Probing the magnetic fields in 3C273 through Faraday rotation observations

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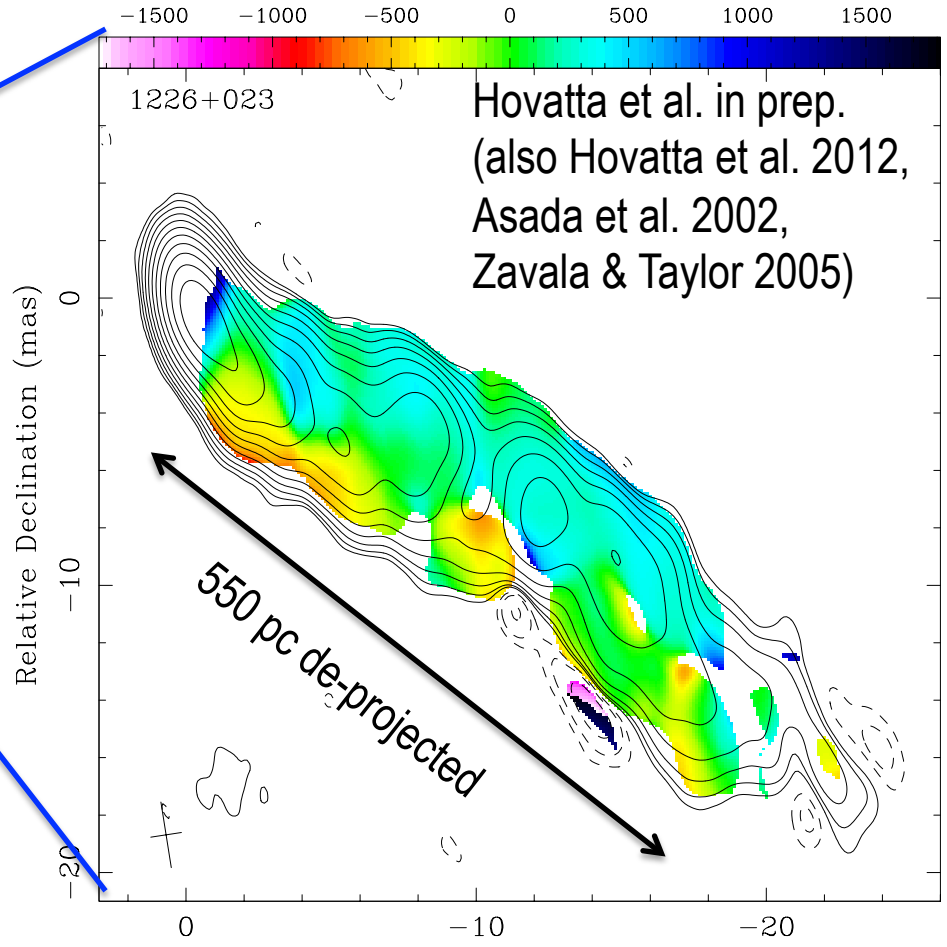
3C273 Faraday rotation on parsec scales

Very Long Baseline Array



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3C273 Faraday rotation on parsec scales

