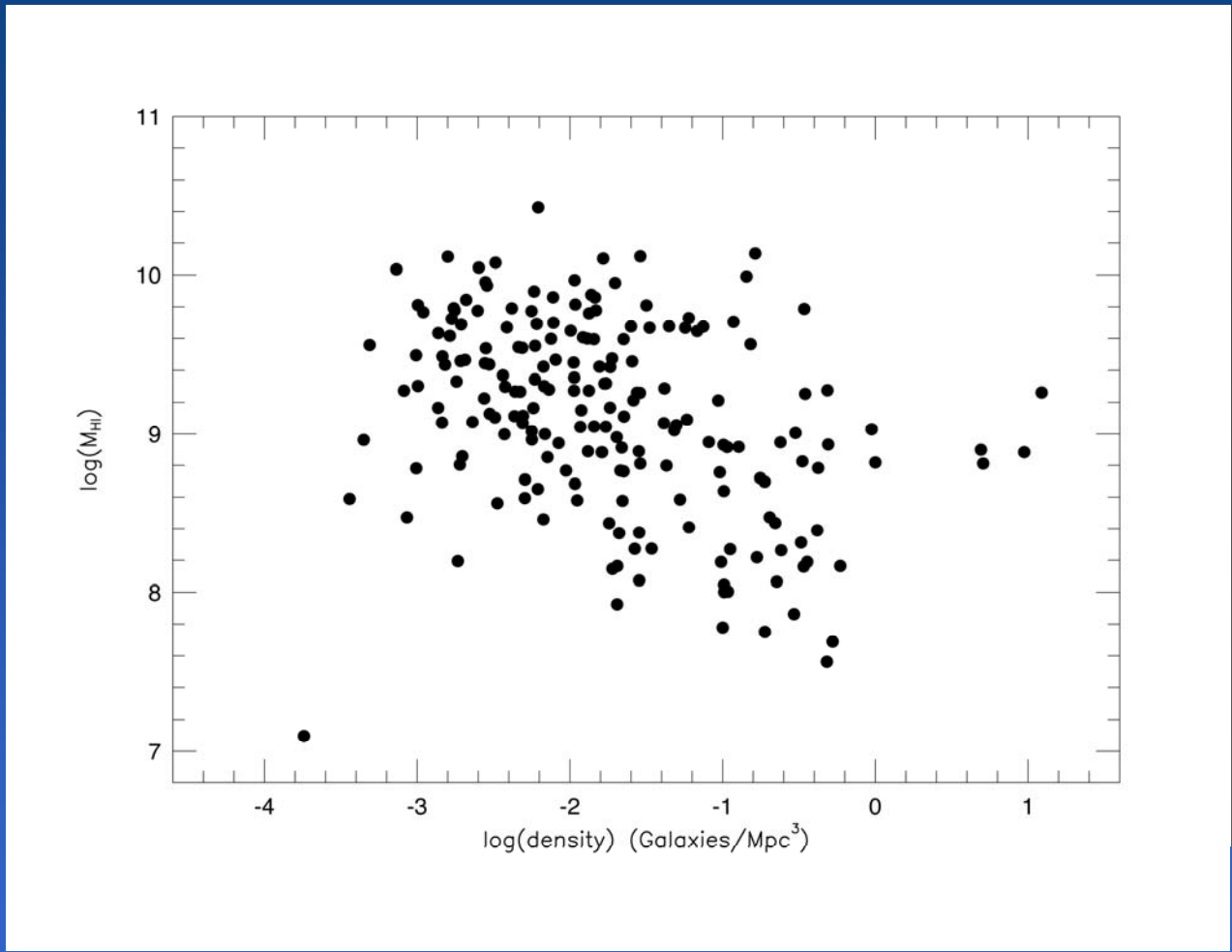
Density Environment & Analysis



Velocity circle diagrams (analogous to cone diagrams) show the UZC galaxies (small dots) and the ADBS galaxies (open circles). RA is “circular”, declination is suppressed and velocity moves outwards. Clusters, filaments and voids can be seen.

To first order, the ADBS galaxies follow the spatial distribution of the UZC galaxies. This is to no surprise since ~50% of the ADBS galaxies are in the UZC.

Density Environment & Analysis



A weak relationship is seen in the sense that the HI mass in low density environments is slightly greater than in high-density environments. This *may* be to due to gas stripping in the denser environments.

Current/Future Work

- Currently obtaining Hα Imaging to measure total amount of star formation in each galaxy. Will constrain star formation rates as a function of density.

