ALFALFA and its Low Mass Dwarf Galaxies

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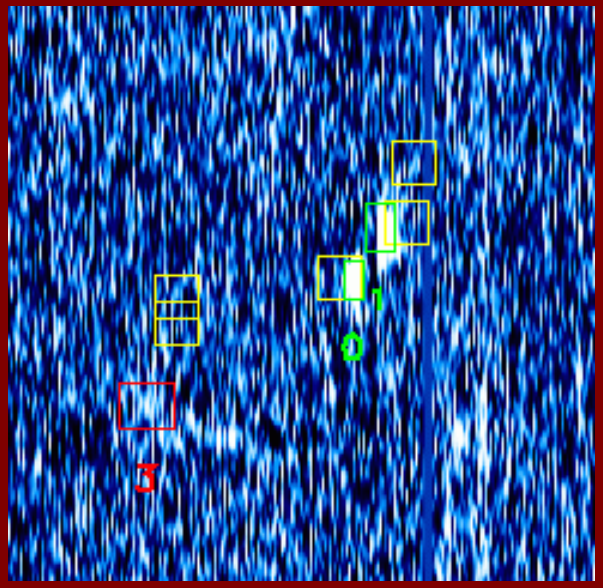
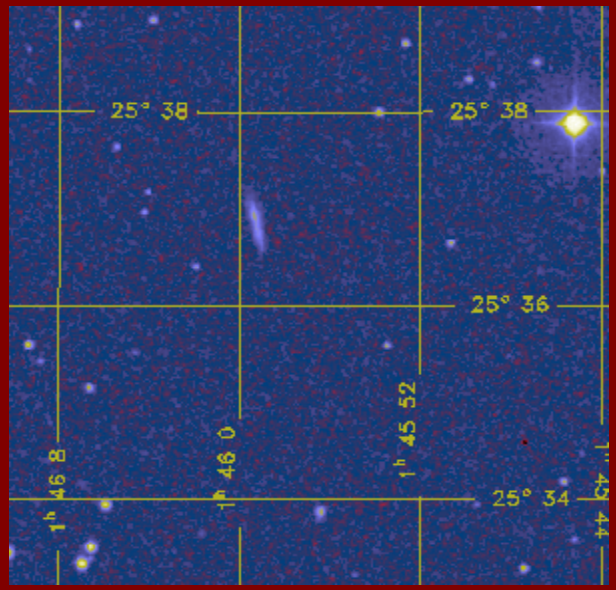
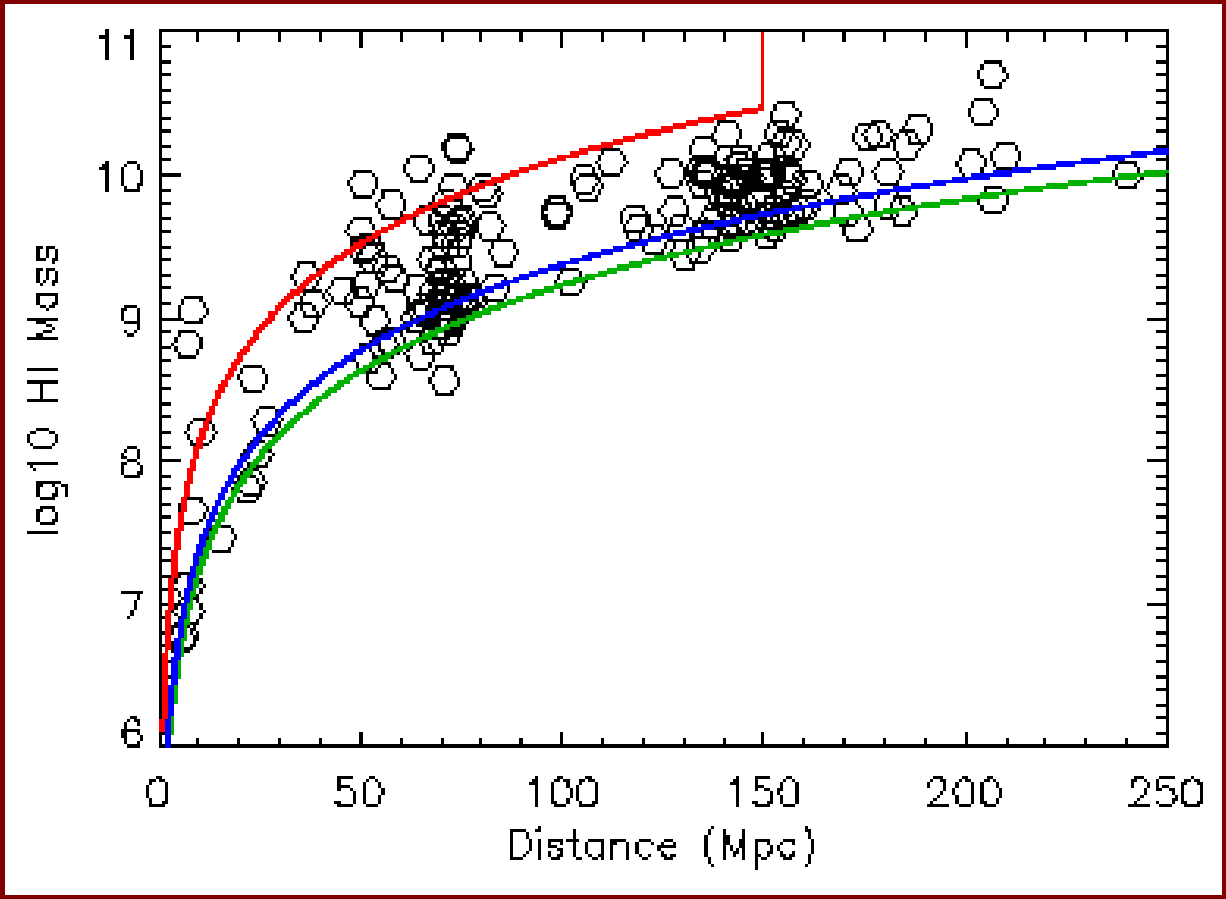
June 23, 2006





Context – ALFALFA and low-mass galaxies



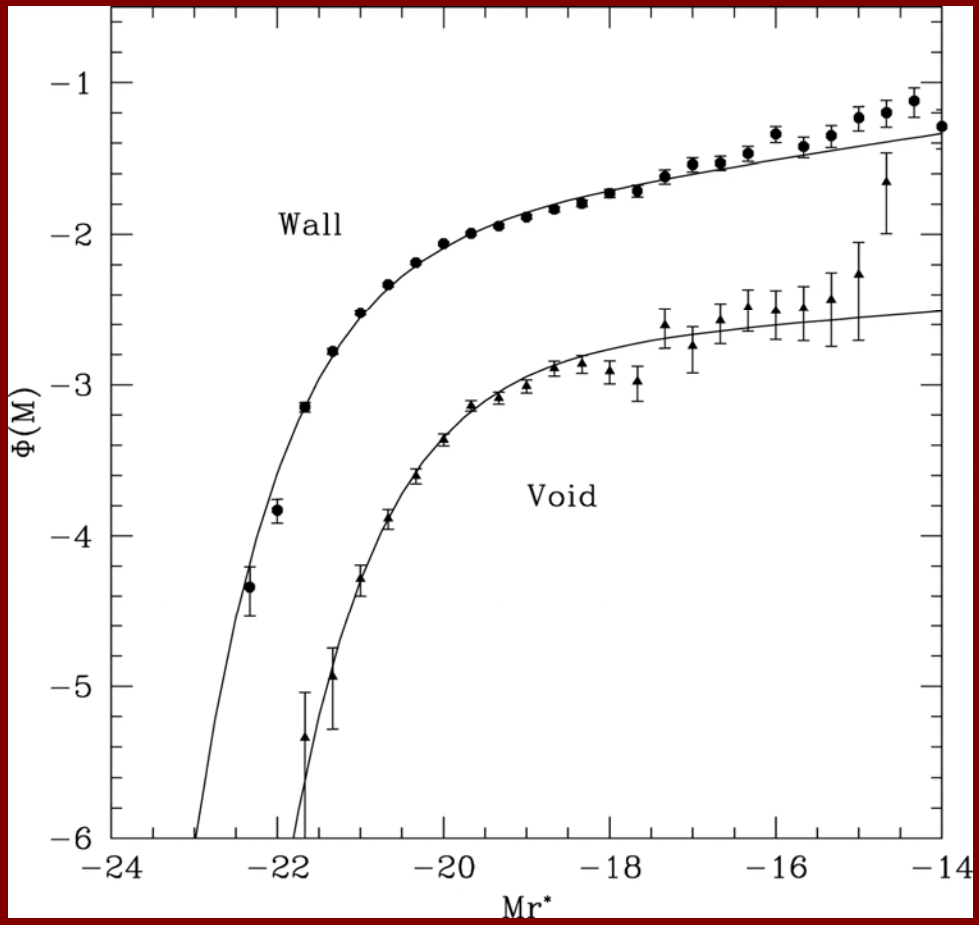
Giovanelli et al. (2005)

