Spectral Line polarization - AGN/ULIRGs, Star Formation and Evolved Stars

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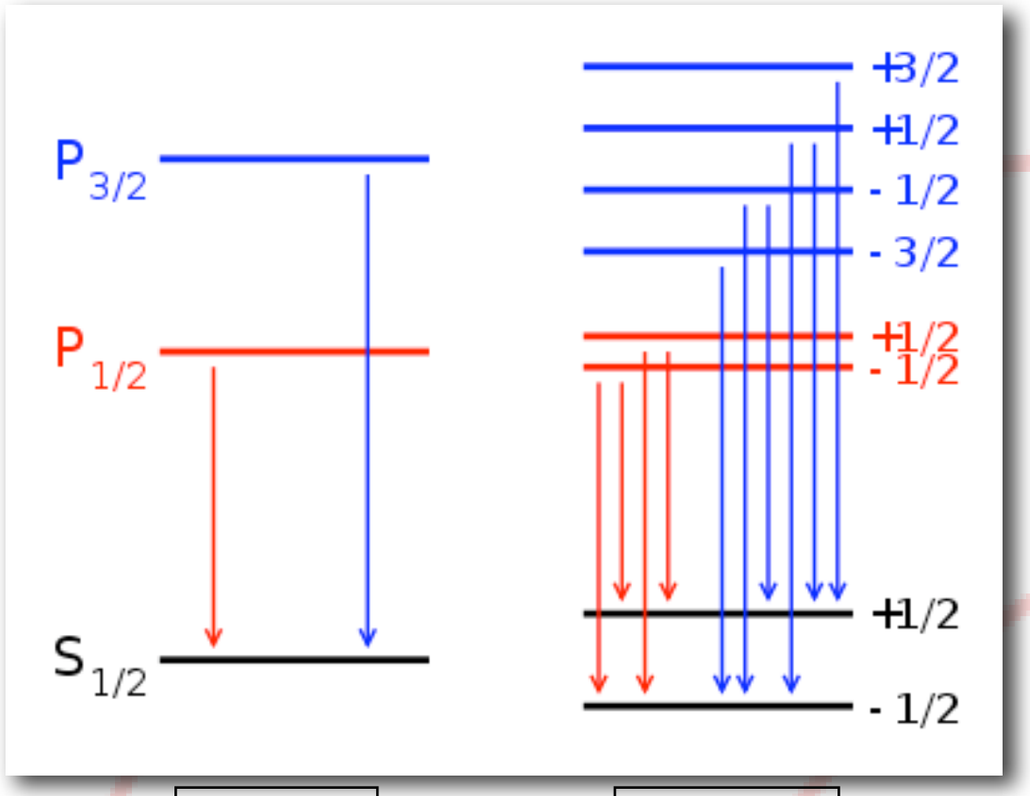
Line polarization

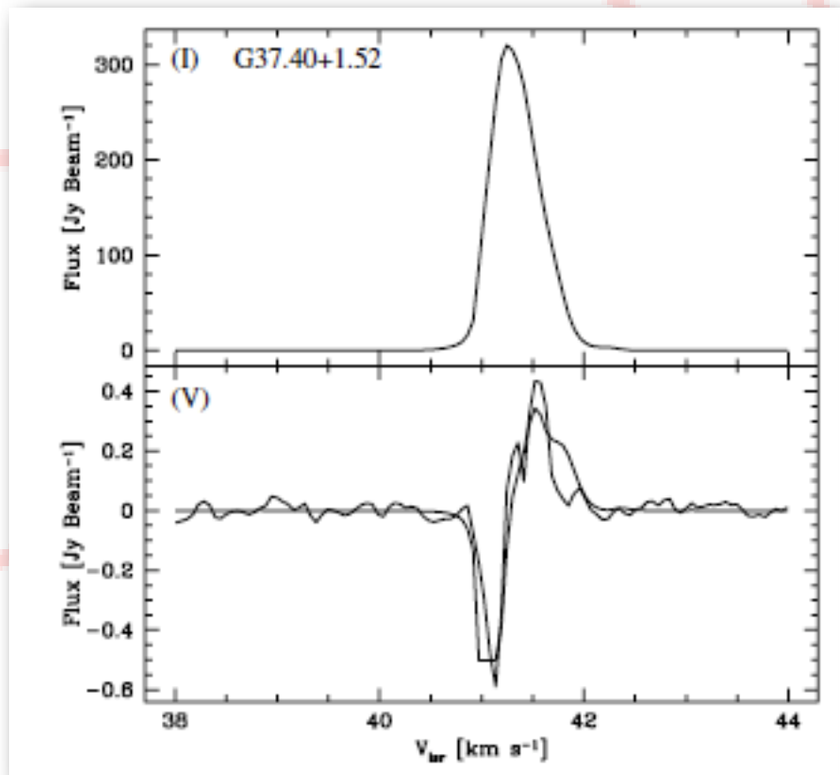
- Circular Polarization - Zeeman-splitting ⇨ $B_{||}$
  - Maser lines (OH, H_2O, SiO, methanol)
    - circular polarization from ~0.1 - 100%
  - CN (and potentially HCN, CS etc.)
    - up to few percent
- Linear Polarization - Goldreich-Kylafis effect (anisotropy) ⇨ $B_{\perp}$
  - Masers, CO and various others

