

Radio detection of high velocity clouds in nearby galaxies

ILANCE internship

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Plan

- I. What is a molecular cloud?
- II. Why are we interested in high velocity Molecular clouds?
- III. PHANGS ALMA
- IV. High velocity giant molecular clouds in nearby galaxies
- V. Conclusion



Giant Molecular Clouds (GMCs)

- Part of the interstellar medium (ISM)
- Dense and cold
- H_2 (mostly), H_2O , CO , NH_3
- $<1\%$ of volume in the Milky Way but 50% mass of gas
- Giant if $M > 10^4 M_{\text{sun}}$
- 5-200pc in diameter

High Velocity GMCs

Velocity relative
to host galaxy $>$
50km/s

Maintains star
formation rate

Origin : unknown
(nearby galaxies,
supernovae,...)

PHANGS- ALMA data

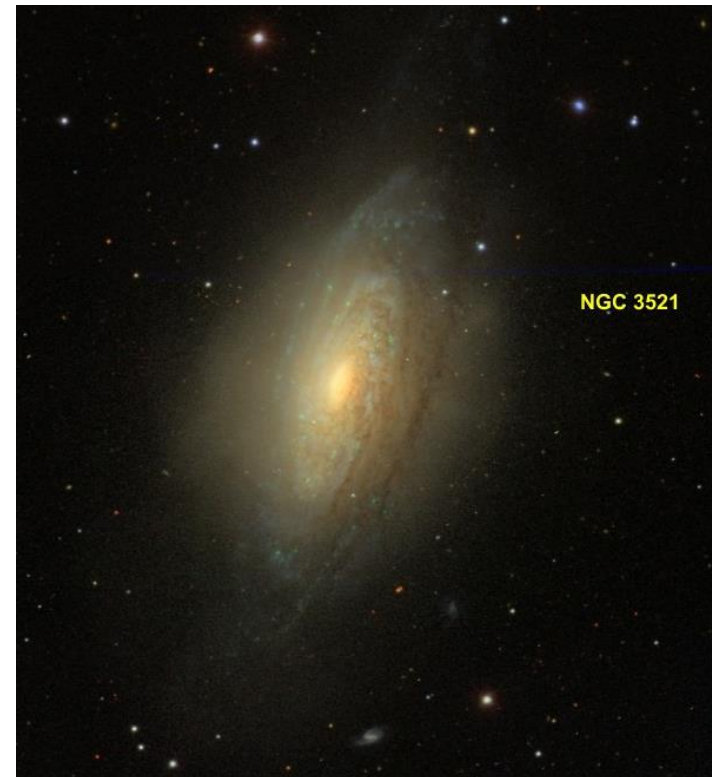
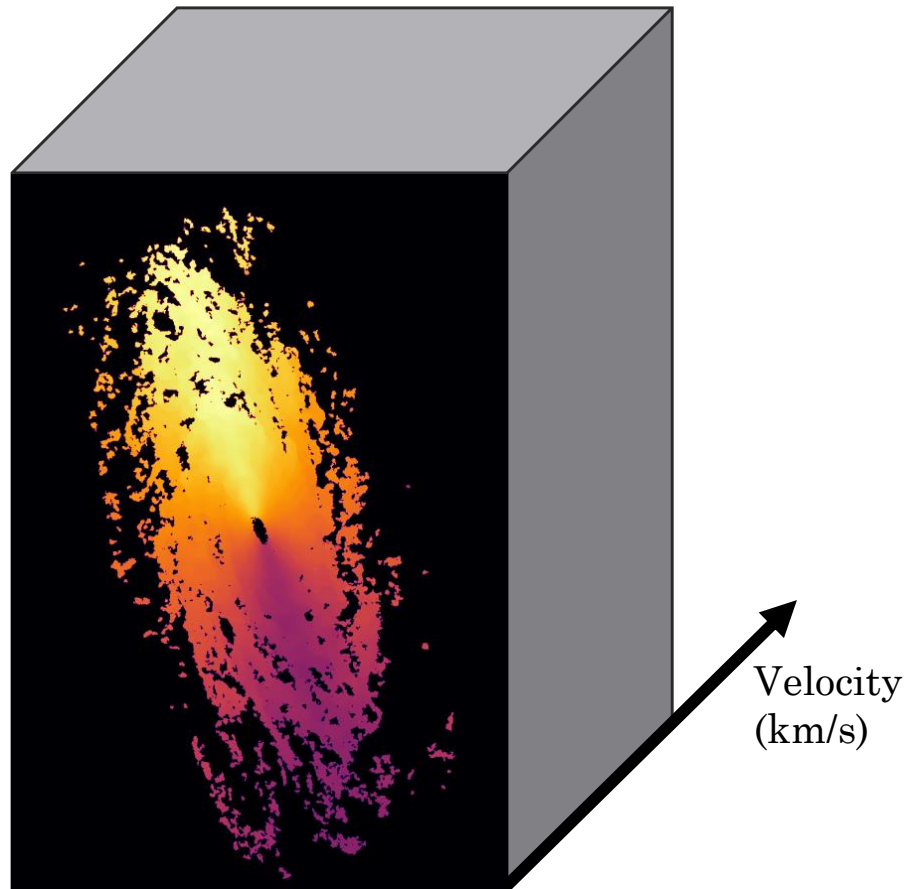
- Physics at High Angular resolution in Nearby Galaxies
- Atacama Large Millimeter Array
- Radio interferometer
- CO (1-0) transition data
- Cube data

Object	Beam size (°)	Pixel size (°)
M74	$3,1 \cdot 10^{-4}$	$5,6 \cdot 10^{-5}$
M64	$4,0 \cdot 10^{-4}$	$8,3 \cdot 10^{-5}$
NGC 2903	$3,5 \cdot 10^{-4}$	$8,3 \cdot 10^{-5}$



Encyclopedia Britannica - Artist's rendering of the Atacama Large Millimeter Array (ALMA) in an extended configuration.

