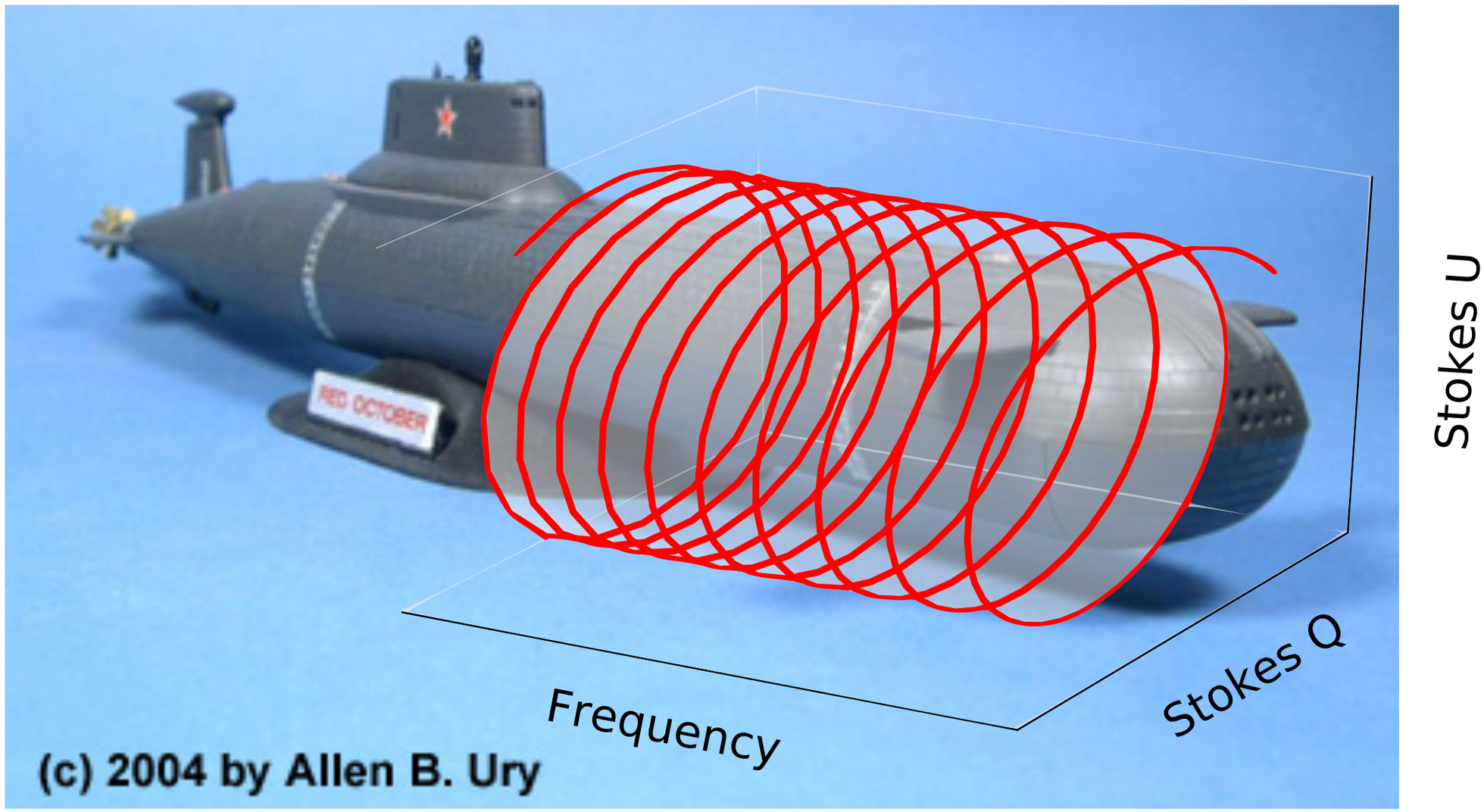
The Hunt for ~~Red October~~ Extreme RMs



Cameron Van Eck

EMU/POSSUM Busy Week

18 Dec 2019

UNIVERSITY OF TORONTO
DUNLAP INSTITUTE for ASTRONOMY & ASTROPHYSICS
CIRADA
CANADIAN INITIATIVE FOR RADIO ASTRONOMY DATA ANALYSIS

