

V-LoLSS: A census of circularly polarised sources at 50 MHz

**Henrik Edler, *Bell Burnell Fellow*, ASTRON
with Joe Callingham, Francesco de Gasperin, Cristina Cordun, Le
Hoang Long, Cees Bassa**



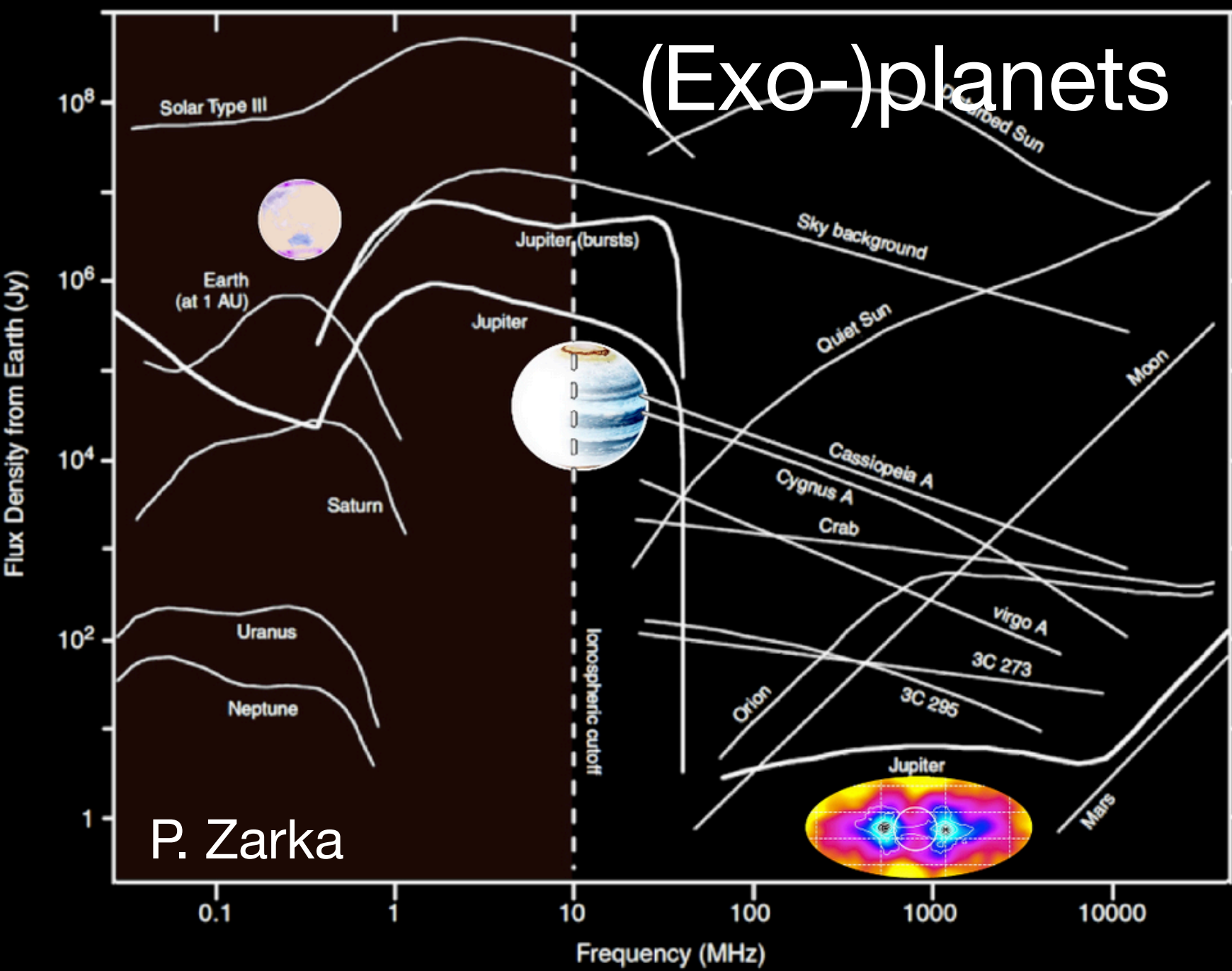
The circularly polarised radio sky

At ultra-low radio frequencies



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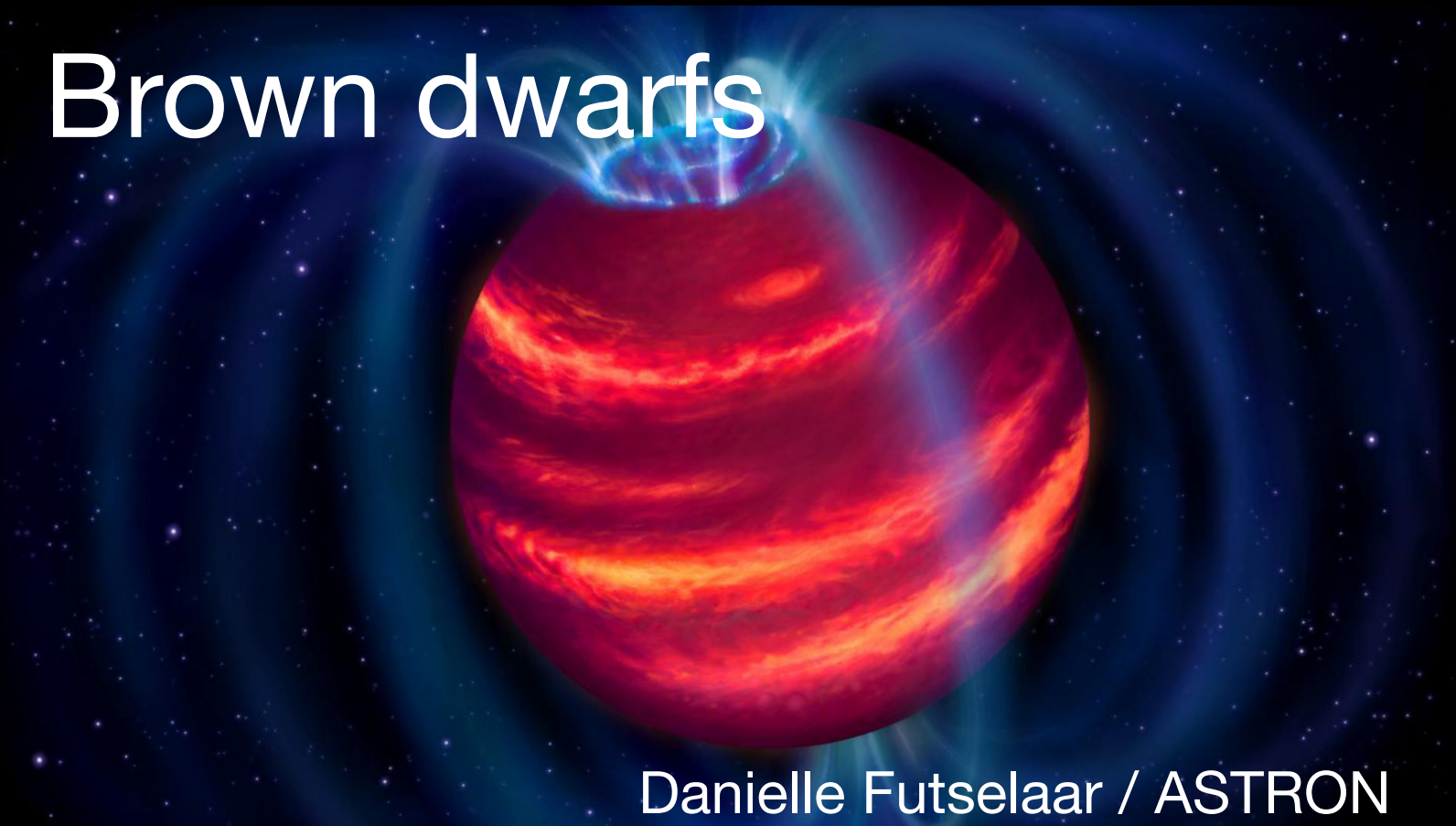
Active stars