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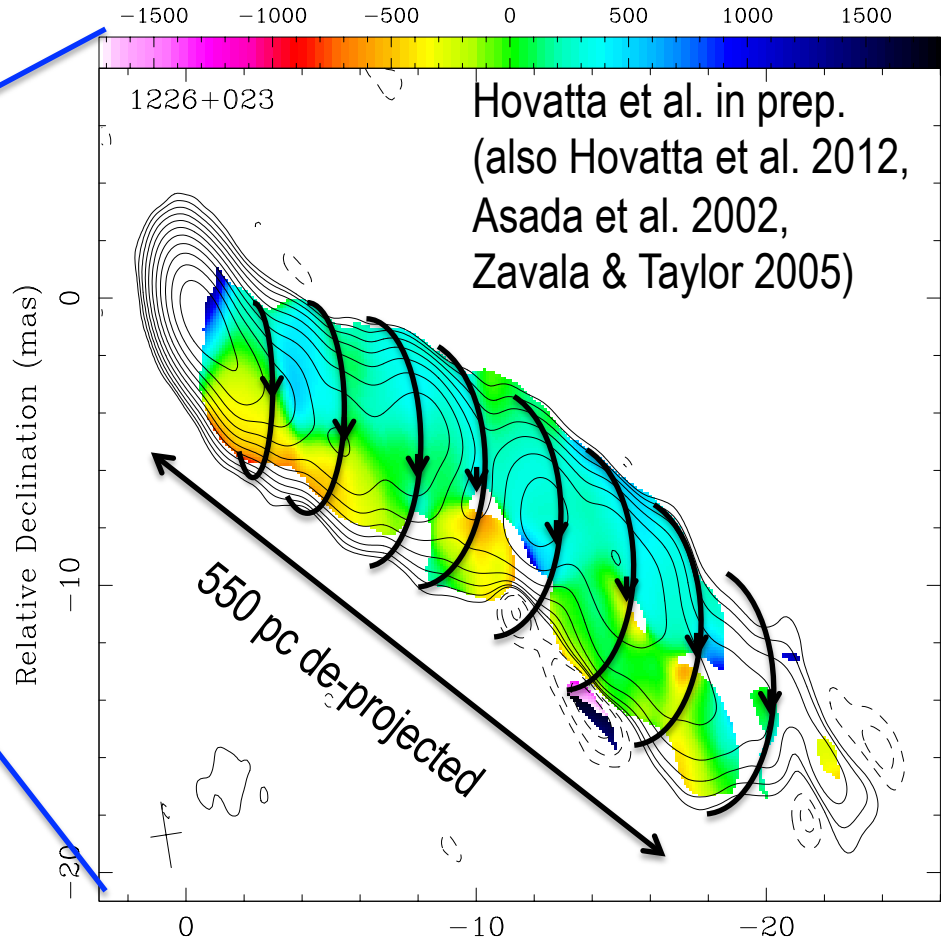

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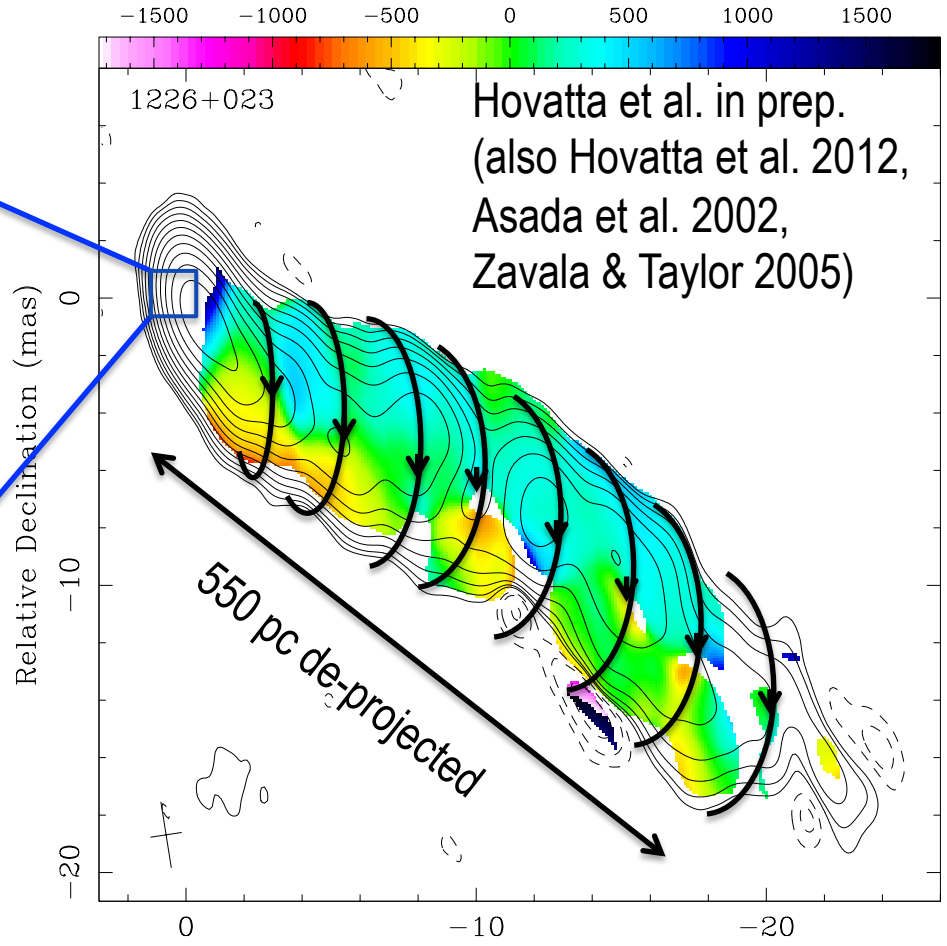
3C273 Faraday rotation on parsec scales