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STRONG EXCESS FARADAY ROTATION ON THE INSIDE OF THE SAGITTARIUS SPIRAL ARM

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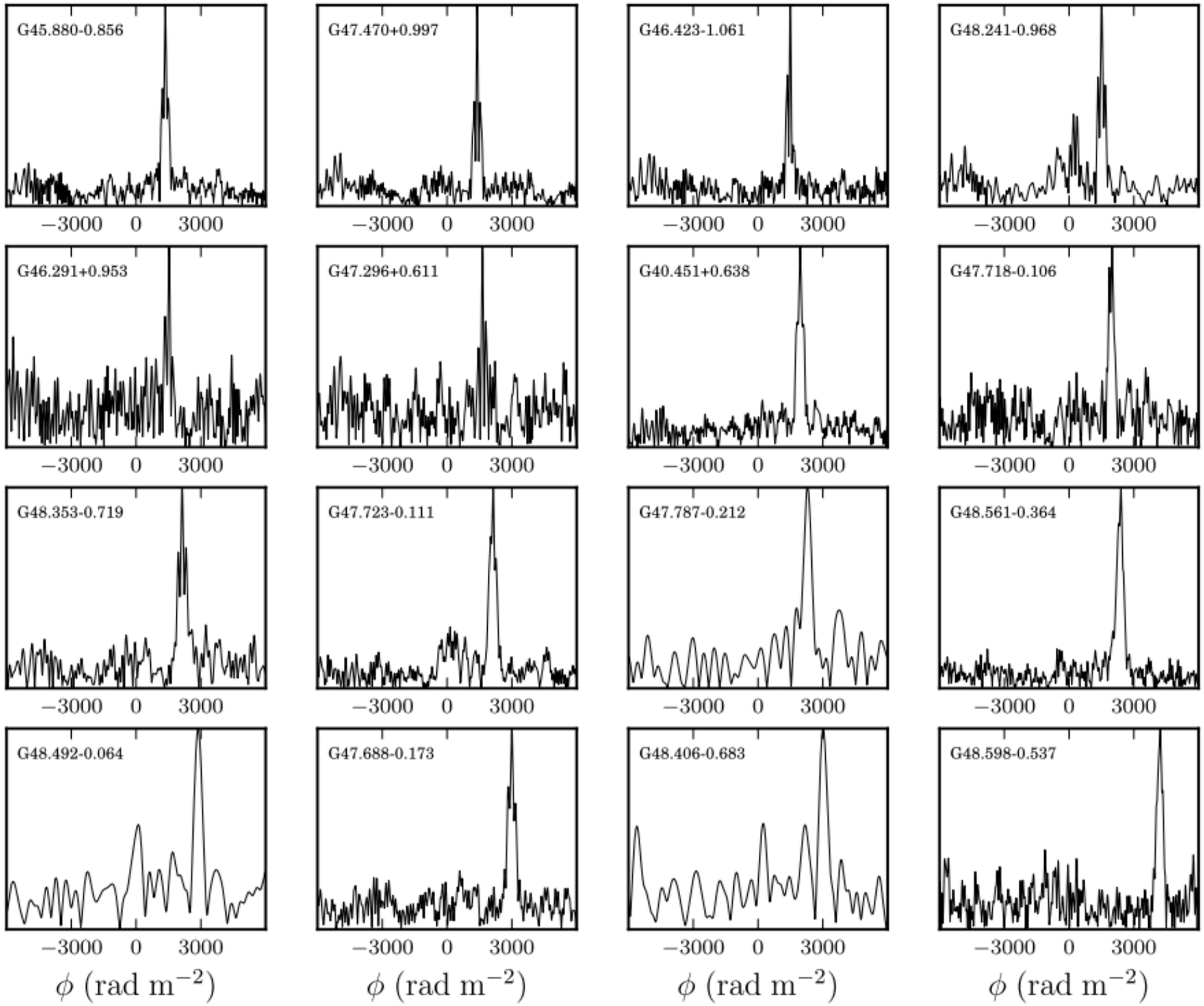