Extra-solar space weather



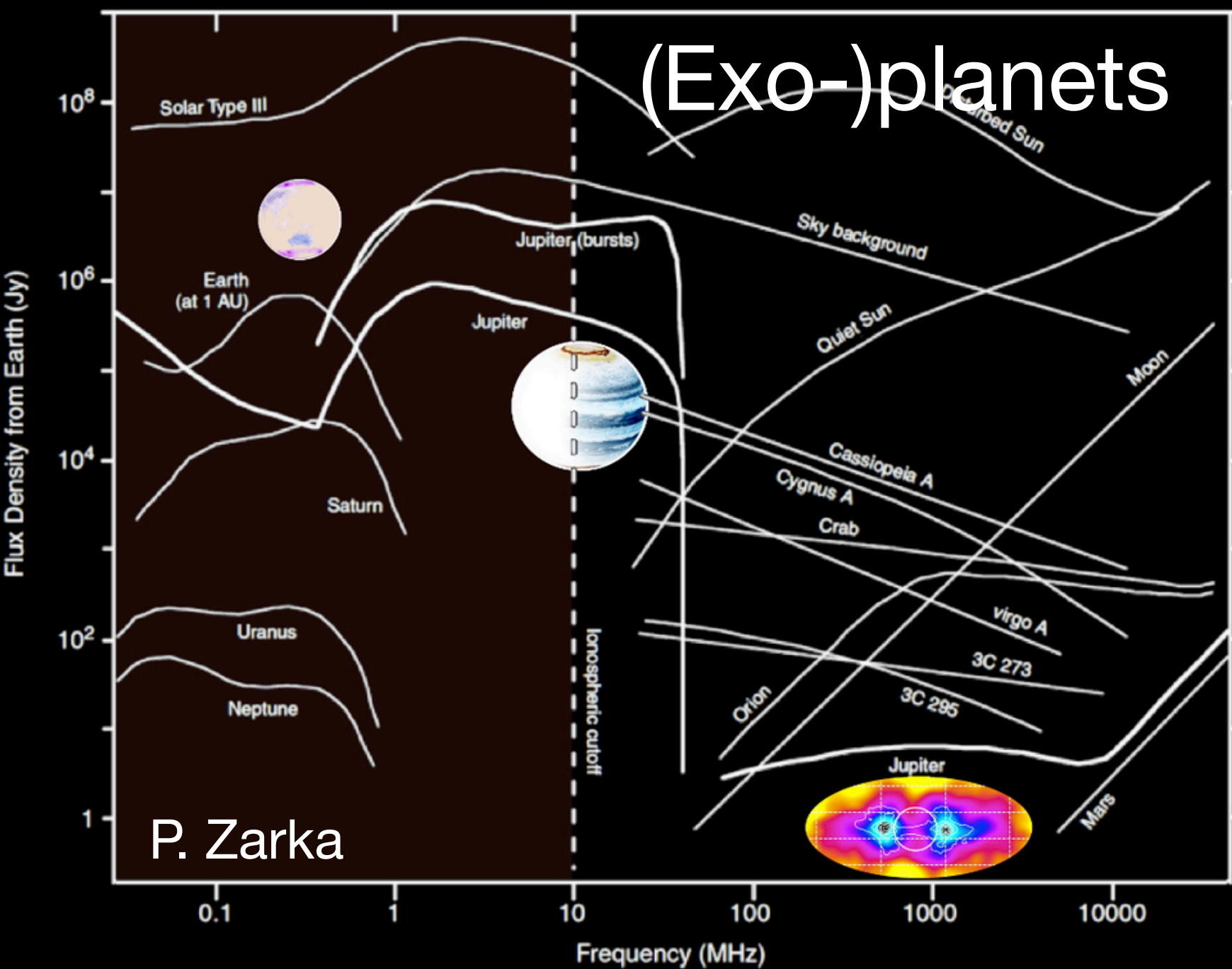
Brown dwarfs



Danielle Futselaar / ASTRON

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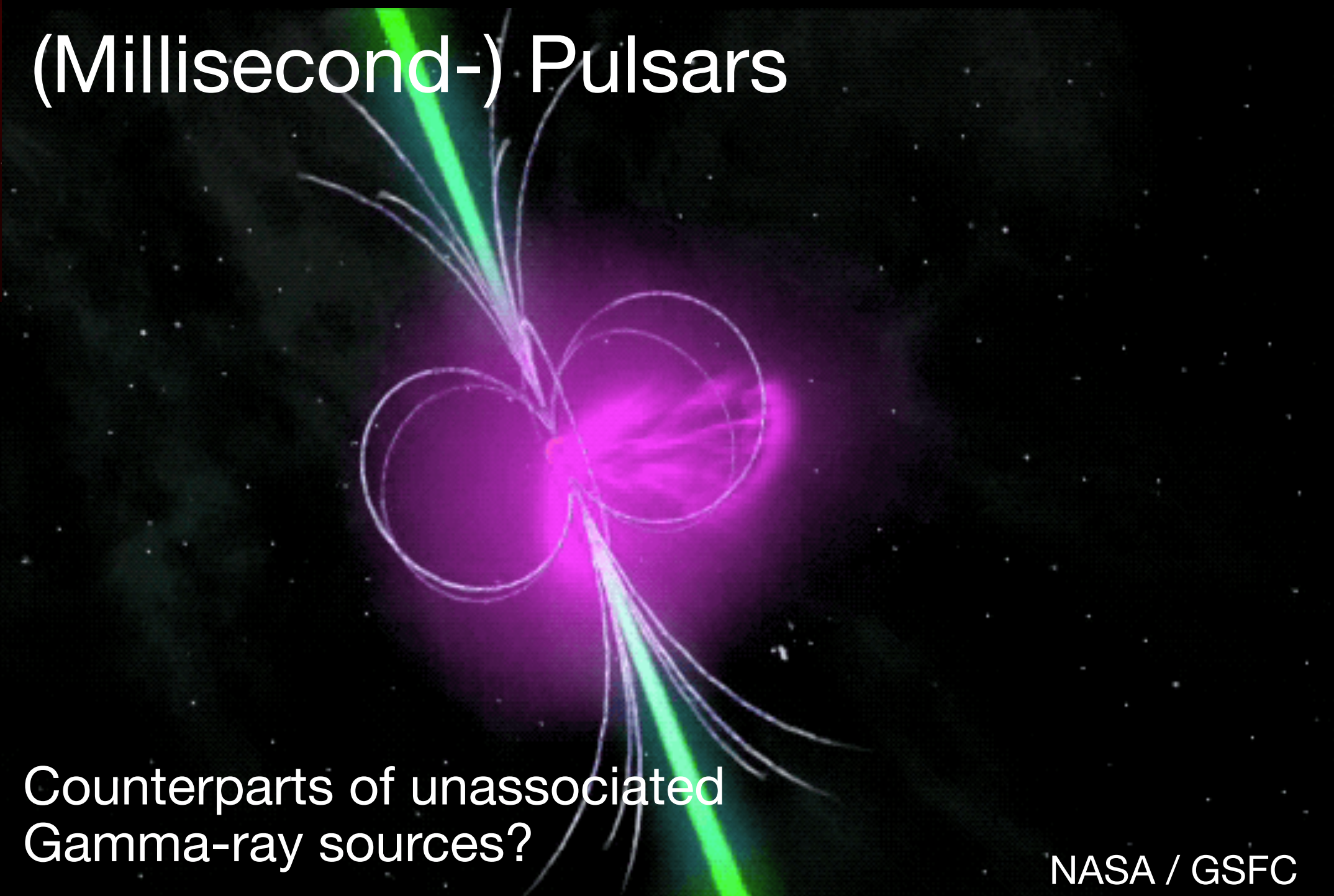
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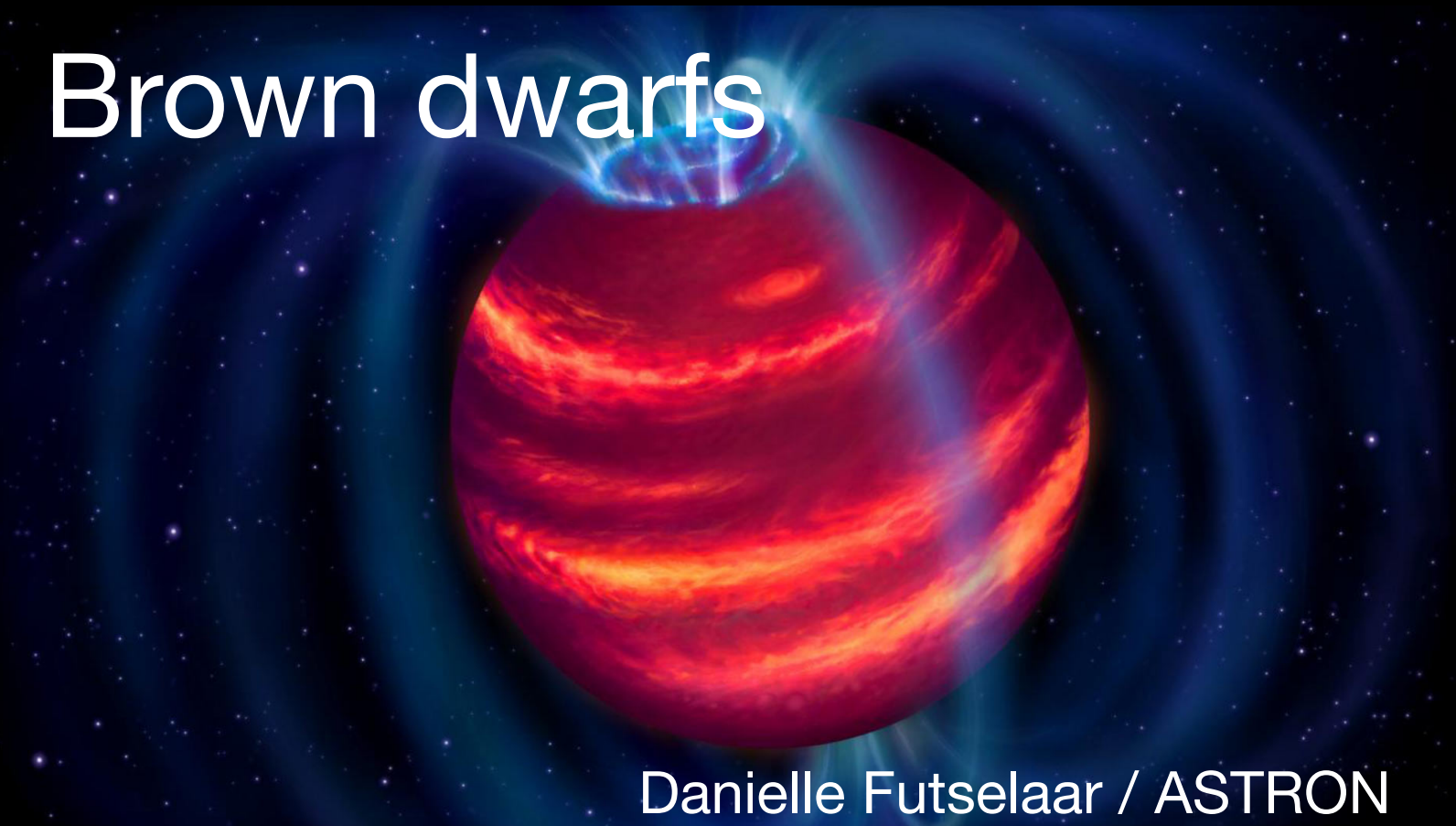
Extra-solar space weather



(Millisecond-) Pulsars

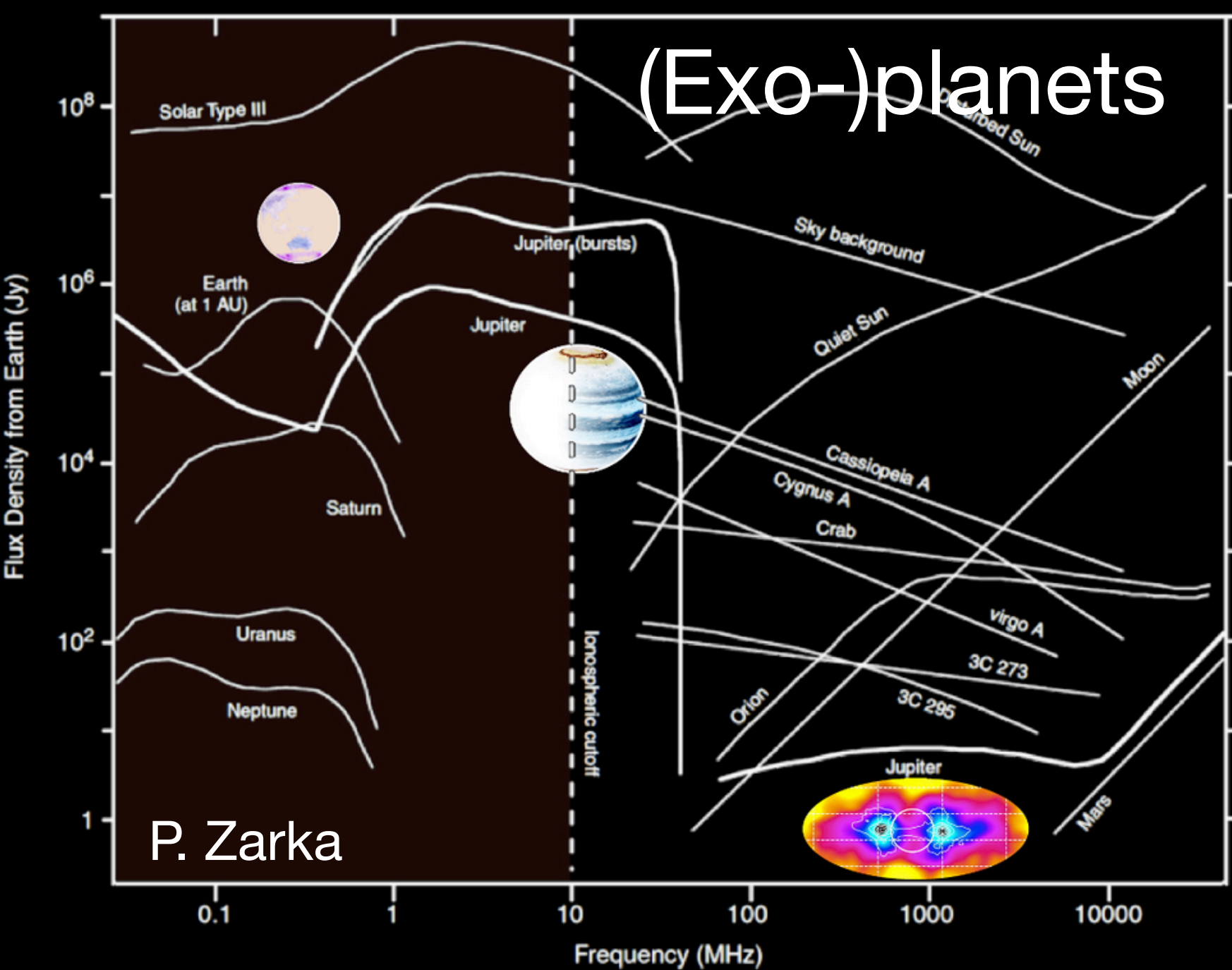


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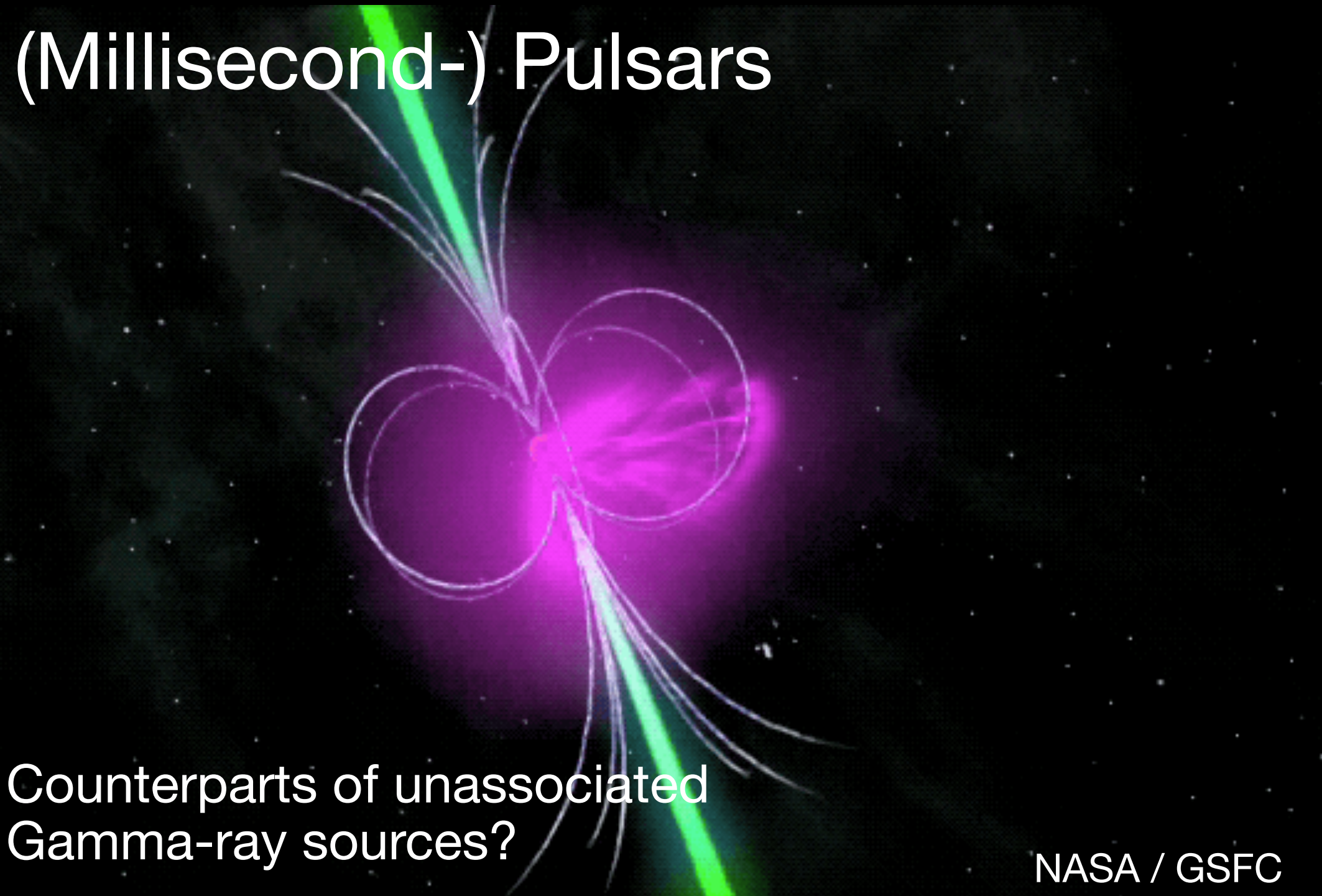
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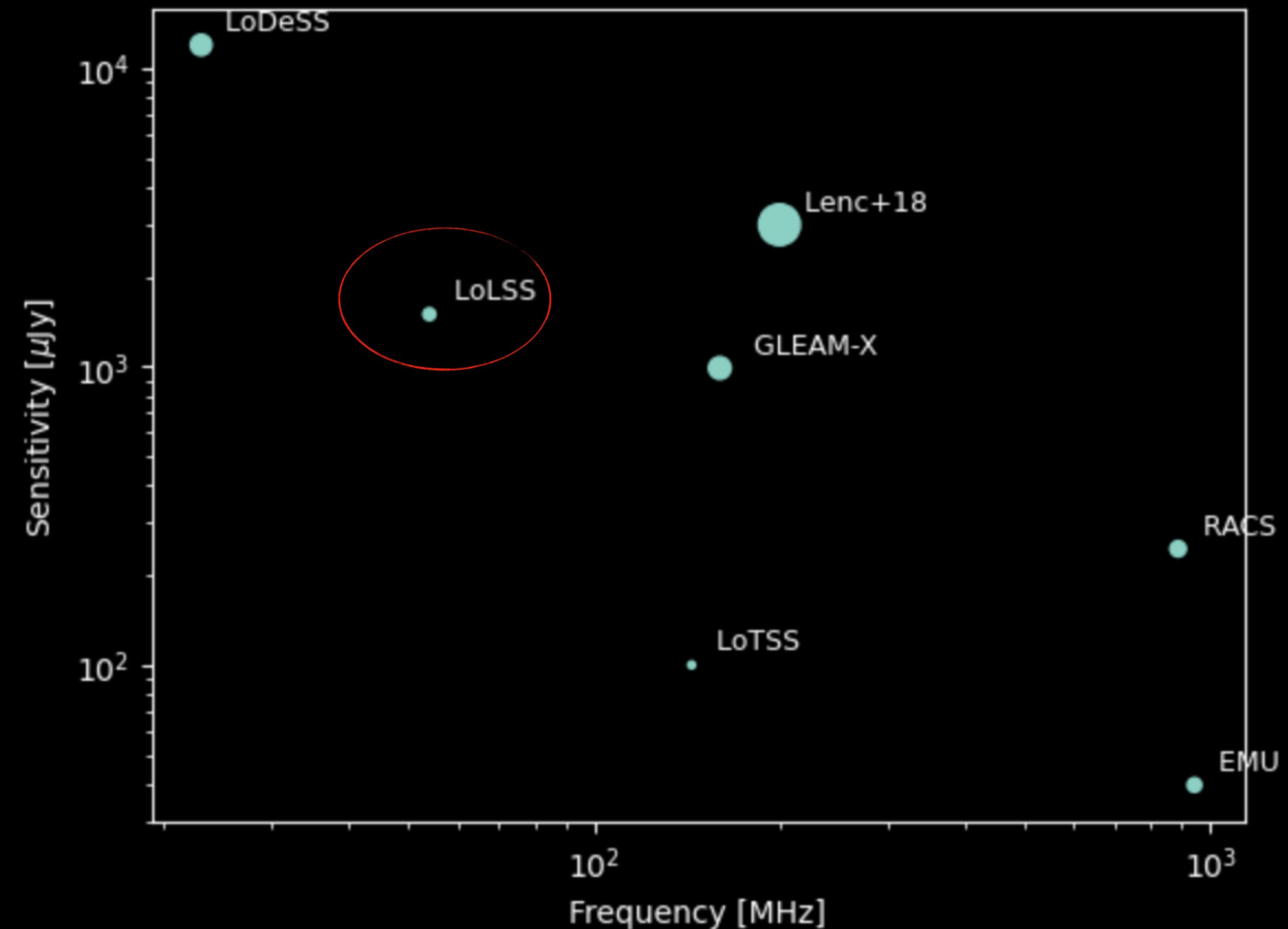


Counterparts of unassociated Gamma-ray sources?