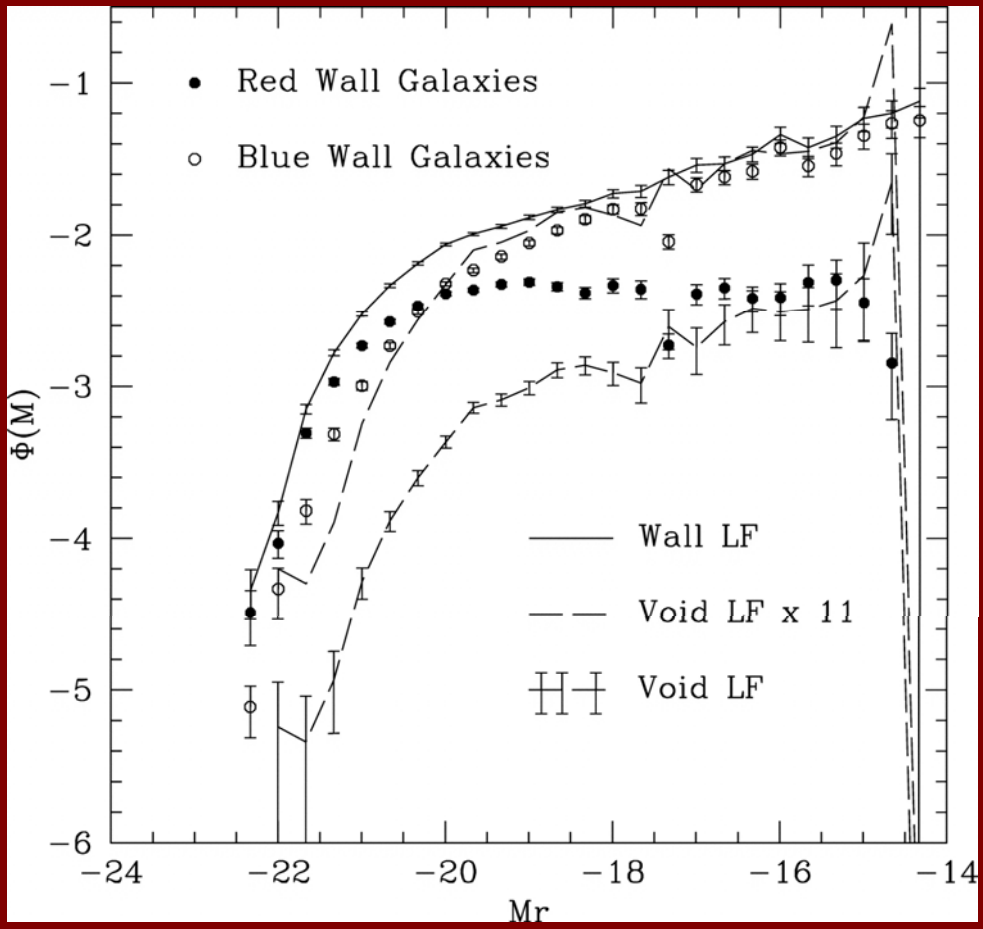
Context – Dwarfs and their environments

- Dwarfs are formed out of low amplitude density perturbations. (Dekel & Silk 1986)
  - CDM model
  - uniform distribution of dwarfs
- However, the “void phenomenon” (Peebles 2001)
  - voids contain few galaxies
  - dwarfs roughly follow “normal” galaxies
  - if dwarfs trace mass, they should be there!