Very Long Baseline Array



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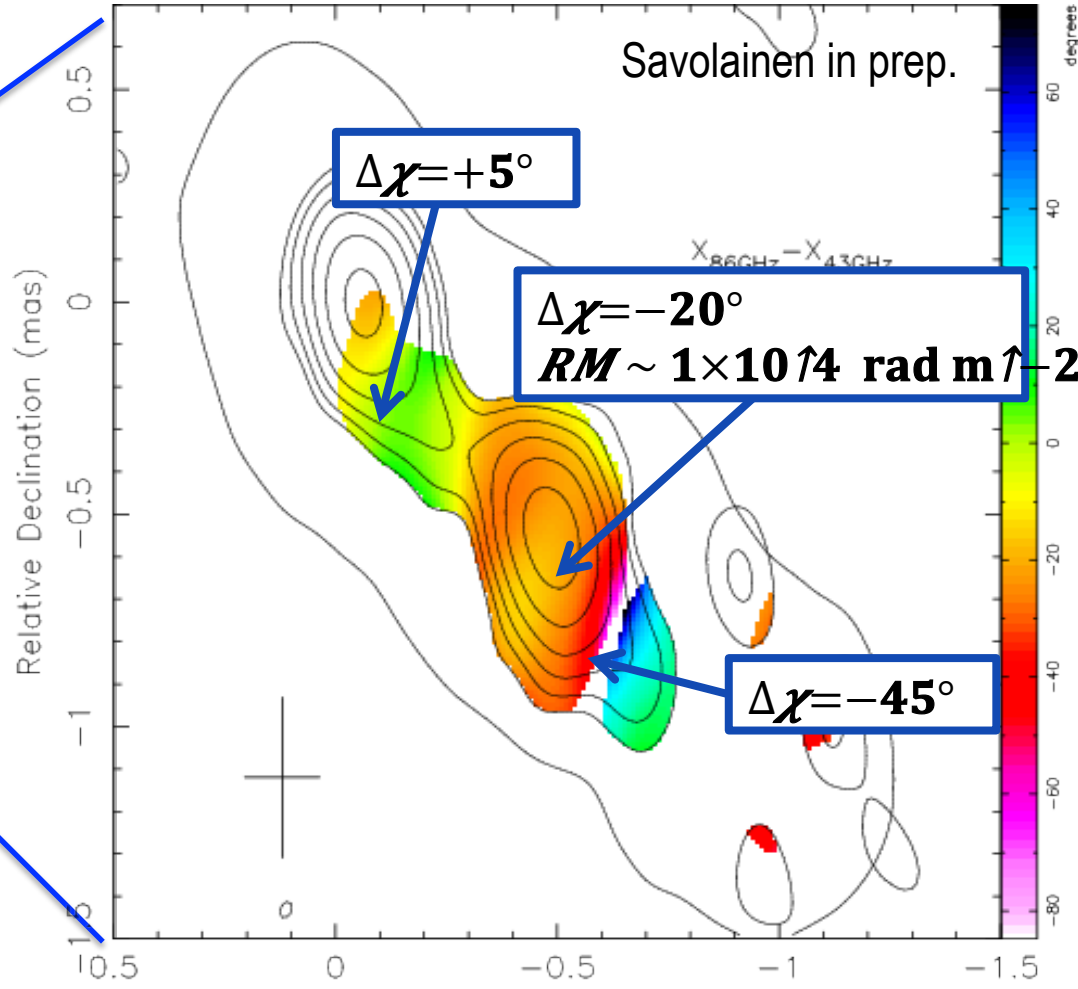
3C273 Faraday rotation at 43-86 GHz

