VLBA SiO Maser Observations of the OH/IR Star OH 44.8-2.3: Magnetic Field and Morphology

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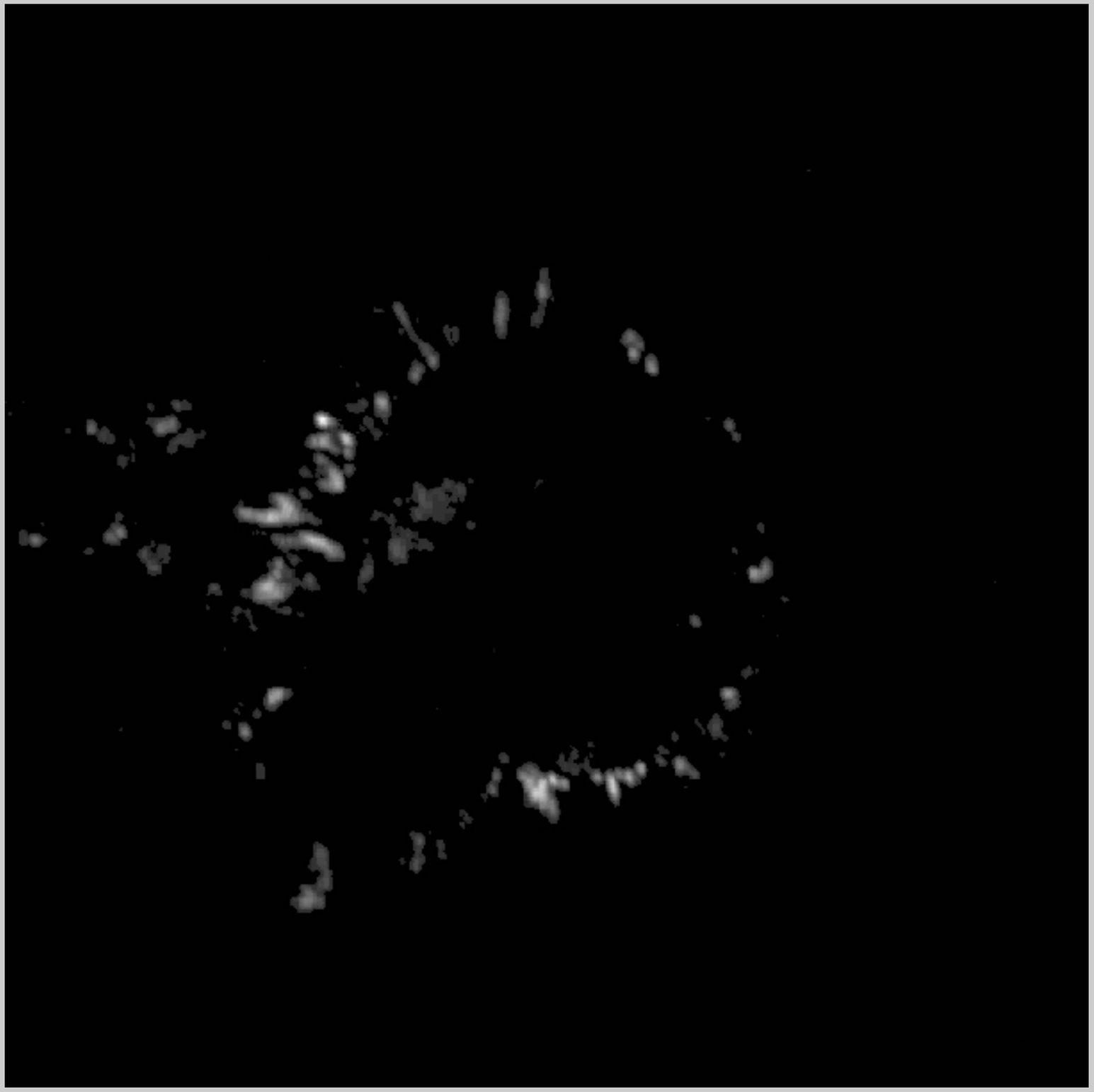
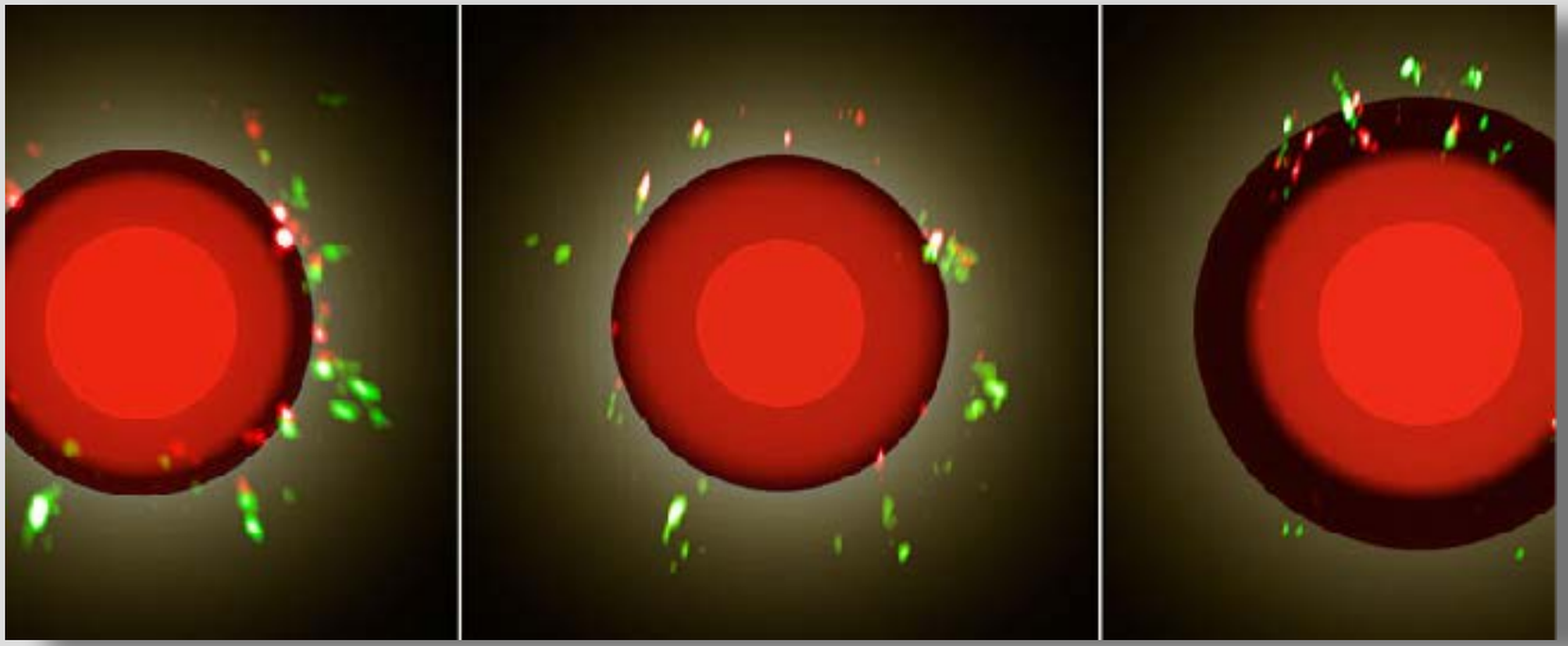
TX Cam (73 Epochs)



