ALFALFA and its Low Mass Dwarf Galaxies

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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
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

Example -- HIPASS(2)
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!
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

You can now:
- ignore a detection and remove from catalog (d gain or d+click)
- delete ALL galaxies from catalog (d 99)
- add a galaxy in the catalog that was rejected (a gain or a+click)
- add a comment for a galaxy (no apostrophes!) (c gainr)
- 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 (pol, 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
  - Modeled 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.
Example: A very low surface brightness galaxy?
3D Extraction: The Complete Data (1)

Channel 579 Velocity= 274.4874 km/s Avg Pol

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