Context – Void Galaxies

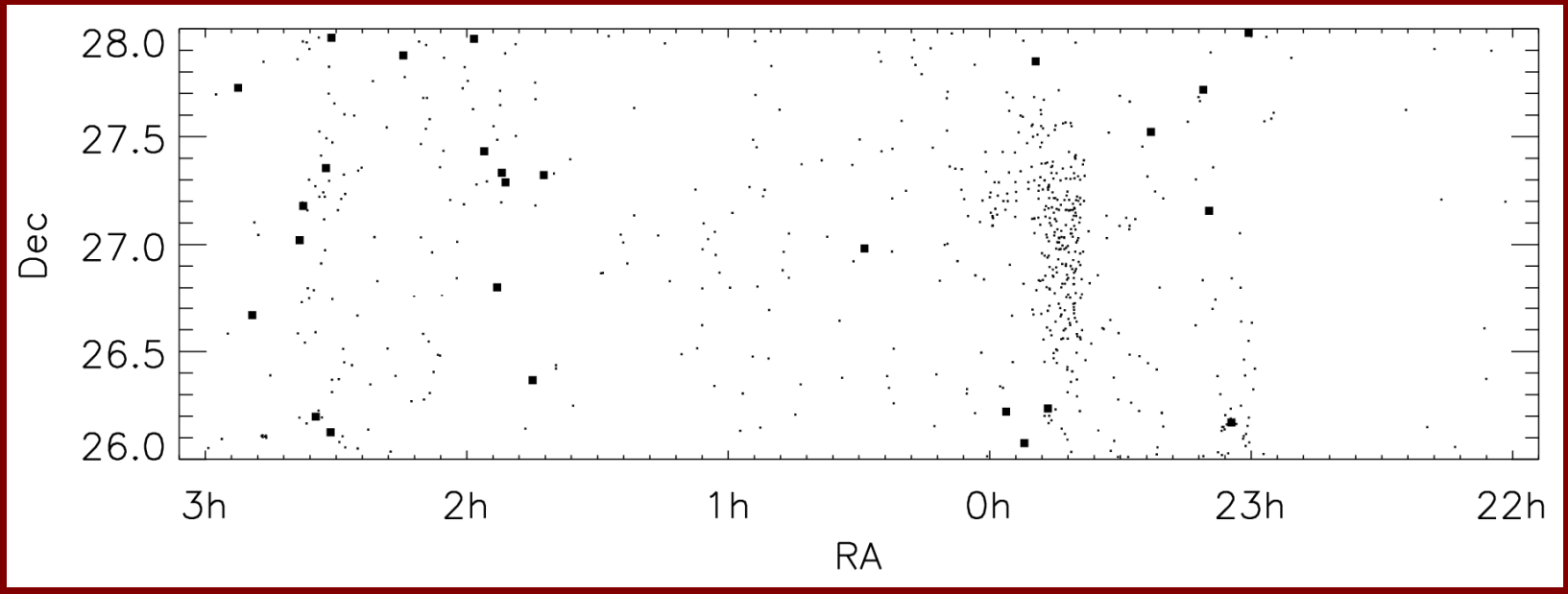
- Void galaxies in the SDSS

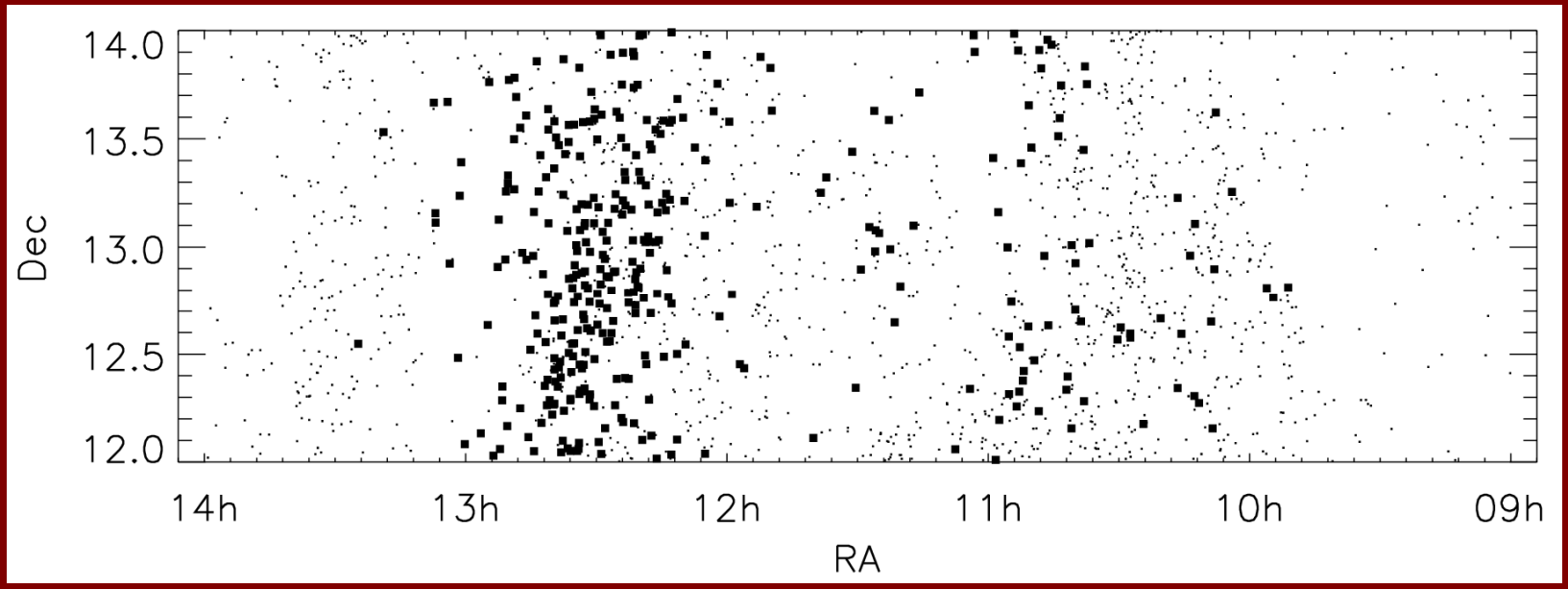




Hoyle et al. (2005)

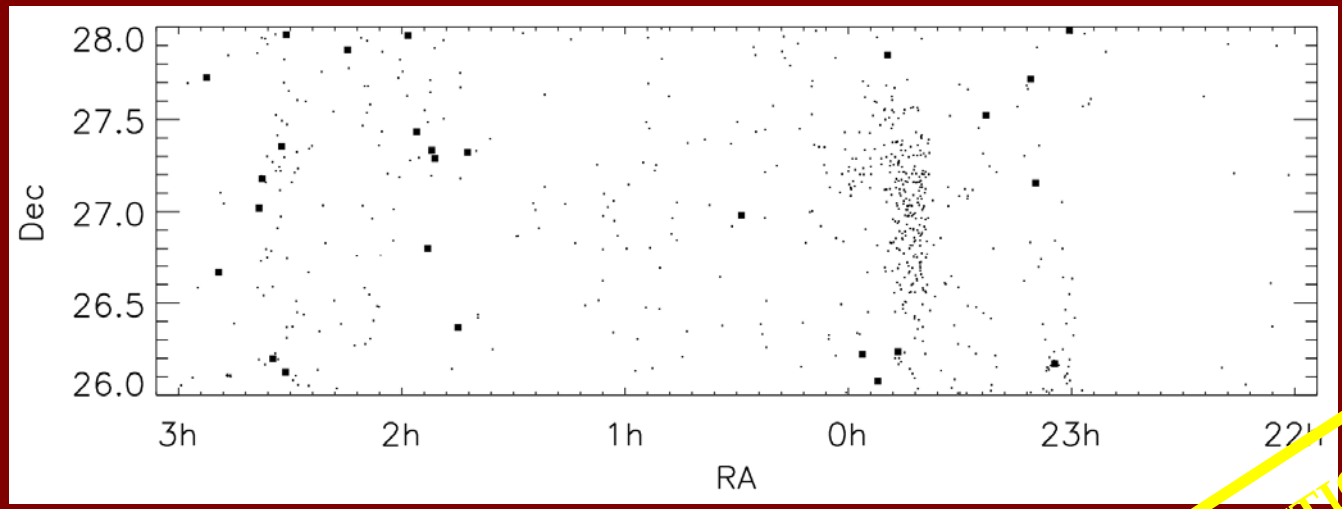
ALFALFA – Galaxy Environments

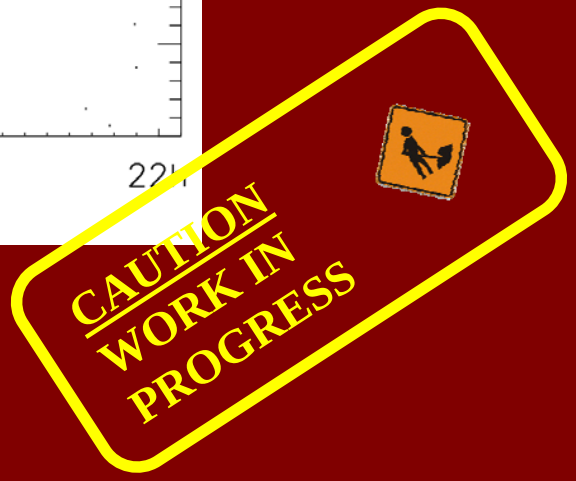




ALFALFA data

- 22h<RA<03h, 26°<Dec<28°
- 40 grids
- data release coming soon!
- identify low mass galaxies





