WHAT LOCAL MAGNETIC FIELDS CAN TEACH US ABOUT A POSSIBLE SUPERNOVA REMNANT G182.5-4.0

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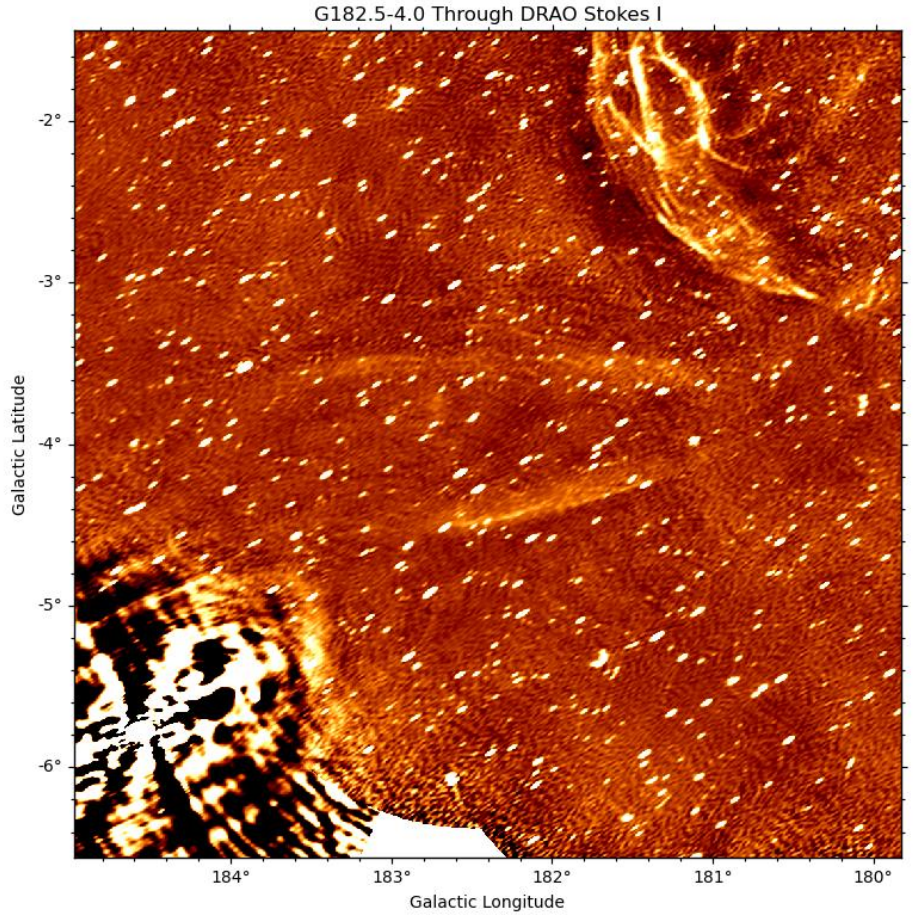
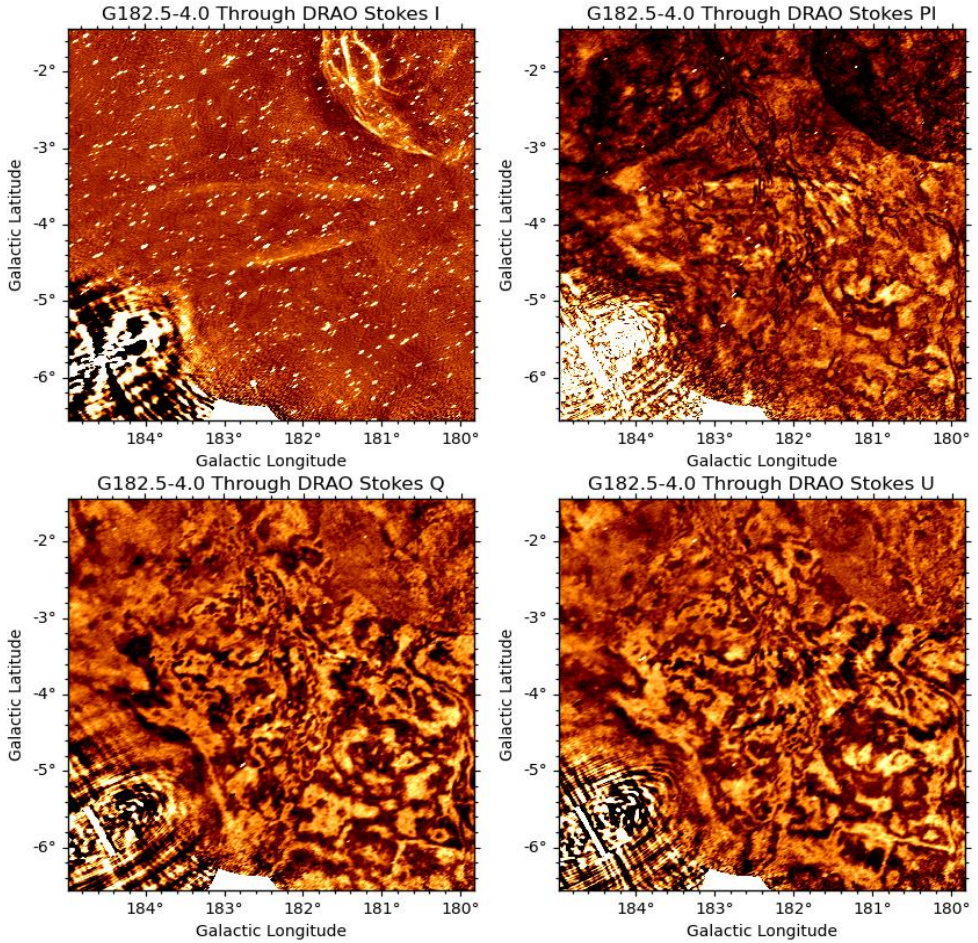
Research Goal

- **Goal:** Classifying a currently unknown object which we refer to as G182.5-4.0



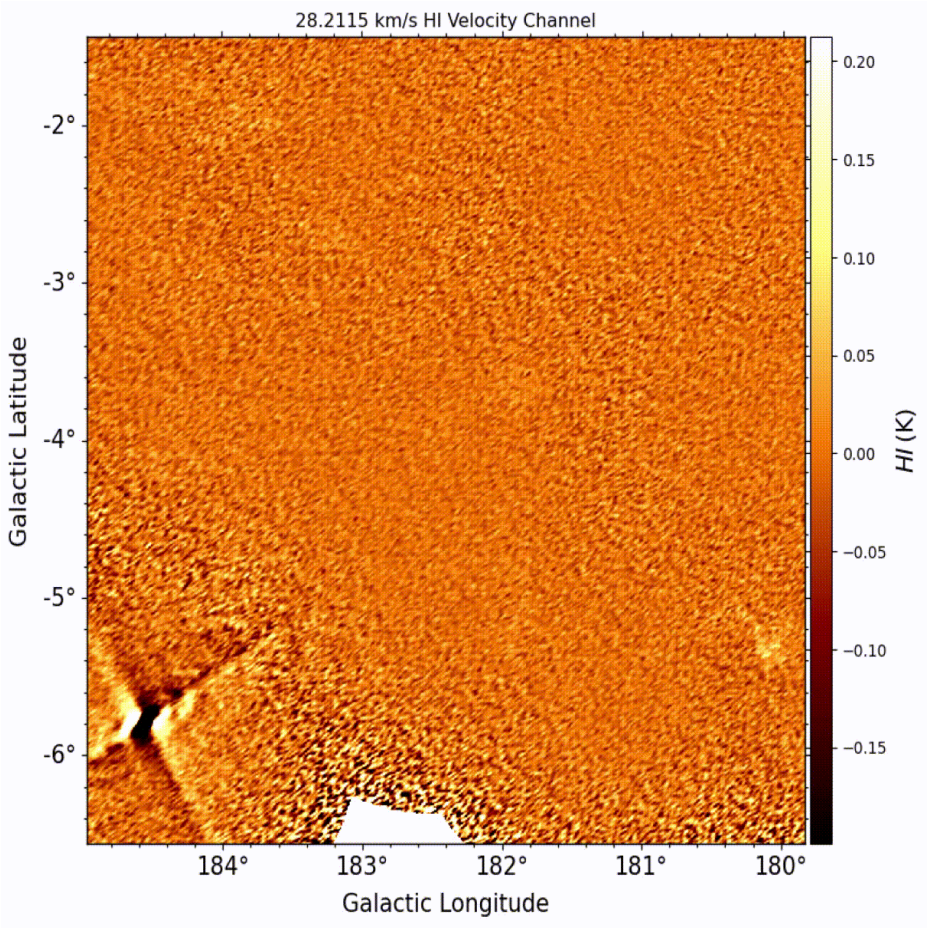
Data (DRAO - ST)

- Data: **D**ominion **R**adio **A**strophysical **O**bservatory – **S**ynthesis **T**elescope @ 1.4 GHz
- Understanding the Stokes Parameters