Zeeman Splitting

- "splitting of a spectral line into several components in the presence of a static magnetic field"



B=0 B≠0



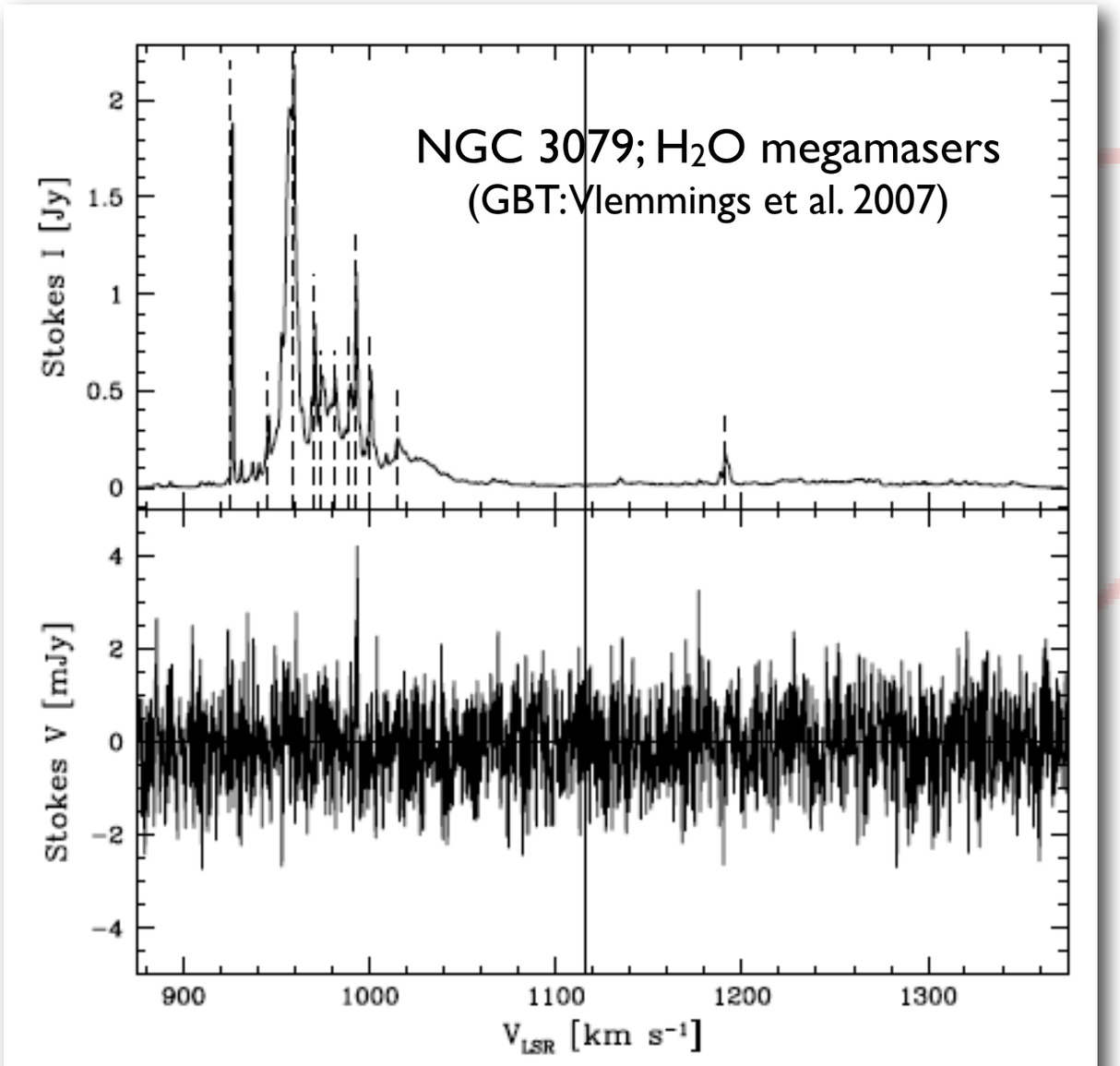
- Circular polarization, V ∝ dI/dv
  - Good test of polarization calibration