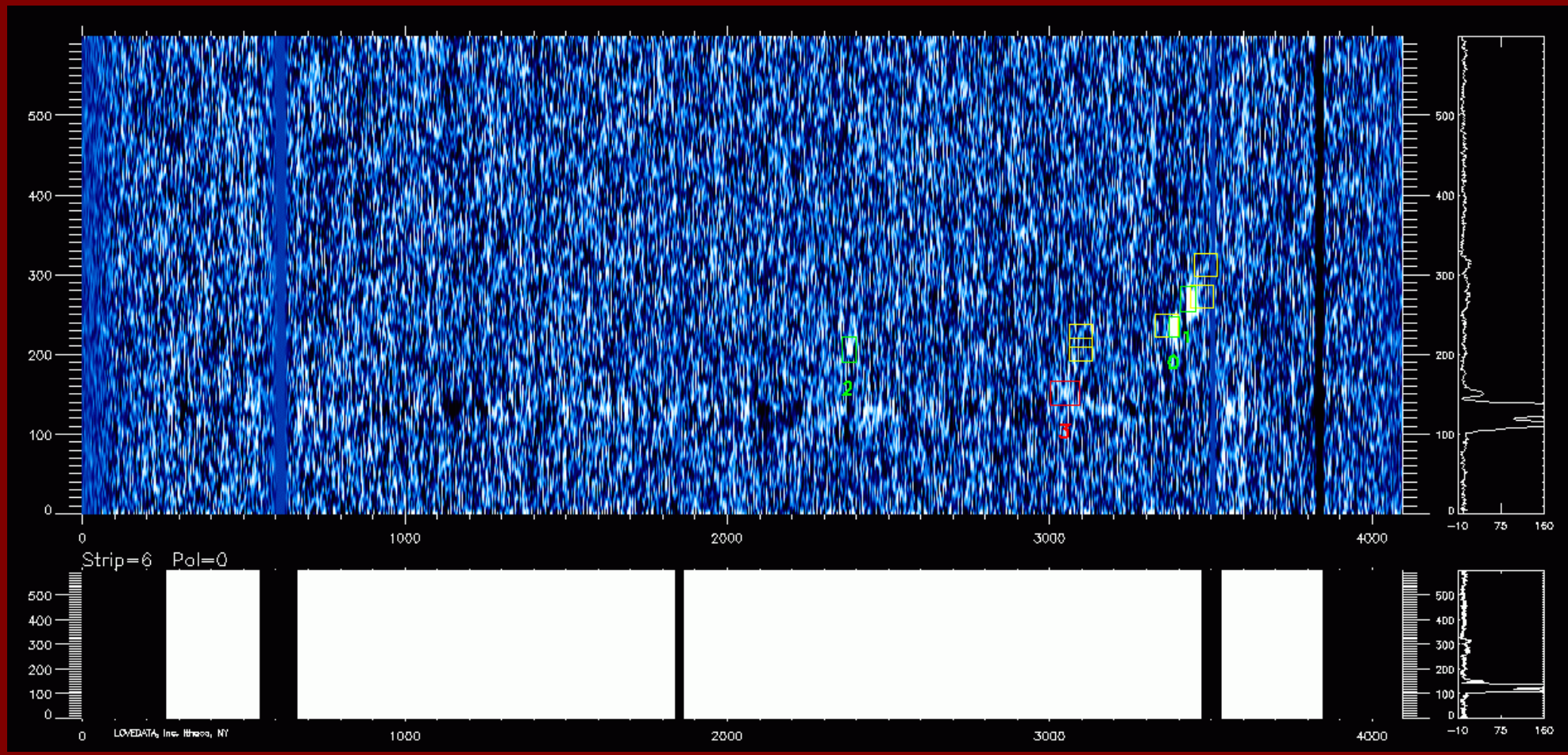
Project Overview

- Perform follow-up observations
  - optical imaging in UBVR and H
  - optical spectroscopy
- Multi-wavelength study: complete picture of SF history:
  - Hα imaging: current SF and location of HII regions
  - Broad-band imaging: past SF activity
  - Spectroscopy: chemical abundance
  - HI data: gas distribution and surface density

Scientific Objectives

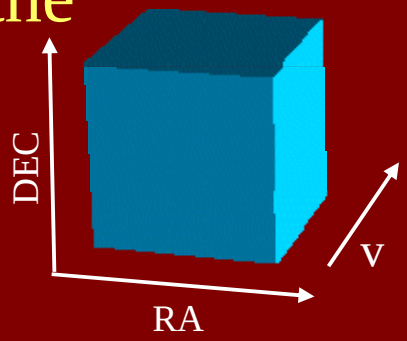
- Establish the star formation history of a population of low mass, gas rich, metal poor dwarfs for which optical spectroscopy will be obtained.
- Study the dependency of metallicity on environment (*more later*).
- Determine the abundance of low surface brightness dwarf galaxies in very low density environments, compared to other galaxy types.

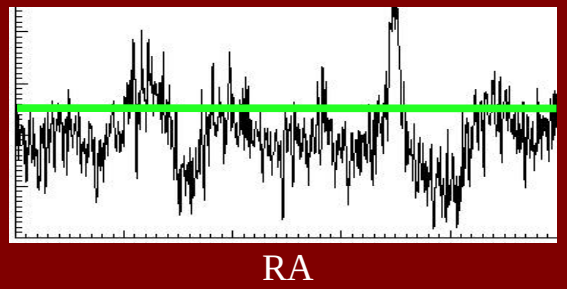
Signal Extraction Strategies for the ALFALFA Survey



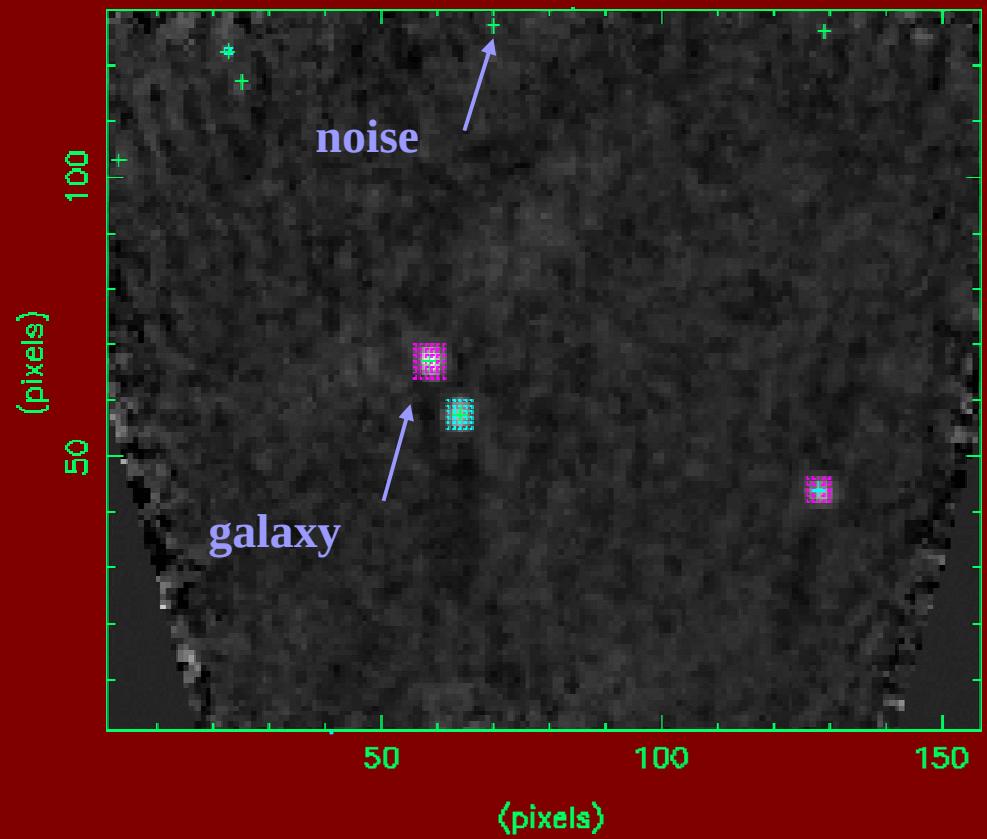
Example -- HIPASS(1)

- Galaxies are extracted from the HIPASS data cubes by MultiFind (Kilborn, 2001)