Very Long Baseline Array



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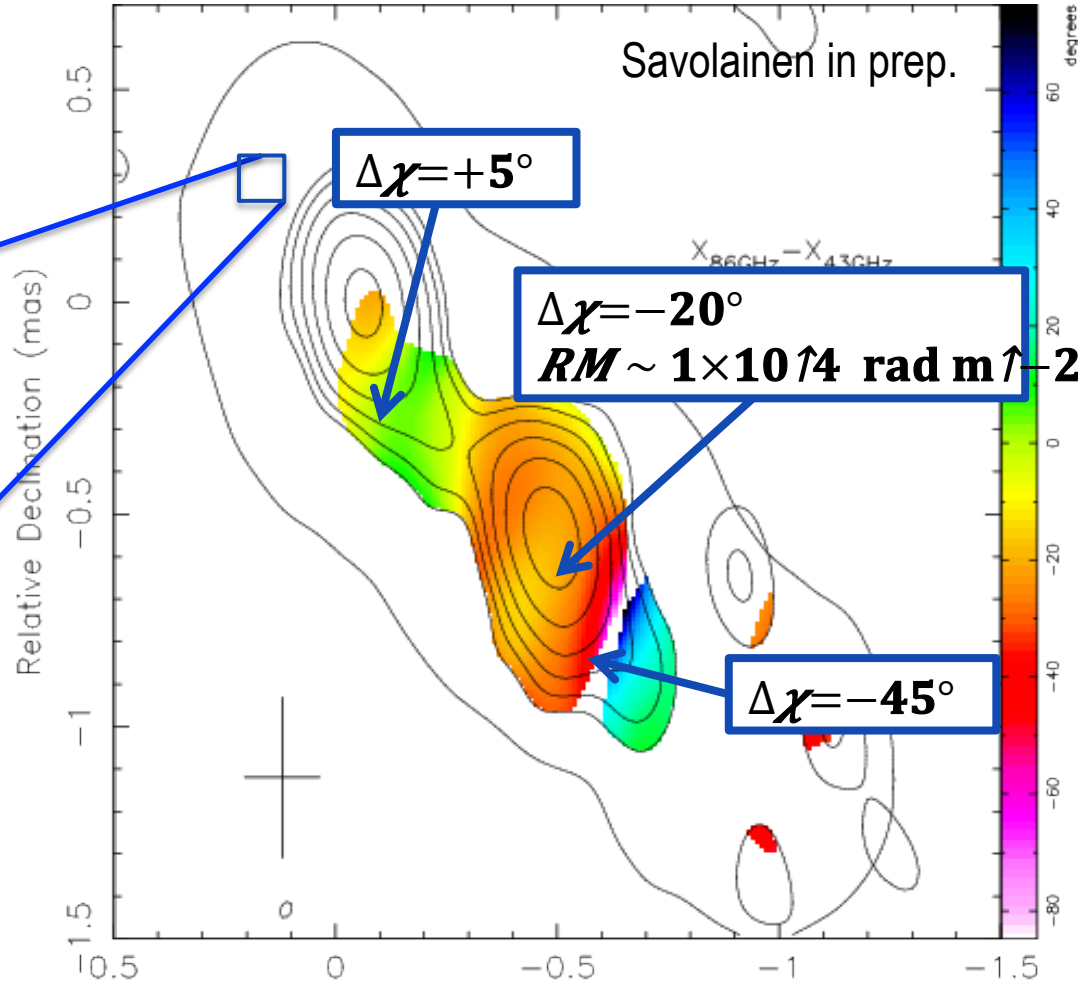
3C273 Faraday rotation at 1mm