Objects of study



NGC 3521

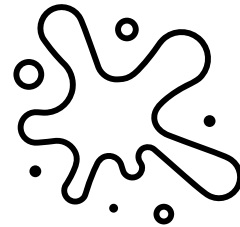
Detecting High Velocity clouds in the cube



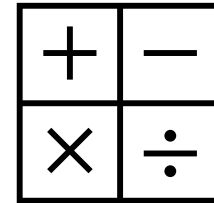
Subtract noise and
apply mask



Detect maximums
of emission



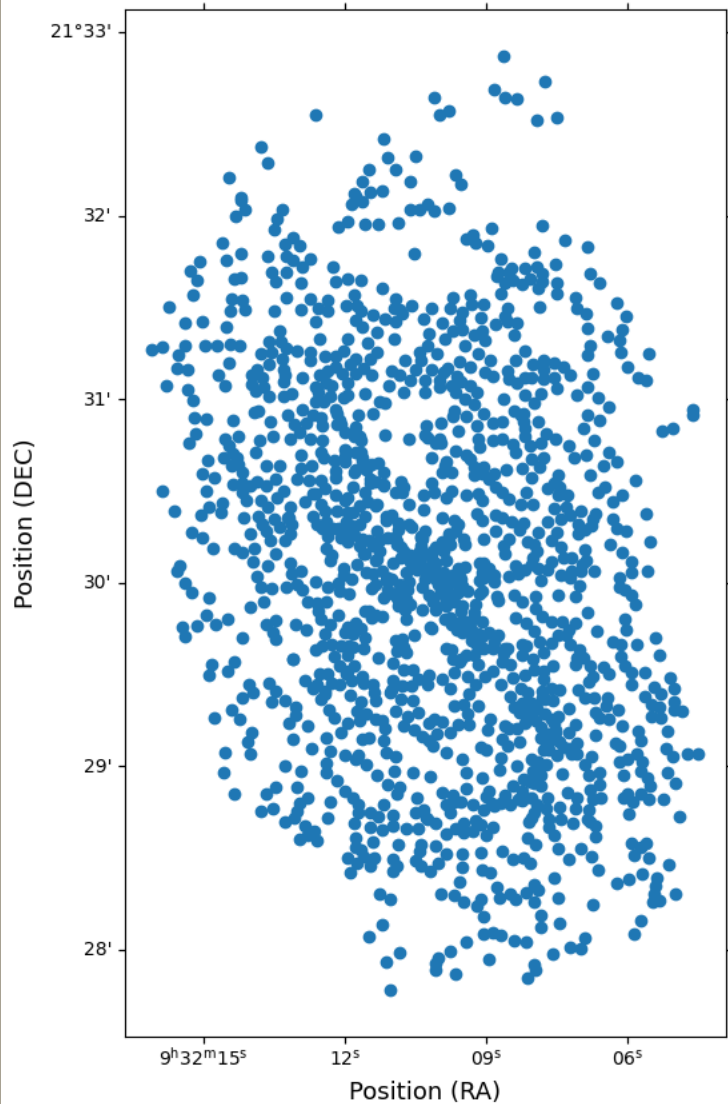
Associate emission
pixels (watershed
algorithm)