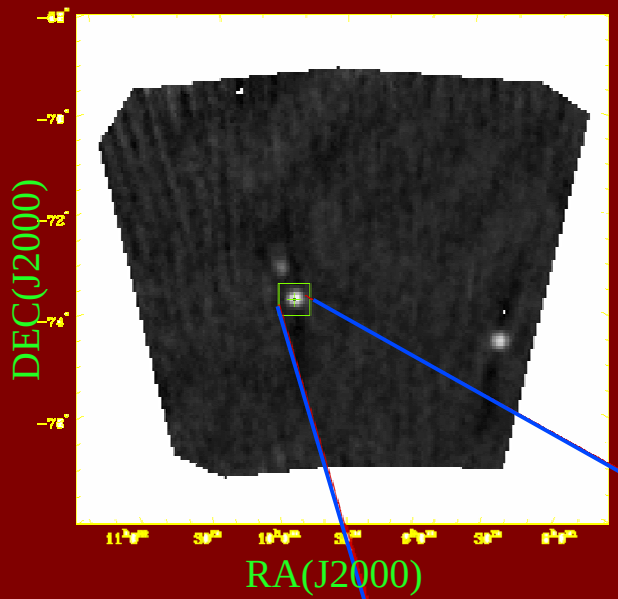


- Consider a velocity plane
  - Identify points above flux limit
  - Detection if :
    - connected in one velocity plane
    - at least two planes

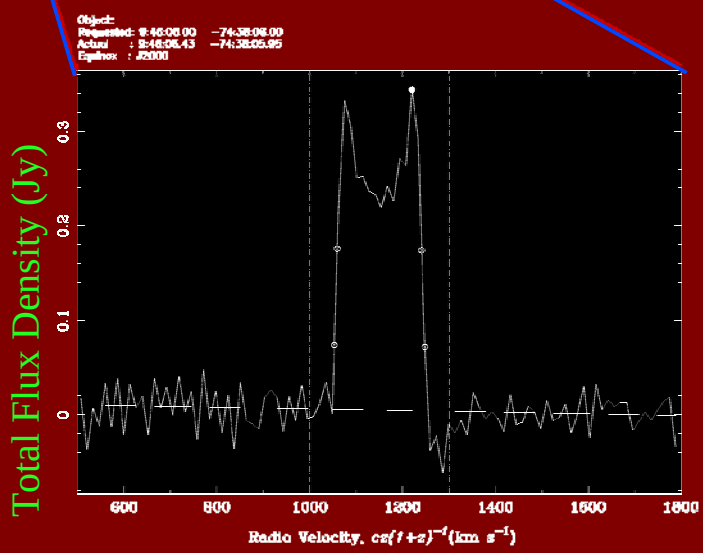


Example -- HIPASS(2)

- Detectability depends on the degree of smoothing
  - Smooth the data cube (Hanning)
  - New detection limit determined
  - Repeat detection process
- Lists of detections compared and final catalogue produced

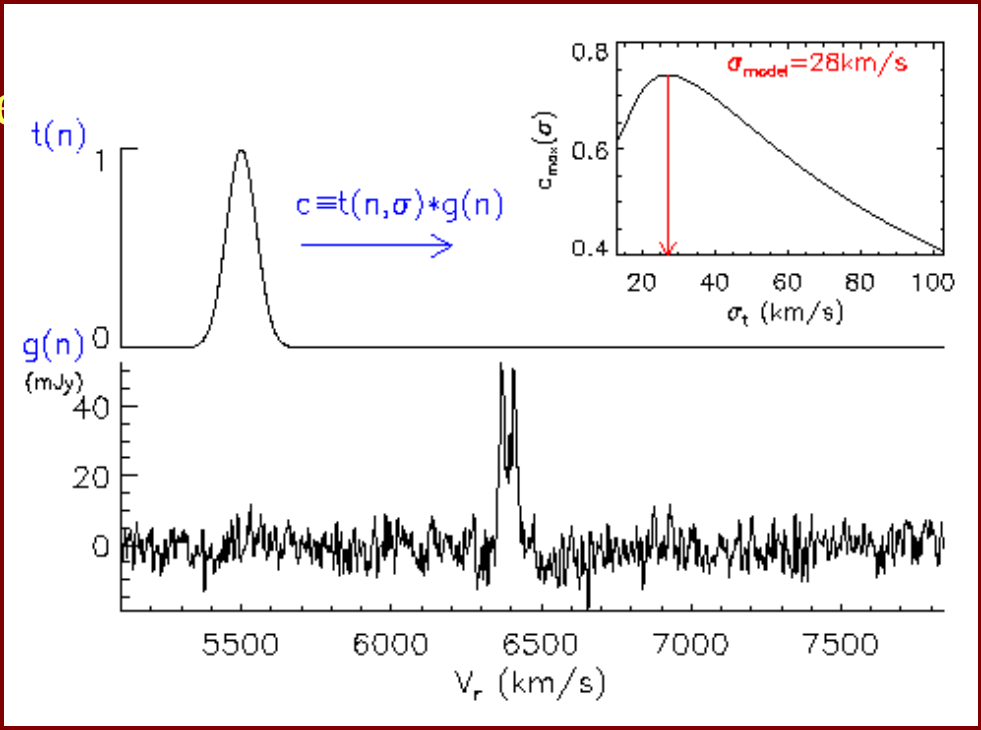


Kilborn, 2001



1D Extraction : The Spectral Direction

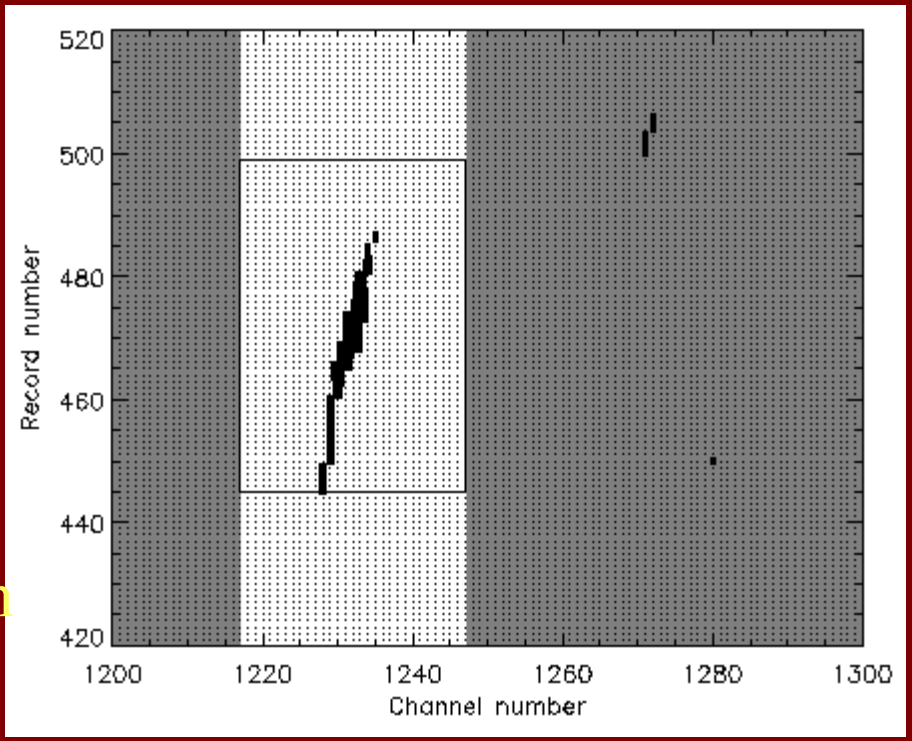
- The signals are extracted by doing cross-correlations of a template with the spectra.
  - Matched-filtering is more sensitive than peak-finding algorithms.
    - total flux!
    - important for broad features
  - Using FFT's, cross-correlations are fast!