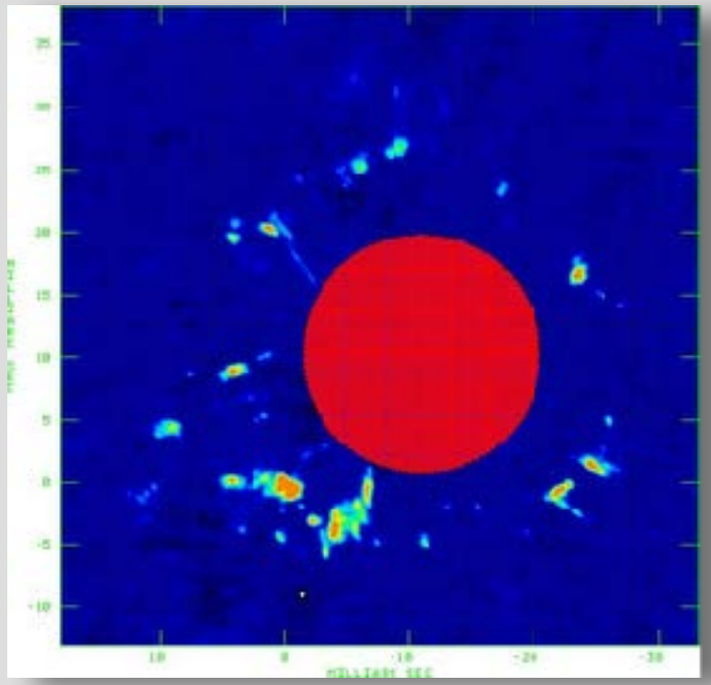
I. Gonidakis, P. J. Diamond, A. J. Kemball (2010)

SiO Masers in Evolved Stars

- SiO in OH/IR stars?
  - Bigger dust shell,Larger CSE,Longer periodsSiO Masers in OH/IR stars the same as Miras?
  - SiO emission Mechanism the same as Mira variables?