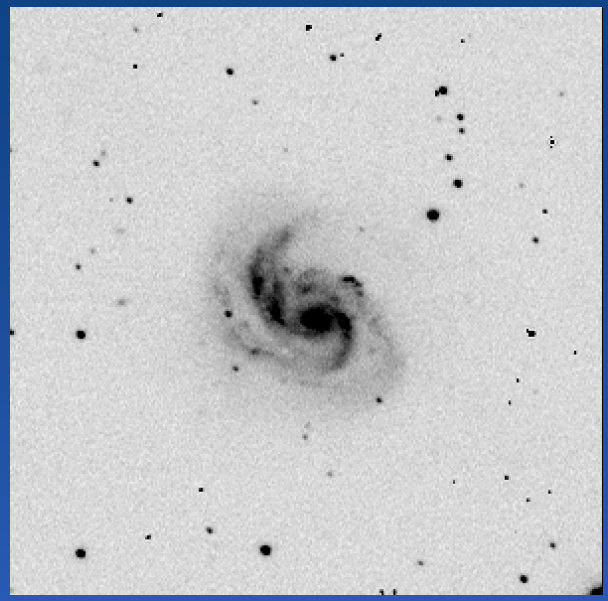
- Spectroscopy of HII regions to measure abundances. Use the Hα images to provide targets for spectroscopy - Starting in Spring ‘06

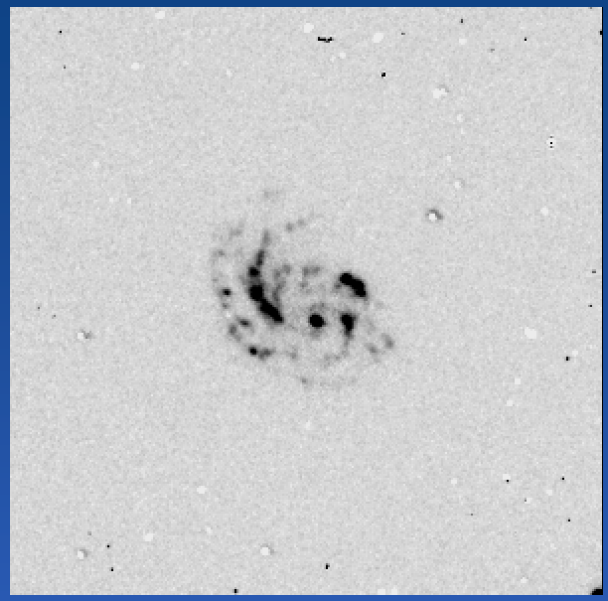
Example Hα Images:

Continuum Image

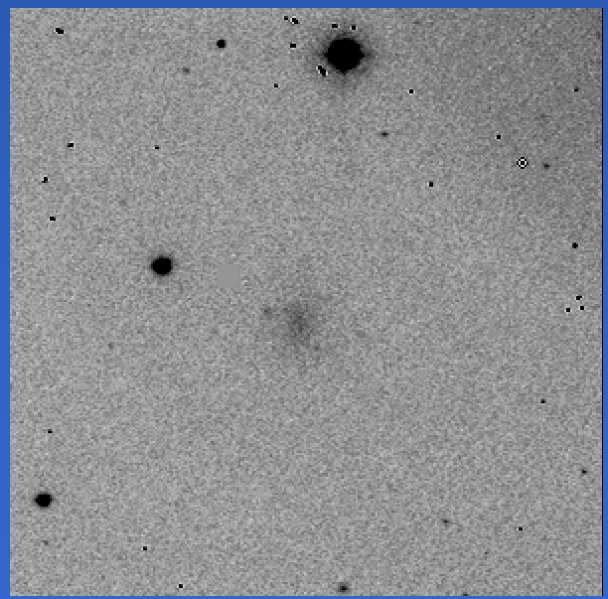
Hα Image

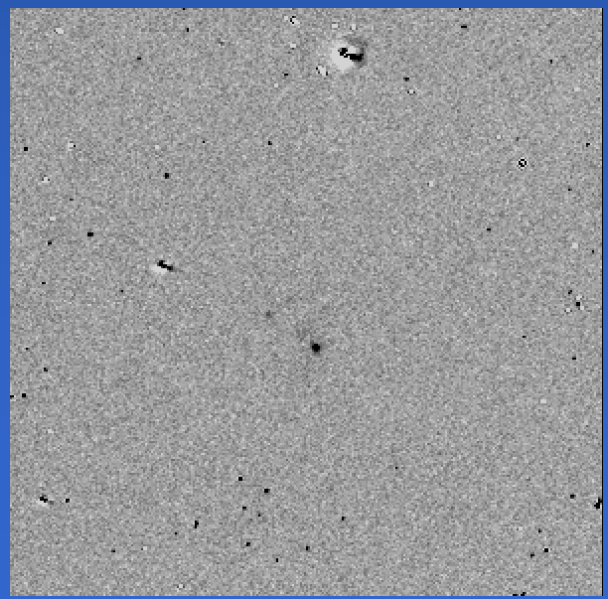
070911+2036





004649+2134





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Abundances and Chemical Evolution of Galaxies

- Accurate nebular abundances for blue compact dwarf galaxies, some with extremely low [O/H].
- Use to constrain chemical evolution of galaxies.
- Clues to star-formation histories in individual galaxies.