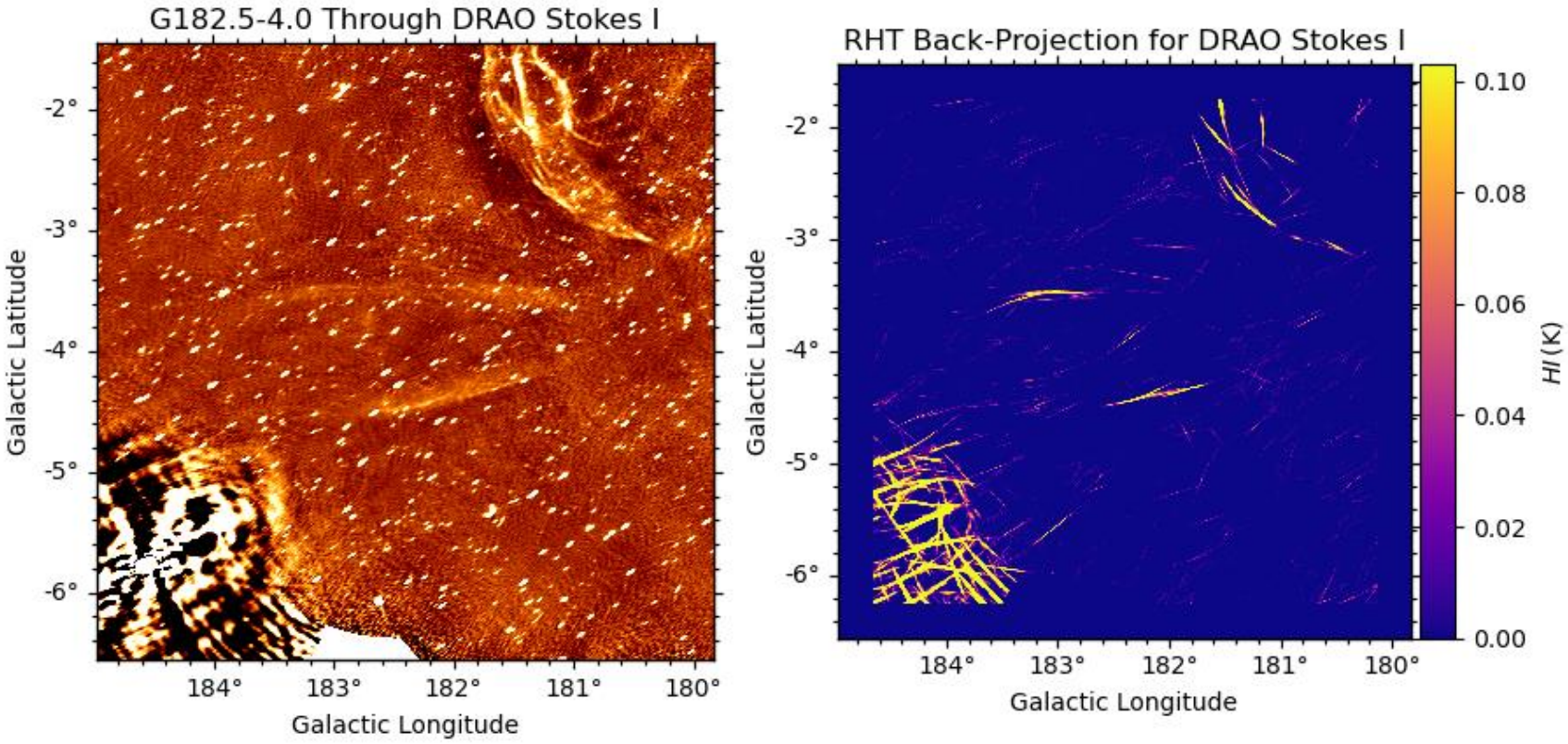
Data (DRAO - ST)

- **D**ominion **R**adio **A**strophysical **O**bservatory – **S**ynthesis **T**elescope @ 1.4 GHz
- HI Cube

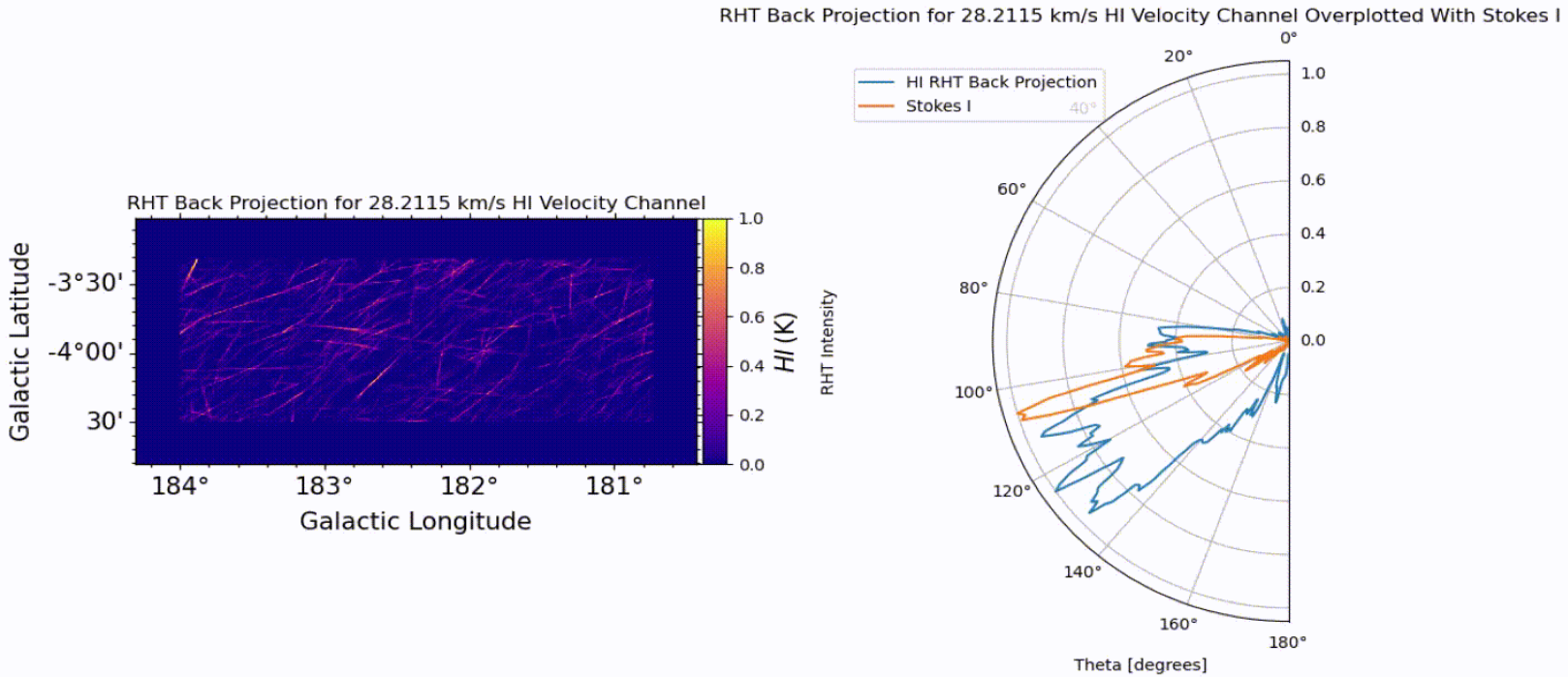


The RHT

- What is the **R**olling **H**ough **T**ransform?