V-LoLSS

Stokes V component of LoLSS-DR2 [de Gasperin+ in prep.]

- 1972 pointings above Dec=+24°
- Observed for 3 epochs of 1h
- Blind search
- Covers a third of the sky
- LoLSS DR1: only PSR B1508+55 detected in Stokes V, at low significance

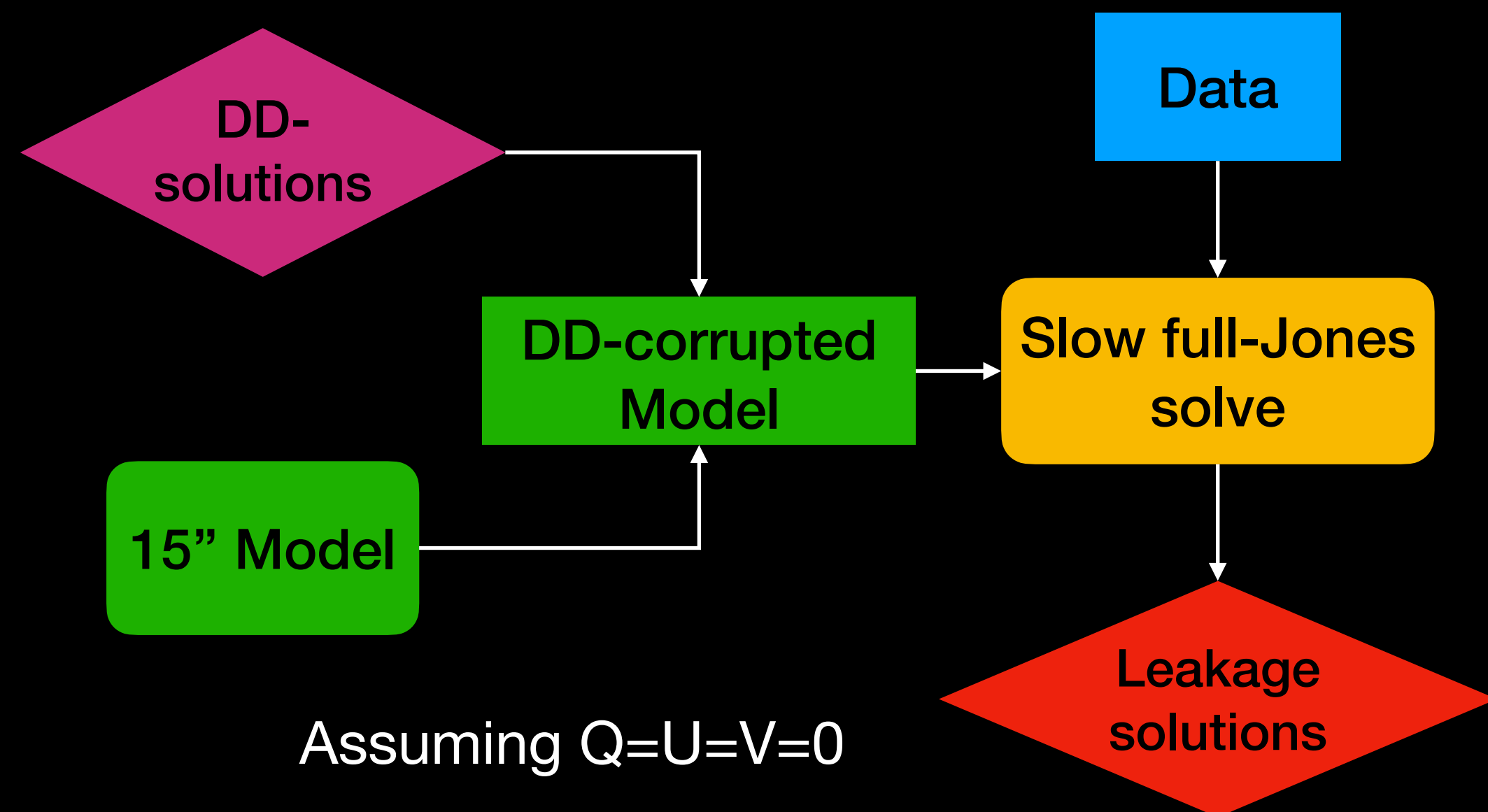


LoLSS-DR2 Polarization Calibration



w/ ASTRON summer
student Long Le Hoang

- Uncorrected LBA: 1-2% pol. leakage
- Prohibits detection of moderately polarized source (<10%)

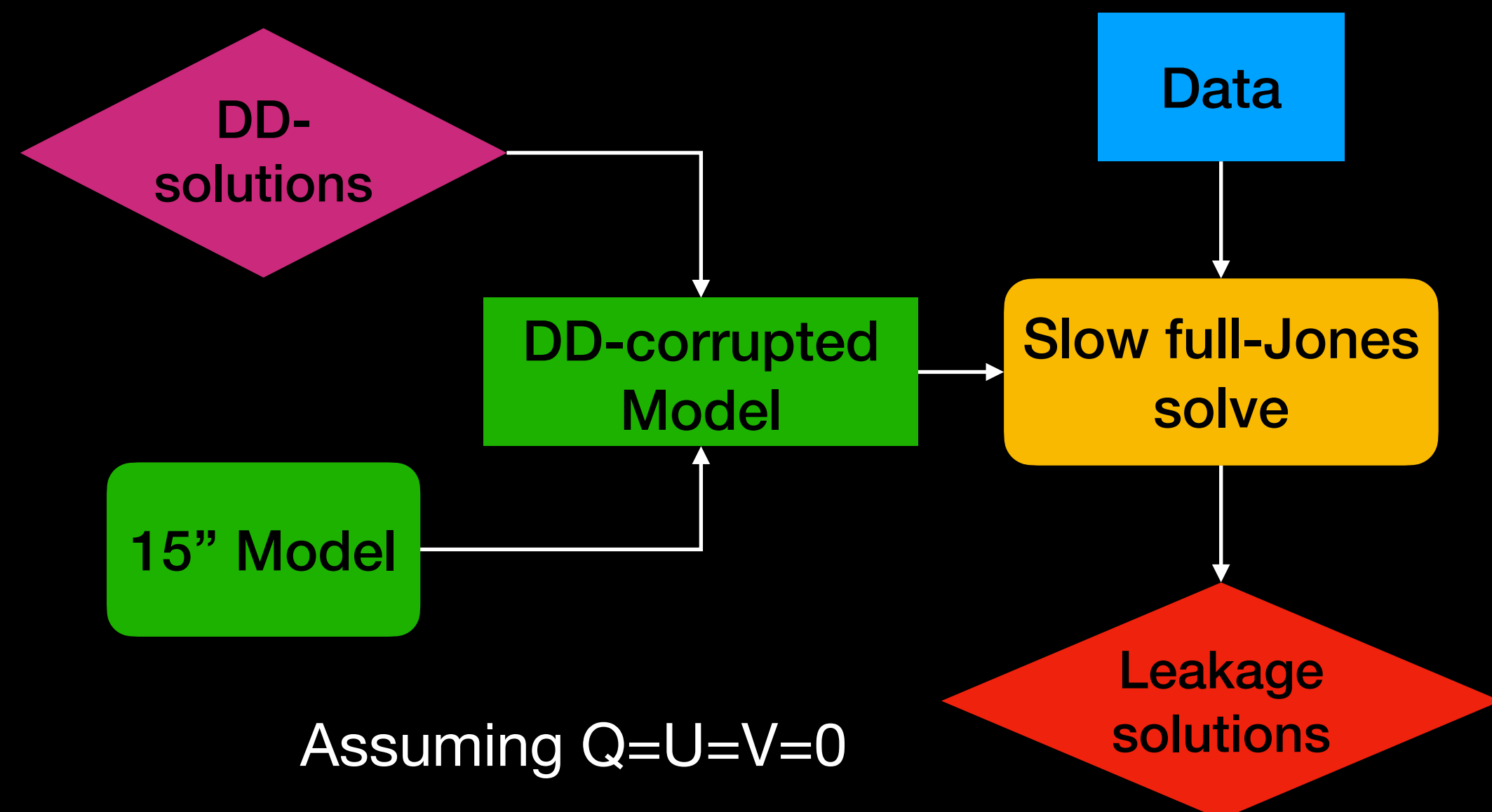


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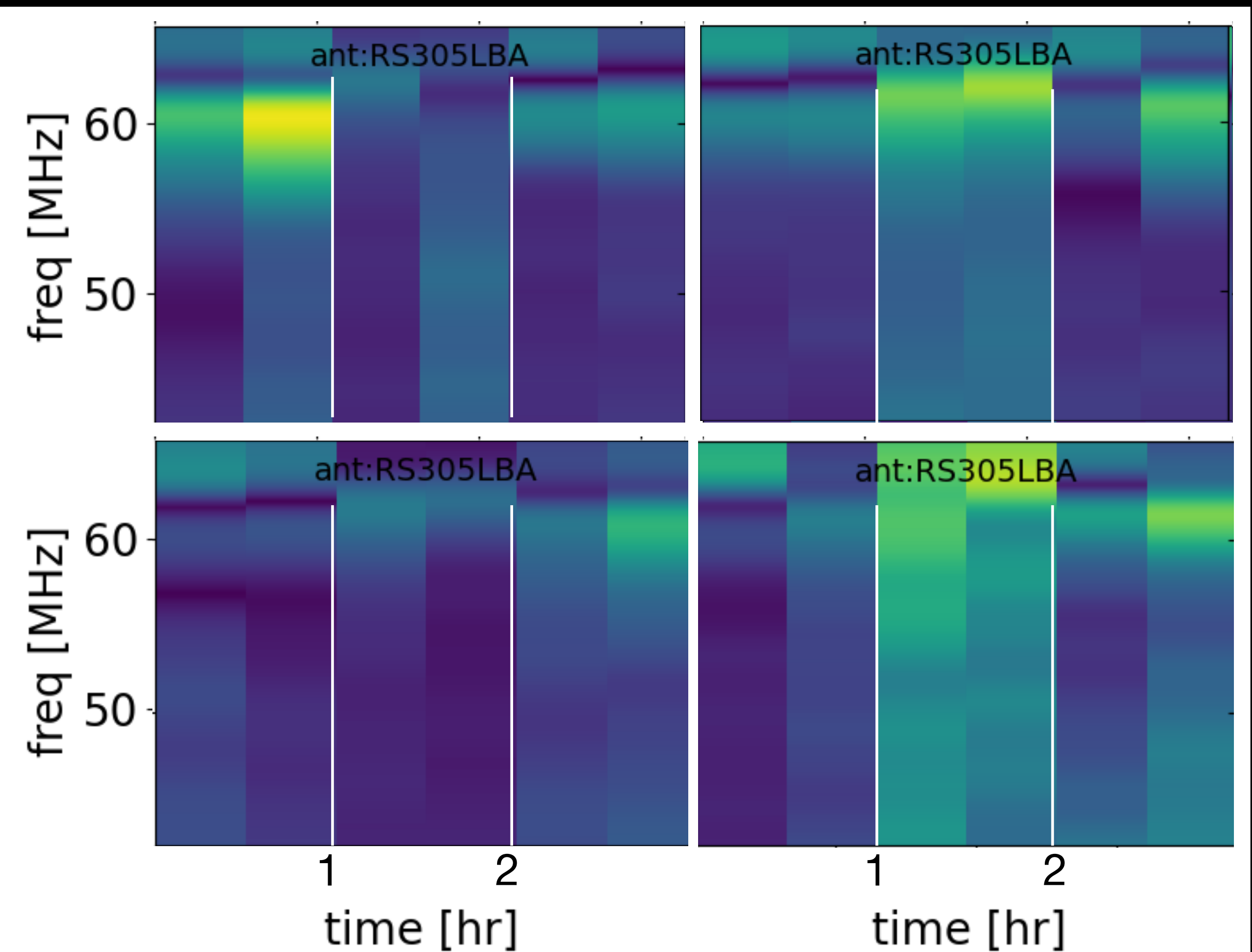


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- Leakage dominated by “bump” at ~62 MHz