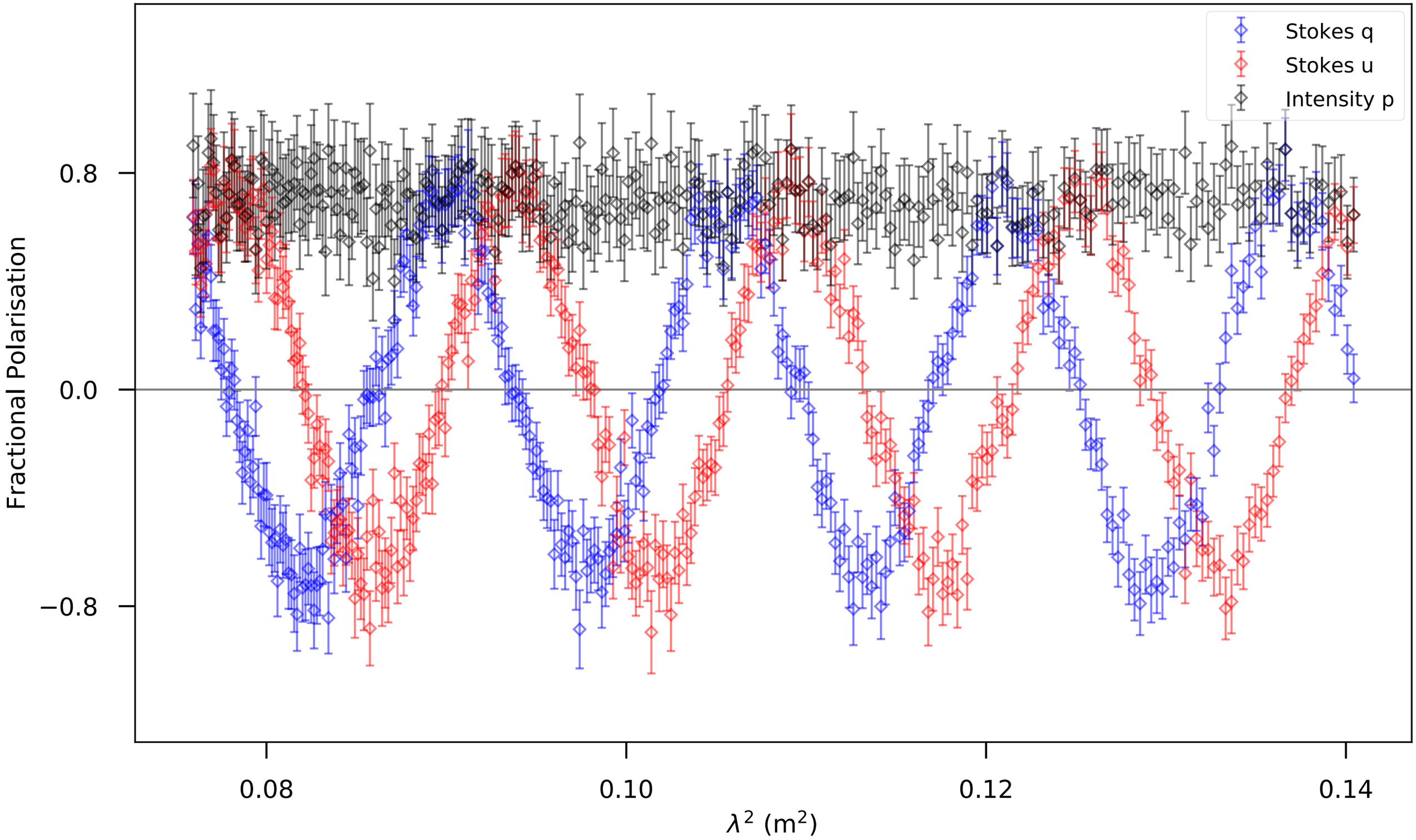
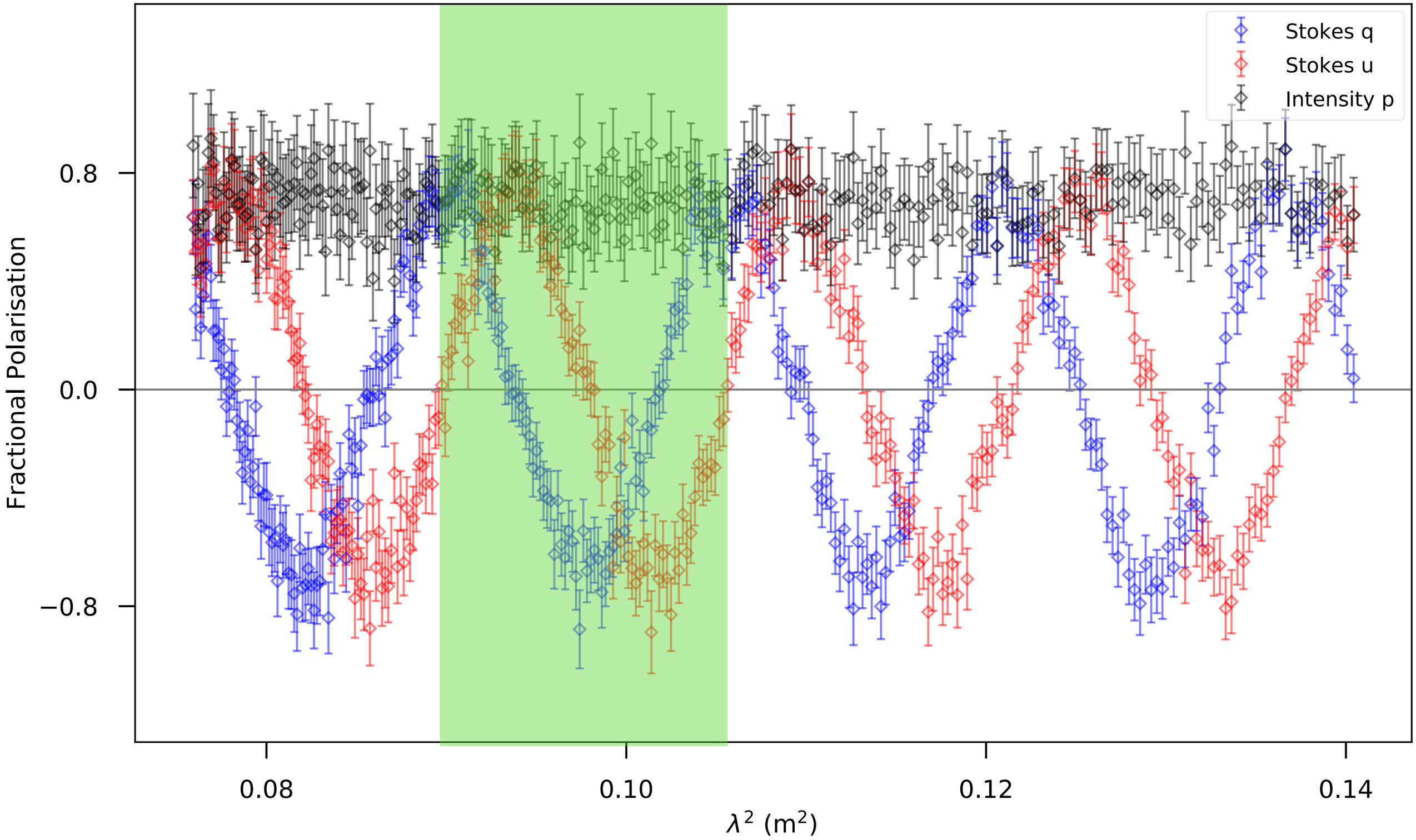