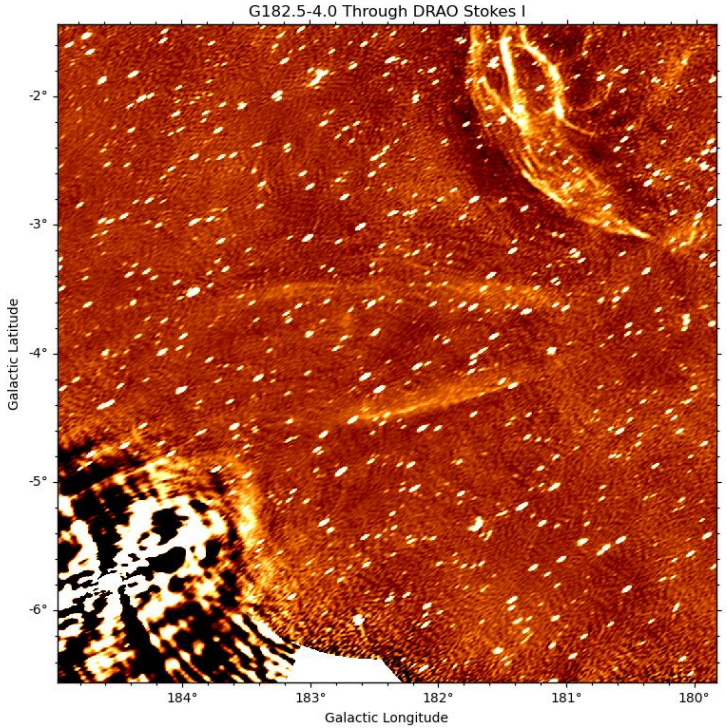
Polar Plots

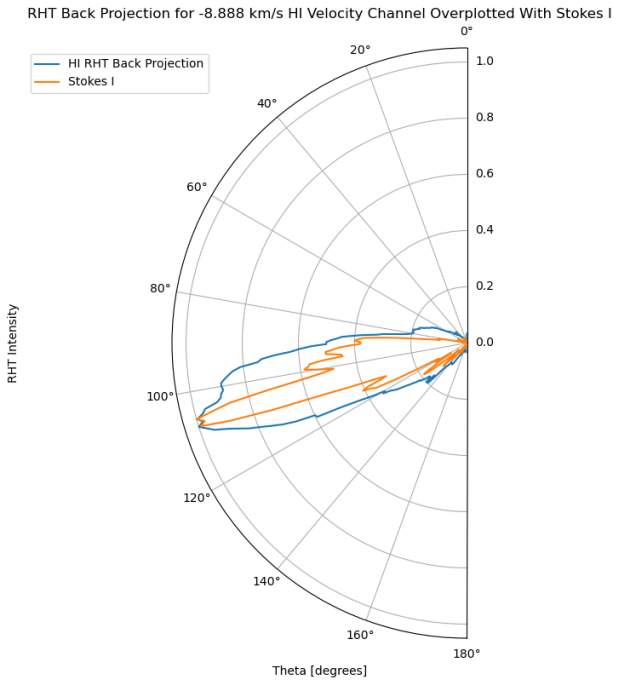

RHT Back Projection for 28.2115 km/s HI Velocity Channel
Galactic Latitude
-3°30'
-4°00'
30'
184°
183°
182°
181°
Galactic Longitude
HI (K)
1.0
0.8
0.6
0.4
0.2
0.0
RHT Back Projection for 28.2115 km/s HI Velocity Channel Overplotted With Stokes I
HI RHT Back Projection
Stokes I
RHT Intensity
0°
20°
40°
60°
80°
100°
120°
140°
160°
180°
Theta [degrees]

First Conclusion

- Connection Between Orientation in Two Mediums

- Relativistic Medium – G182.5-4.0 Orientation ⟶ 101° ± 12°
- Neutral Medium – HI Fibers & Magnetic Field Orientation

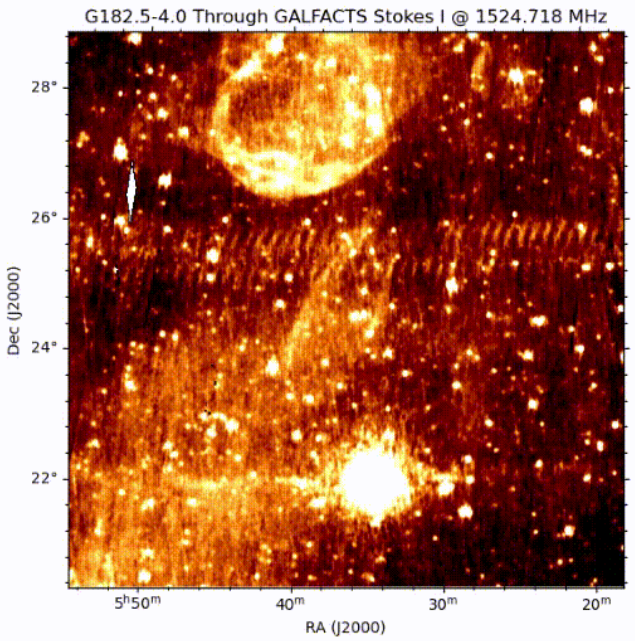


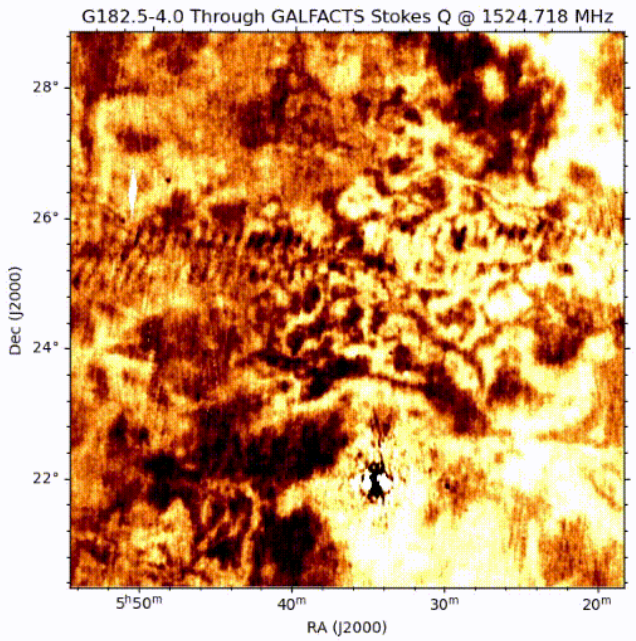


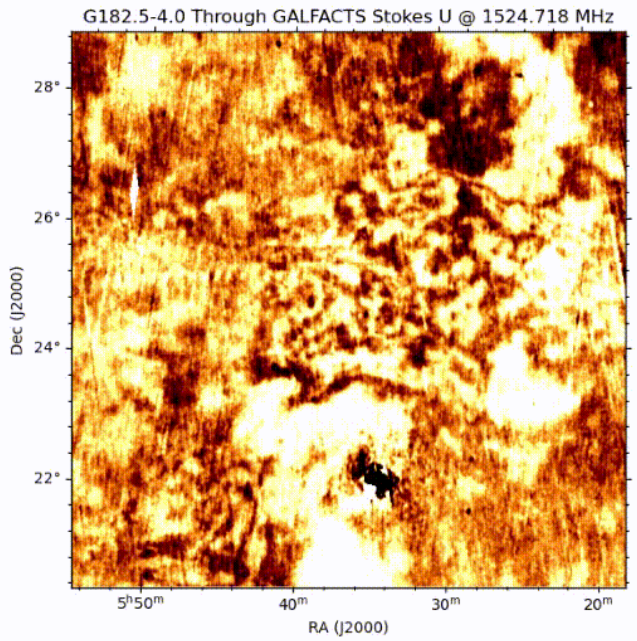
Data (GALFACTS)

- **G-ALFA C**ontinuum **T**ransit **S**urvey – Arecibo Telescope
  - Why are we doing this?
    - Major Differences
- Frequency channels 1.37 GHz – 1.52 GHz vs 1.4 GHz
- Telescopes
- Resolution
- FOV

Data (GALFACTS)