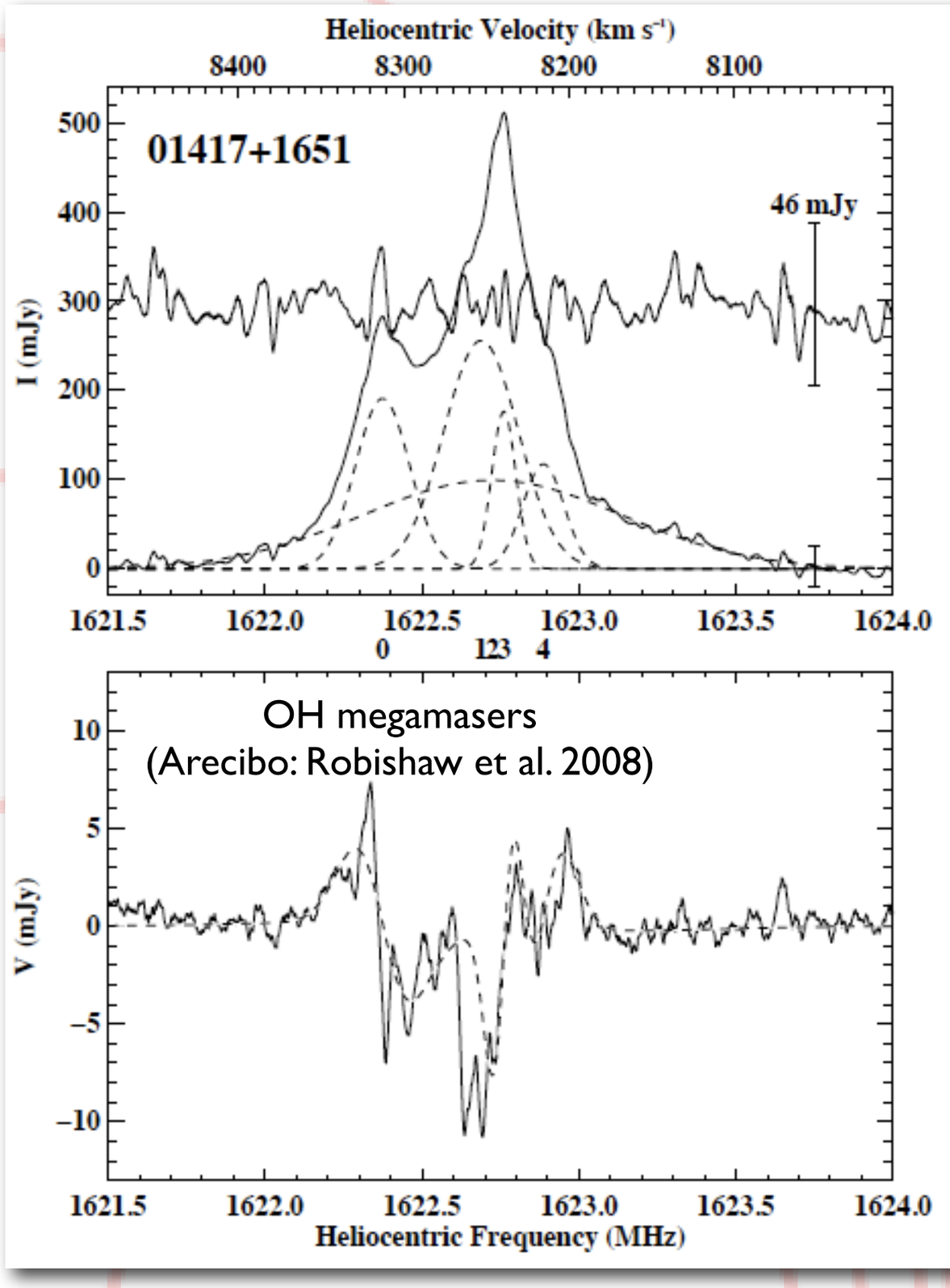
Single-dish polarization

- Disadvantages:
  - Lack of spatial information
  - Line blending
    - suppression of B-field
- Advantages:
  - No loss of flux - larger samples