Four fields @ three epochs

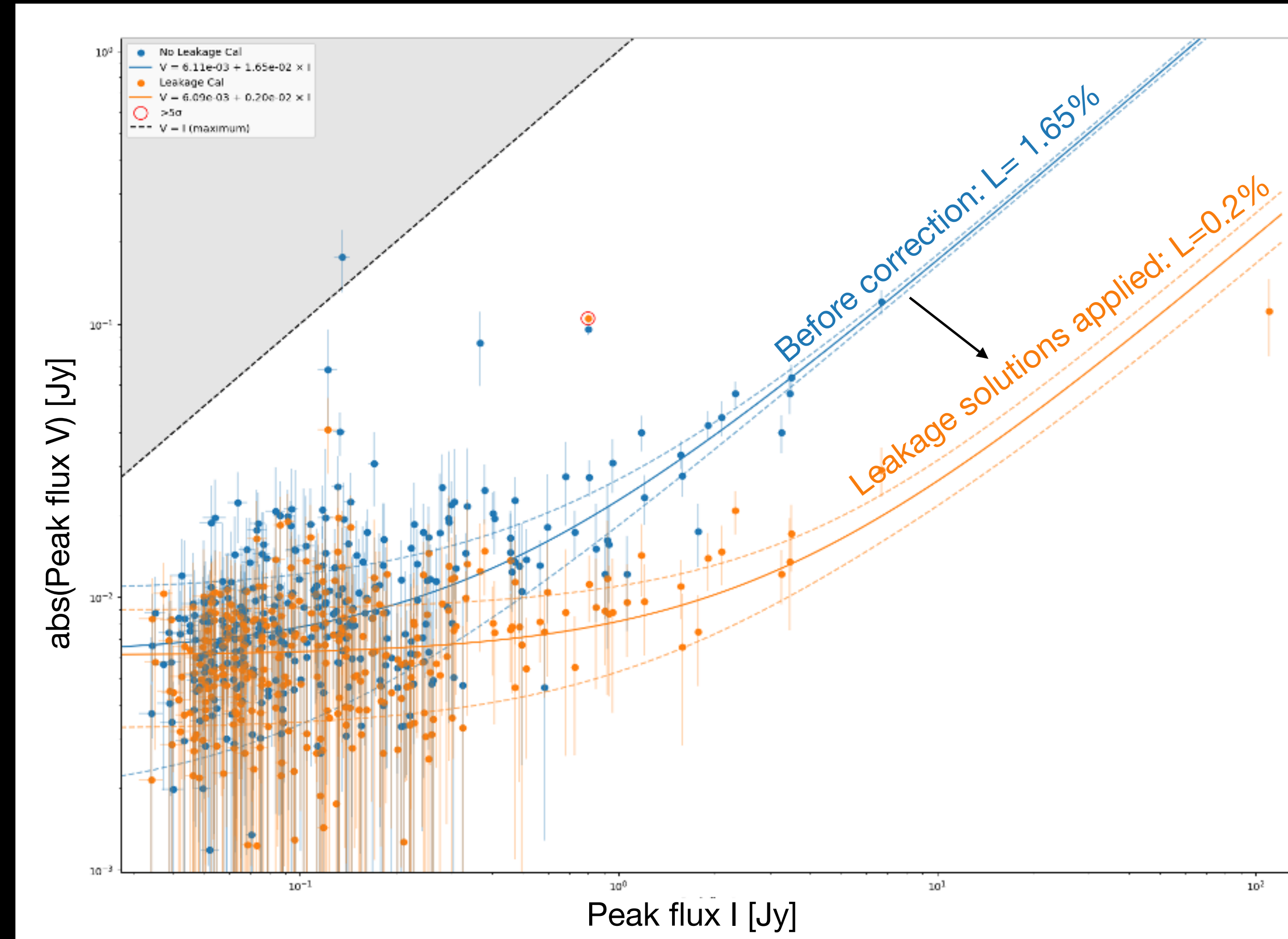
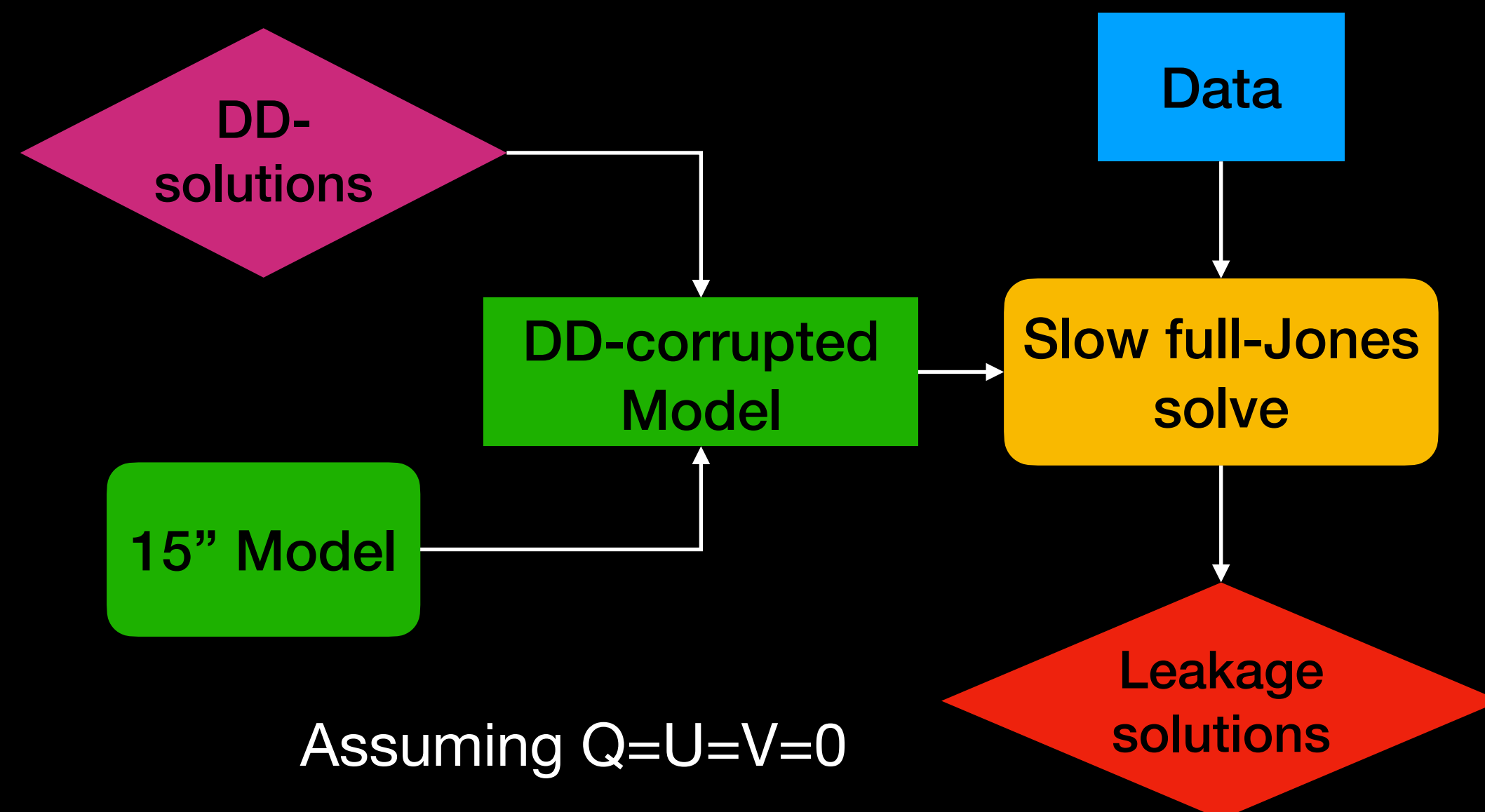


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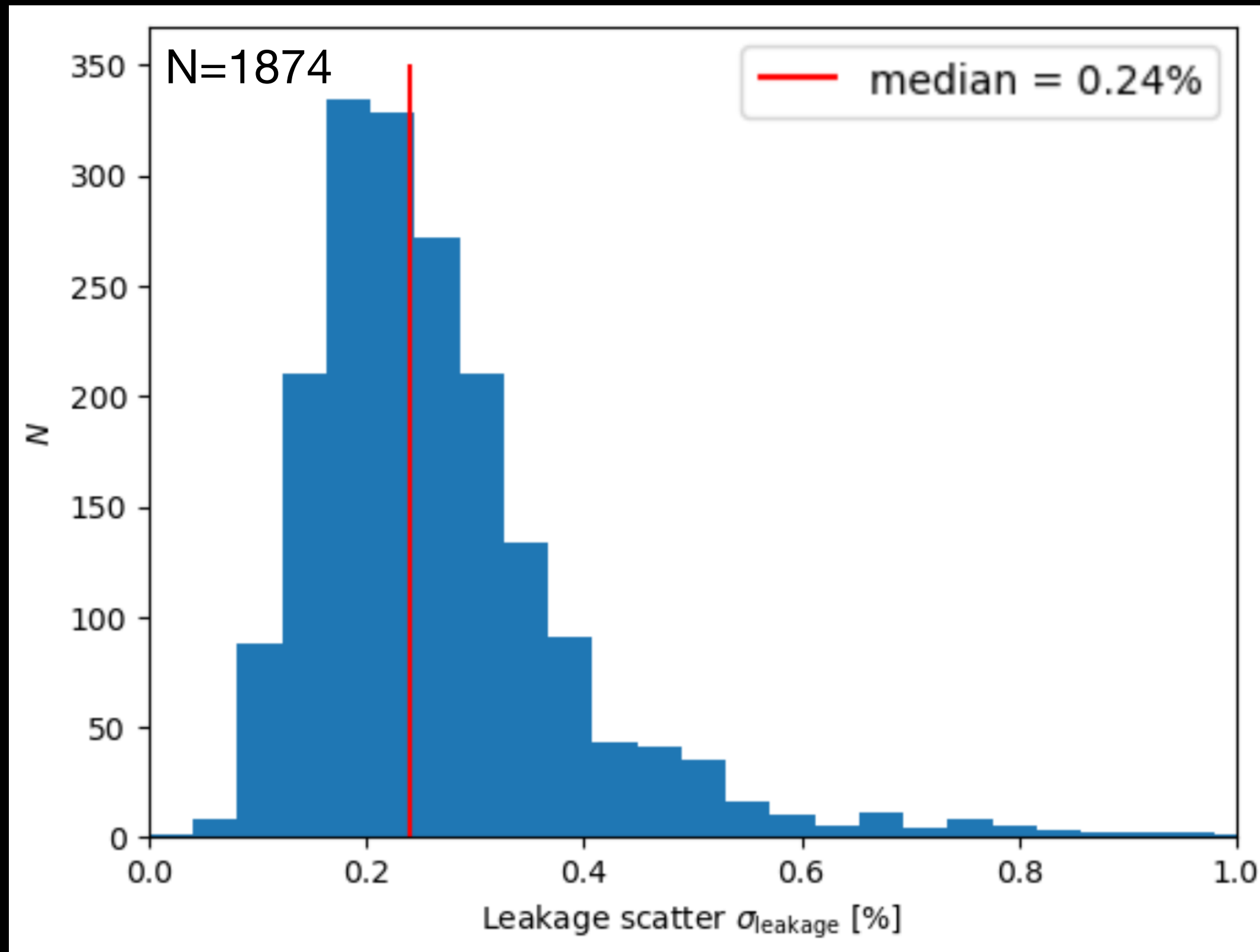
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V-LoSS Performance