Figure 2. Faraday depth spectra before RM clean for the 16 sources with the highest RM, sorted in reading order by increasing RM. The spectra are normalized to the peak of the Faraday depth spectrum and show the search range -6000 rad m^{-2} to 6000 rad m^{-2}.

Image credit: Forbes.com


Stokes q
Stokes u
Intensity p
0.8
0.0
−0.8
Fractional Polarisation
0.08
0.10
0.12
0.14
λ^2 (m^2)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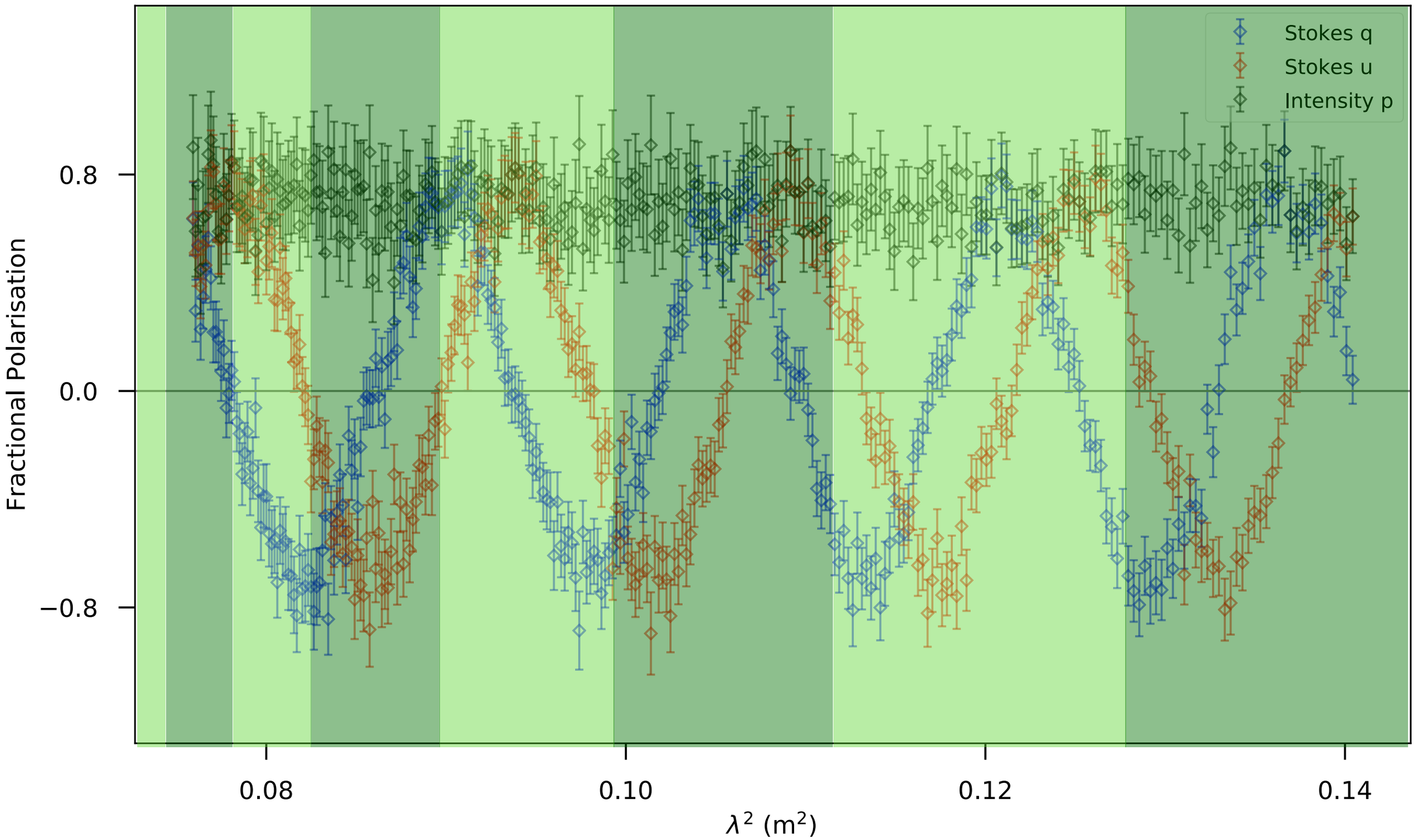
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0.08
0.10
0.12
0.14
λ^2 (m^2)

- Differential Faraday rotation: $$\phi\ \delta\lambda^2 \lessapprox 10^\circ$$

leads to…

- Maximum Faraday depth
  50% sensitivity point (B&dB05) $$|\phi_{\rm max}| = \frac{\sqrt{3}}{\delta\lambda^2}$$

- Differential Faraday rotation: $\phi\ \delta\lambda^2 \lessapprox 10^\circ$

leads to…

99°

- Maximum Faraday depth
  50% sensitivity point (B&dB05) $|\phi_{\rm max}| = \frac{\sqrt{3}}{\delta\lambda^2}$

Upcoming Surveys

- EMU/POSSUM (1 MHz channels)

Bottom of band 1	(800 MHz)	4 934 rad m^{-2}
Top of band 1	(1 088 MHz)	12 410 rad m^{-2}