  - Less need of very accurate positions (wrt VLBI)
  - Typically good sensitivity

AGN and ULIRGs

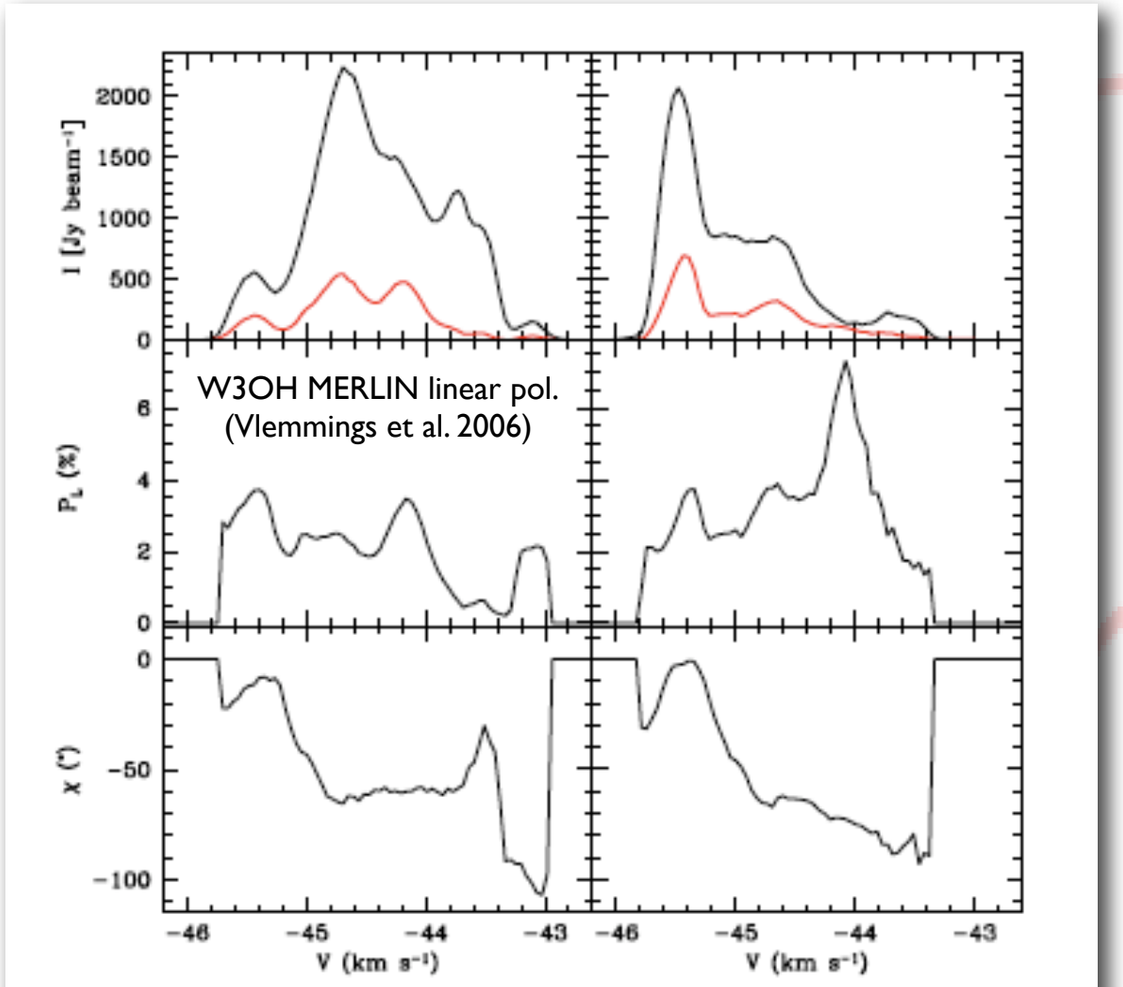
- Currently:
  - AGN upper limits around BH (~10 mG)
  - ULIRGs 0.5-18 mG