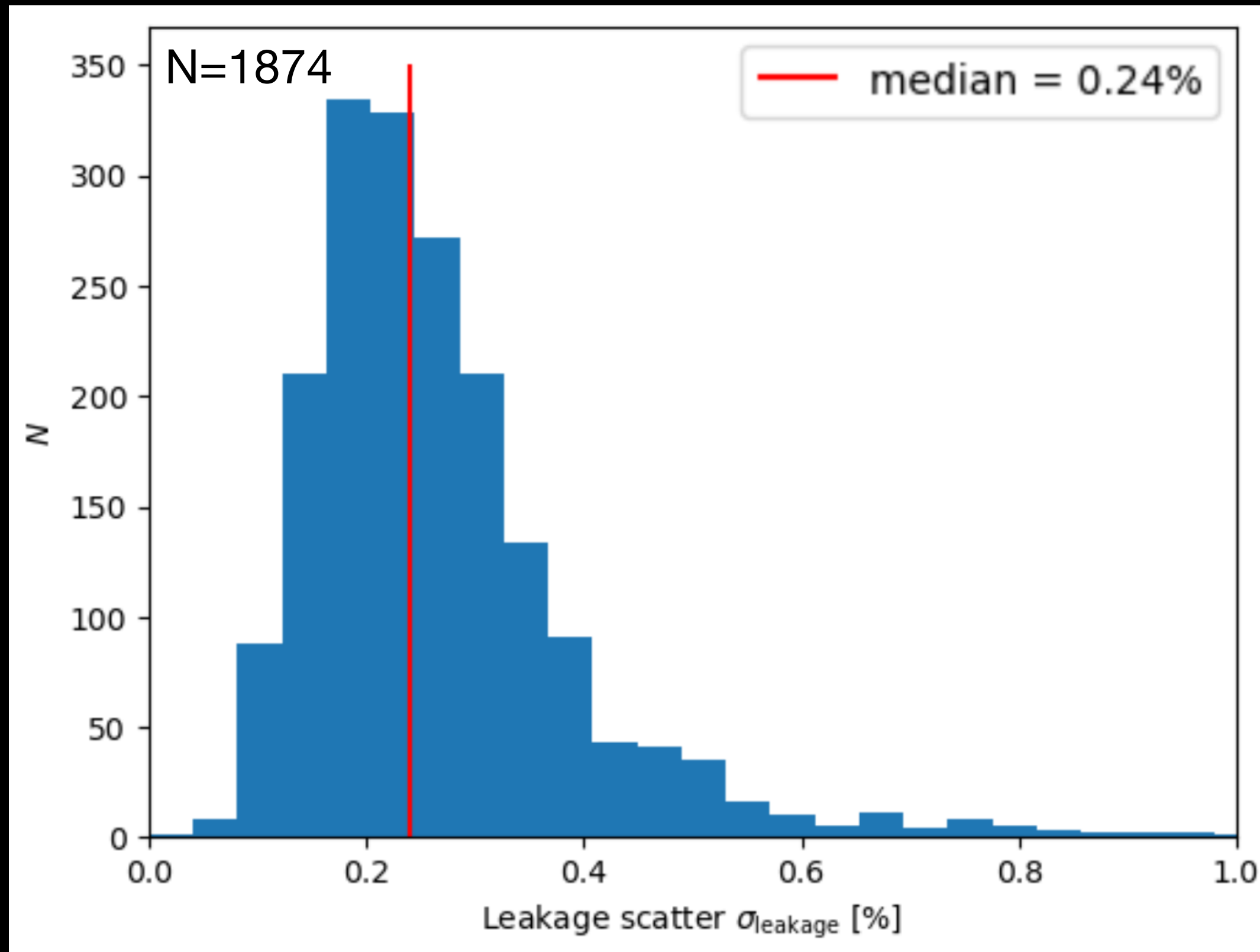
Polarization leakage



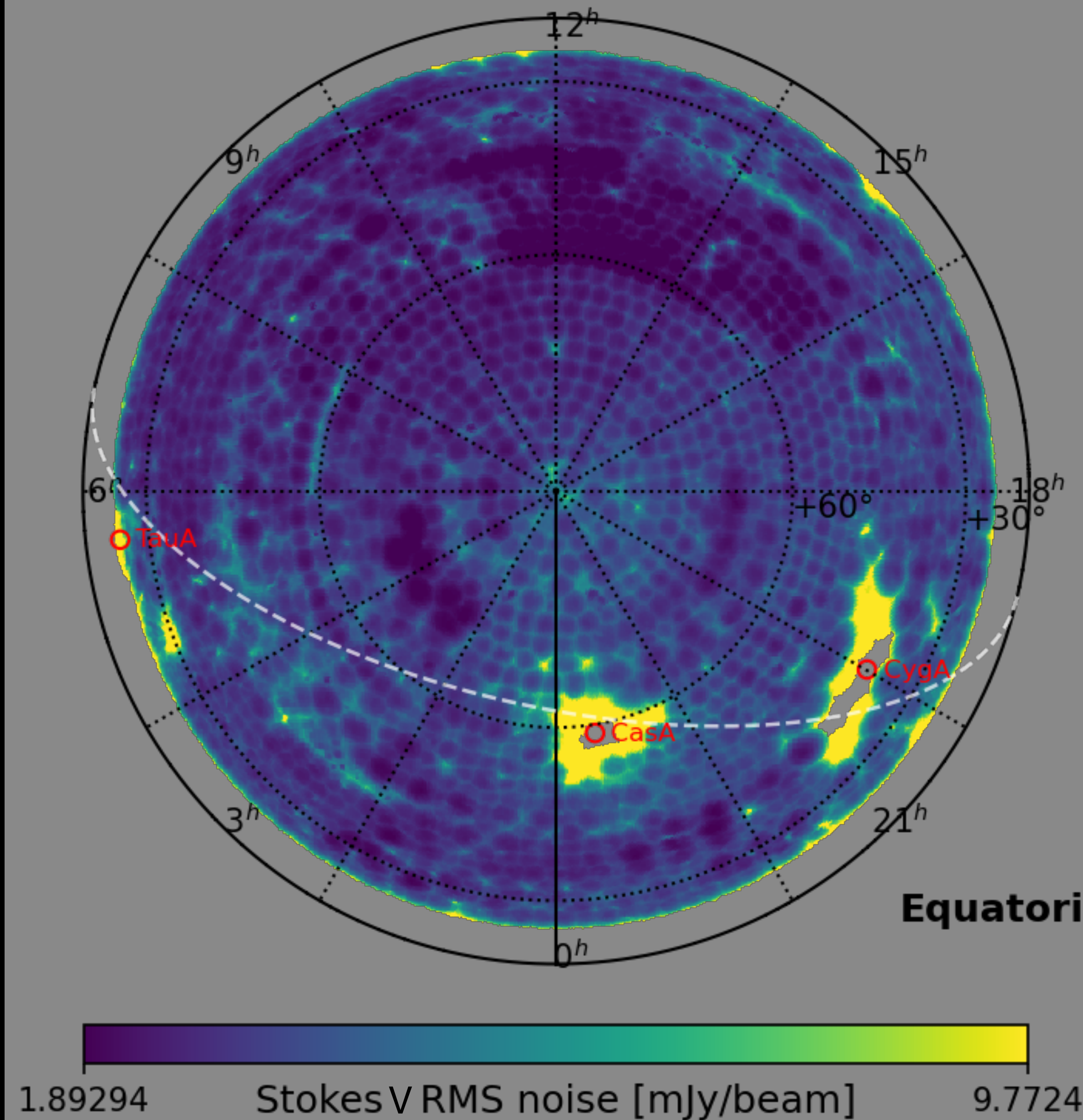
Can significantly detect sources
down to $V/I \sim 1\text{-}2\%$

V-LoLSS Performance

Sensitivity

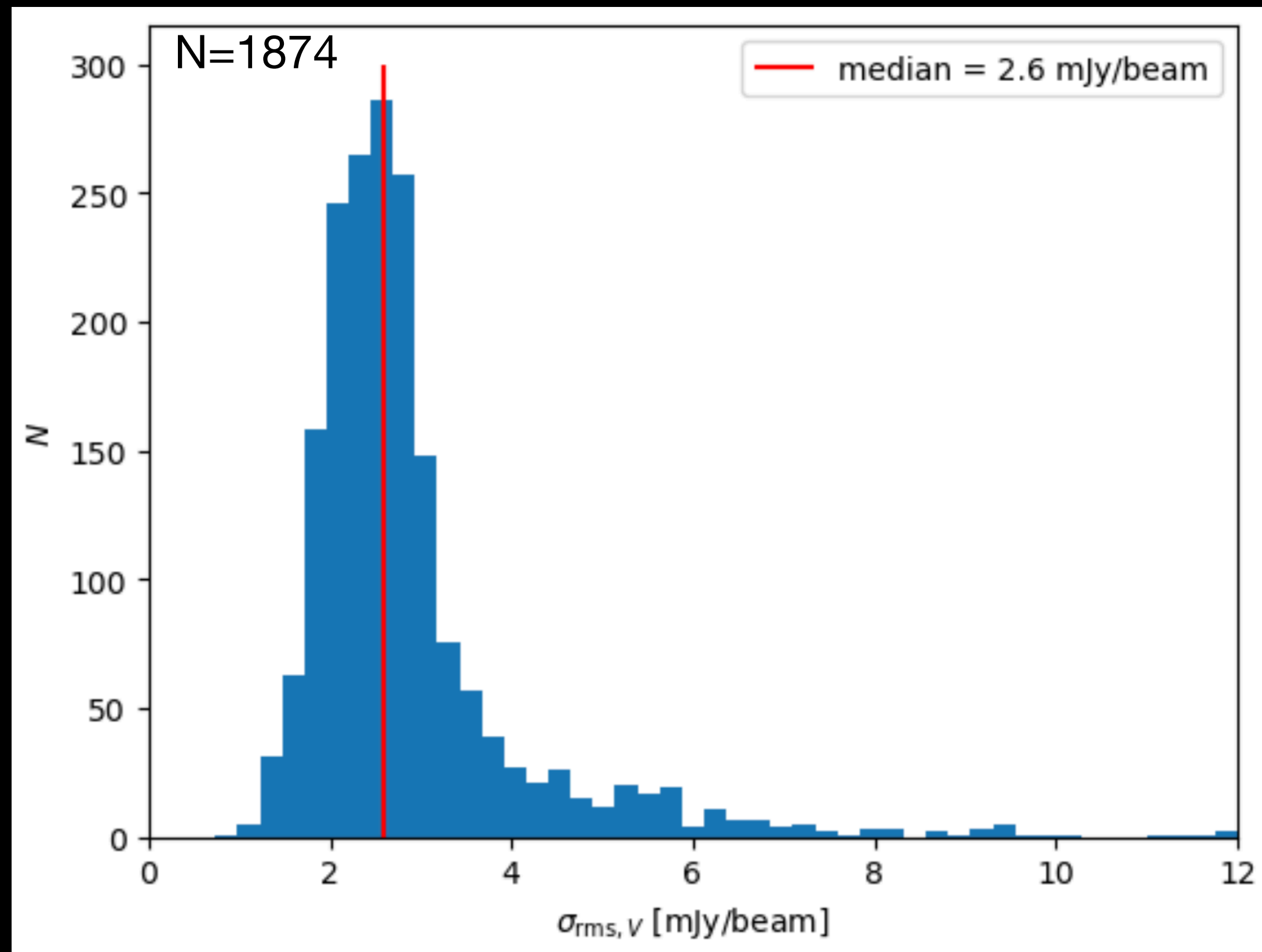


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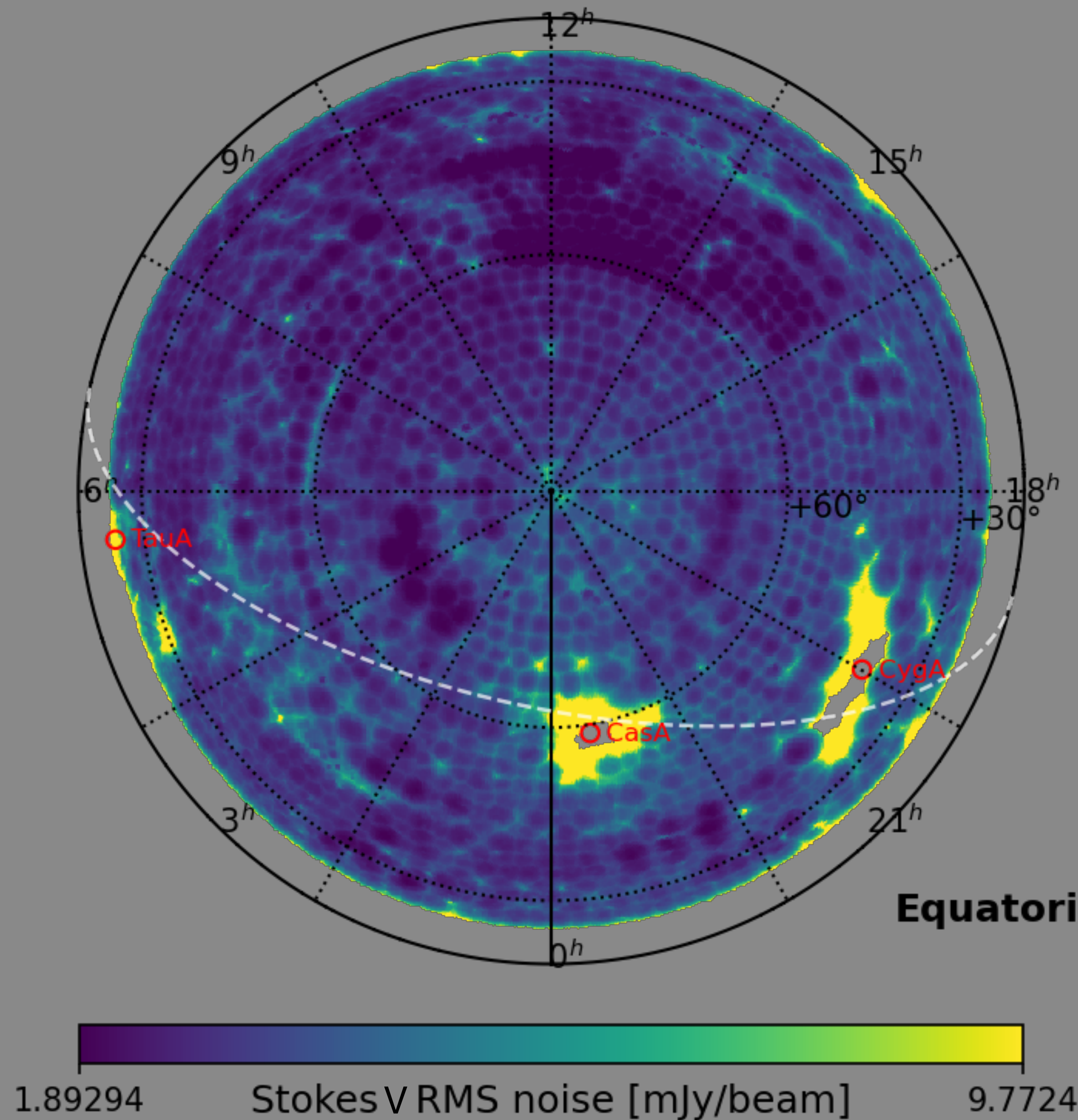


V-LoLSS Performance

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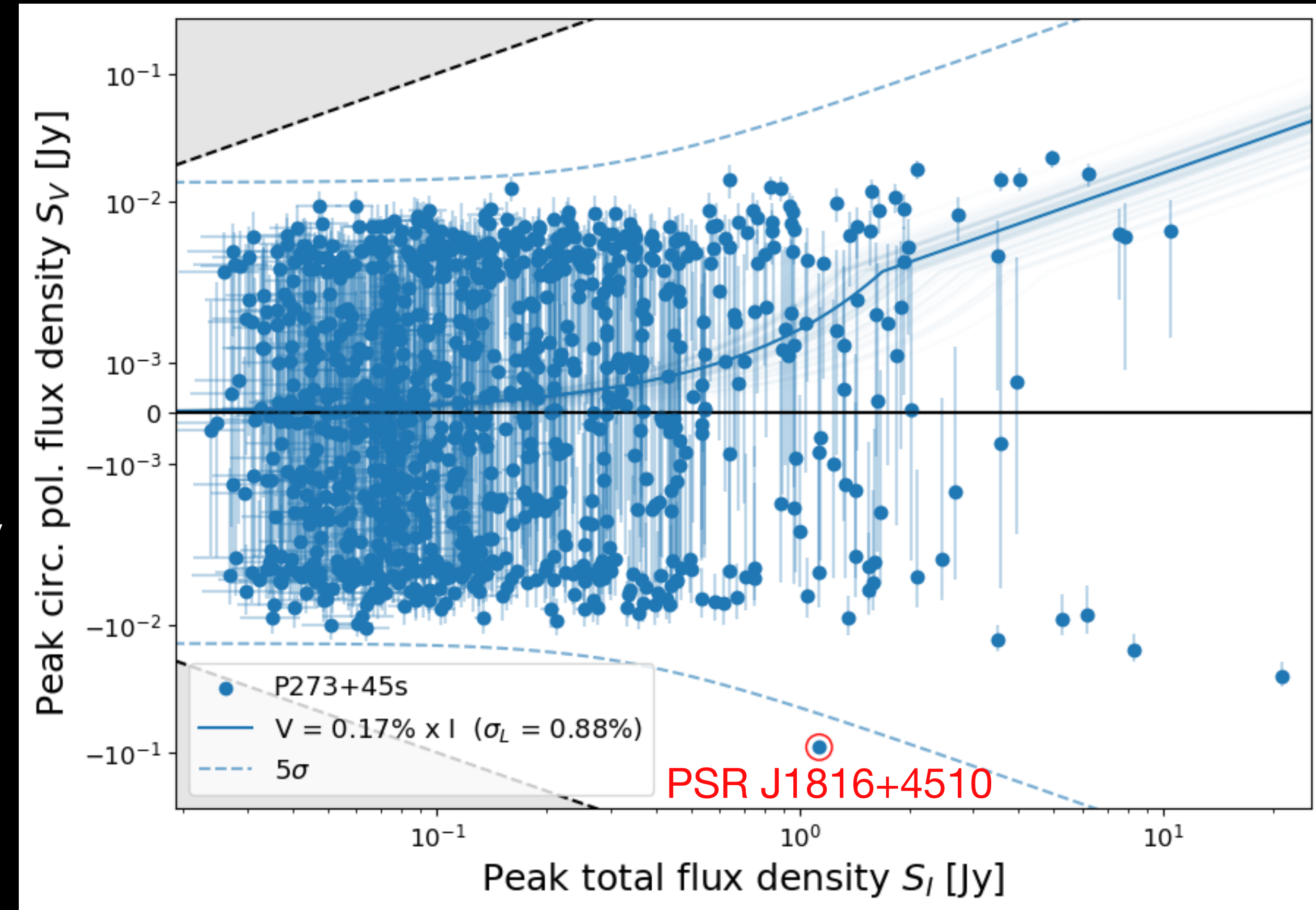
(Non-mosaiced, typically 3h)