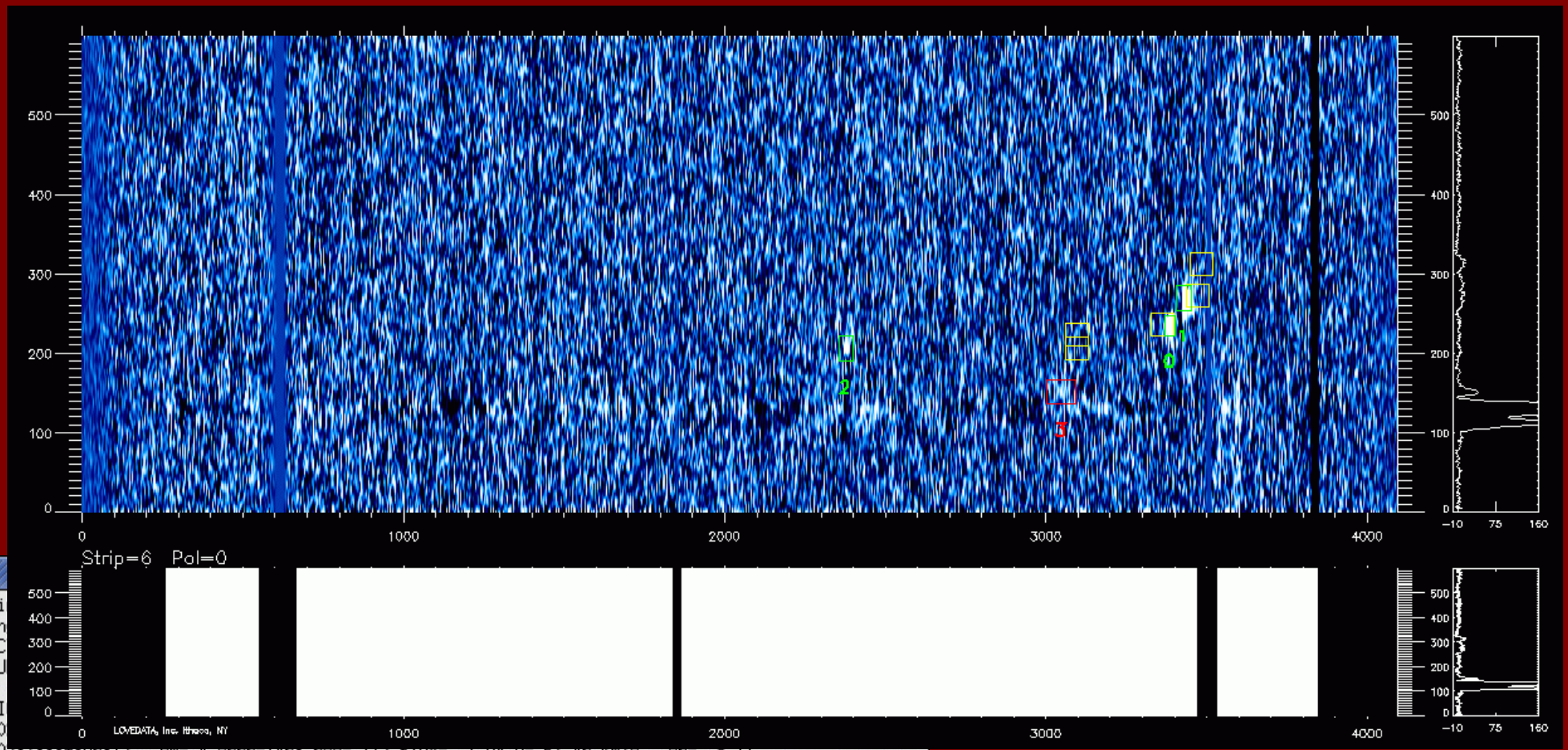
2D Extraction : The Time Direction (1)

- The spectra are not independent
- A 2D Extractor is needed to find signals in individual drifts (i.e. position-velocity maps)

  - define boxes
  - fit spatial direction
  - compare polarisations
  - reject a detections if:
    - it appears in <10 spectra
    - significant flux difference between polarisations



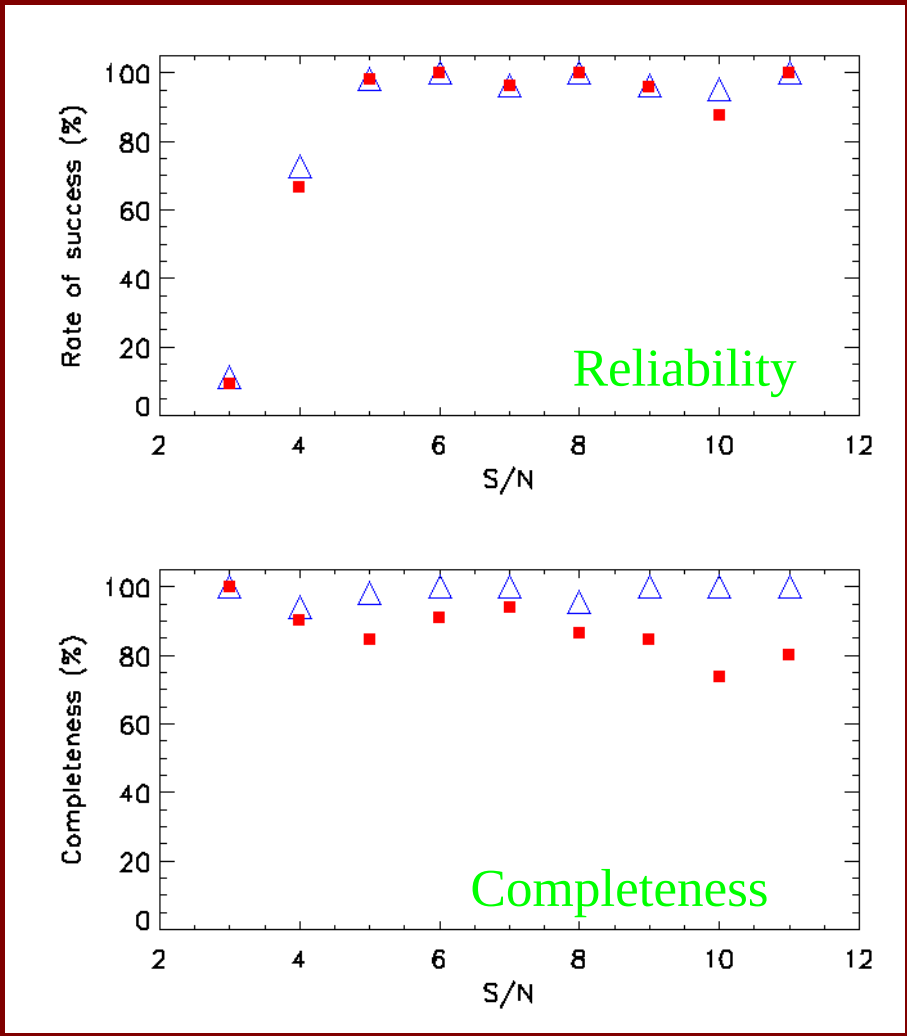
2D Extraction : An Interactive Display




```
Restori
Startin
% LOADC
AGC SOU
  2116
DETECTI
  0   0
  1   0237333+305312   bm= 4 chnr=1455 rec= 112 flux=  1.04 w= 67.45 km/s   sn=  8.11
  2   0238164+305313   bm= 4 chnr=2802 rec= 155 flux=  0.34 w= 37.47 km/s   sn=  3.62
  3   0244003+305314   bm= 4 chnr= 476 rec= 498 flux=  0.54 w=120.91 km/s   sn=  3.14
-----------------------------------
You can now :  - ignore a detection and remove from catalog          (d galnr or d+click)
               - delete ALL galaxies from catalog                    (d 99)
               - add a galaxy in the catalog that was rejected       (a galnr or a+click)
               - add a comment for a galaxy (no apostrophes!)        (c galnr)
               - show the spectrum of a point in the map             (s)
               - display the maps for each pol separately            (p)
               - blow-up a part of the map (pols. separate)          (b)
               - get the DSS image                                   (g)
               - find a source in a delimited region                 (f)
               - continue with the next beam                         (n or CR)
               - exit program                                        (e)
?
```