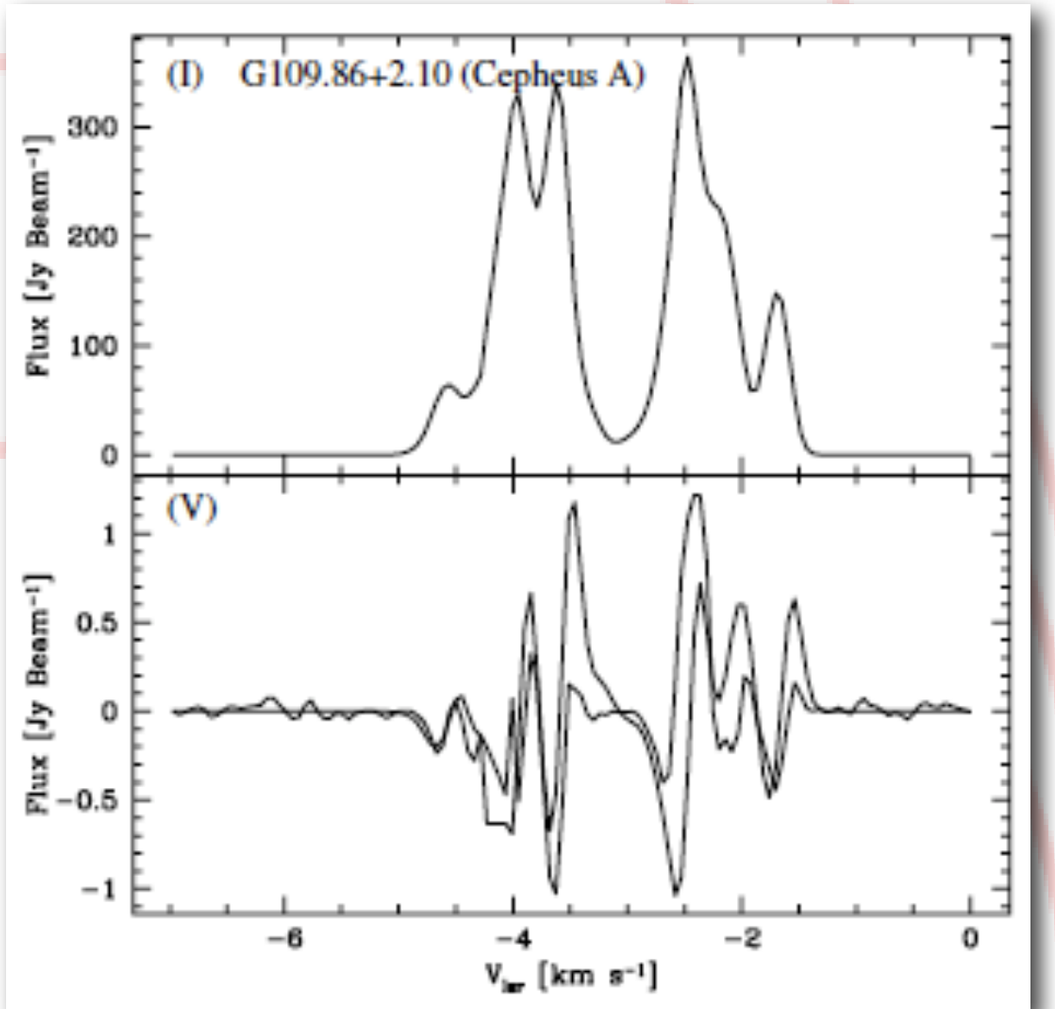


Massive SF regions

- Dynamically important B-fields in MSF regions
  - small number statistics
  - lines probe different densities
    - B vs. density?