The V-LoLSS search

Initial results

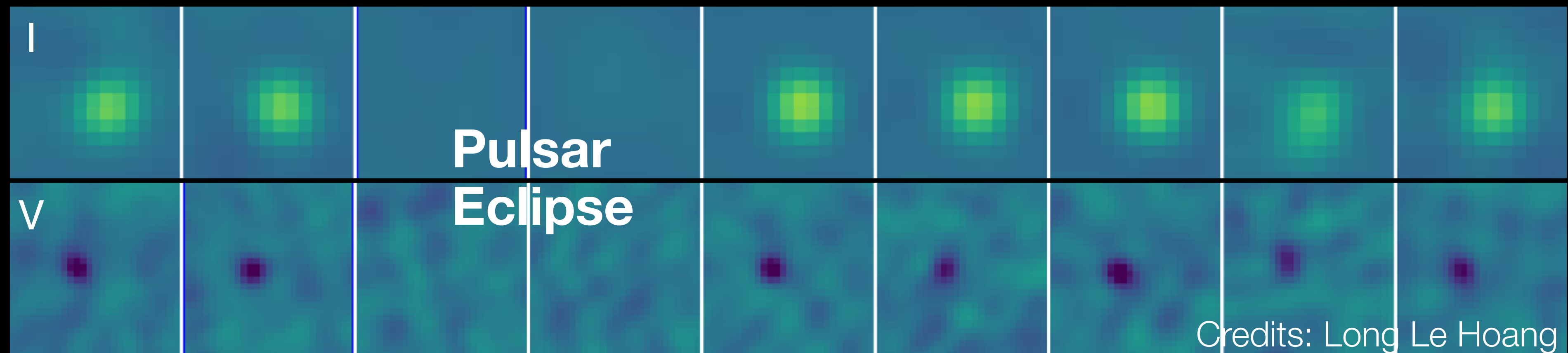
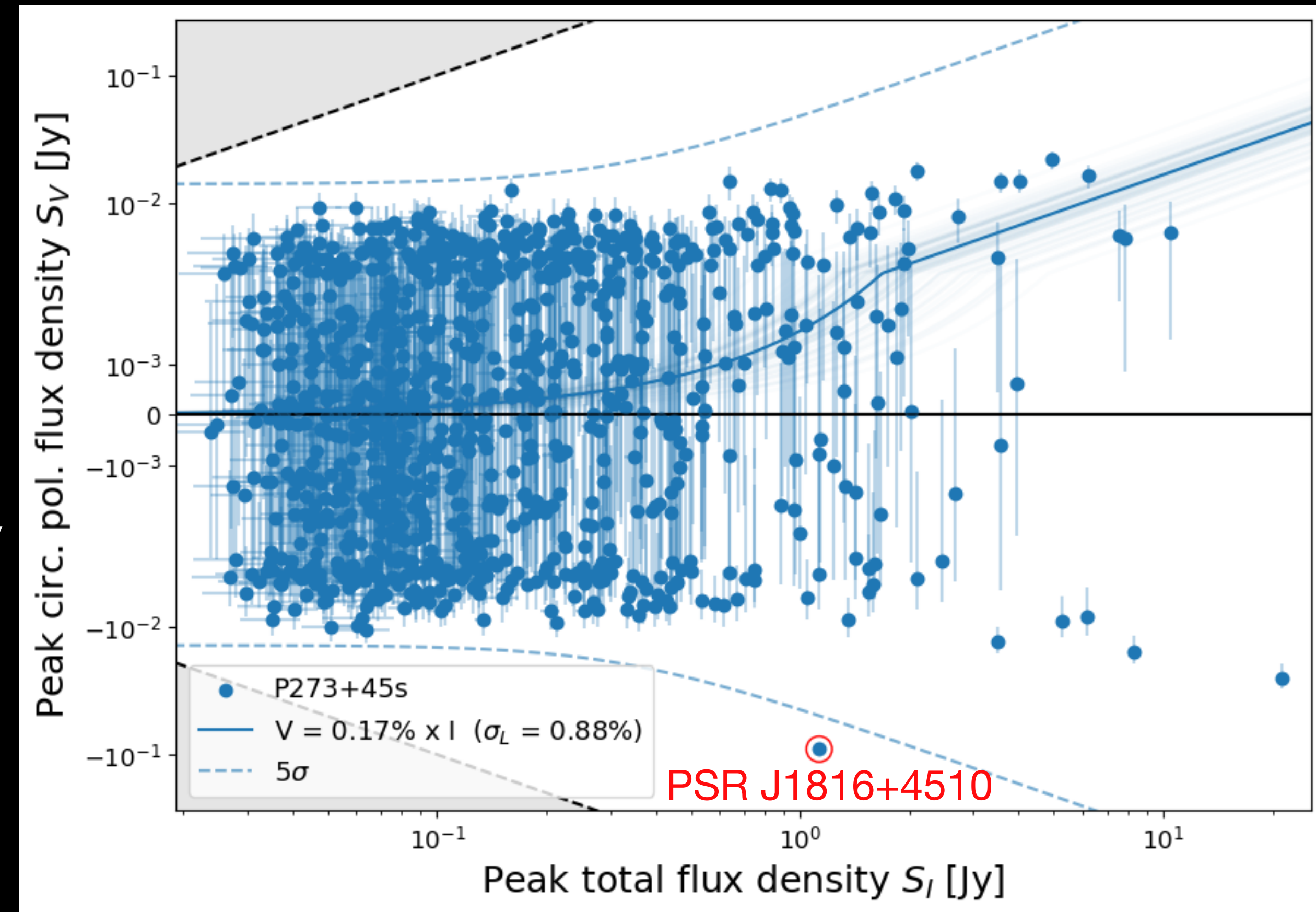
- First blind search on **combined** pointings
- For all pointings, get Stokes V flux density of sources and calculate significance
- 15 confirmed as of now, 50+ more candidates (mostly false-positives)
- Mostly known pulsars (12/15)



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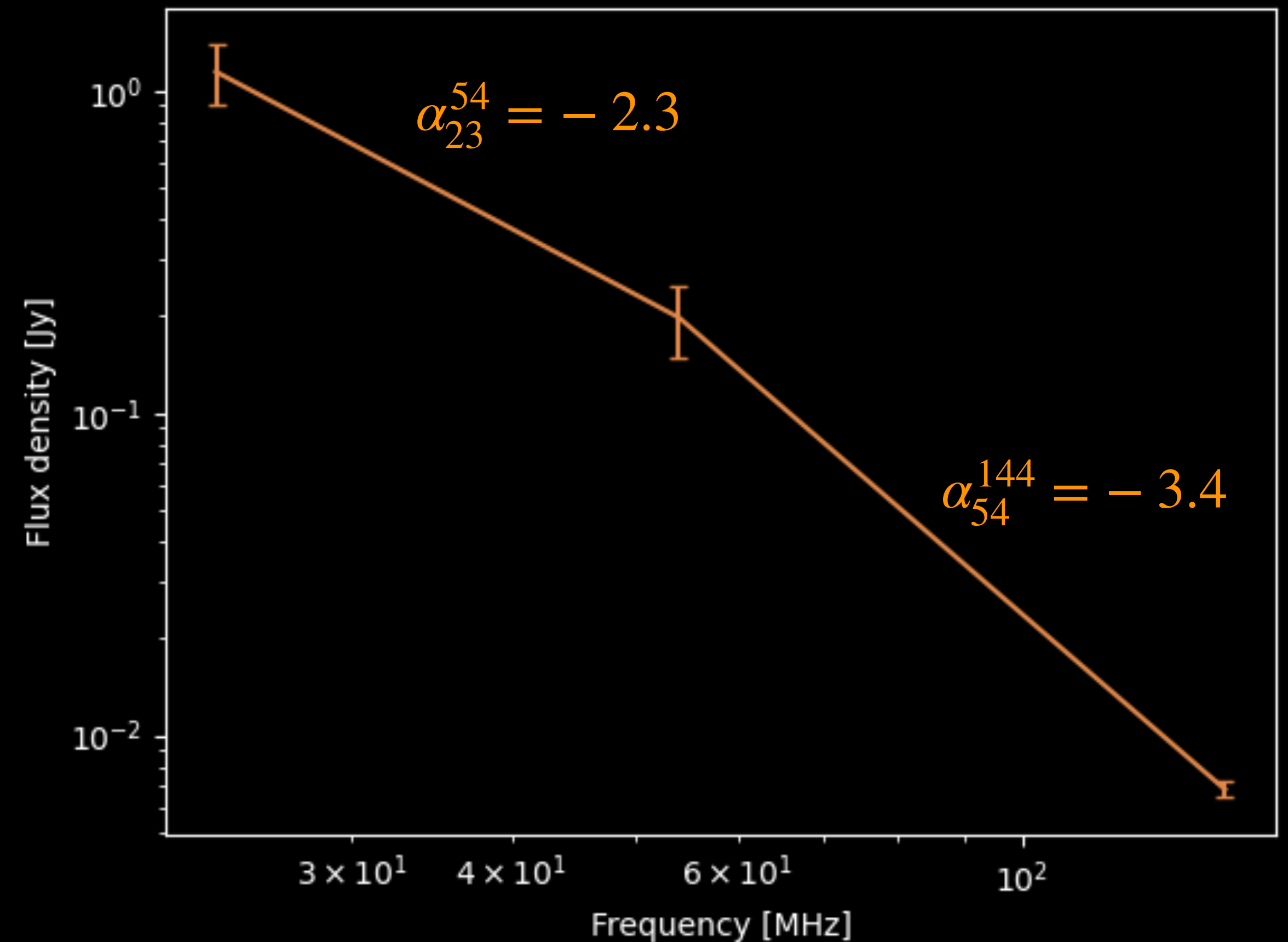
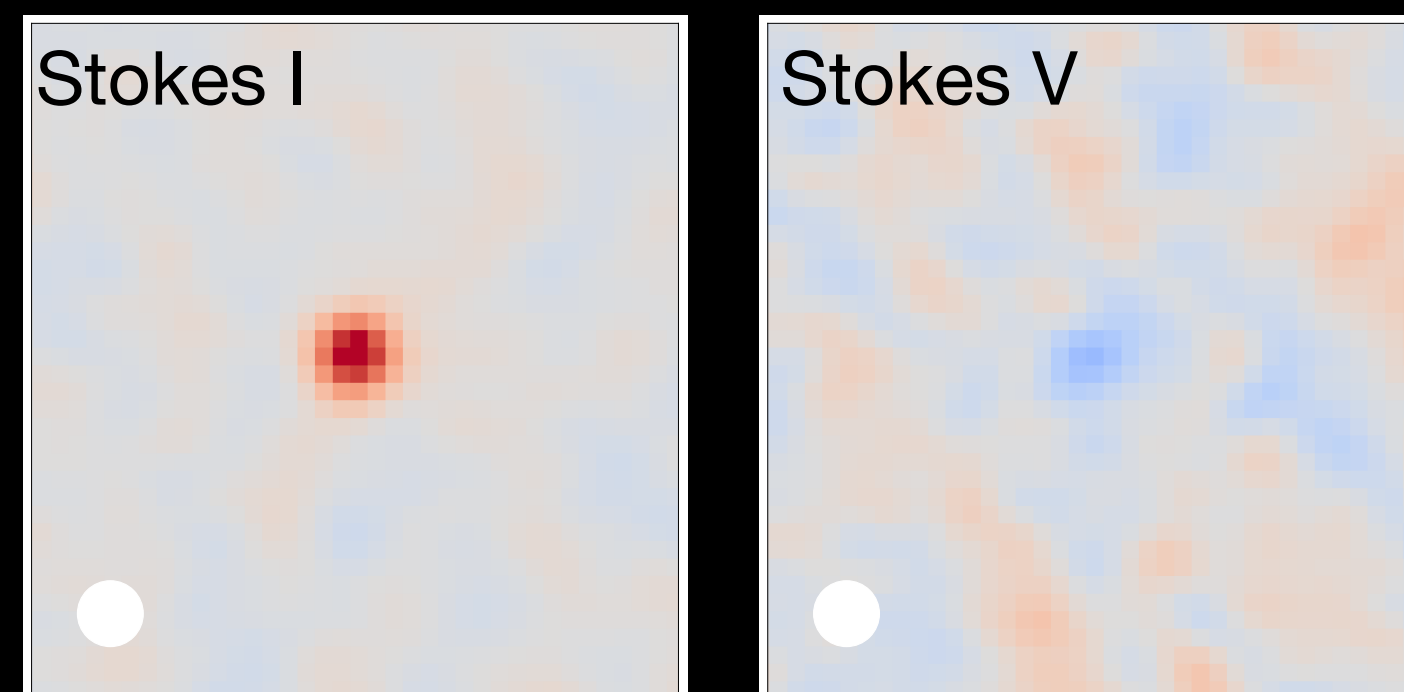
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Credits: Long Le Hoang