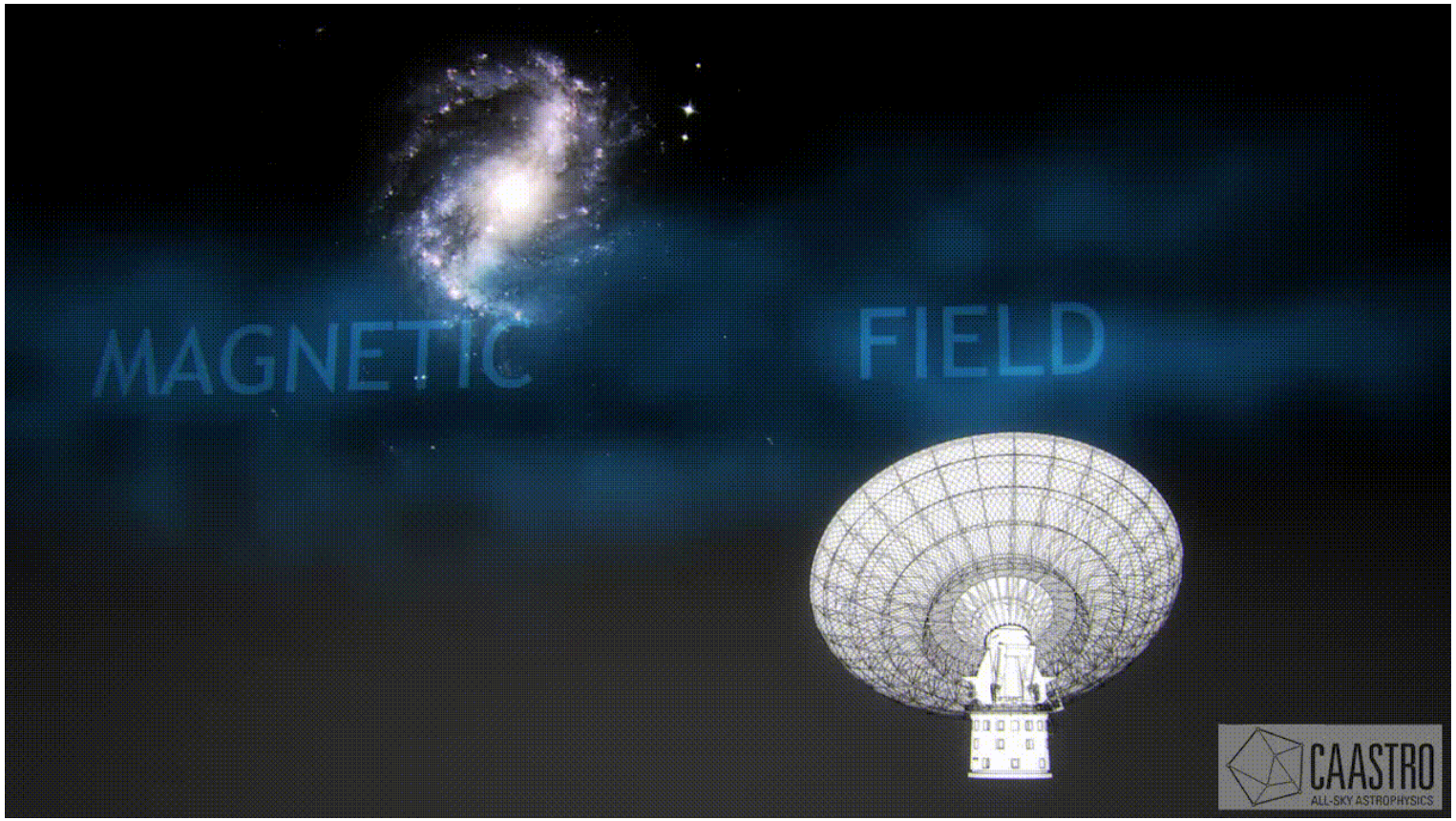






RM-Synthesis

- What is **R**otation **M**easure Synthesis?
  - Faraday Rotation



RM-Synthesis

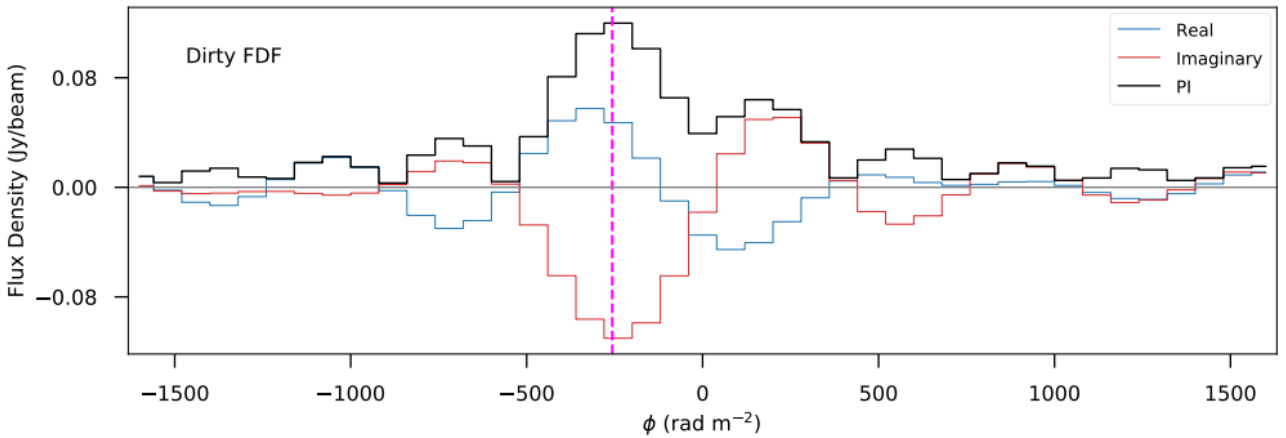
- What is **R**otation **M**easure Synthesis?
  - Rotation Measure (RM)

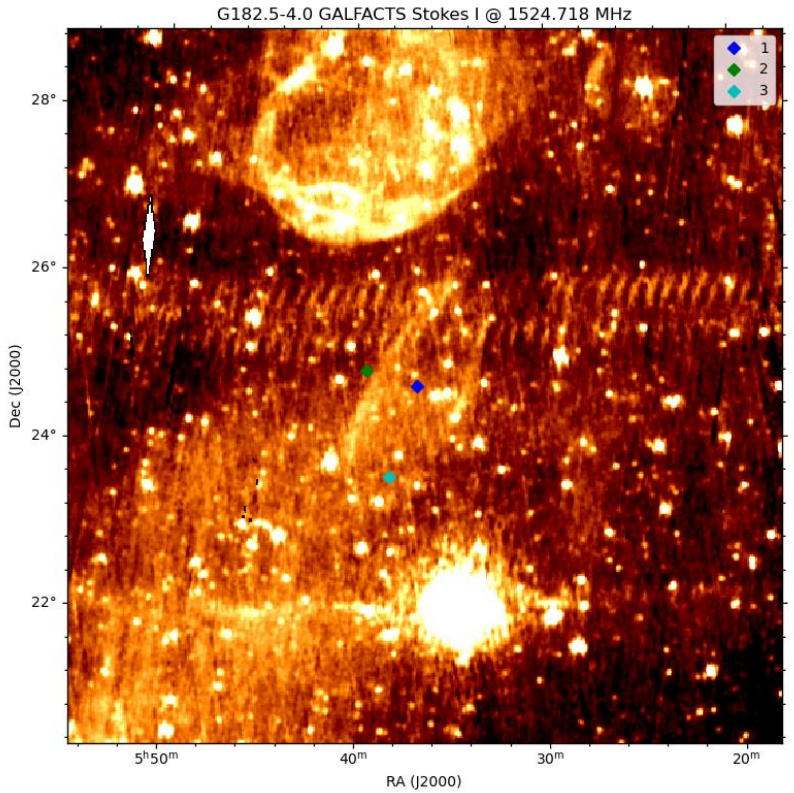
$$RM = 0.81 \int_{source}^{observer} n_e \vec{B} \cdot d\vec{l}$$

- Infer Magnetic Field Orientation and/or Electron Number Density
- RM Units: $rad \cdot m^{-2}$
- Un-Ravel Effect of Faraday Rotation: $\chi(\lambda^2) = \chi_0 + RM\lambda^2$

RM-Synthesis

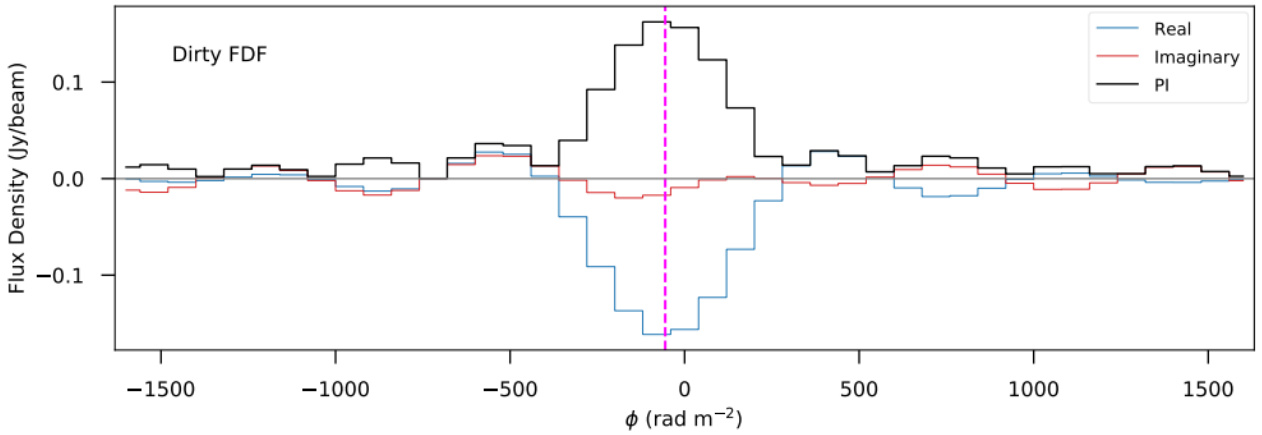
- What is **R**otation **M**easure Synthesis?
- 1D RM-Synthesis – Single Pixel Line of Sight RM
- Point 1