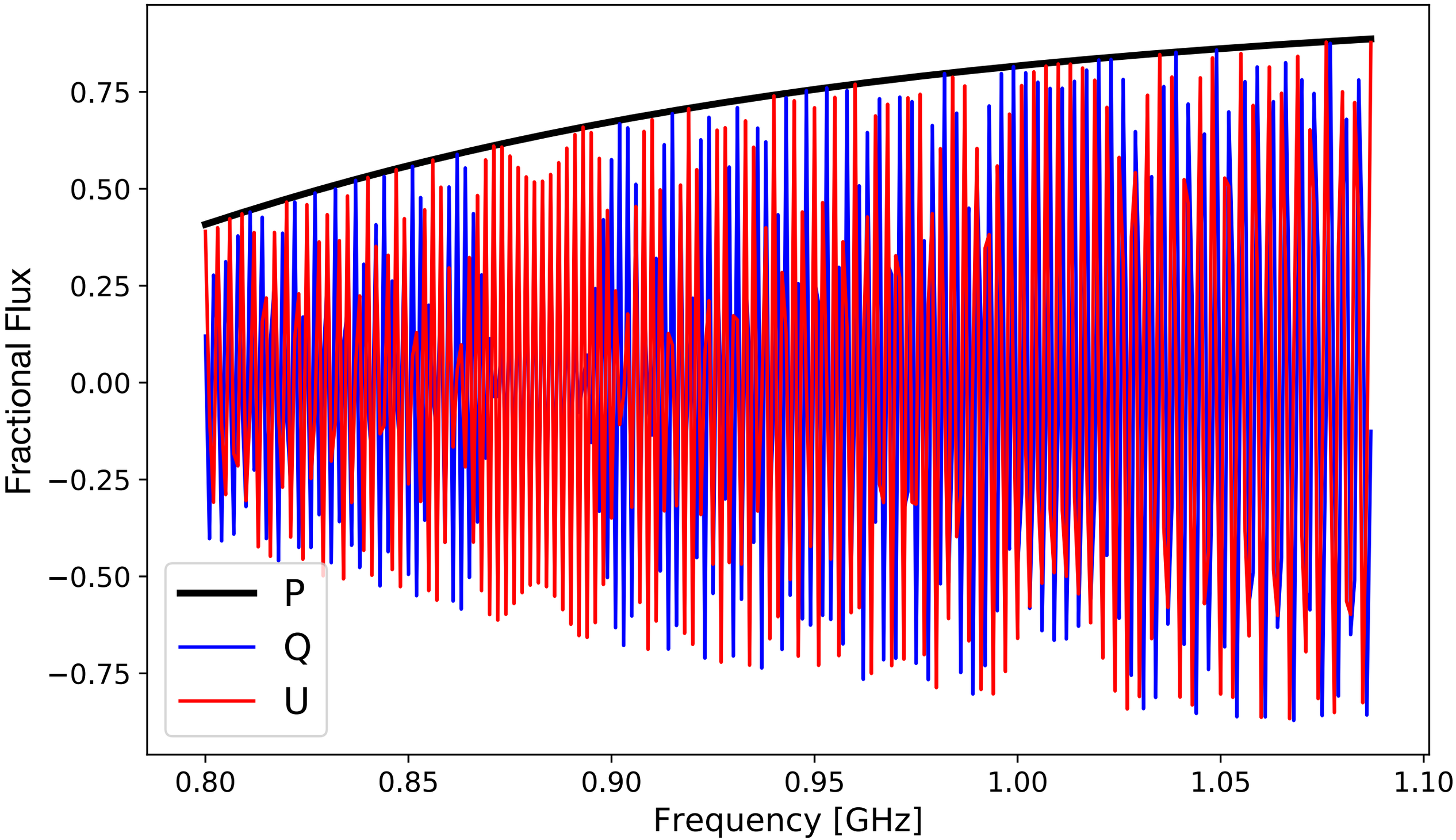
- VLASS (128 MHz channels)