Source 13: Candidate Millisecond Pulsar

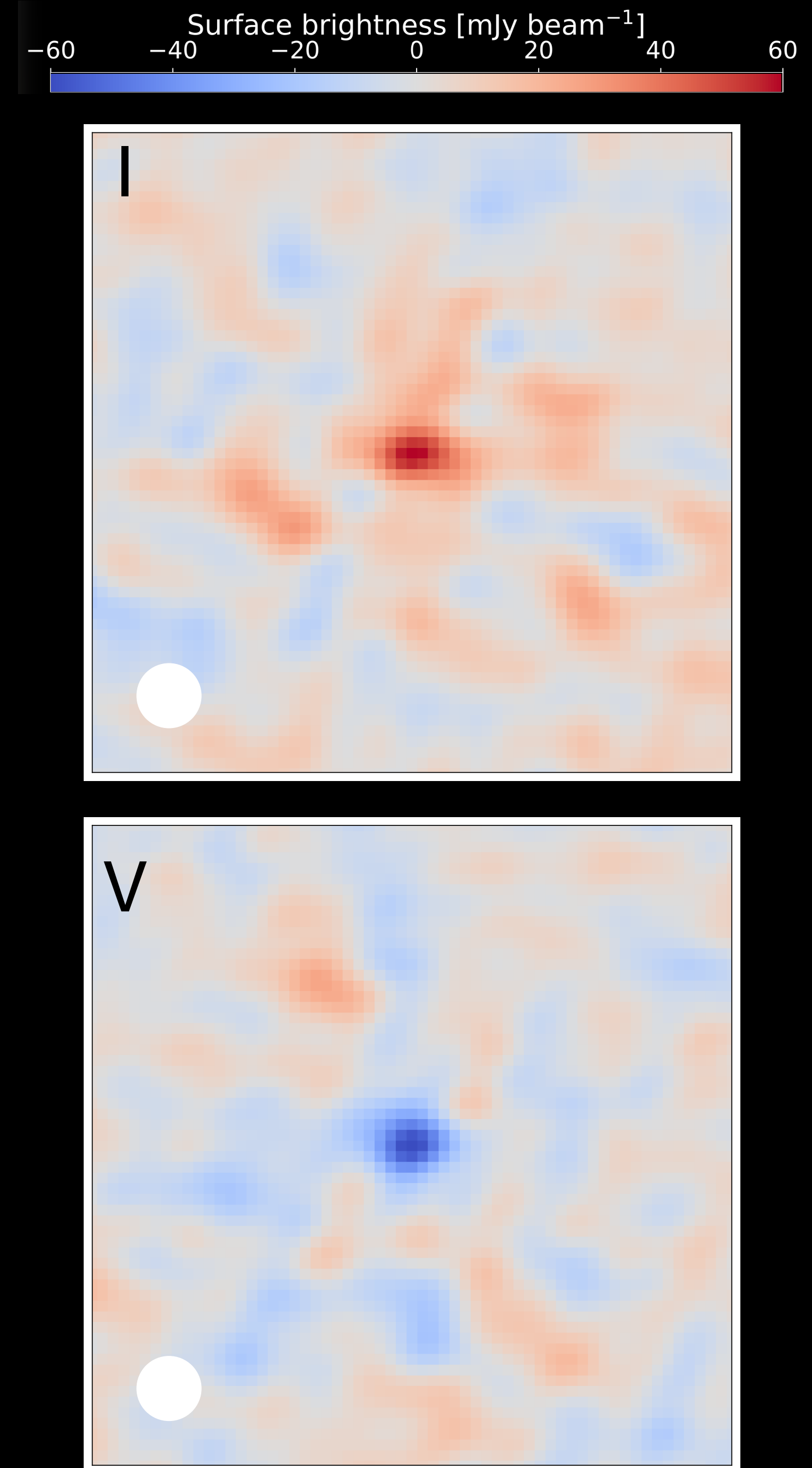
- Persistent source
- Circ. pol. fraction = 13%
- Extremely steep spectrum
- Fermi gamma ray counterpart
- Possibly (extreme?) millisecond-pulsar



Source 14: FG Cam

RS CVn class variable star

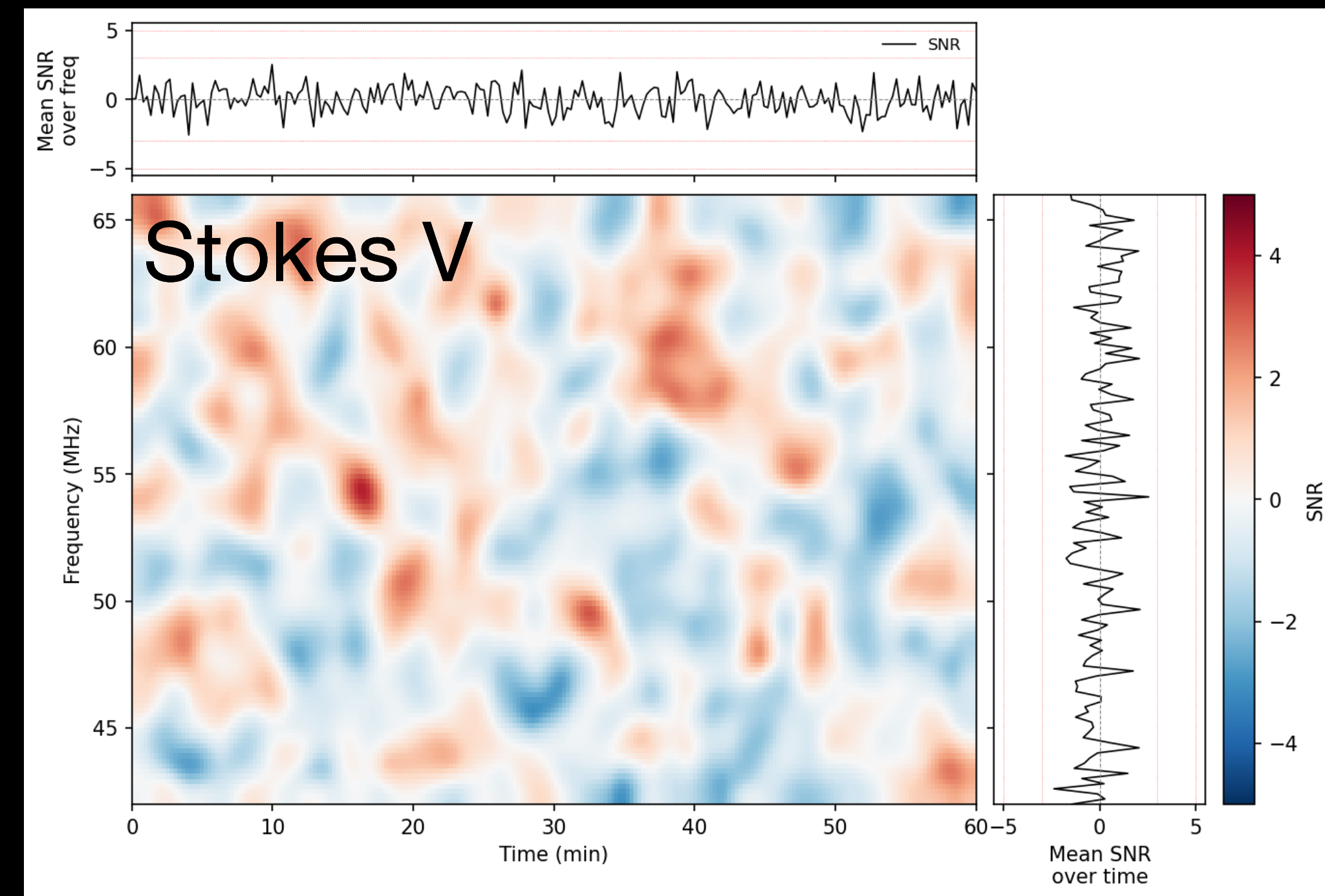
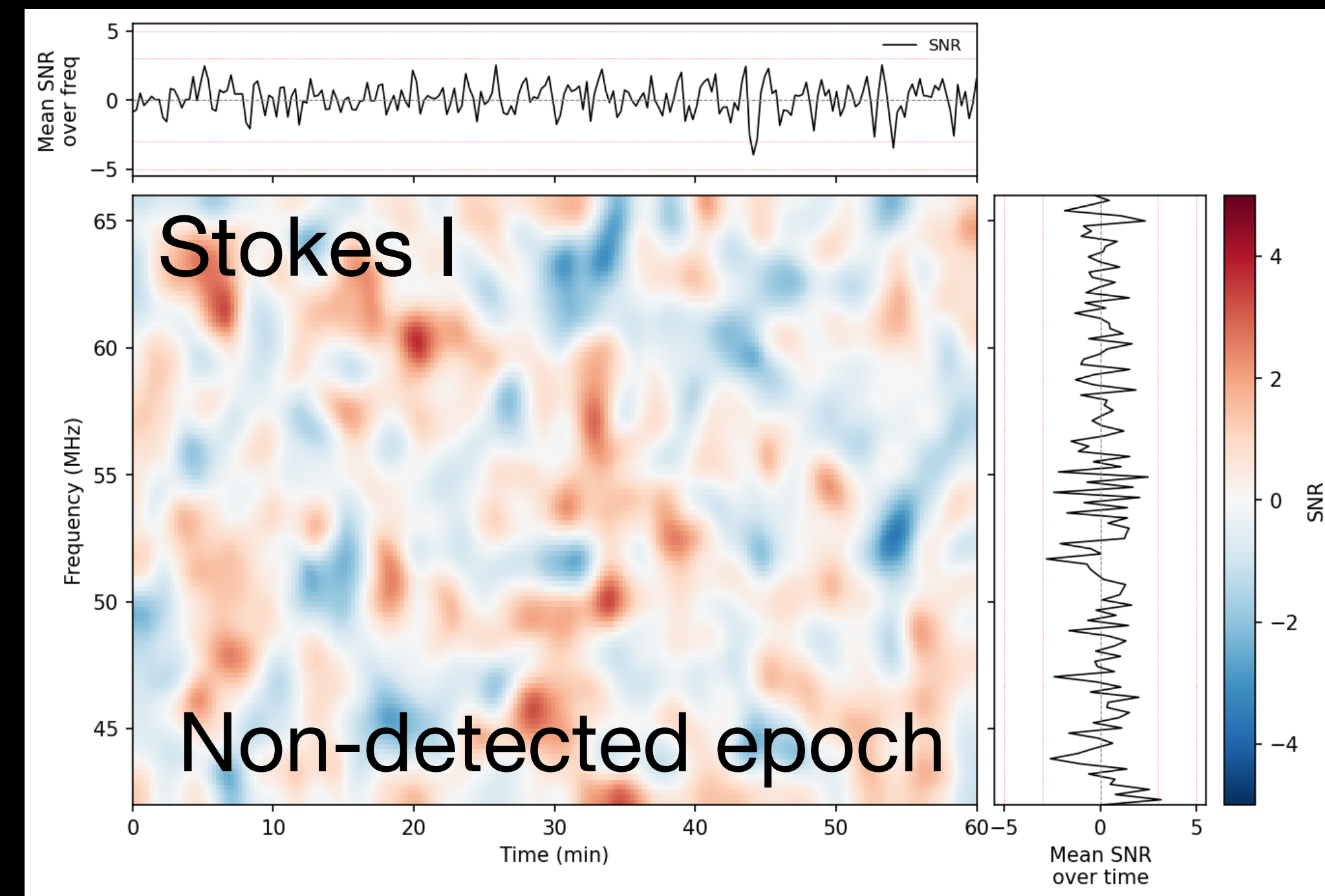
- 90% circularly polarised
- Mass-transfer binary at 320 pc
- Possibly first clear detection of a star sub-100 MHz (other than the sun)?