ALMA

- ALMA 1mm observations probe the optically thin emission somewhere near the black hole
- Observations done in Dec 2016



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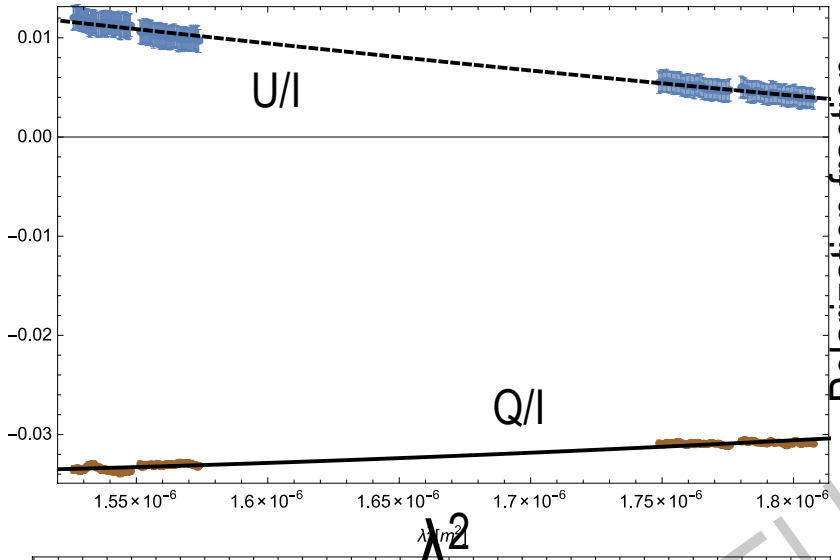