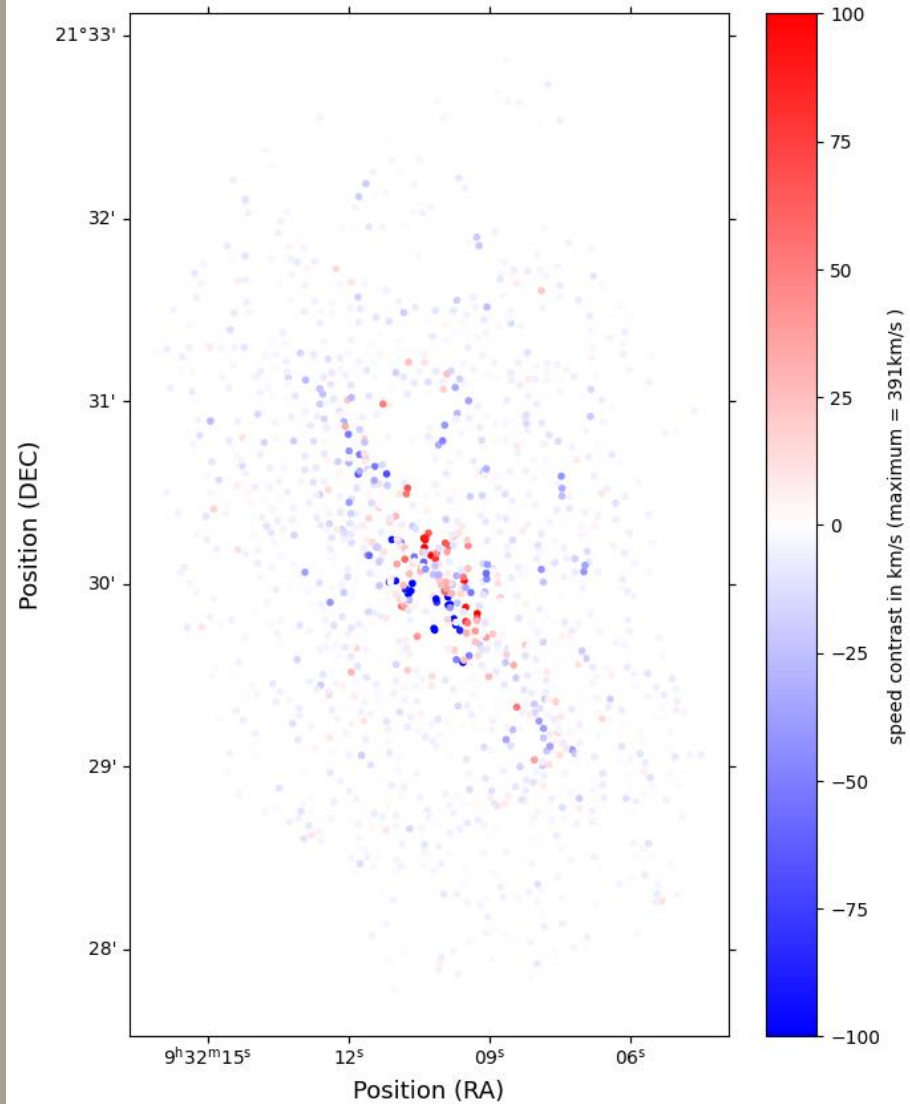
Compute properties
(mass, velocity
dispersion, ...)

One Example : NGC 2903

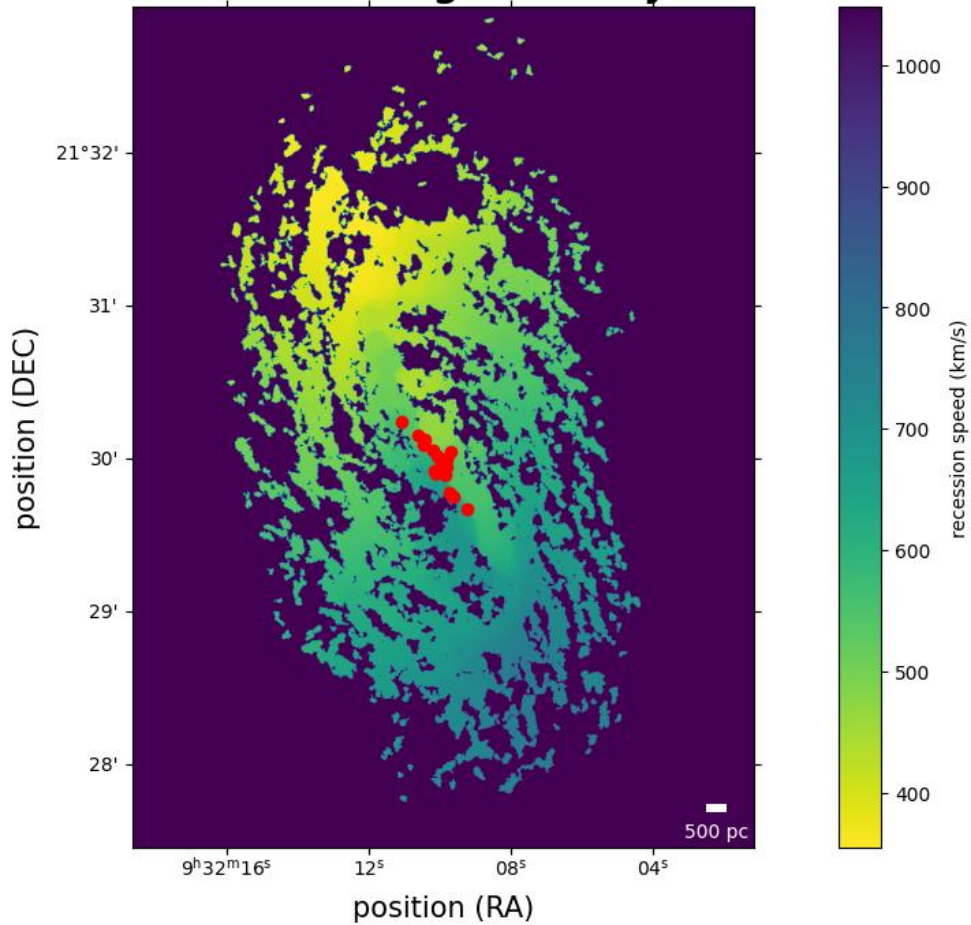
Velocity and position of clouds in ngc2903



