A SIGNAL EXTRACTION UTILITY FOR THE ALFALFA SURVEY

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ALFALFA: A SURVEY OF EXTRAGALACTIC HI WITH THE ALFA MULTI-BEAM SYSTEM AT ARECIBO

- Sky area that will be covered: 7074 deg^2
- Declination range: 0° - 36°
- Right Ascension range: 07h30m - 22h30m, 03h00m - 09h00m
- Frequency range: 1335 - 1435 MHz
- Velocity range: -1600 to 18000 km s^{-1}
- Observing mode: Fixed azimuth drift scan
- Number of passes: 2
- Integration time per beam: 48 seconds
- Telescope time required: 4130 hours

The signal extraction utility consists of:
- a computation module that works on individual position-velocity maps or on 3-D data cubes
- an interactive display to allow the user to view the results of the search
- a final catalog containing the detections made above the requested S/N threshold

The catalog contains for each galaxy: a centroid position, a redshift, a velocity width, scale lengths for both spatial directions, peak and integrated fluxes, rms noise and S/N ratio.

A VERY LOW SURFACE BRIGHTNESS GALAXY

No optical counterpart down to the surface brightness limit of the DSS2 blue.

APPLICATIONS OF THE SIGNAL EXTRACTION TOOLS

THE USGC844 GROUP

27 confident detections with S/N>5.5, 12 of which had no previously known optical counterpart or catalogued redshift.

THE NGC 672 GROUP

Three galaxies with M_2<10^7 M_☉, one previously unknown.

A SIGNAL EXTRACTION UTILITY

OVERVIEW

- A matched filtering approach
- Matching Gaussian templates with the spectra
- Calculations done in Fourier space
- Detections from individual spectra are combined
- 3-D models of the detected galaxies are made

PERFORMANCE

The matched filtering approach and the Fourier space calculations make this signal extraction tool:
- quick to perform the calculations and more robust and consistent than 'human' extraction
- sensitive to the total flux of the galaxy rather than just the peak flux

We have adopted the following definition for the signal-to-noise ratio

\[ S/N = \begin{cases} 
\frac{\sigma}{\sigma_{\text{peak}}} \left( \frac{W}{2 \sigma_{\text{peak}}} \right)^{1/2} & \text{if } W < 200 \text{ km s}^{-1} \\
\frac{\sigma}{\sigma_{\text{peak}}} \left( \frac{200}{2 \sigma_{\text{peak}}} \right)^{1/2} & \text{if } W \geq 200 \text{ km s}^{-1}
\end{cases} \]

where \( \sigma \) is the spectral resolution in km s^{-1}

so for instance, a 50 km s^{-1} wide feature with a peak flux to noise ratio of 3.5 will here have S/N>5.5

A very low surface brightness galaxy

No optical counterpart down to the surface brightness limit of the DSS2 blue.