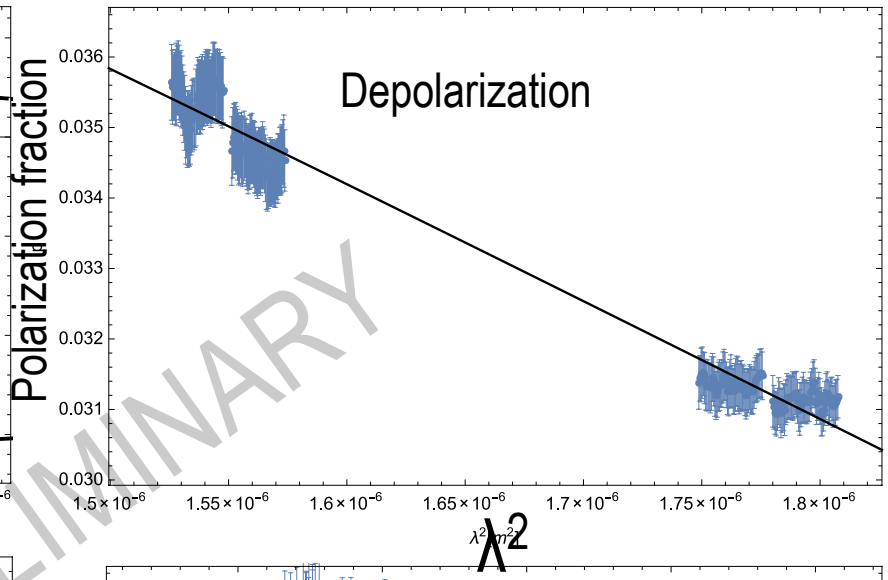
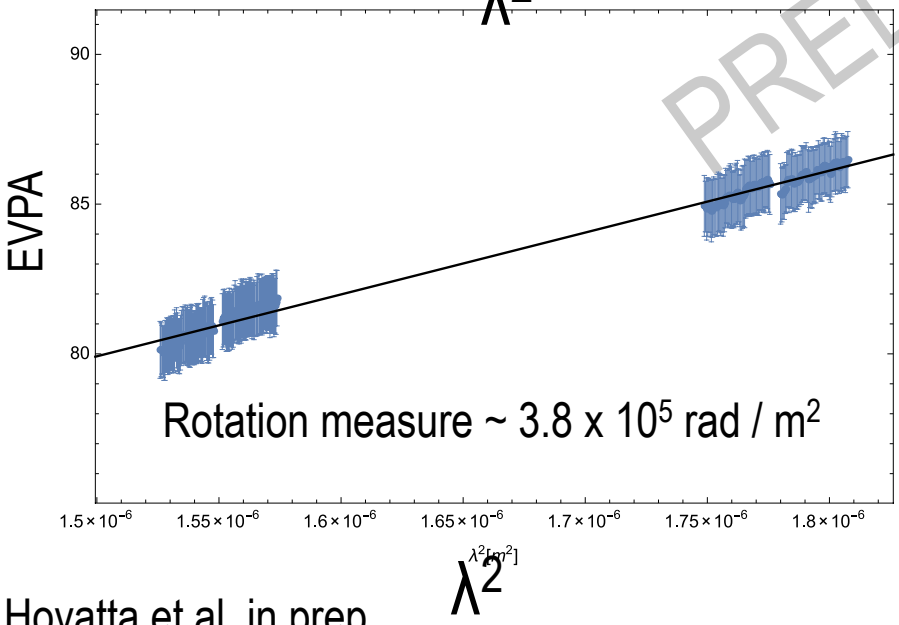
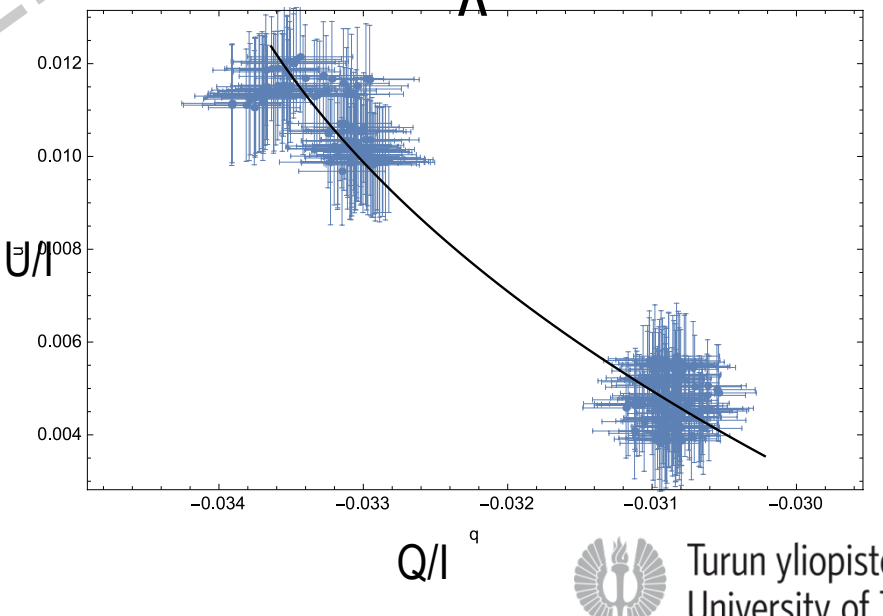
ALMA observations reveal a large RM at 1mm









Hovatta et al. in prep.