Speed and position of clouds in ngc2903

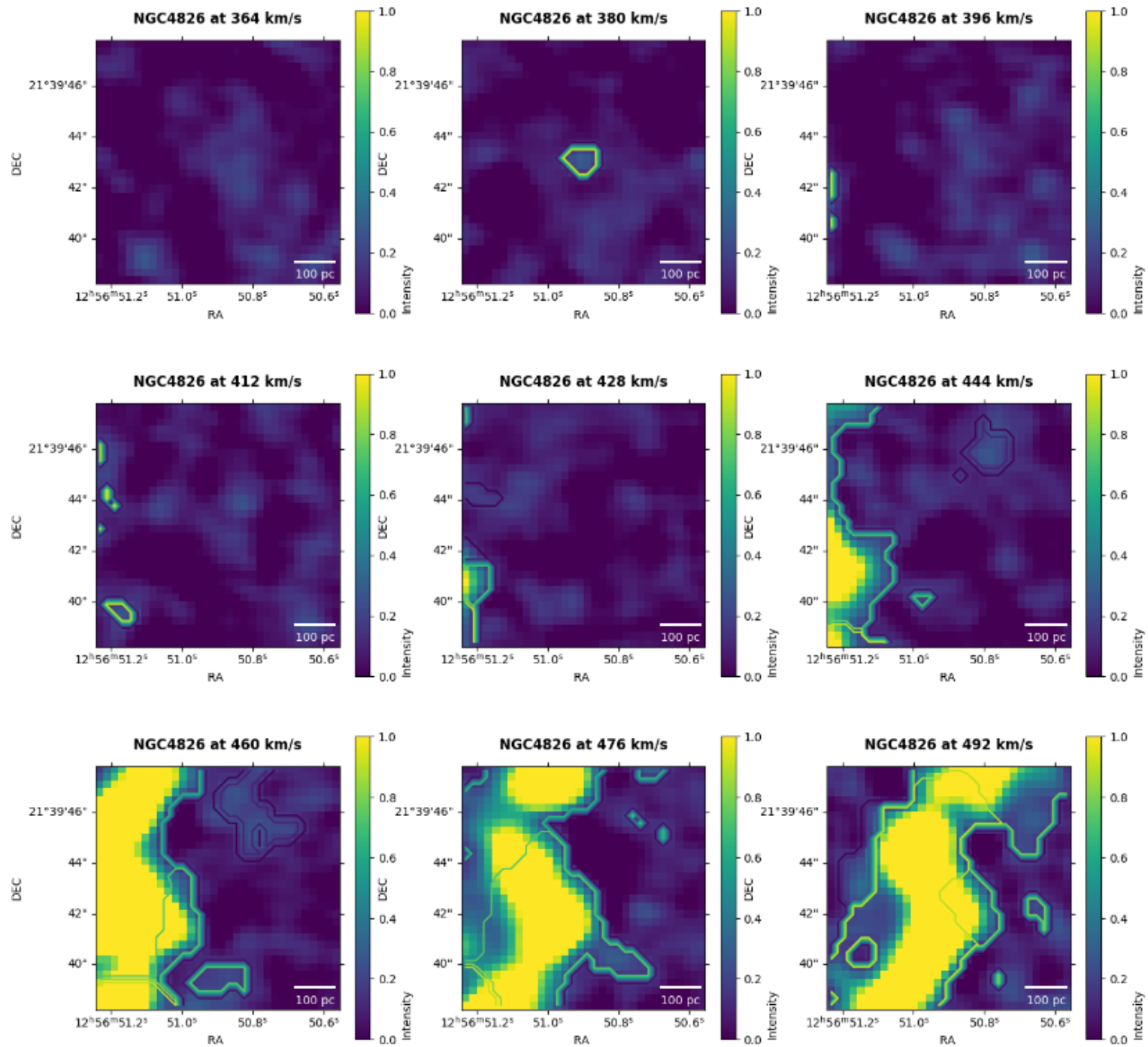


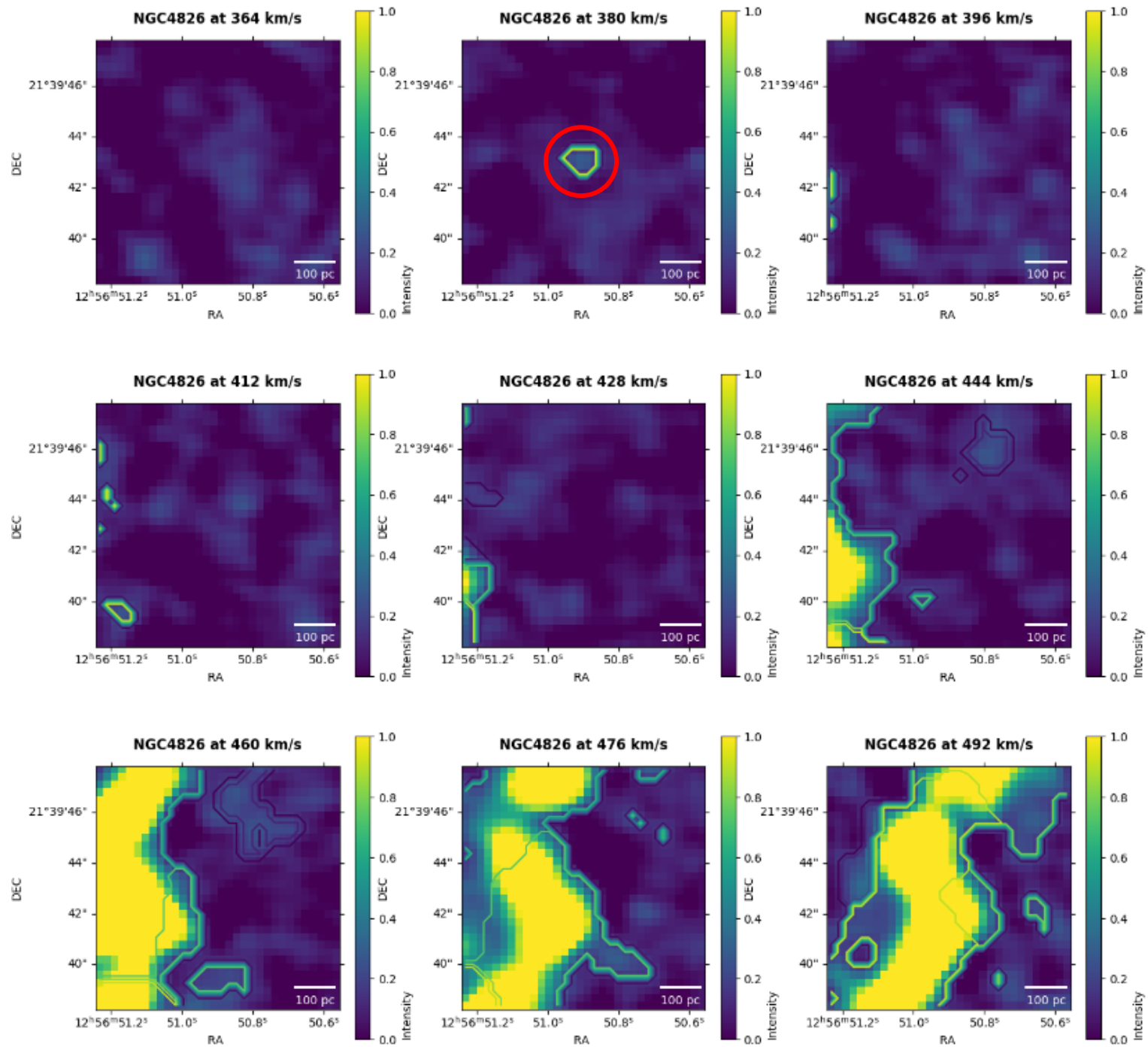
Position of the high velocity clouds

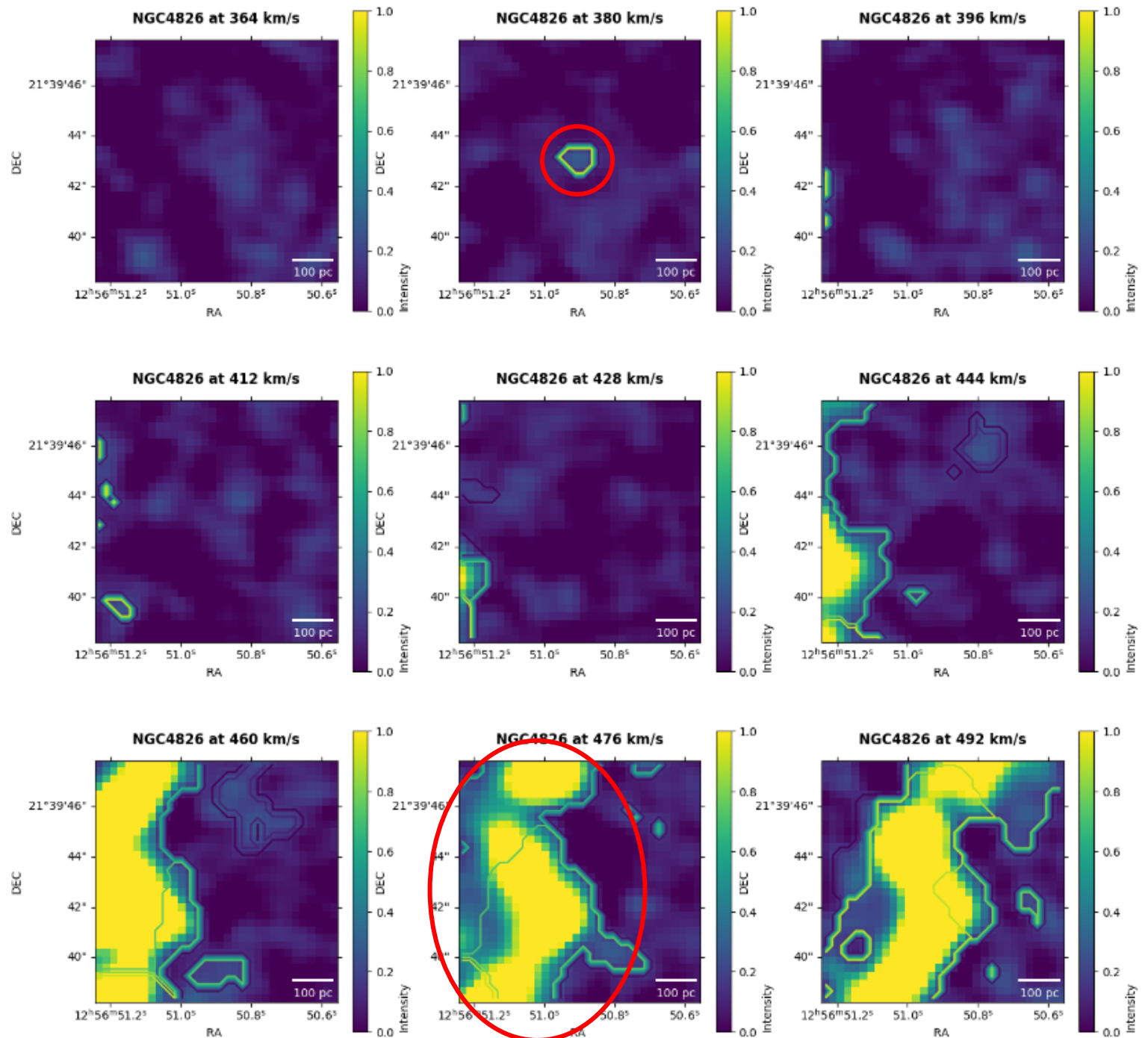


NGC 2903 Adam Block Arizona