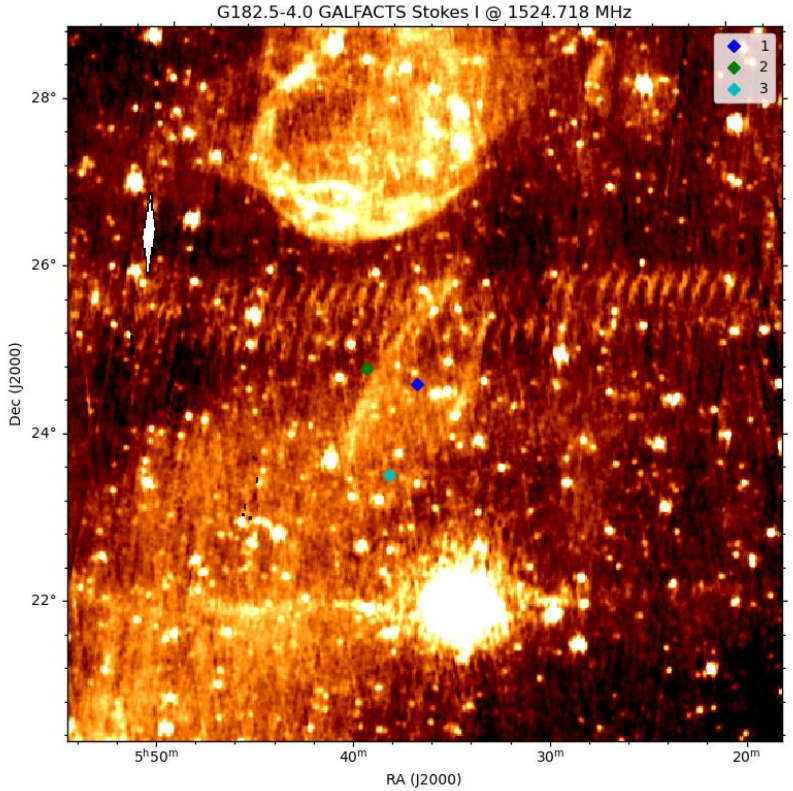




RM-Synthesis

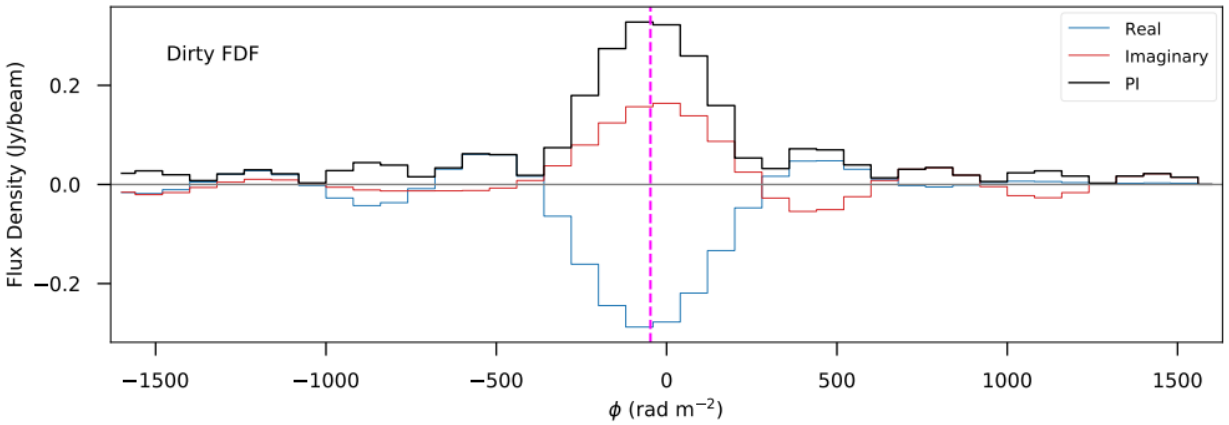
- What is **R**otation **M**easure Synthesis?
- 1D RM-Synthesis – Single Pixel Line of Sight RM
- Point 2

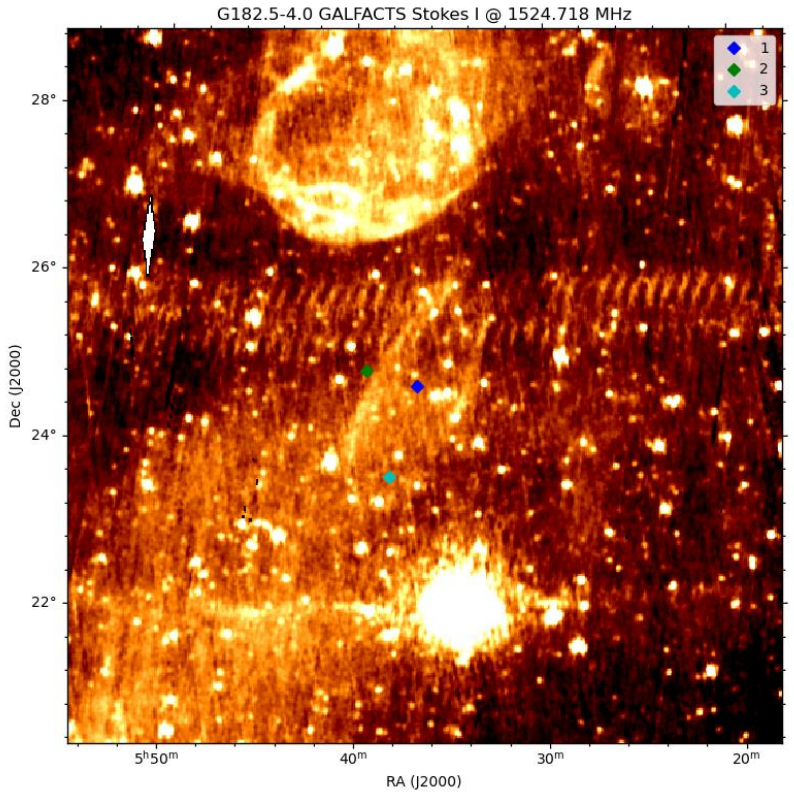




RM-Synthesis

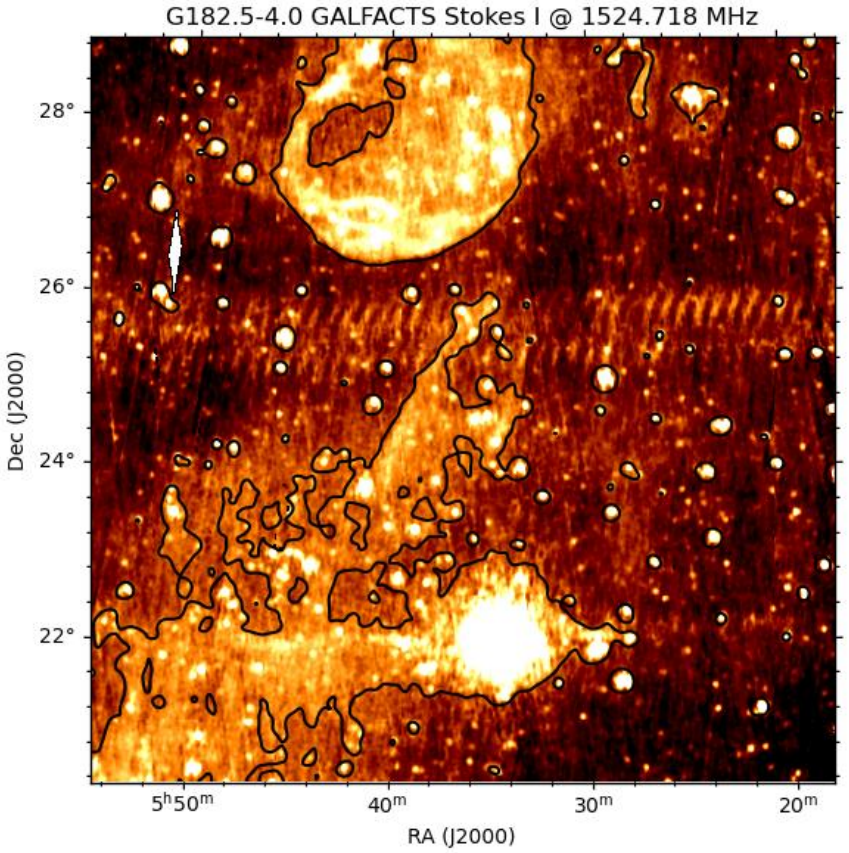
- What is **R**otation **M**easure Synthesis?
- 1D RM-Synthesis – Single Pixel Line of Sight RM
- Point 3