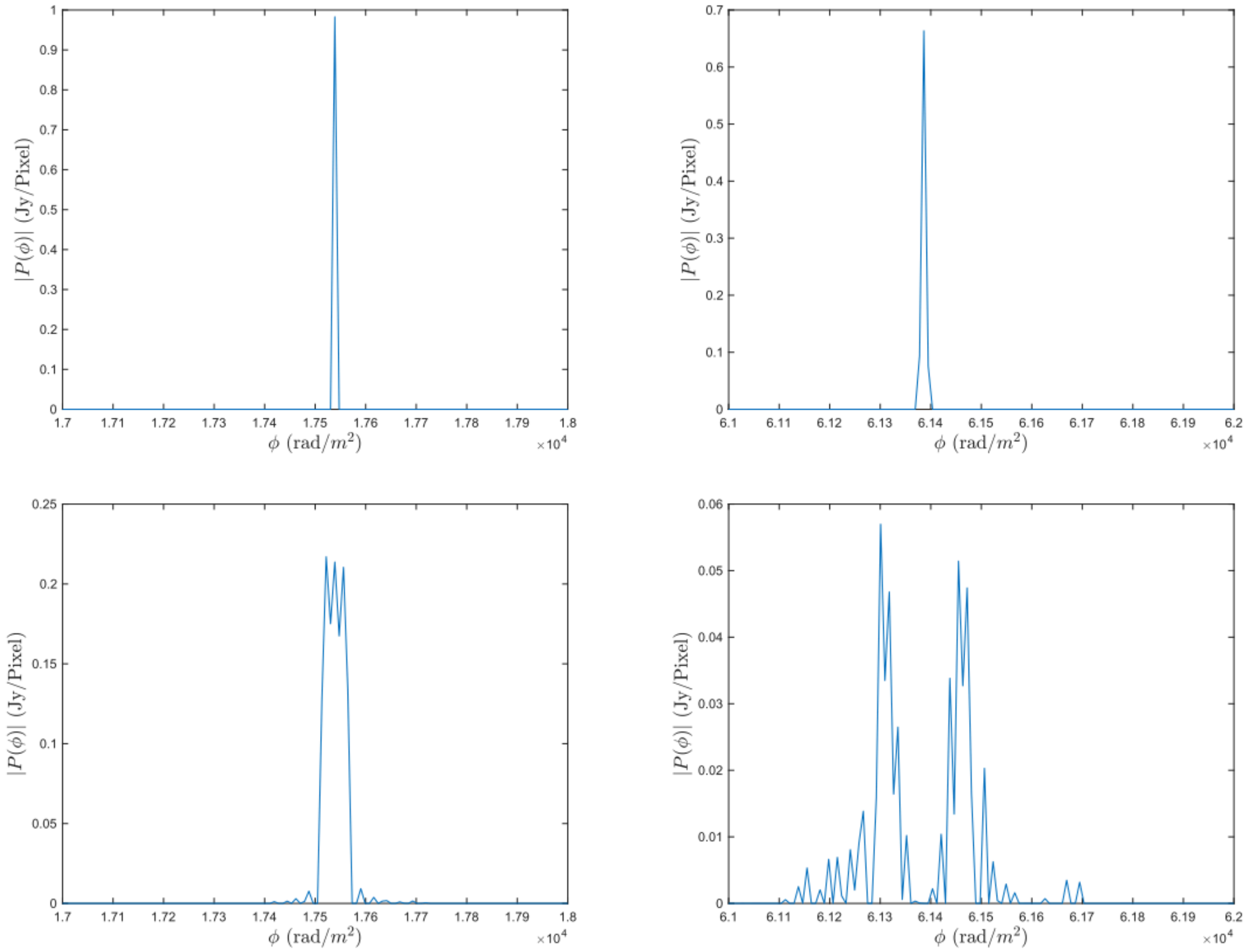
Bottom of band	(2 GHz)	660 rad m^{-2}
Top of band	(4 GHz)	4 588 rad m^{-2}

- LOTSS (~98 kHz channels)