University Mount Lemon Sky Center

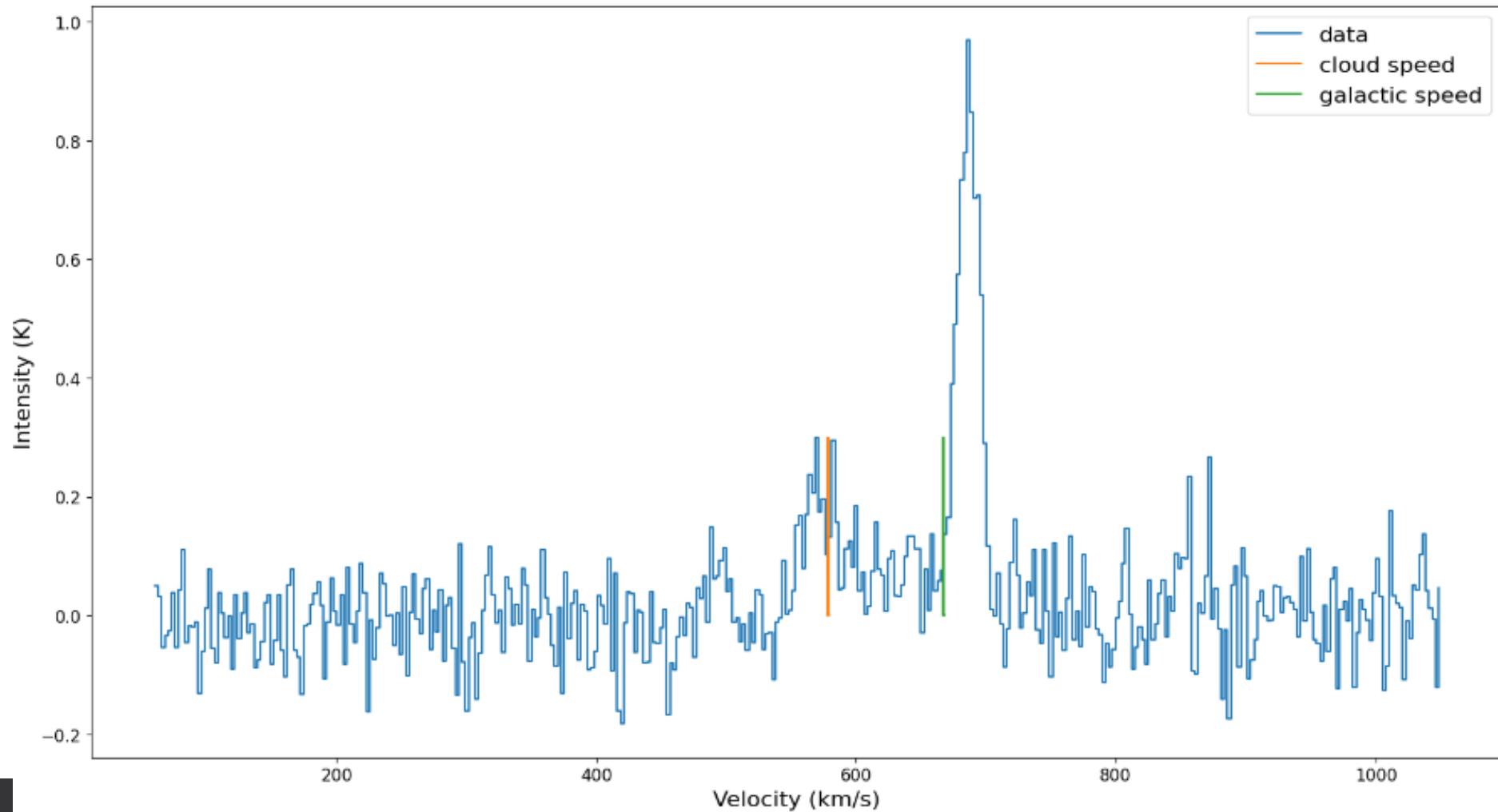
Progress and results





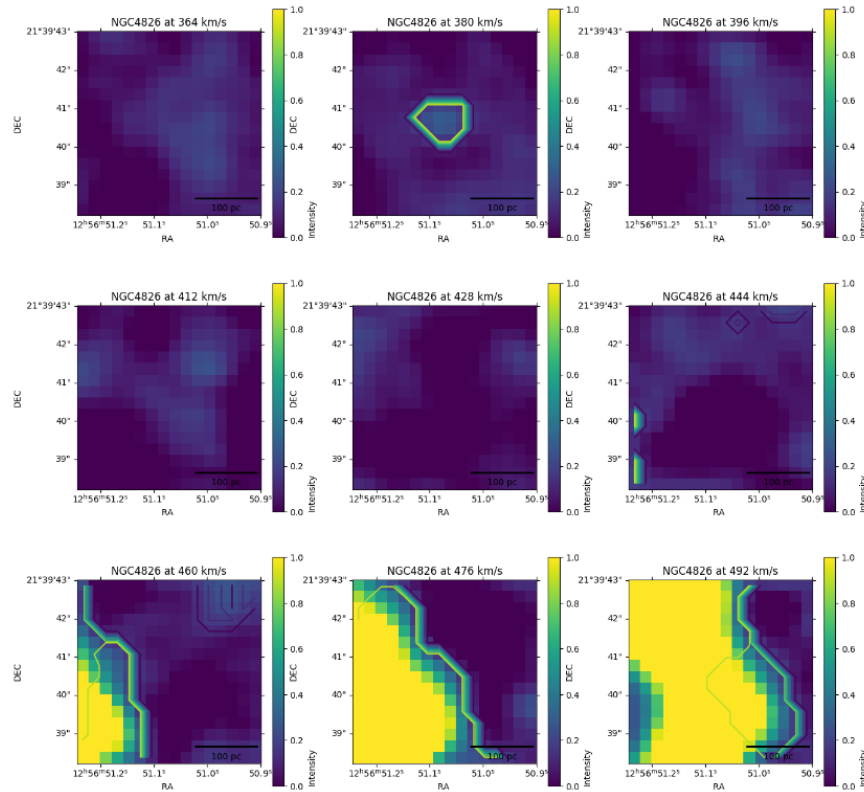


Spectrum of cloud n° 137 in NGC2903

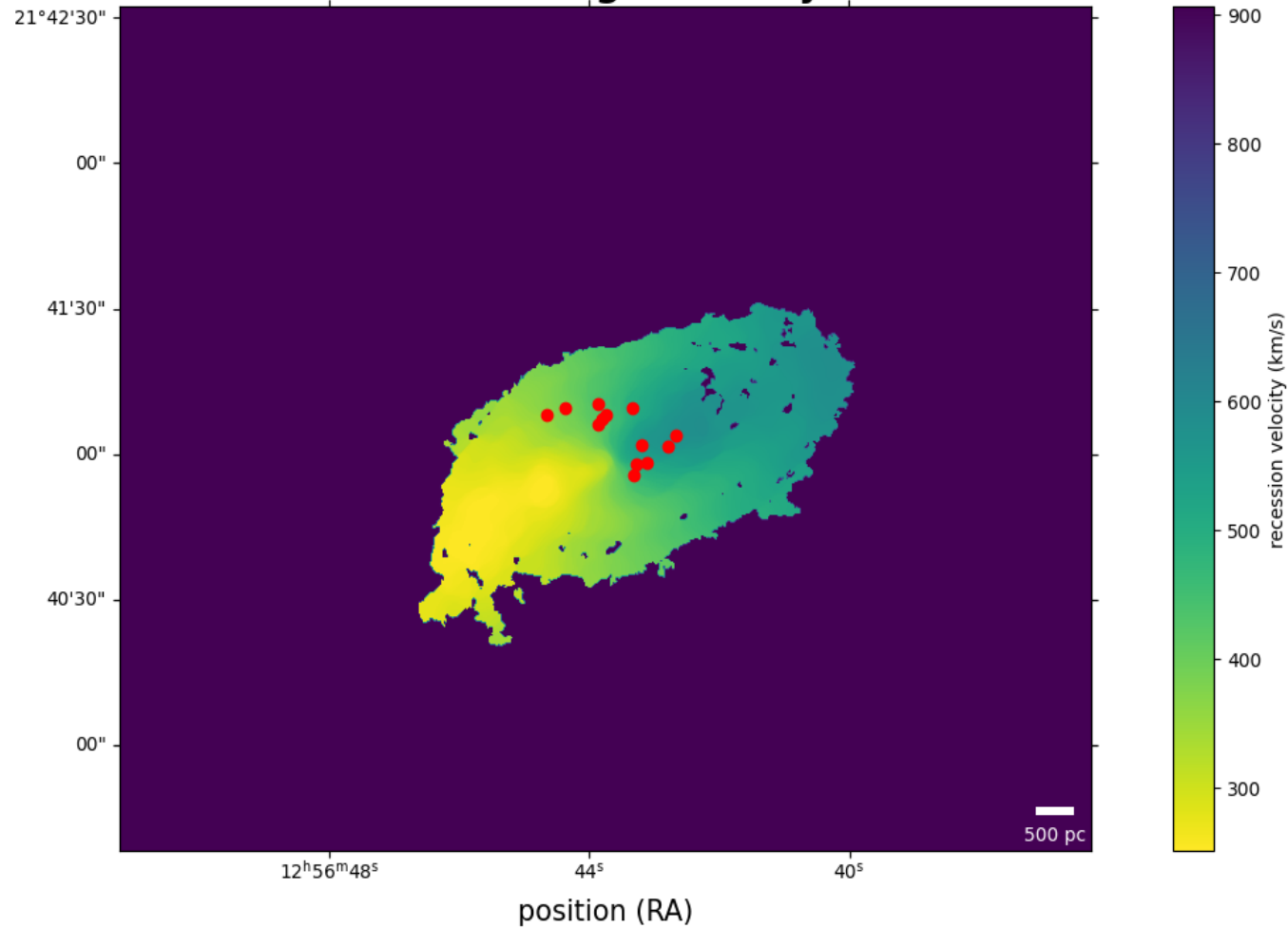


Spectra of a single cloud