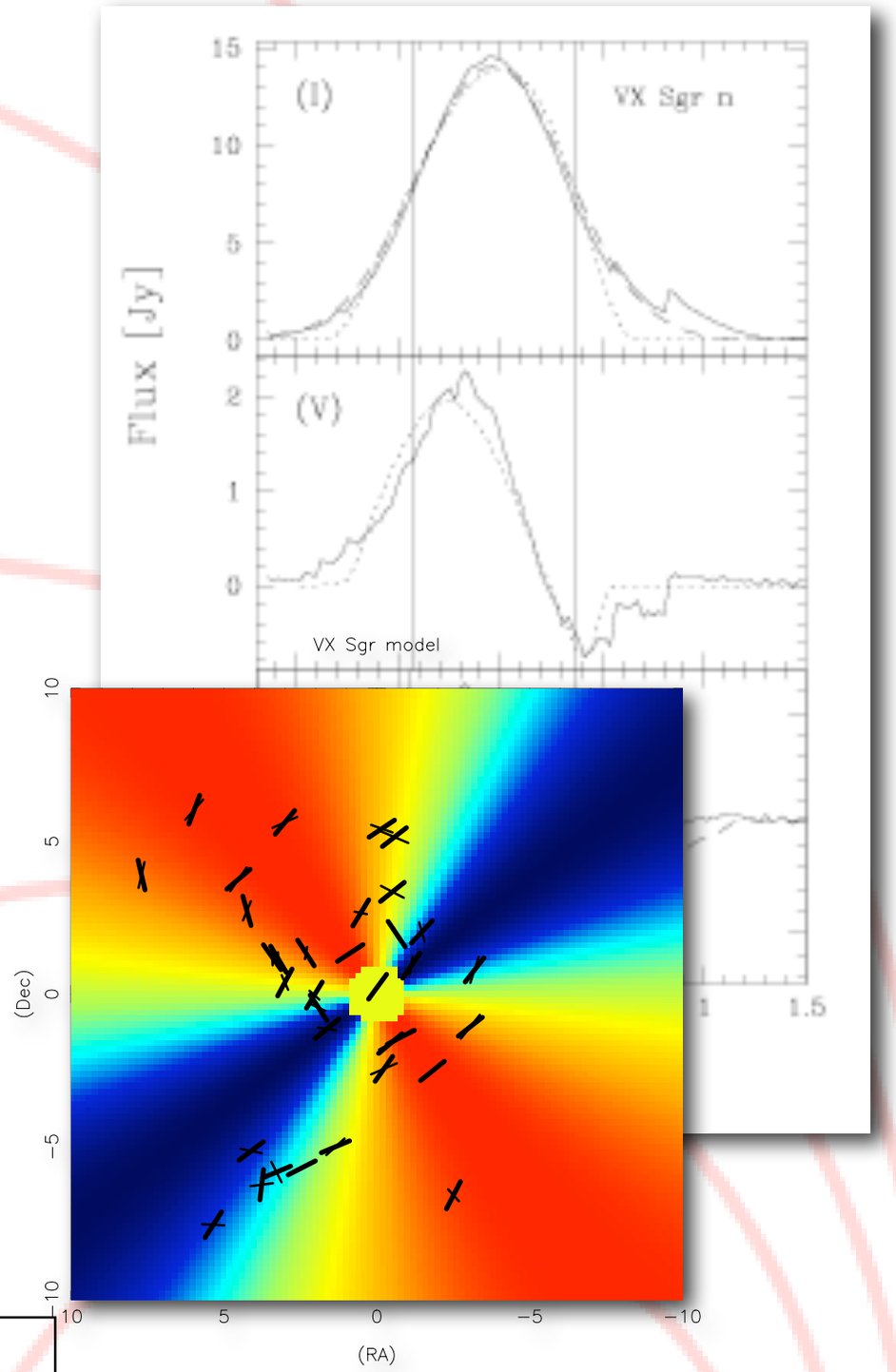


MSF methanol masers
Effelsberg Zeeman splitting
(Vlemmings et al. 2008, 2009)



Evolved Stars

- B-field potentially drive mass-loss and shape outflows/PNe
  - Several maser lines, small samples
  - Spectral line velocity information ⇒ 3D outflow morph. and B-field
    - Dipole?



VX Sgr H_2O CP
and SiO LP
(Vlemmings et al. 2005, 2010)

Possible projects

- Important role for single dish
  - Zeeman splitting also good calibration test
- Current LP+CP observations rare
  - mainly strongest sources with interferometers
  - single dish can significantly expand current samples of and our knowledge of B-fields in:
    - AGN/ULIRG (OH and H_2O megamasers)
    - MSF regions (H_2O, methanol, CO...)
    - Evolved stars (H_2O, OH, CO...)