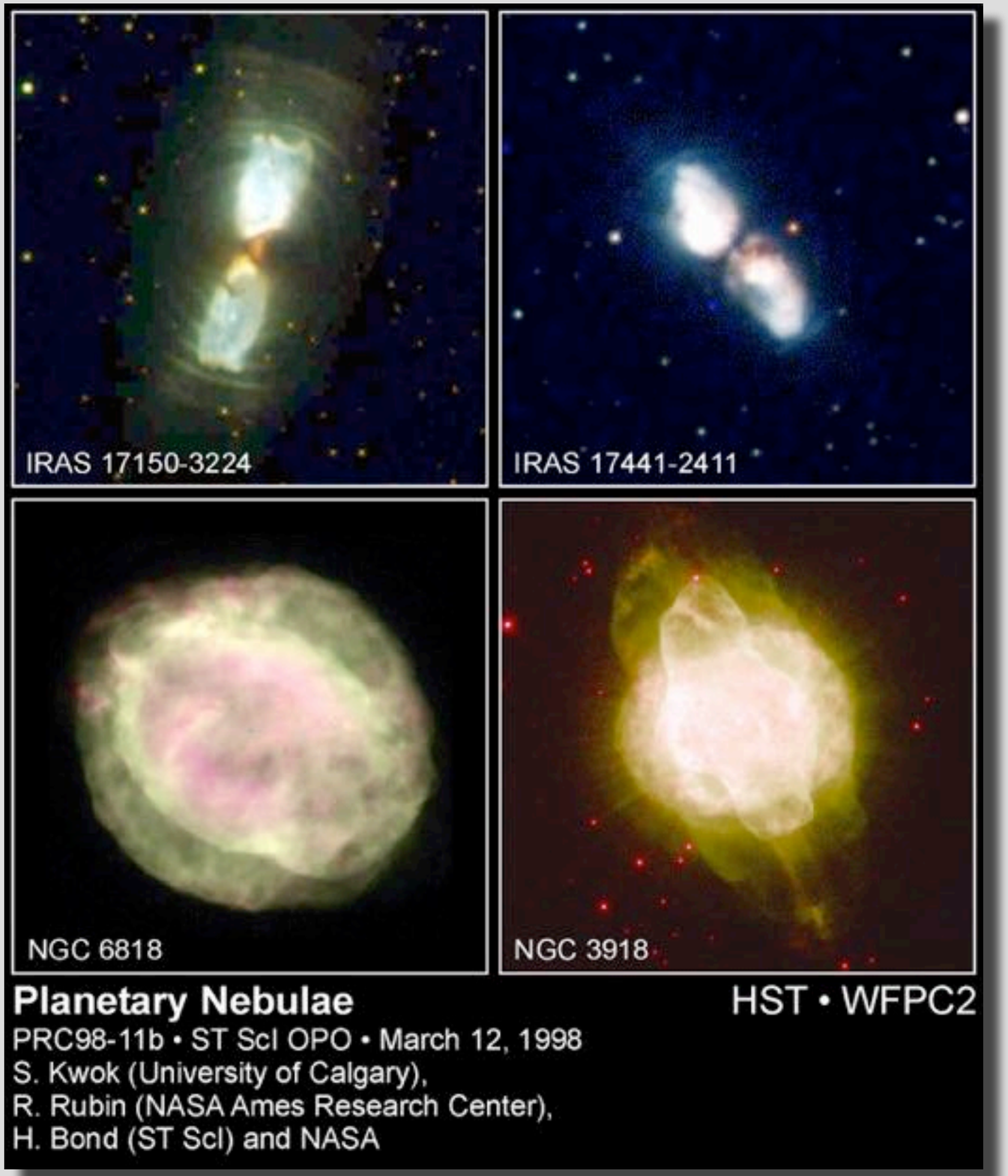


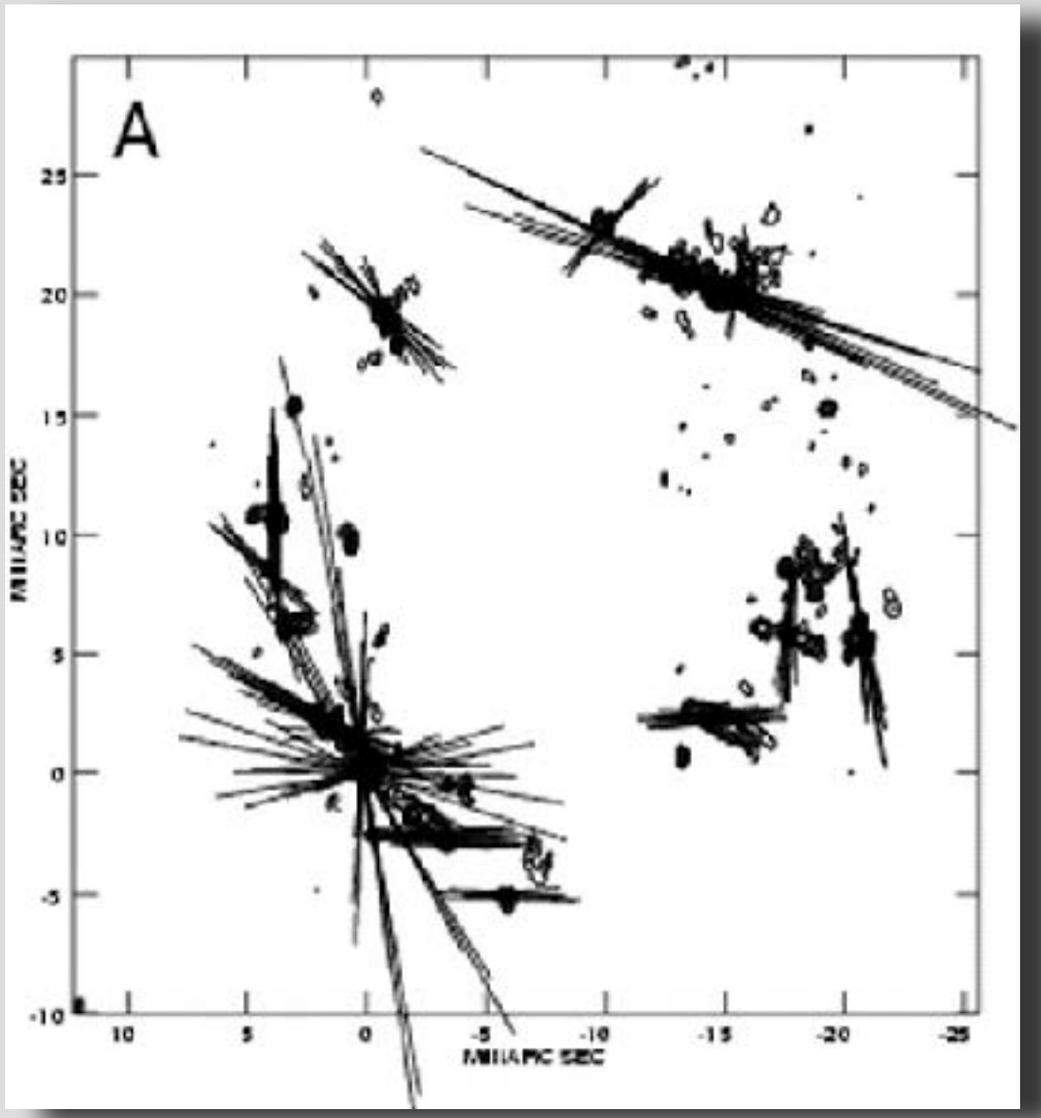
Credit: Makus Wittkowski



TX Cam, Credit: Athol Kemball

SiO Masers- Magnetic Fields

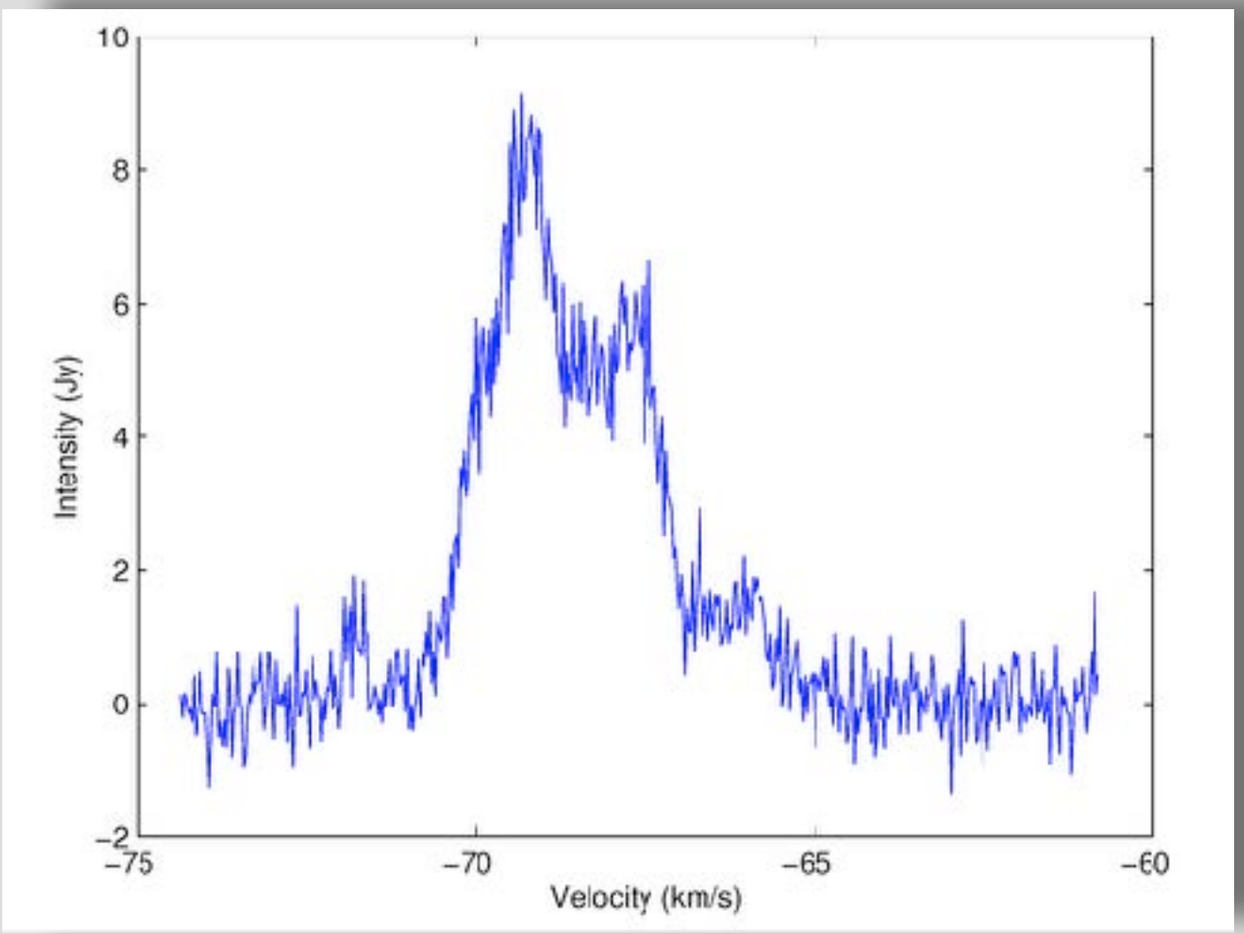


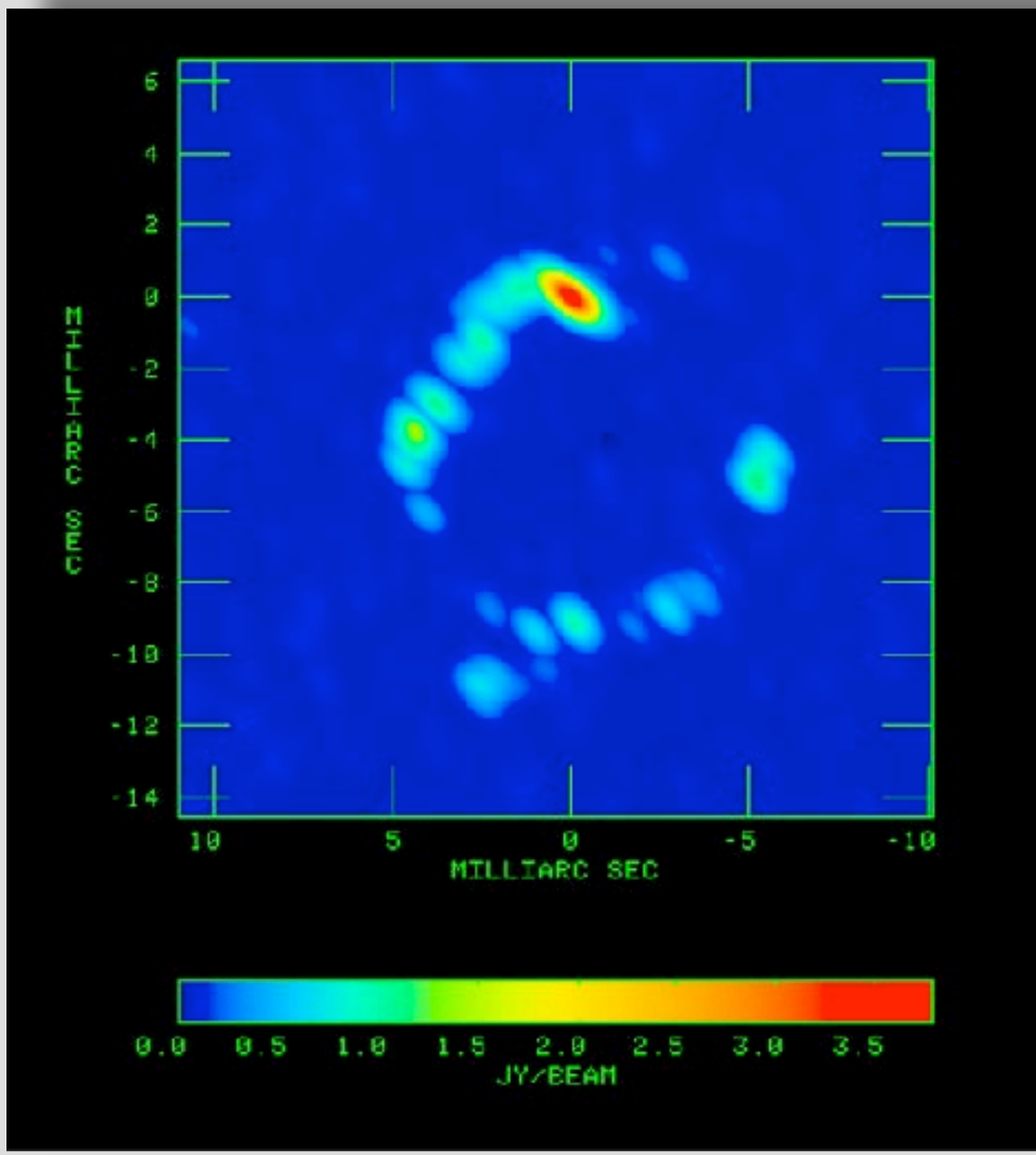


TX Cam, SiO
Kemball and Diamond, 1997, ApJ 481 L111

SiO masers of the OH/IR star OH 44.8-2.3

- **The first SiO maser map of an OH/IR**