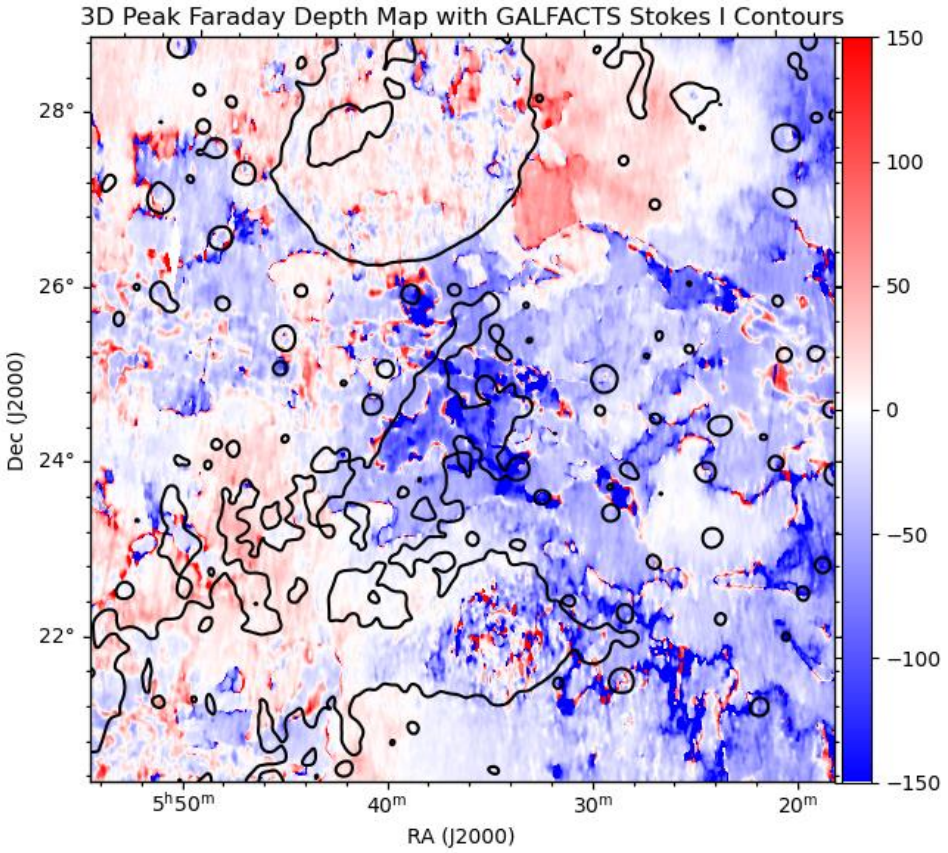




RM-Synthesis

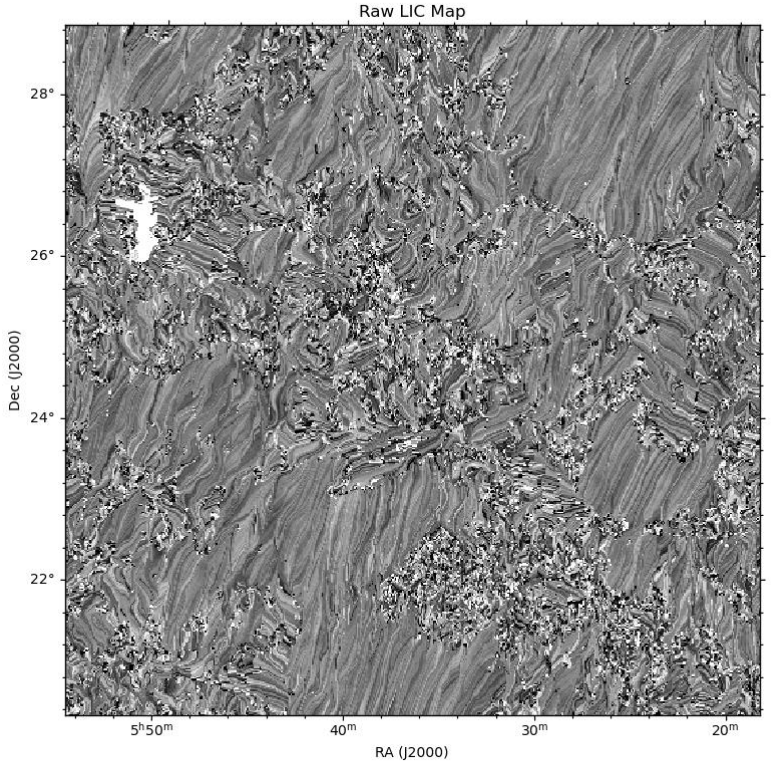
- What is **R**otation **M**easure Synthesis?
- 3D RM-Synthesis – Entire Cube Line of Sight RM





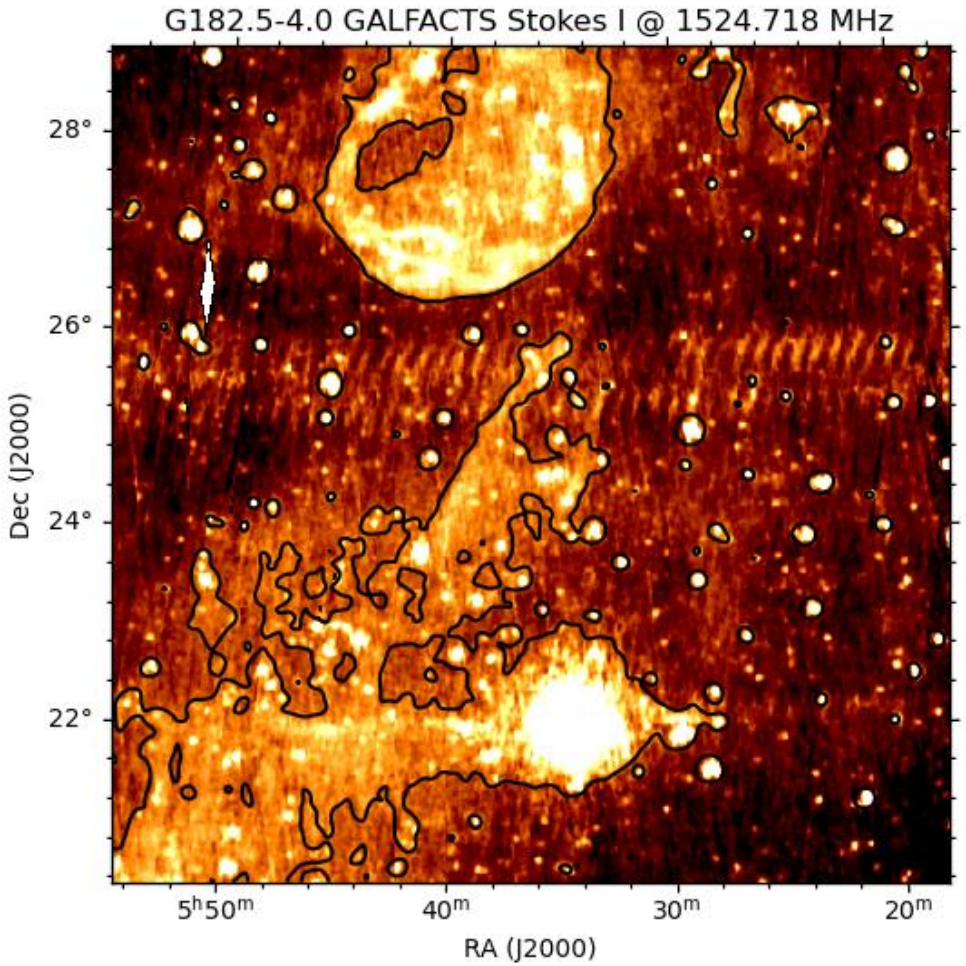
LIC Plot

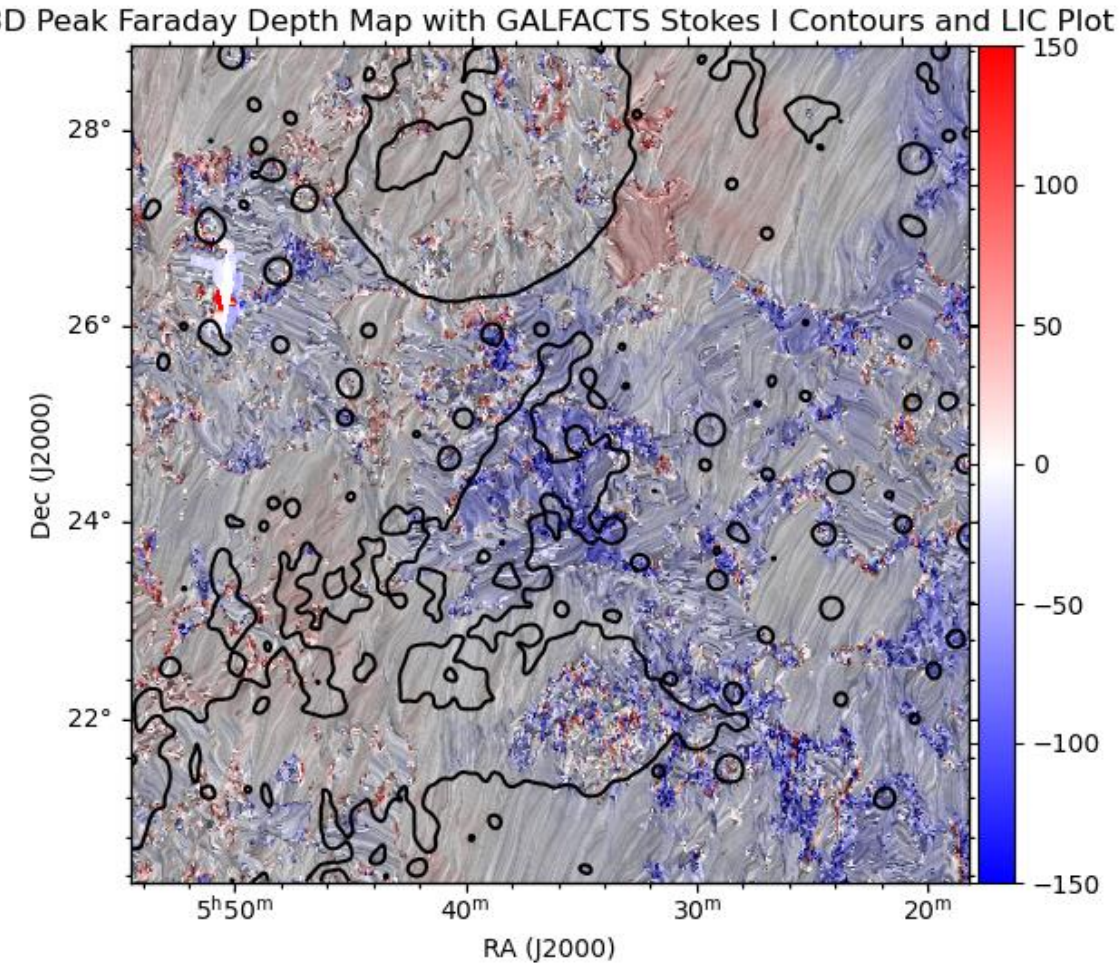
- LIC = **L**ine **I**ntegral **C**onvolution
  - Parameters
- 3D RM-Synthesis Output File – Provides De-rotated Polarized Angles