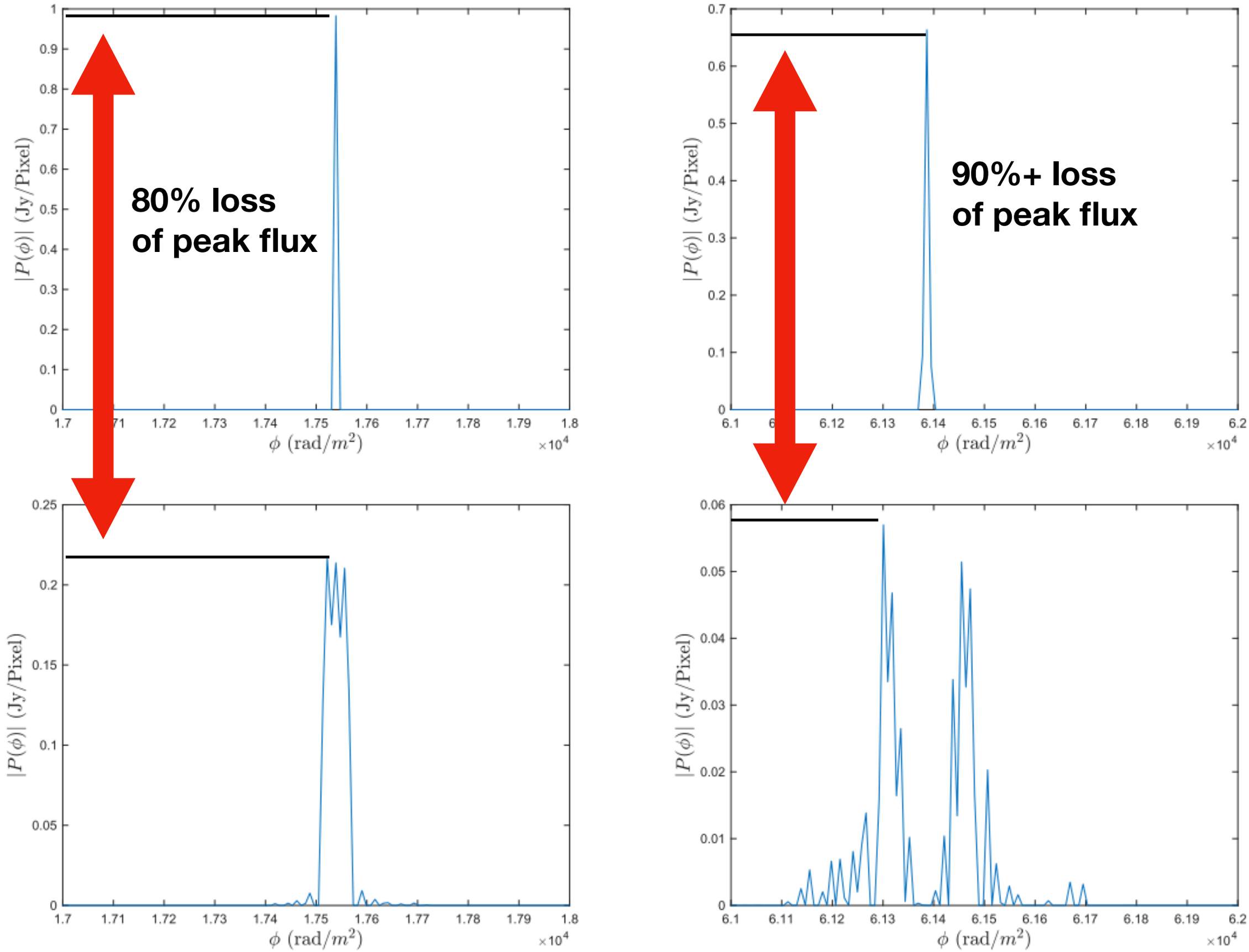
Bottom of band	(~120 MHz)	170 rad m^{-2}
Top of band	(~170 MHz)	480 rad m^{-2}

EMU/POSSUM band 1, ϕ = 6000 rad m^{-2}





Pratley & Johnston-Hollitt 2019, Fig 10



Pratley & Johnston-Hollitt 2019, Fig 10

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Wide-band Rotation Measure Synthesis

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Rotation measure synthesis revisited

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The goal: to develop an algorithm that can

- Maximize the signal-to-noise of the peak
- Recover the correct shape in the Faraday depth spectrum
- Recover the correct RM
- Recover the correct polarized flux
- (Bonus) Do this all in RM-synthesis
  (QU-fitting should be easy-ish?)
- Be built into RM-tools as an optional utility

and to get it all done in one summer.

Then go hunting for extreme RMs!