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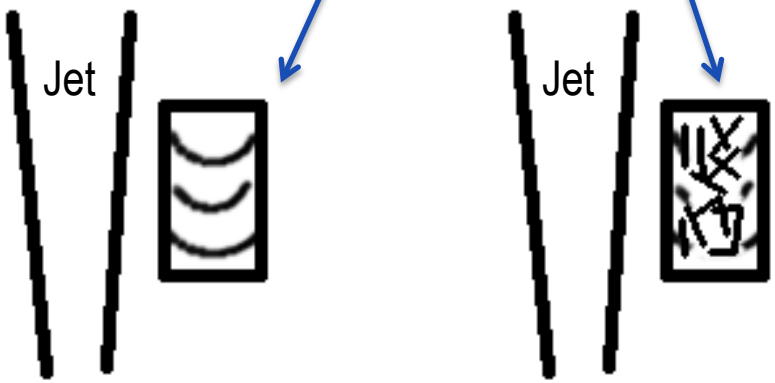
Two plausible models that explain the Q/U behavior

Ordered external screen:

- Requires a rotation measure gradient ΔRM of ~ 9 x 10^5 rad/m^2



Turbulent external screen:

- Requires the Faraday dispersion of the RM screen to be ~ 2.7 x 10^5 rad/m^2

$$P = p_0 \,\mathrm{sinc}(\Delta \mathrm{RM}\lambda^2)\; e^{2i(\Psi_0 + \mathrm{RM}\lambda^2)}$$

$$P = p_0 e^{-2\sigma_{\mathrm{RM}}^2 \lambda^4}\, e^{2i(\Psi_0 + \mathrm{RM}\lambda^2)}$$

Sokoloff et al. 1998, O'Sullivan et al. 2017

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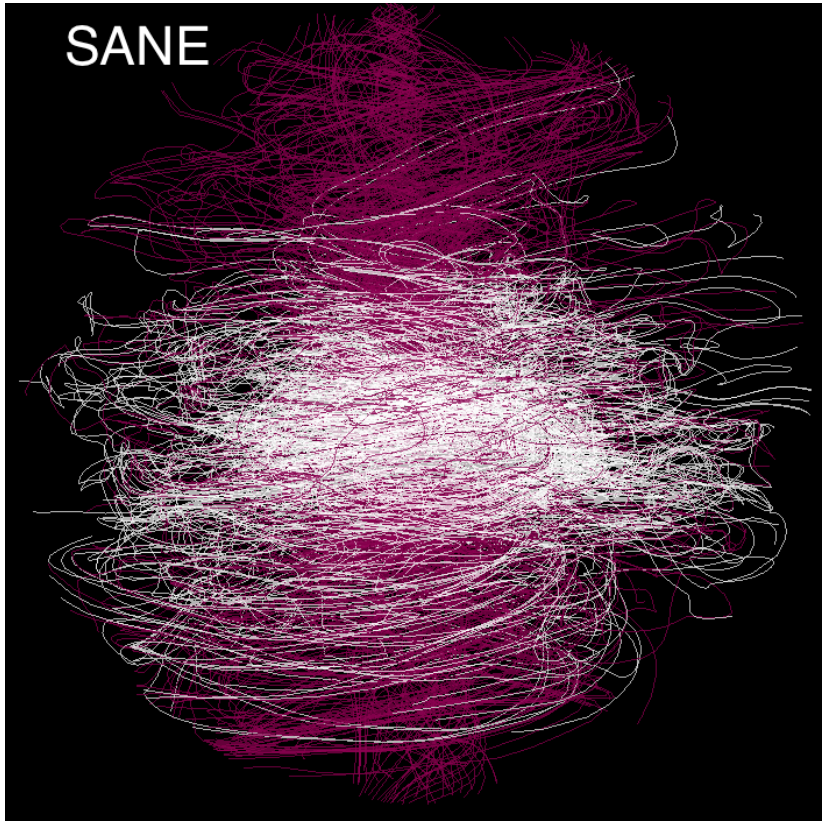
Comparison to simulations may help to distinguish the models

Magnetically arrested disk
(large-scale magnetic field)

Standard and Normal Evolution
(no large-scale poloidal field needed)



Foucart, et al. (2017), MNRAS (arXiv: 1706.01533)