Position of the high velocity clouds

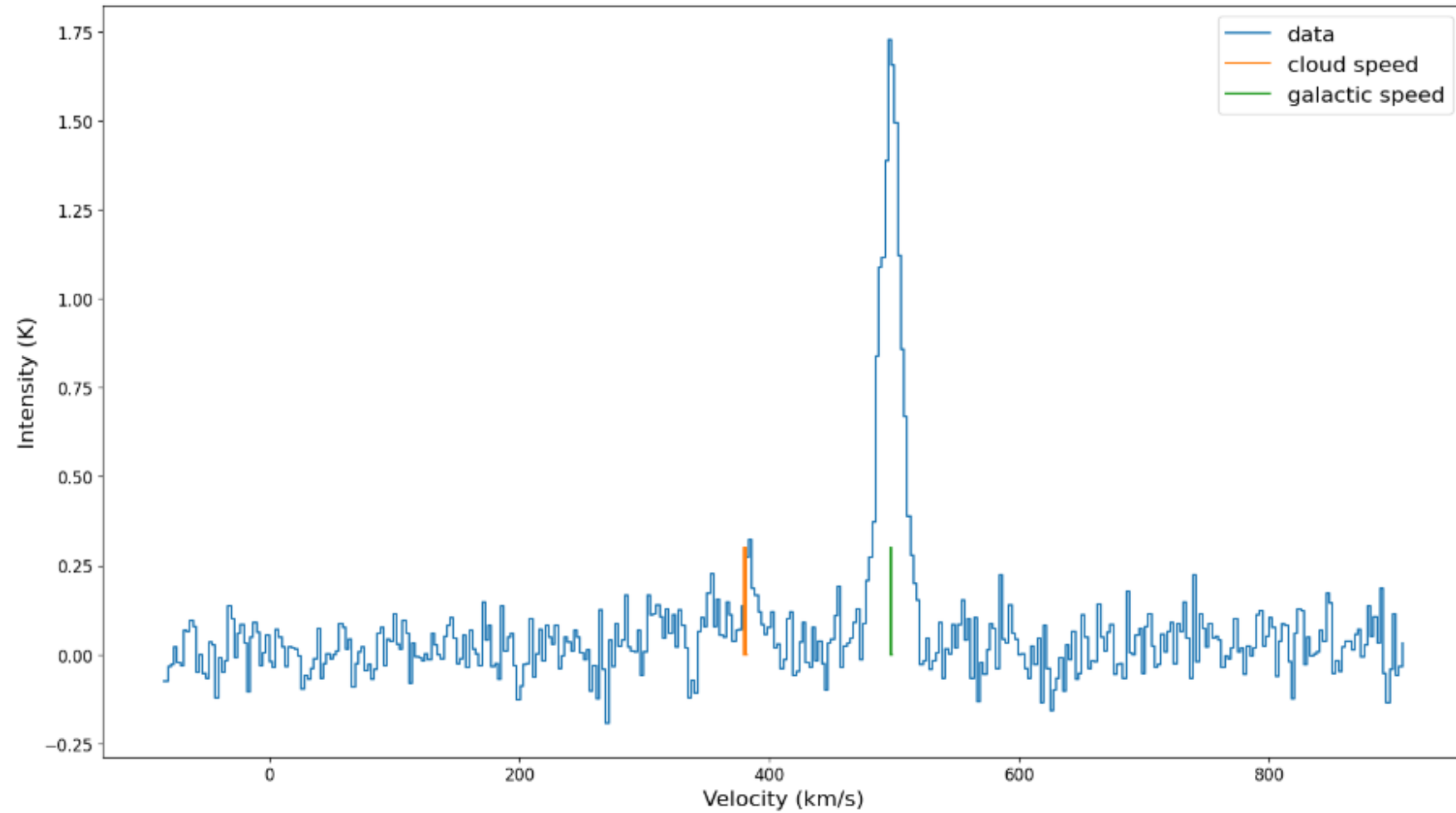


position (DEC)



An example: NGC 4826

Spectrum of cloud n° 10 in NGC4826



A single spectrum

Other parameters

Object	Resolution	Gas mass Sensitivity	Neighbors	Inclination
M74	53 pc	$63 \cdot 10^4 M_{\text{sun}}$	>5	6°
NGC 1637	130 pc	$154 \cdot 10^4 M_{\text{sun}}$	-	31°
NGC 2903	99 pc	$117 \cdot 10^4 M_{\text{sun}}$	-	60°
NGC 3521	73 pc	$108 \cdot 10^4 M_{\text{sun}}$	-	73°
NGC 4826	28 pc	$33 \cdot 10^4 M_{\text{sun}}$	CVI group	60°

- Bar potential
- Inclination influence on detection

Conclusion

- ✓ Extracting clouds
- ✓ Calculate characteristics
- Filter to obtain HVC
- Bias proofing results
- Correlate with presence of neighboring galaxies / other sources