2D Extraction : Completeness & Reliability

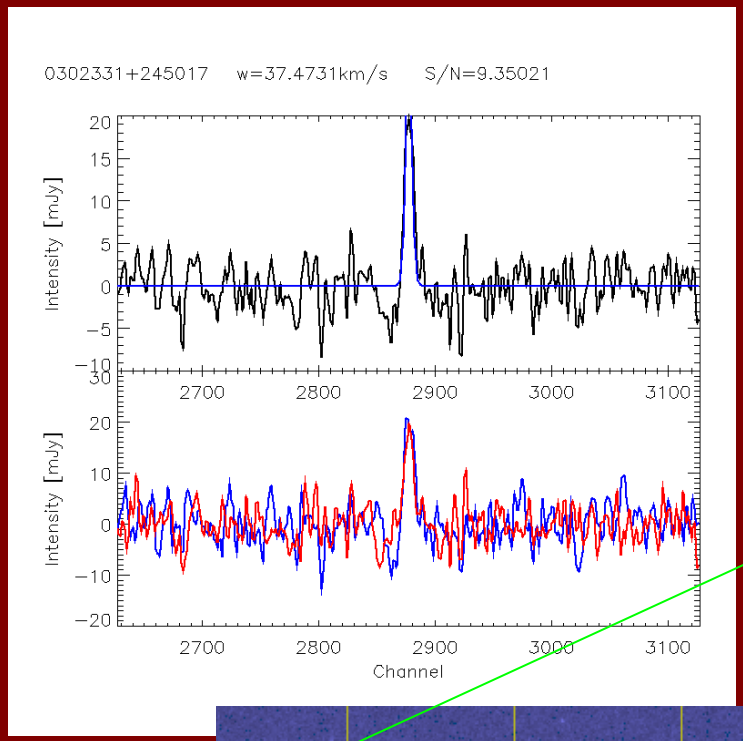
- simulation of 600 galaxies
  - over 30 drifts
  - modelled on the 166 detections of the ALFALFA precursor
  - scaled to 1<S/N<12
- at S/N>5, the catalogue produced by the extractor is ~100% complete and reliable.

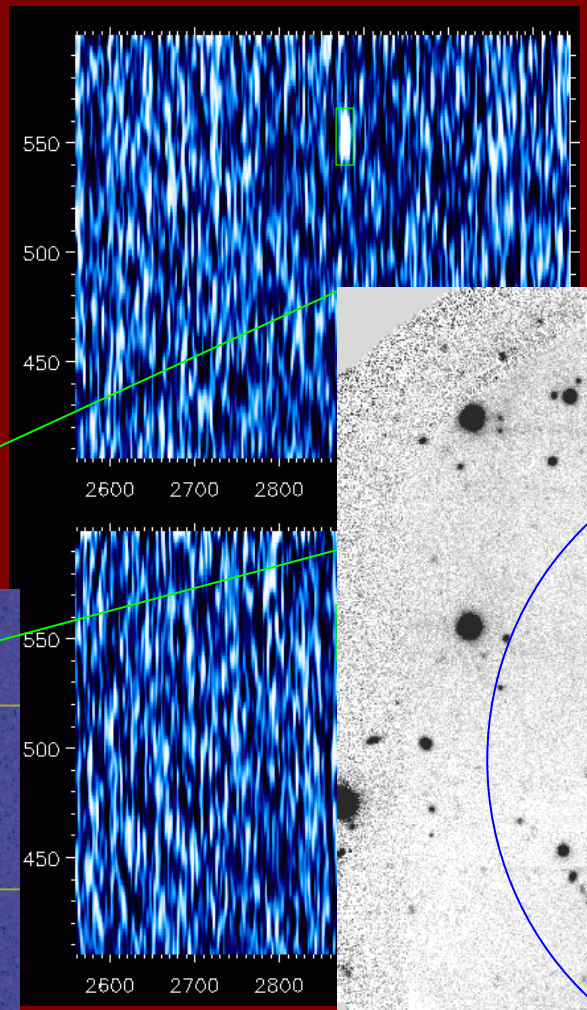


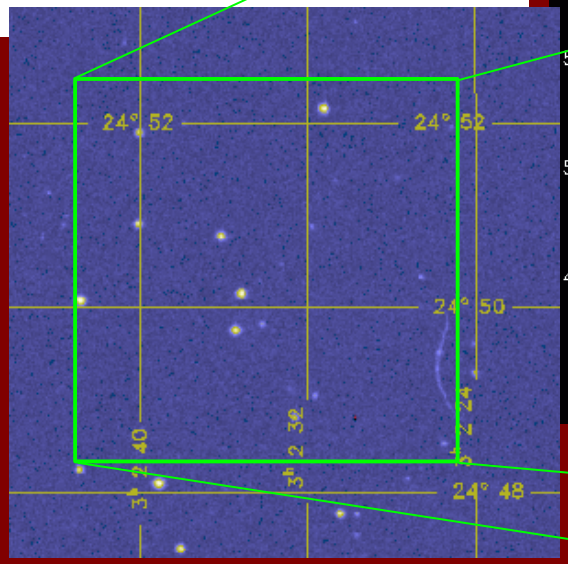
output of the program

after interactive display

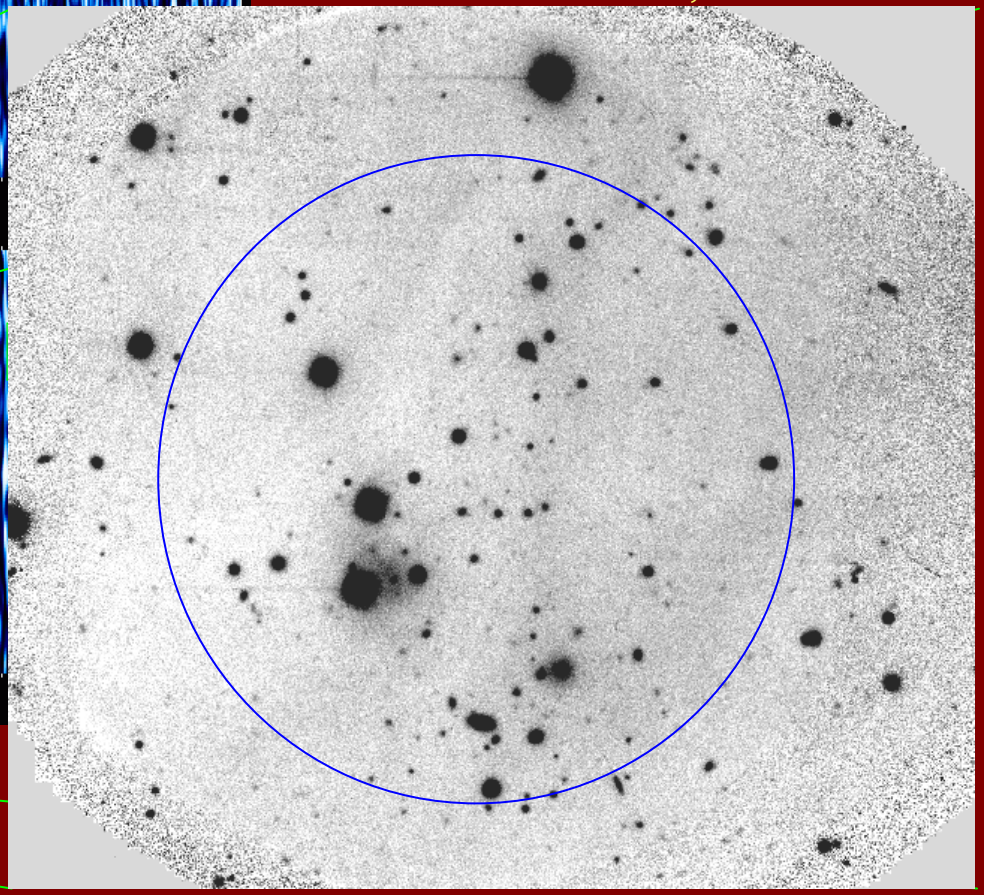
Example : A very low surface brightness galaxy?