LIC Plot

- LIC = **L**ine **I**ntegral **C**onvolution





Explaining Peak RM Values Near G182.5-4.0

- Two Possibilities

- Seeing A lot of Negative Peak RM
- Large Component of Line-of-Sight Magnetic Field? : $\vec{B}$
- High Electron Density? : n_e

$$RM = 0.81 \int_{source}^{observer} n_e \vec{B} \cdot d\vec{l}$$

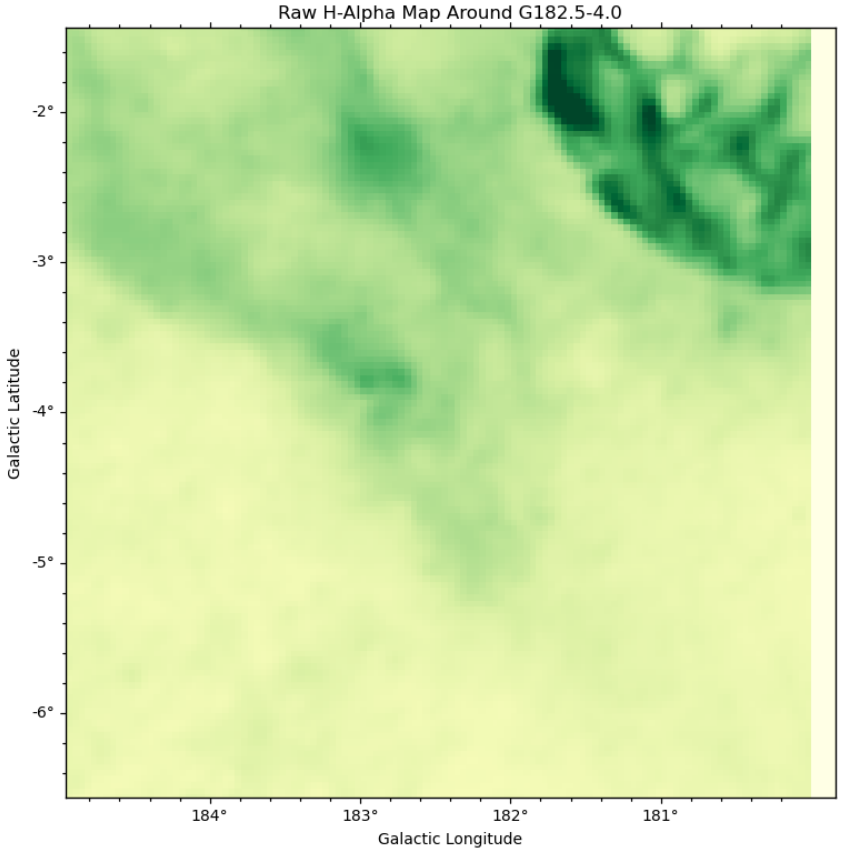
Explaining Peak RM Values Near G182.5-4.0

- Study H-Alpha

- H-Alpha Full Sky Map @ 456.79 THz
- North: Virginia Tech Spectral Line Survey (VTSS)
- South: Southern H-Alpha Sky Survey Atlas (SHASSA)

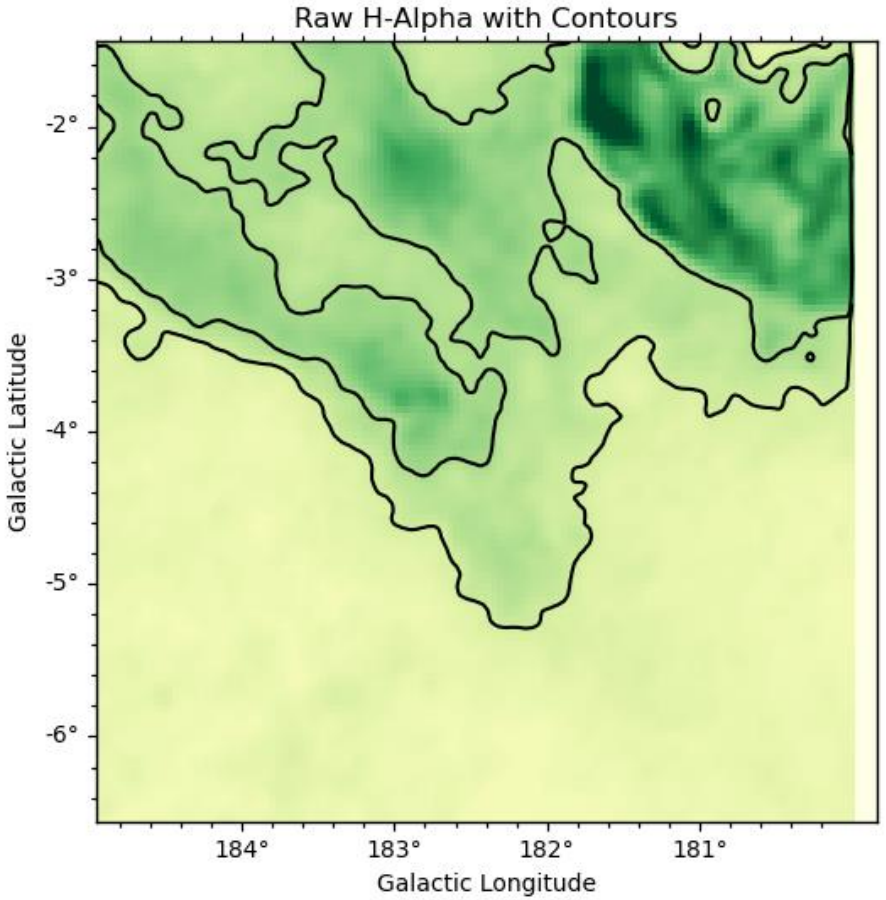
Explaining Peak RM Values Near G182.5-4.0

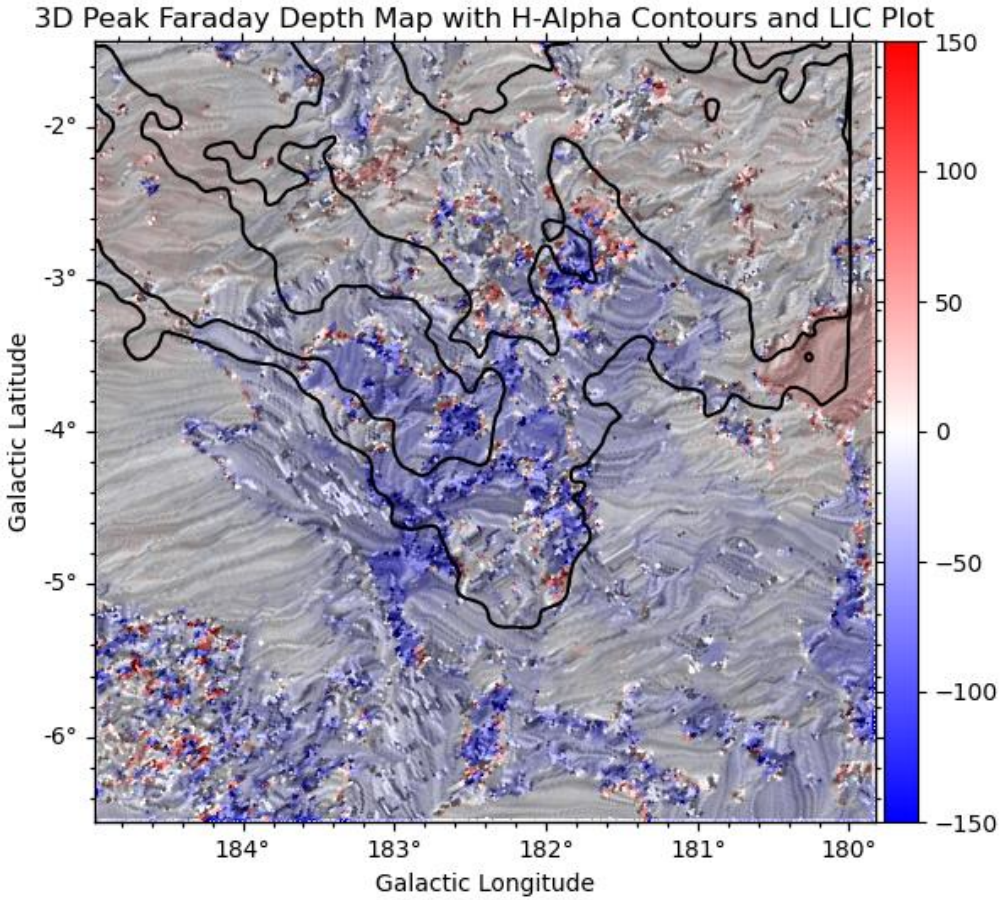
- Study H-Alpha
- Mind the Change in Coordinates (RA/DEC to Galactic)



Explaining Peak RM Values Near G182.5-4.0

- Study H-Alpha





Second Conclusion

- High Negative Peak RM Values Near G182.5-4.0 …
- More Likely Due to Higher Concentrations of H-Alpha in that Region
- Less Likely Due to a Line-of-Sight Magnetic Field
- Magnetic Field is Largely on the Plane-of-Sky – Consistent with RHT Results