- The masers appear to be absent from the eastern and western parts of the ring

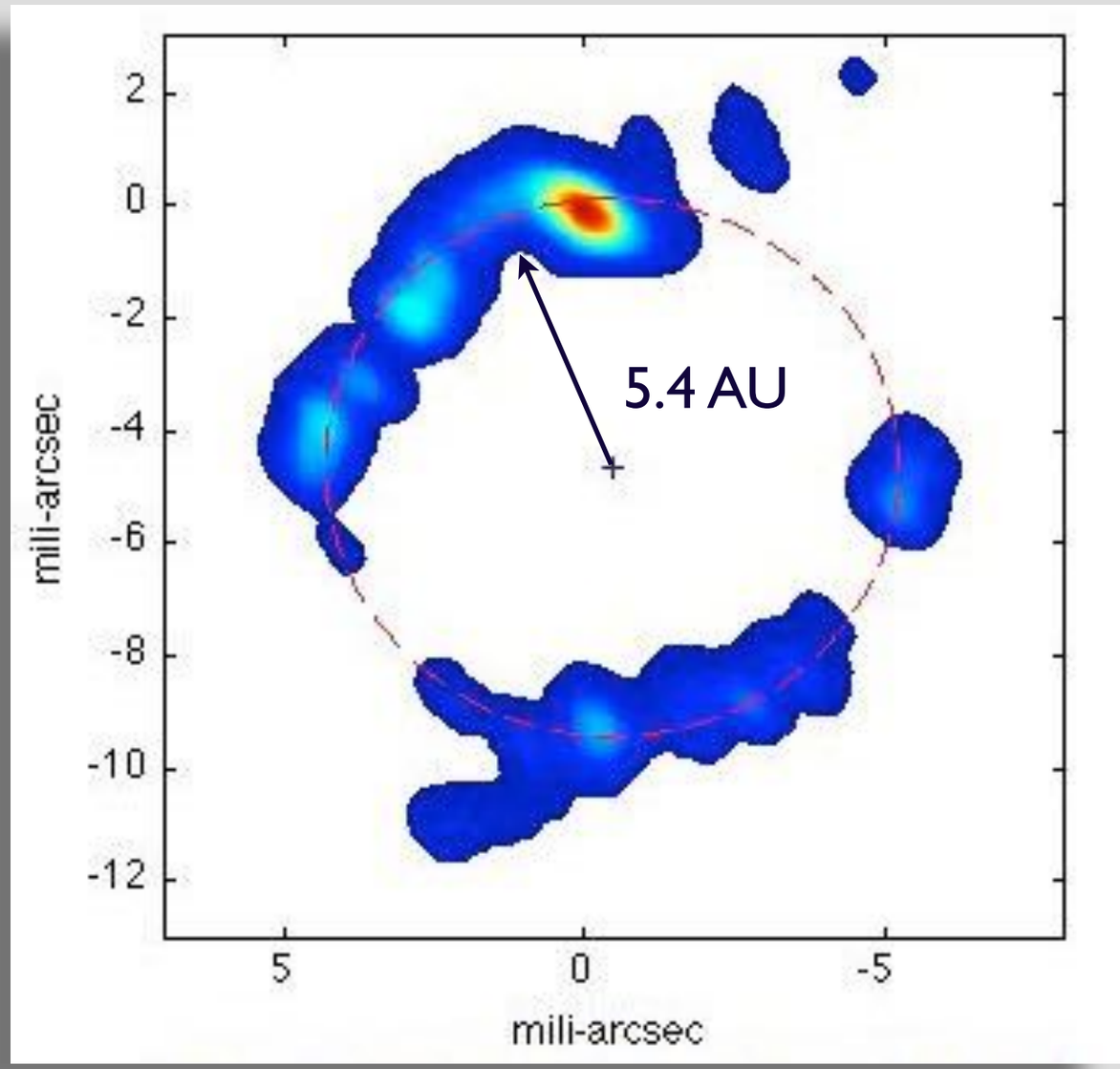




Amiri et al. 2012

SiO masers of the OH/IR star OH 44.8-2.3- Continued

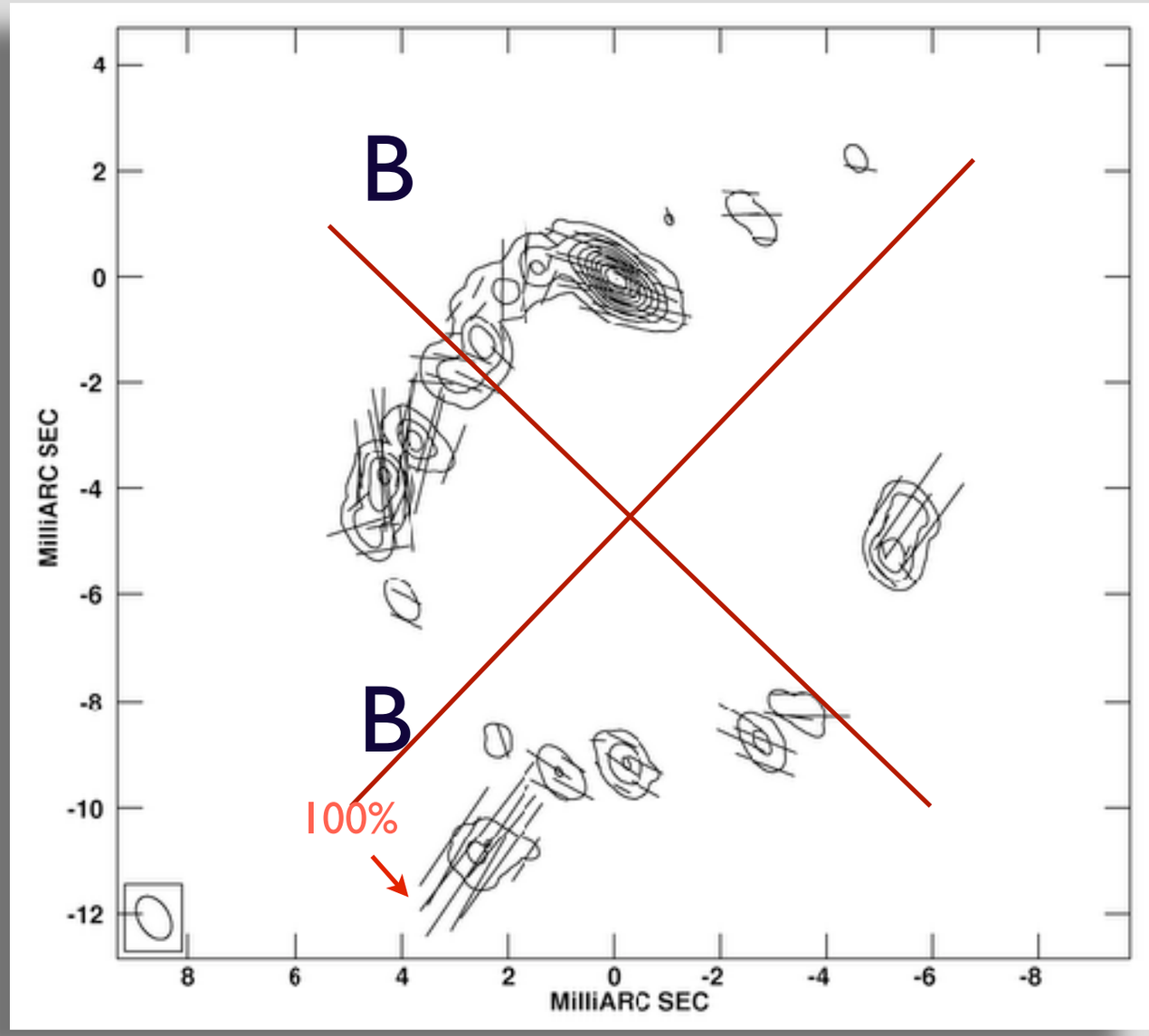
- Distance:1.13±0.34 kpc (Van Langevelde et al. 1990).
- Ring with a radius of ~5.4 AU around the star.
- Similar distance from the star as Mira variables (3-7 AU Cotton et al. 2008).
- Distance determination using parallax