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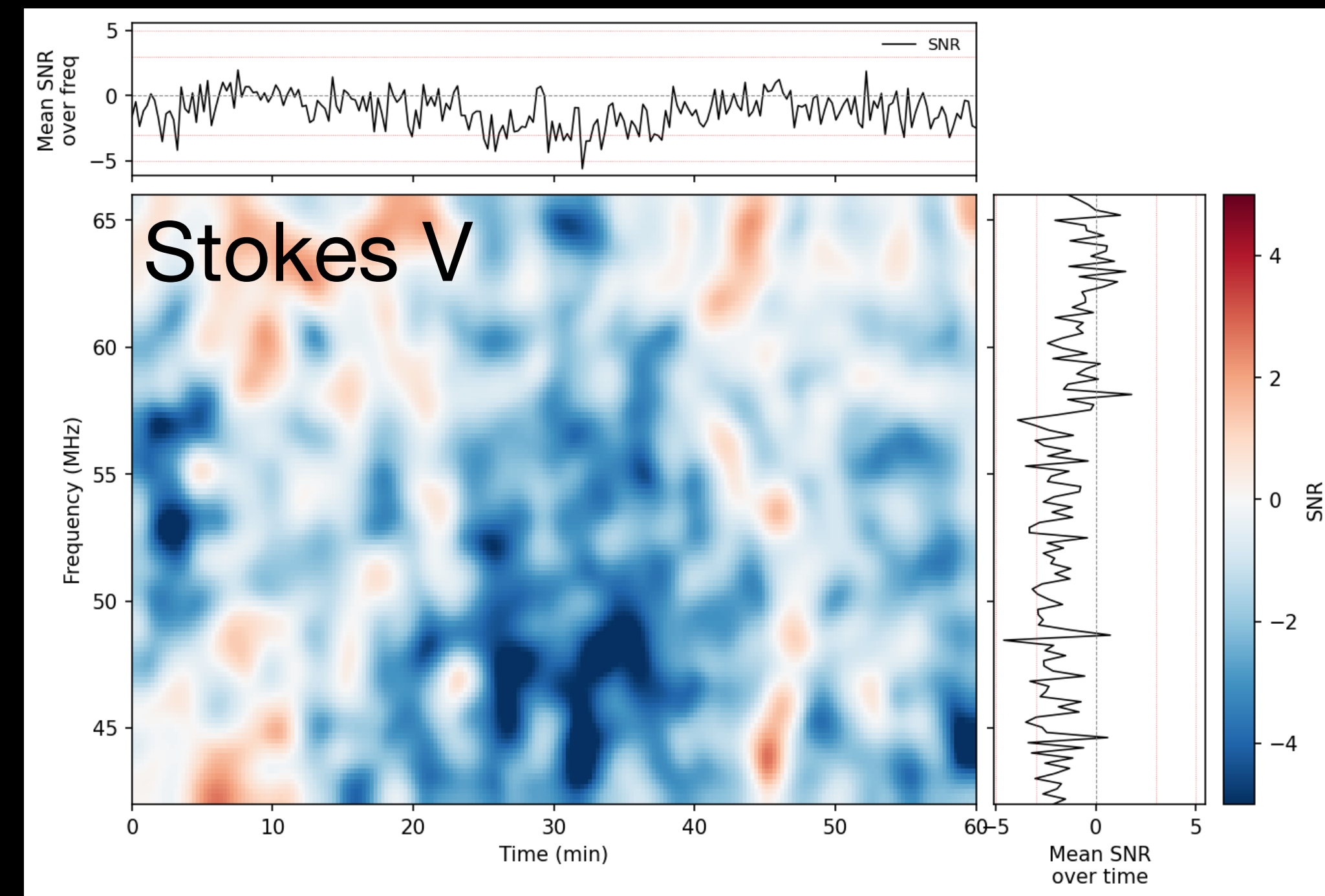
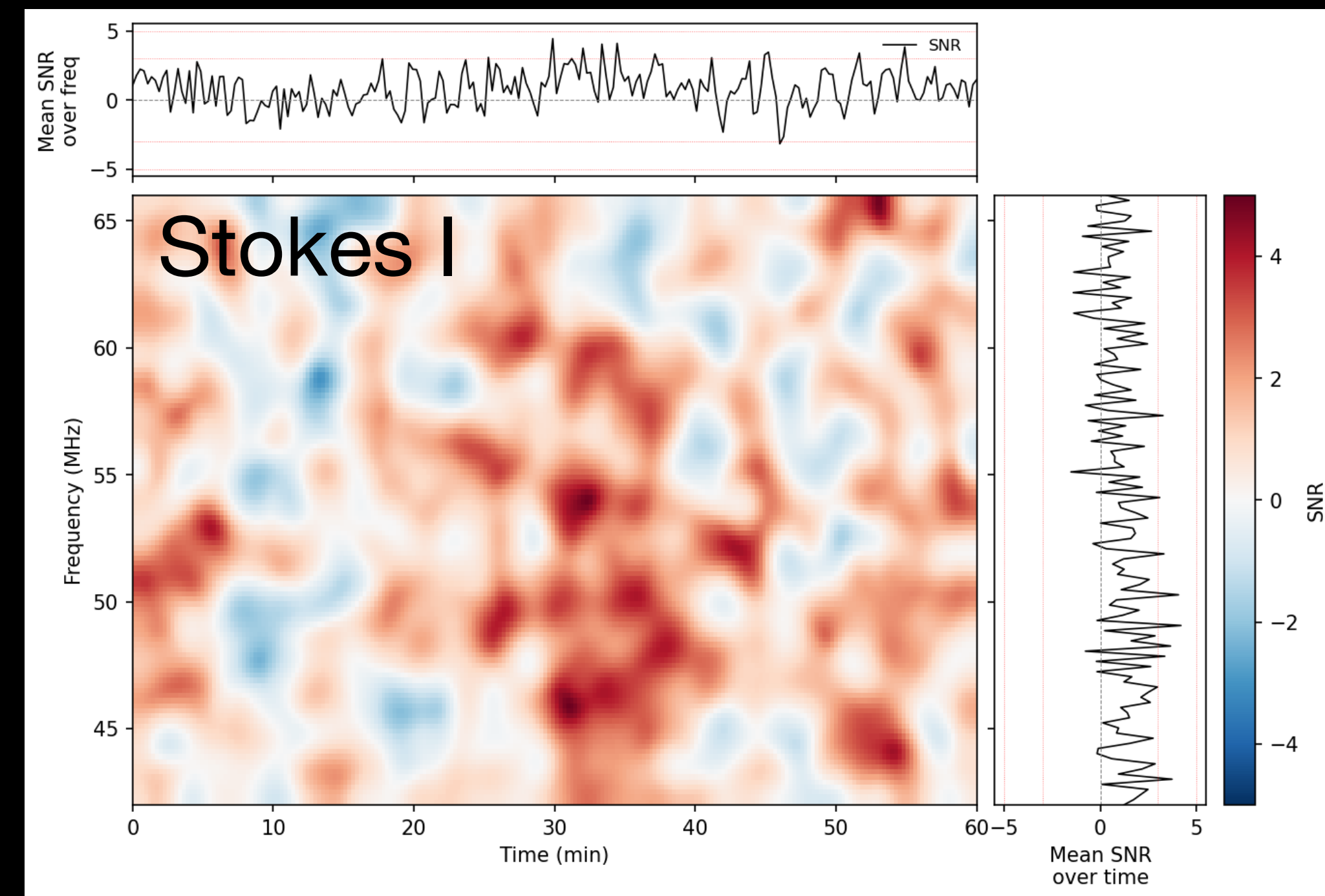
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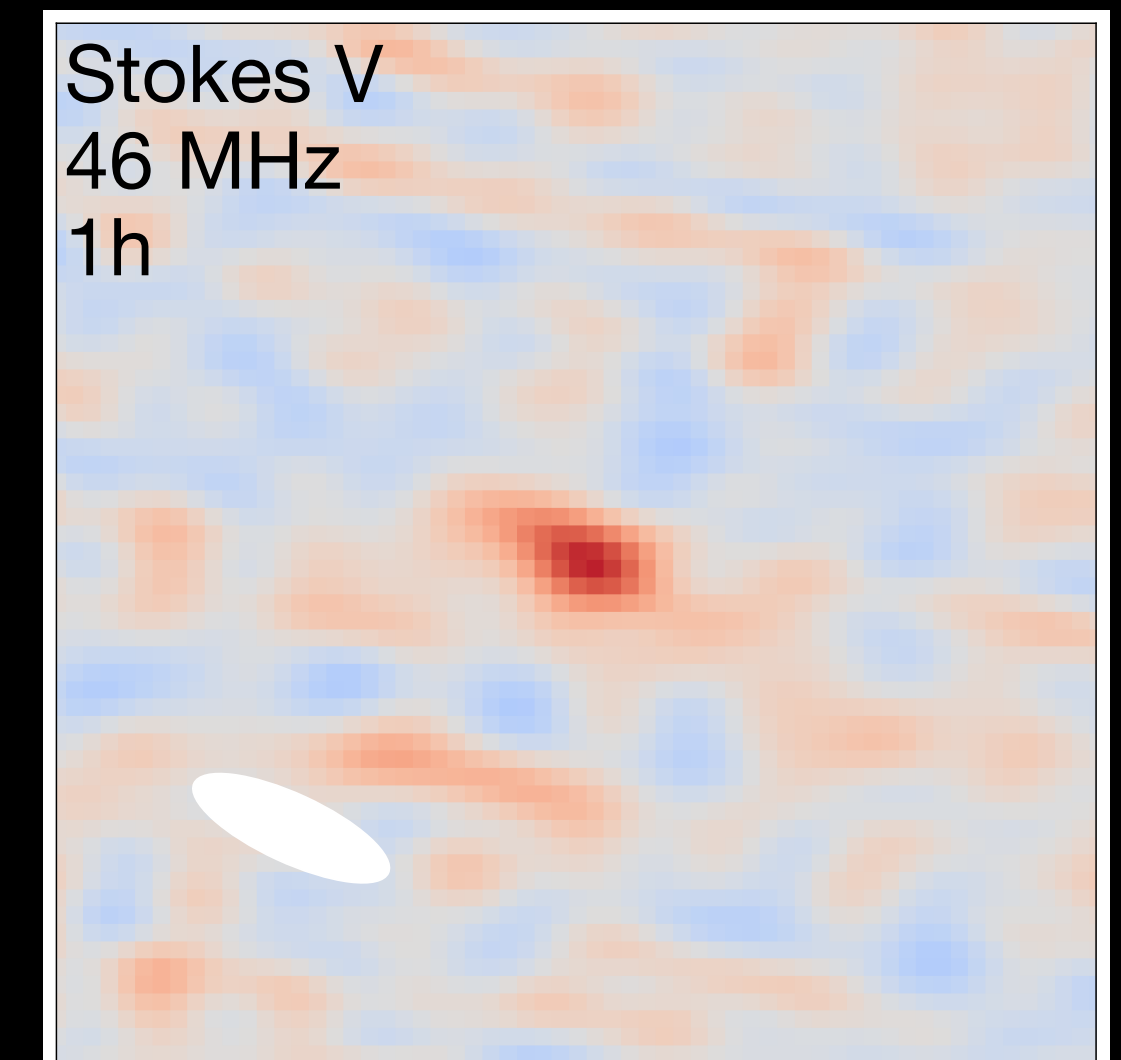
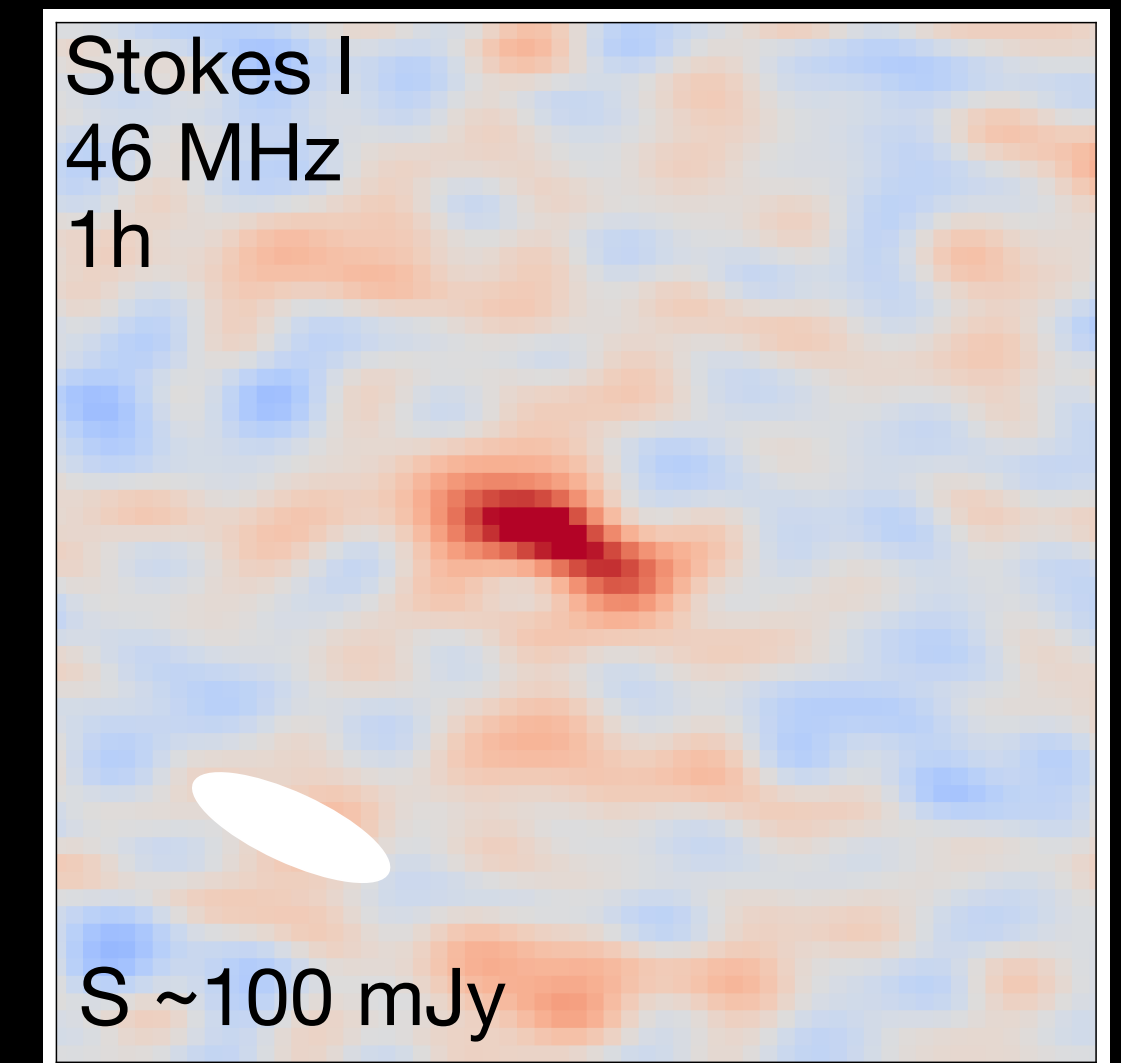
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Source 15: Sub-50 MHz Emission of an M-dwarf System

Hosting a close-orbit exoplanet

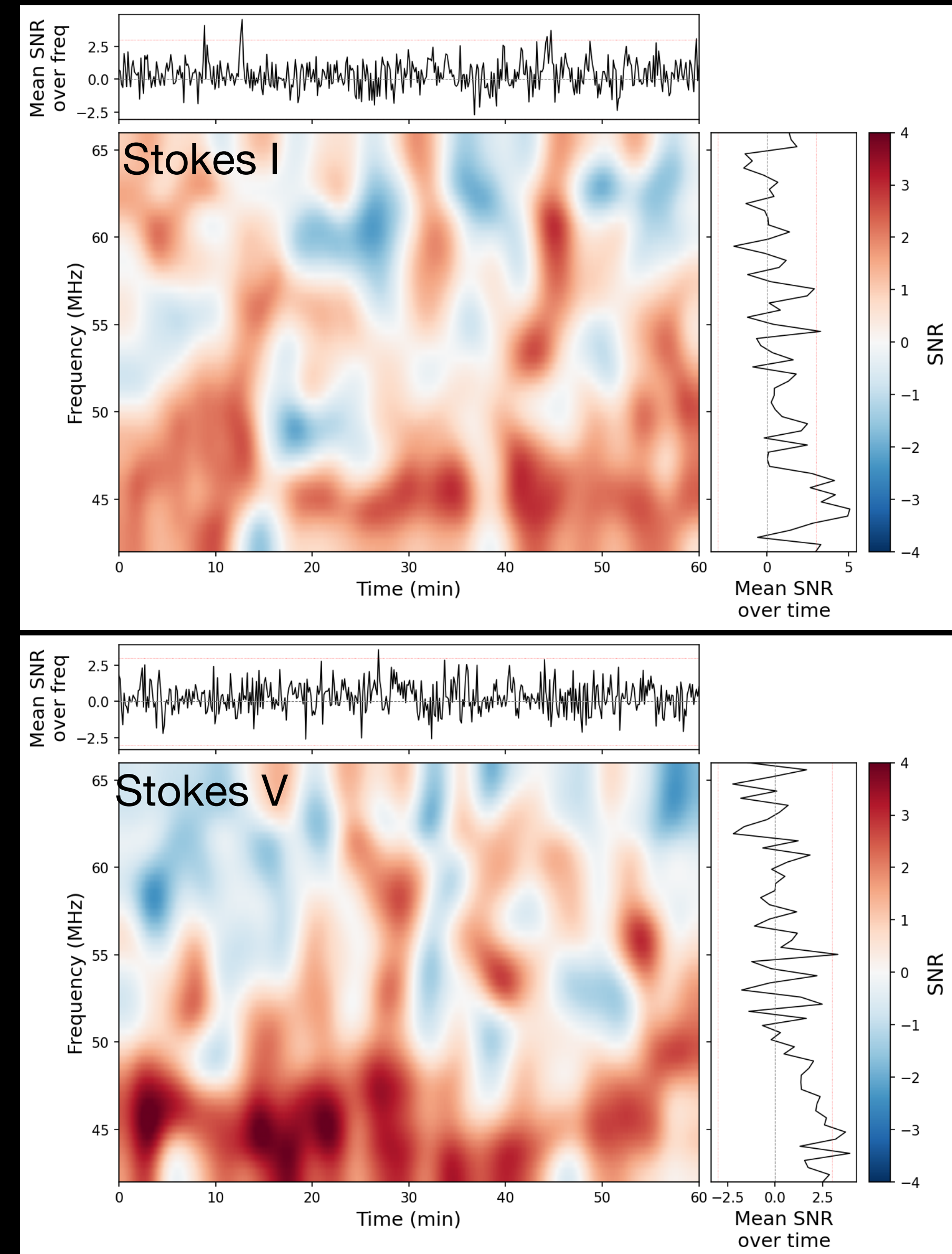
- All very preliminary
- Source detected in one epoch, not in LoTSS
- ~70% circ. polarized
- Star seems low activity
- Stellar emission? Star-planet interaction?



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Next steps

- Current search leaves ~50 more candidates at $5-5.5\sigma$, likely mostly false-positives
- Analyse individual epochs to increase transient sensitivity

LOFAR 2 plans: LLoCuSS

- Greater sensitivity and many more epochs, more coverage of Galactic plane
- Move to new DP3 leakage solver
- Simultaneous observations from 16-64 MHz