Summary

RHT Procedure

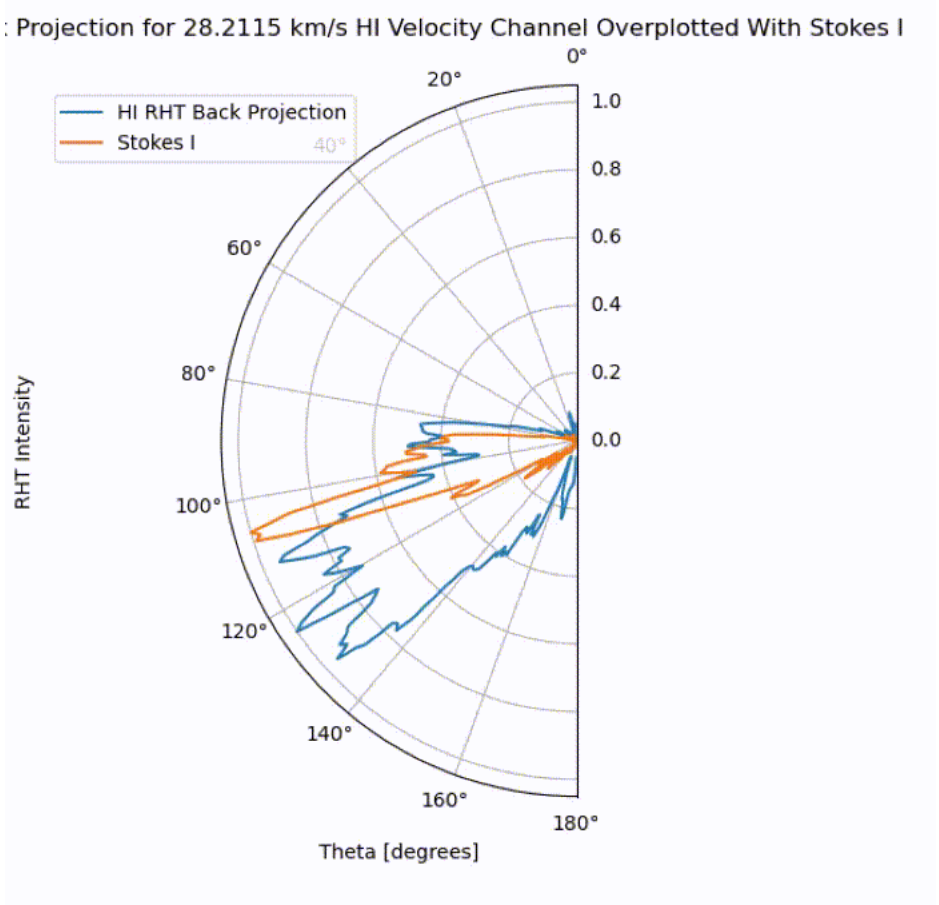
- Inferred Magnetic Field Orientation in the Neutral Medium Through Magnetically Aligned HI-Fibers
- Generated Polar Plots to View Orientation

RM-Synthesis

- Inferred Magnetic Field Orientation in the Polarized Medium Through RM-Synthesis
- Generated LIC Plot to View Plane-of-Sky Orientation

Summary

RHT Procedure



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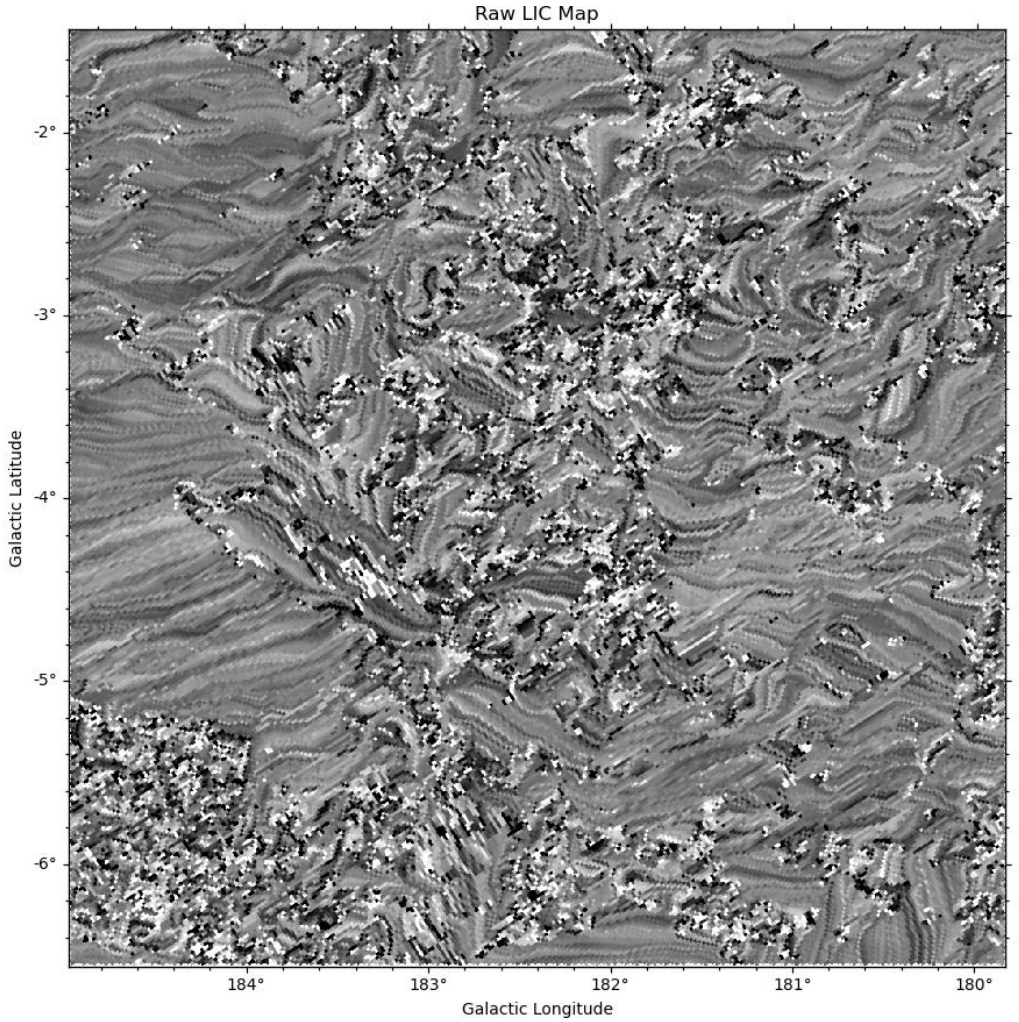
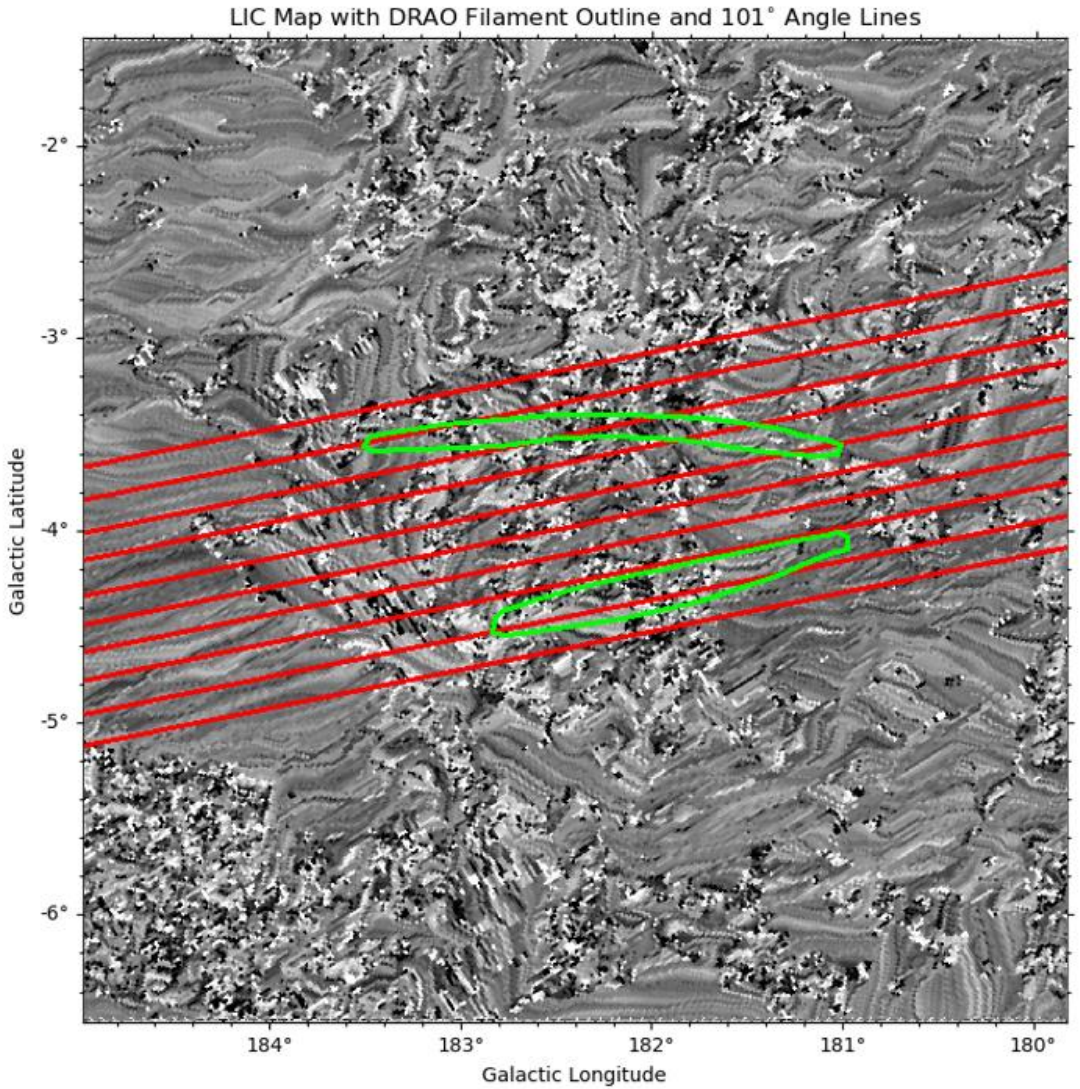


Conclusion



101° ± 12°

Research Goal

- **Goal:** Classifying a currently unknown object which we refer to as G182.5-4.0