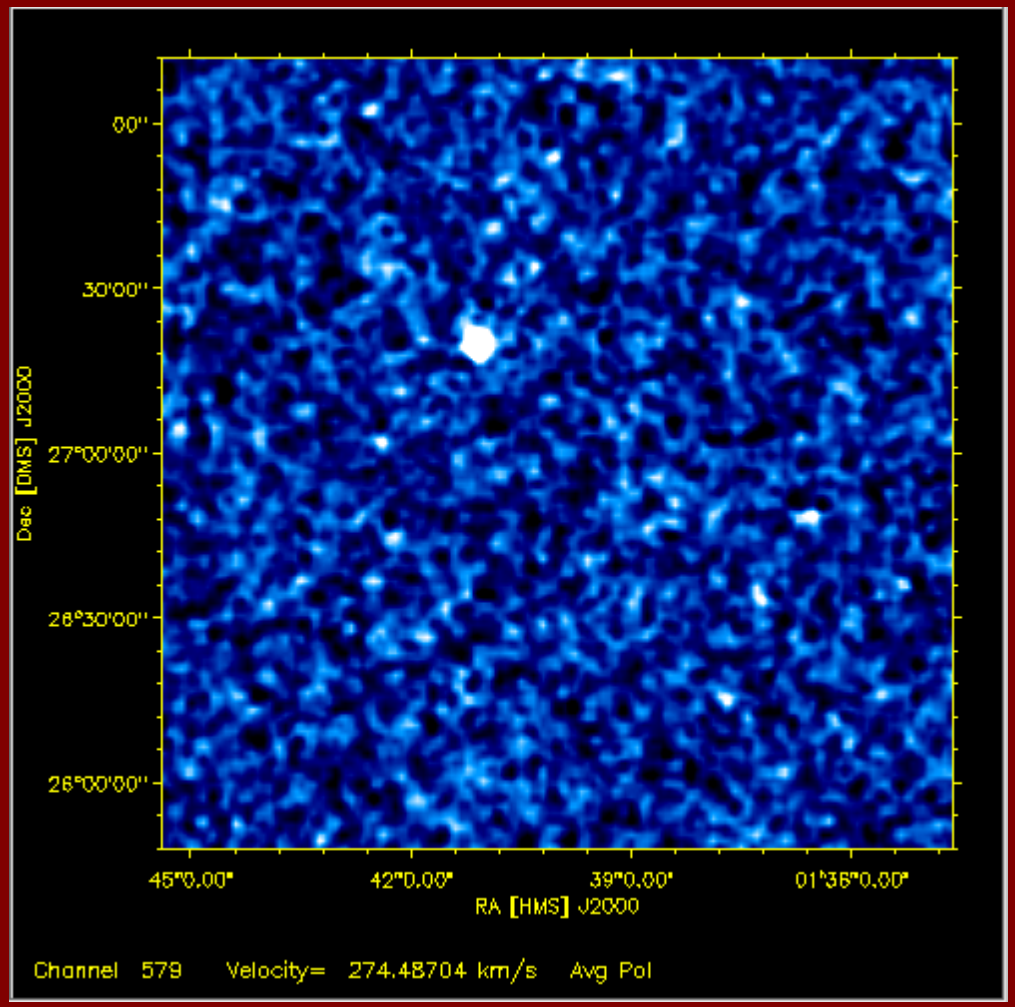


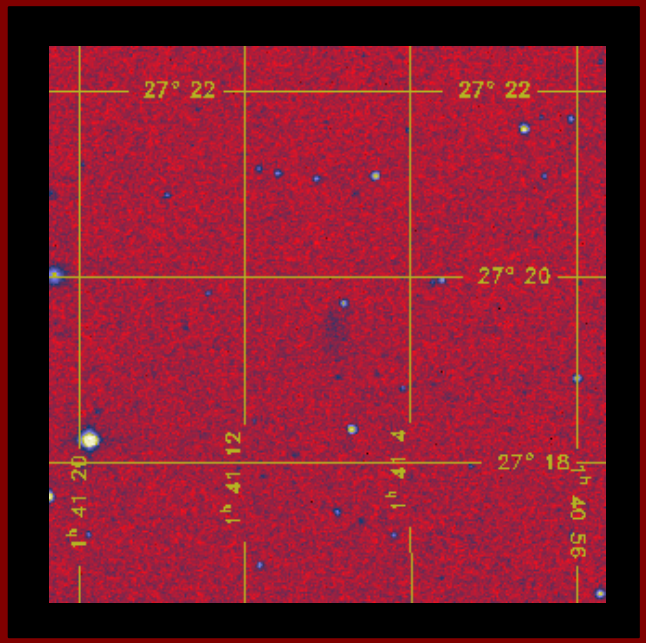


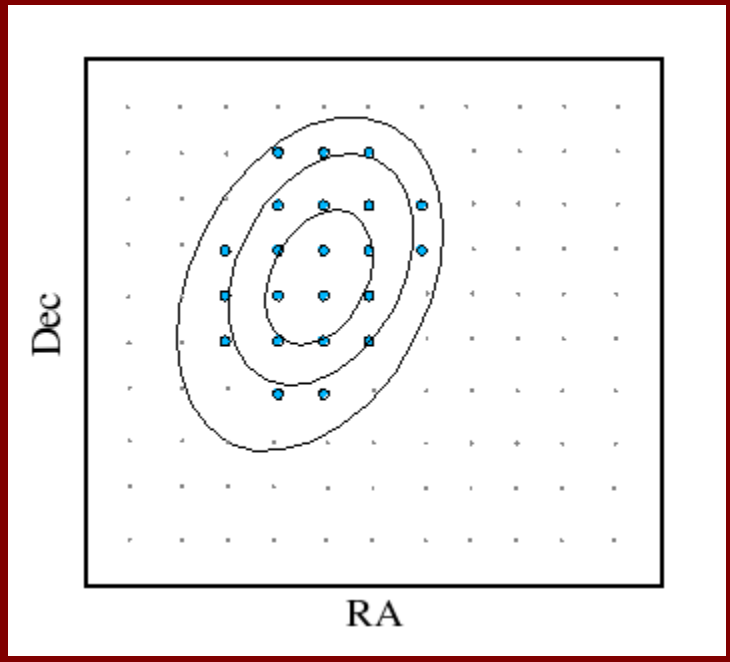
WIYN 3.5m, L. van Zee



3D Extraction : The Complete Data (1)







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