Amiri et al. 2012

Polarization properties-linear

- Highly linearly polarized, up to 100%
- Magnetic field is parallel or perpendicular to the polarization vectors (Goldreich et al. 1973).
- The polarization vectors are consistent with a dipole magnetic field
- Other complex morphologies (Toroidal or Solar type)
  - OH and H_2O polarimetric observations



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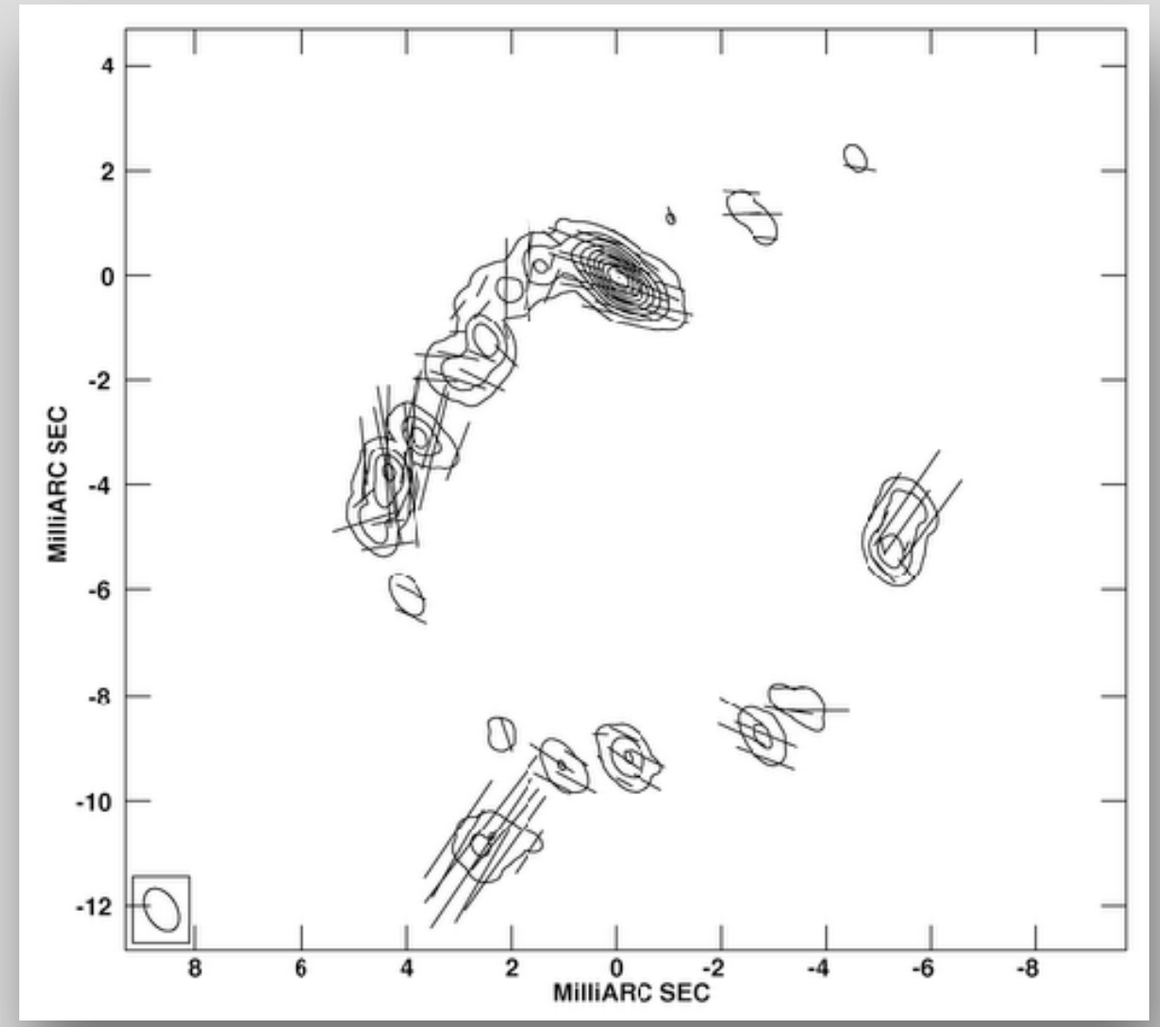
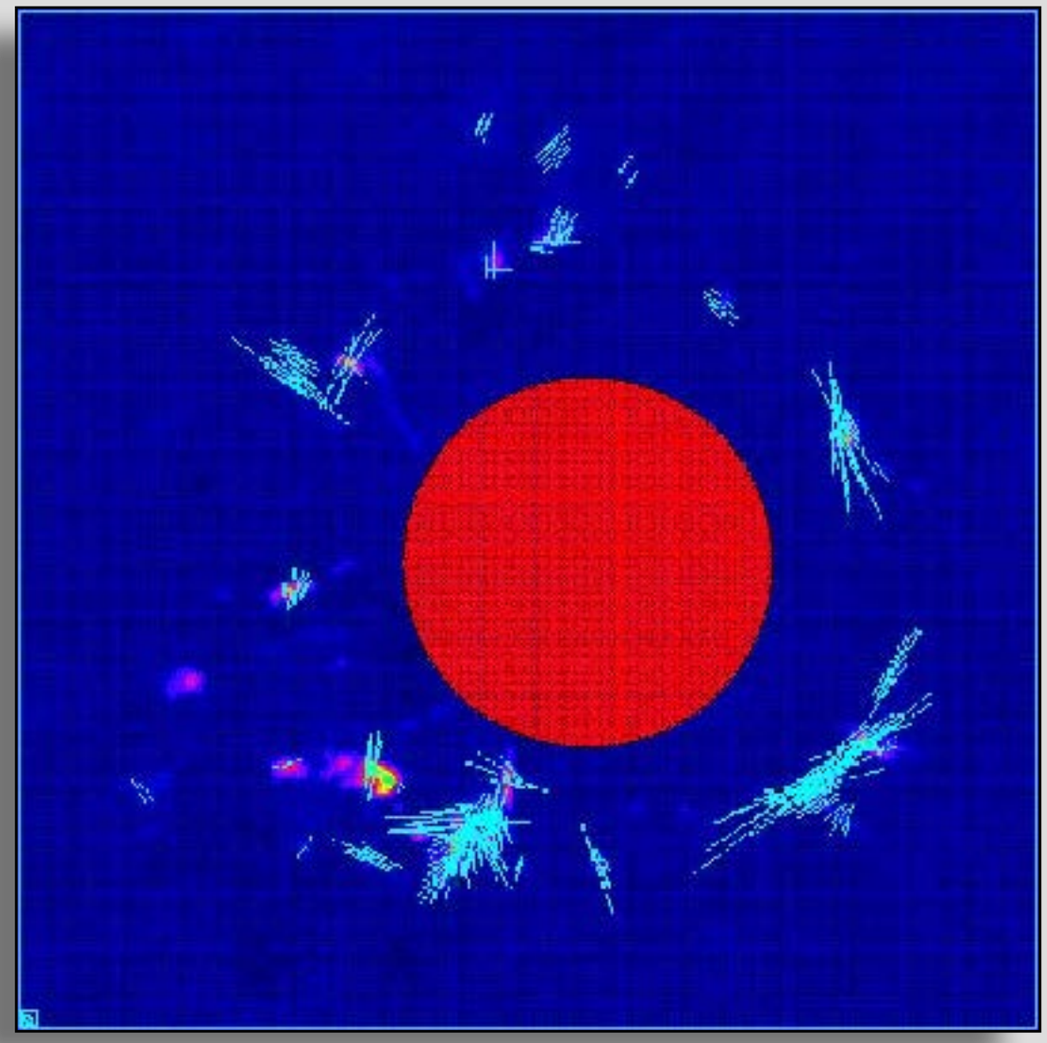
Linear Polarization