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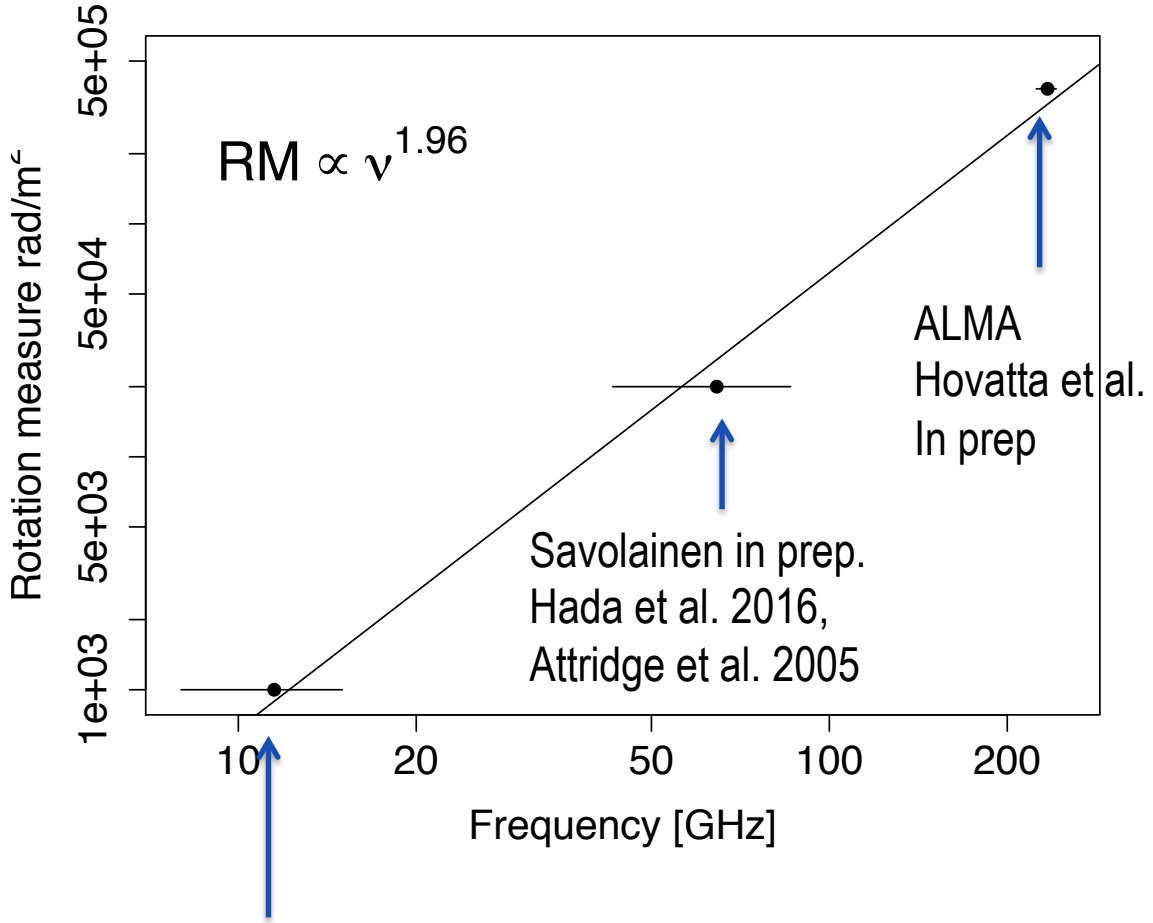
Conclusions

- We detect a high RM of ~ 3.8 x 10^5 rad/m^2 in our 1mm ALMA observations of 3C273
- Together with earlier results, this indicates that RM as a function of wavelength behaves as expected for a helical magnetic field in a conical jet (see also Jorstad et al. 2007, O'Sullivan & Gabuzda 2009, Kravchenko et al. 2014)
- Outlook: EHT observations to resolve the Faraday rotation region



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