- No tangential morphology
- Tangential Polarization

Morphology is not a generic property of SiO masers!!



TX Cam

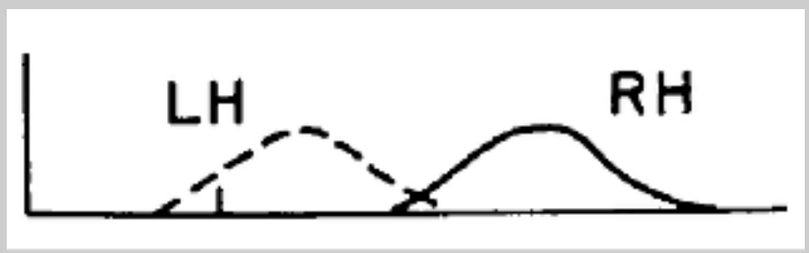


Credit: Athol Kemball

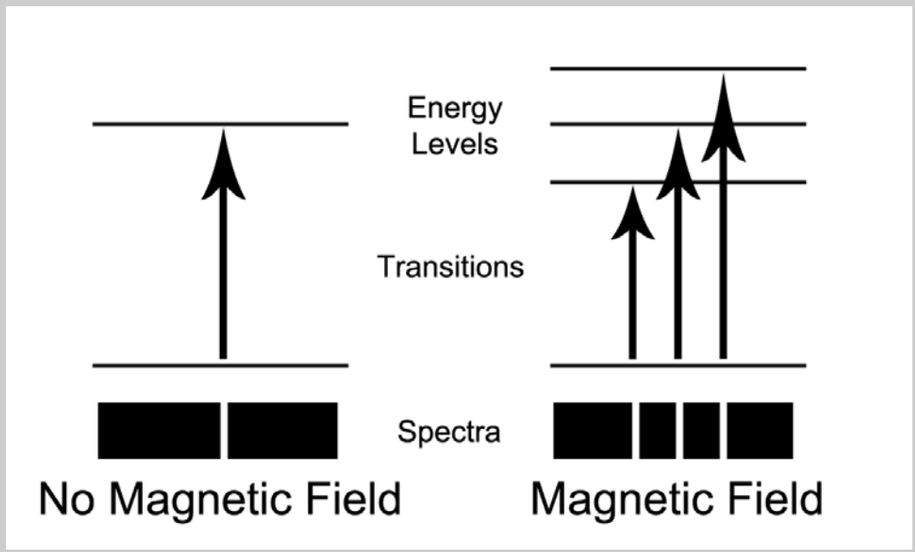
Circular Polarization Analysis-Zeeman Splitting

- Zeeman Splitting: The most direct way to measure magnetic field
- The Zeeman splitting causes a velocity shift between the RCP and LCP spectra

Velocity offset



Zeeman Effect

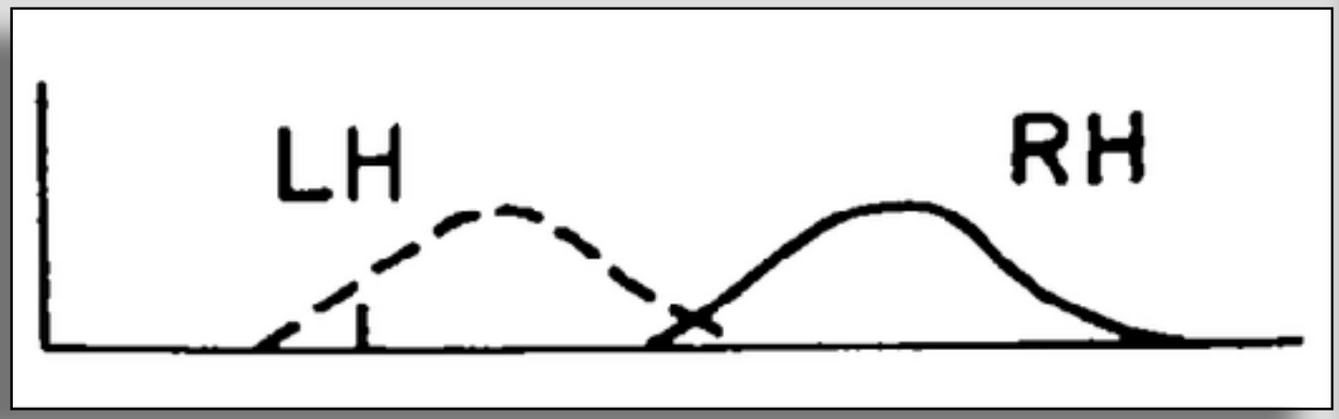


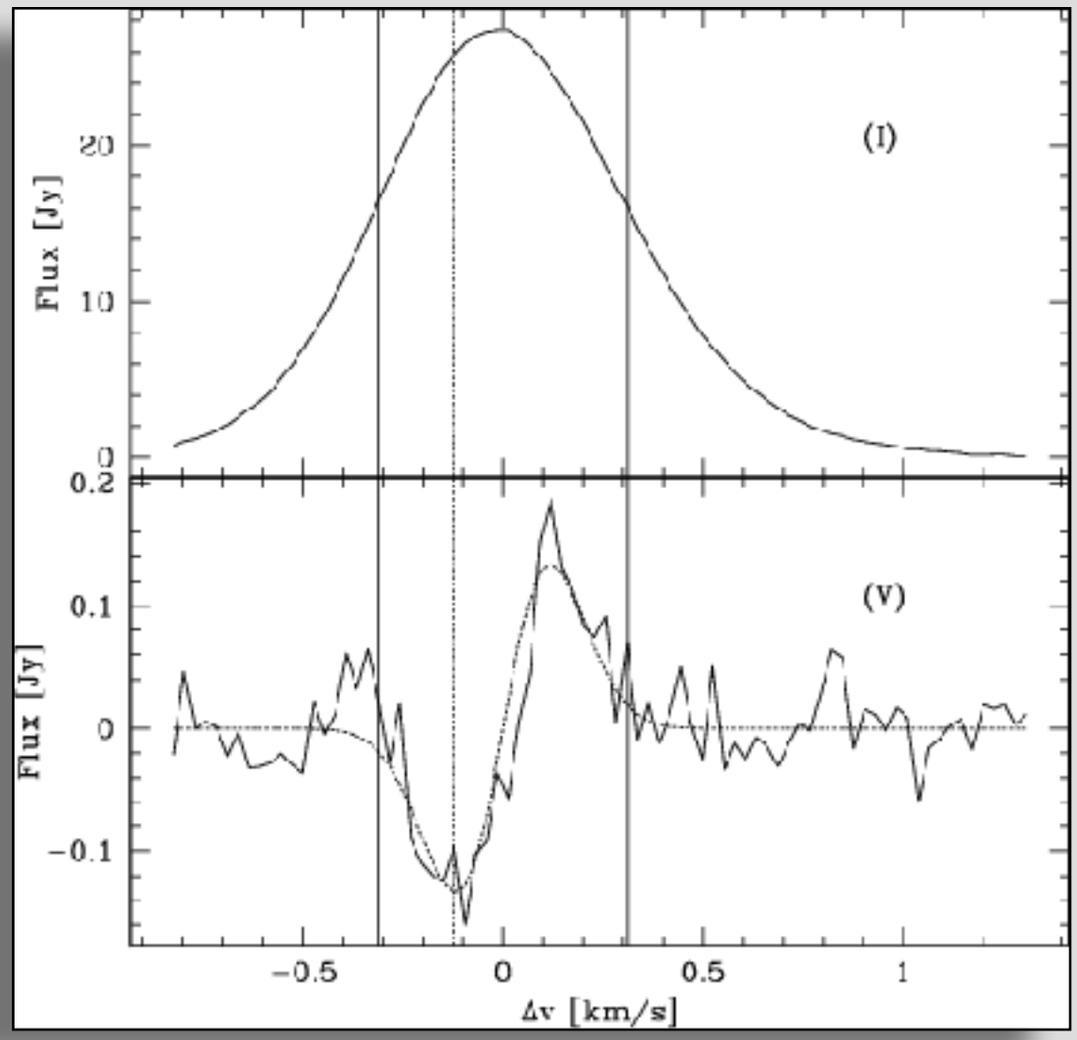
Circular Polarization Analysis

- Both methods require careful polarization Calibration!!!

- S-curve fitting
- V=(LCP-RCP)/2

- Cross-Correlation Method
- Sensitivity of this method is comparable to the S-curve fitting





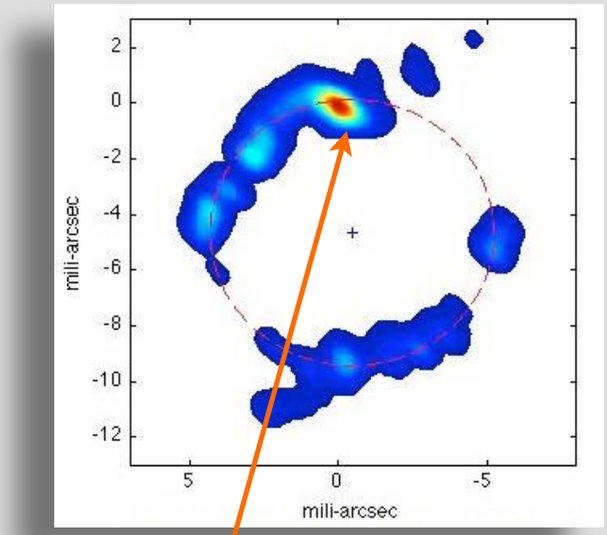
Polarization properties-circular

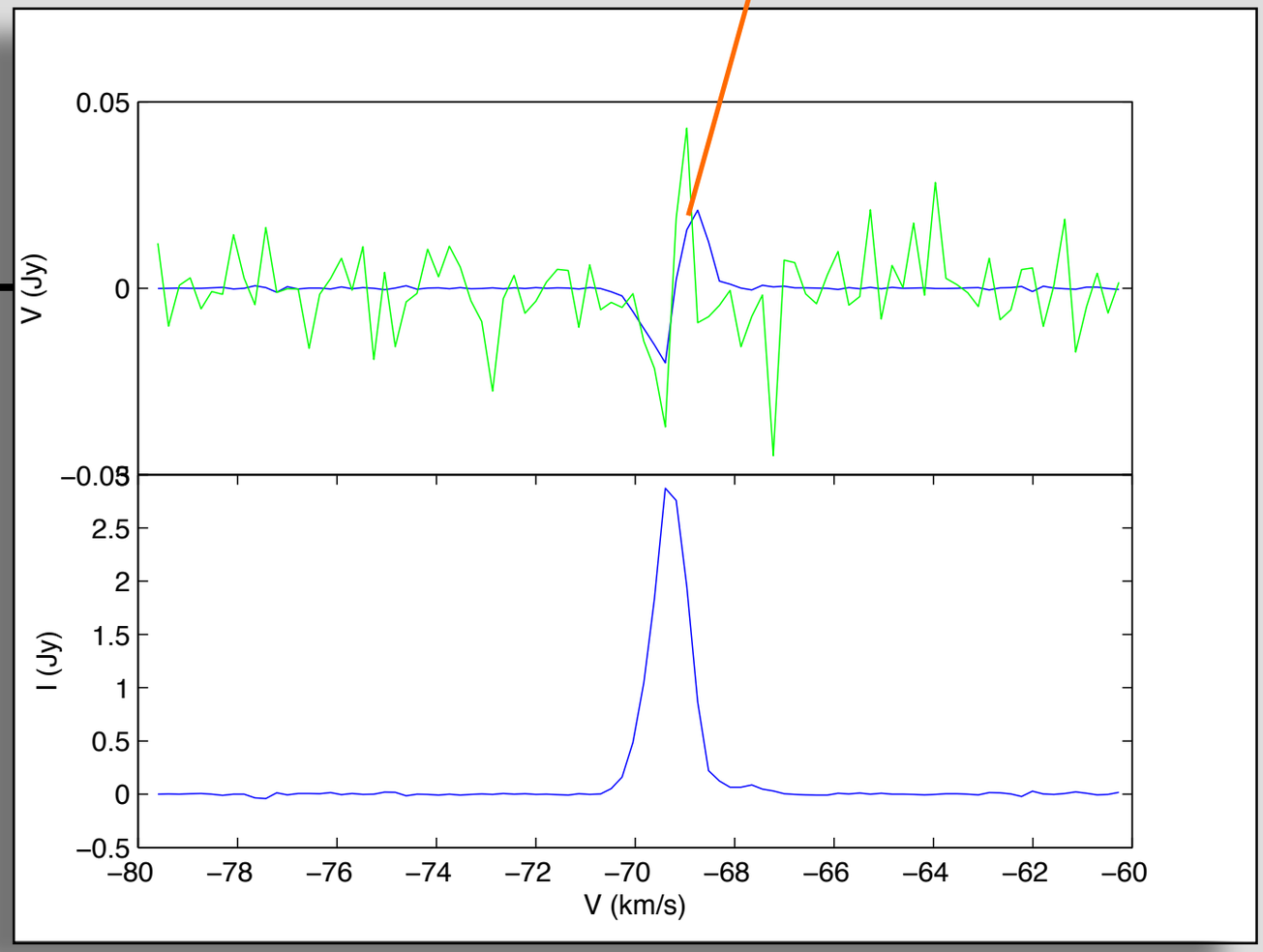
- Tentative detection of circular polarization for brightest maser feature at ~0.7%.

- This corresponds to a magnetic field strength of 1.5+/0.5 G.

- The magnetic field was measured from the S-curve fitting and the cross-correlation method

- Non-Zeeman effects (Wiebe & Watson 1998)





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OH Maser Observations of OH 44.8-2.3

- Are both asymmetries related?
- A mechanism can support asymmetries on many scales?
- Are SiO gaps consistent in Time?

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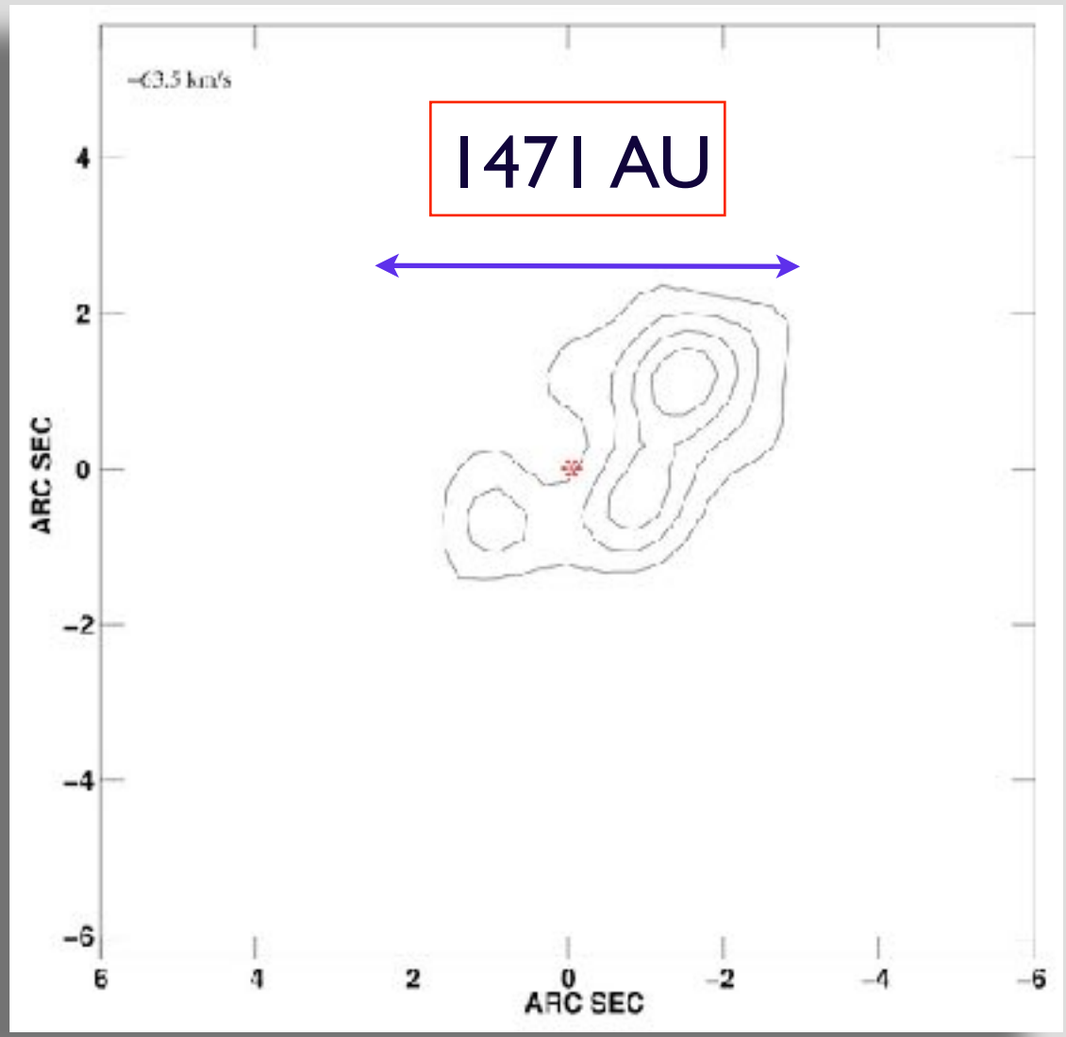

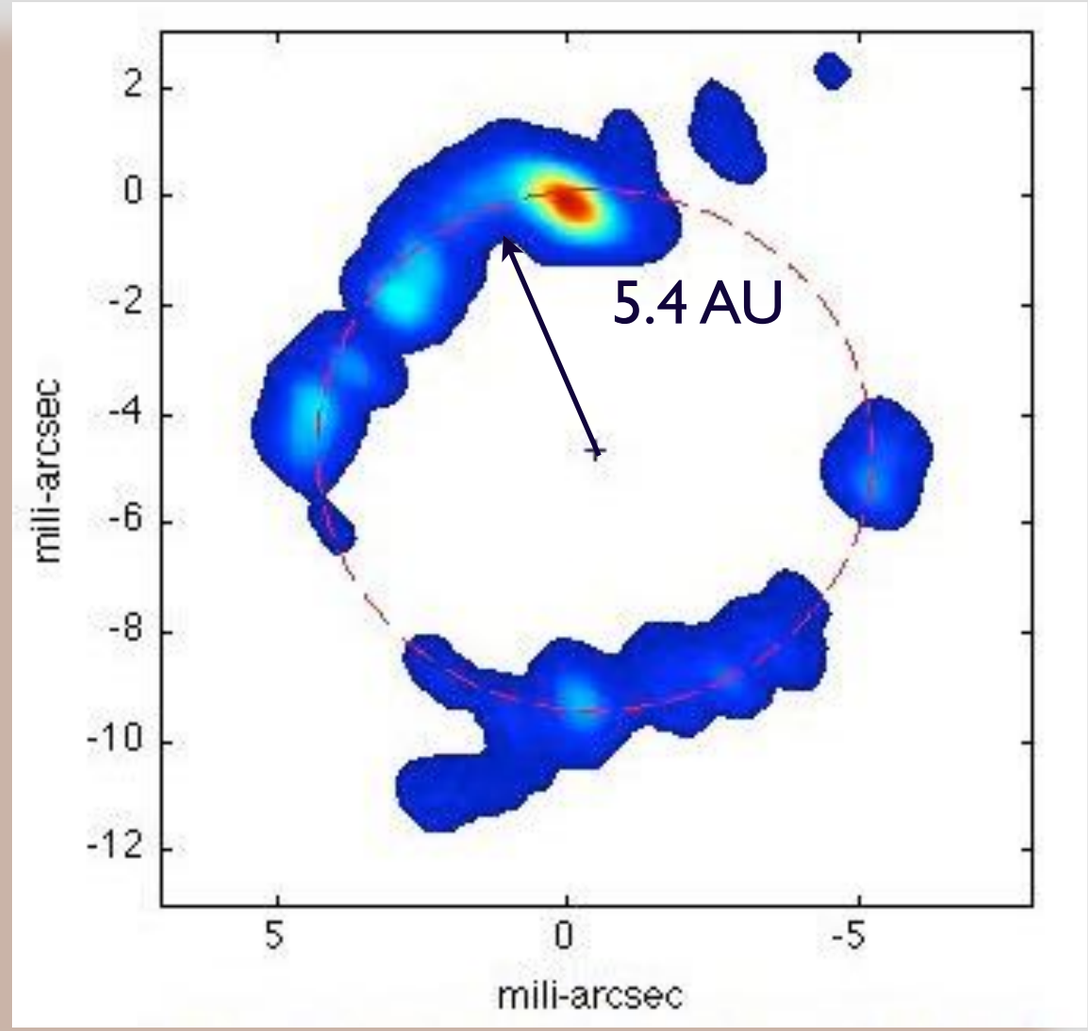

Morphology of the CSE of OH 44.8-2.3