Dust polarisation and magnetic field geometry in Proto Planetary Nebulae

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The sample

CRL 618
C-rich
~200 yrs

OH 231.8+4.2
O-rich
~770 yrs

The method

- **Dust continuum emission polarisation mapping**: Principle of alignment of non-spherical spinning dust grains with their long axis perpendicular to the magnetic field.
- Submillimeter Array in polarimetric mode (interferometry - 8 antennas)

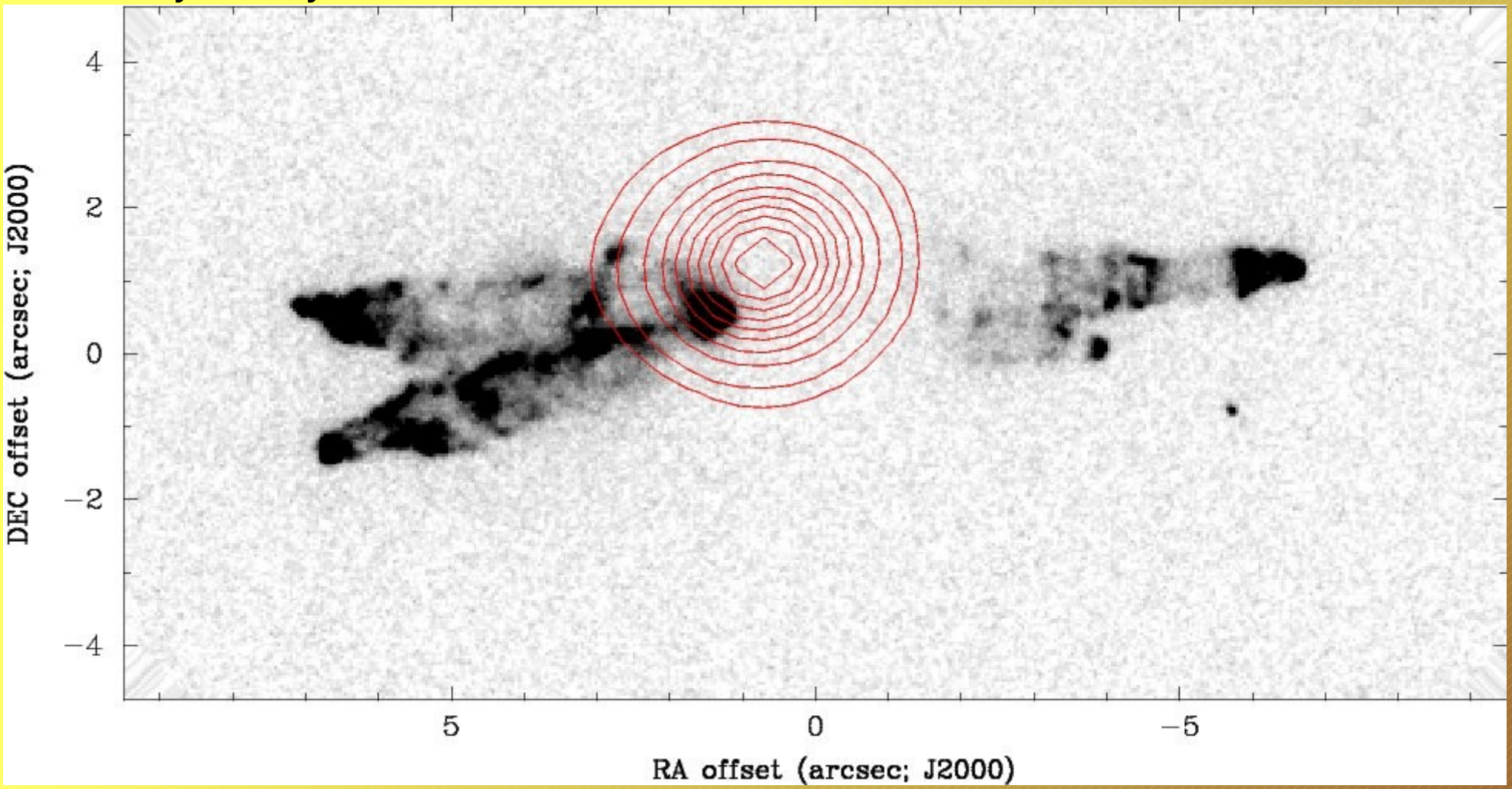
  Compact configuration: Max. baseline ~70m; 2.5” at 345 GHz

  LSB: ~ 330-334 GHz ; USB: ~342-346 GHz

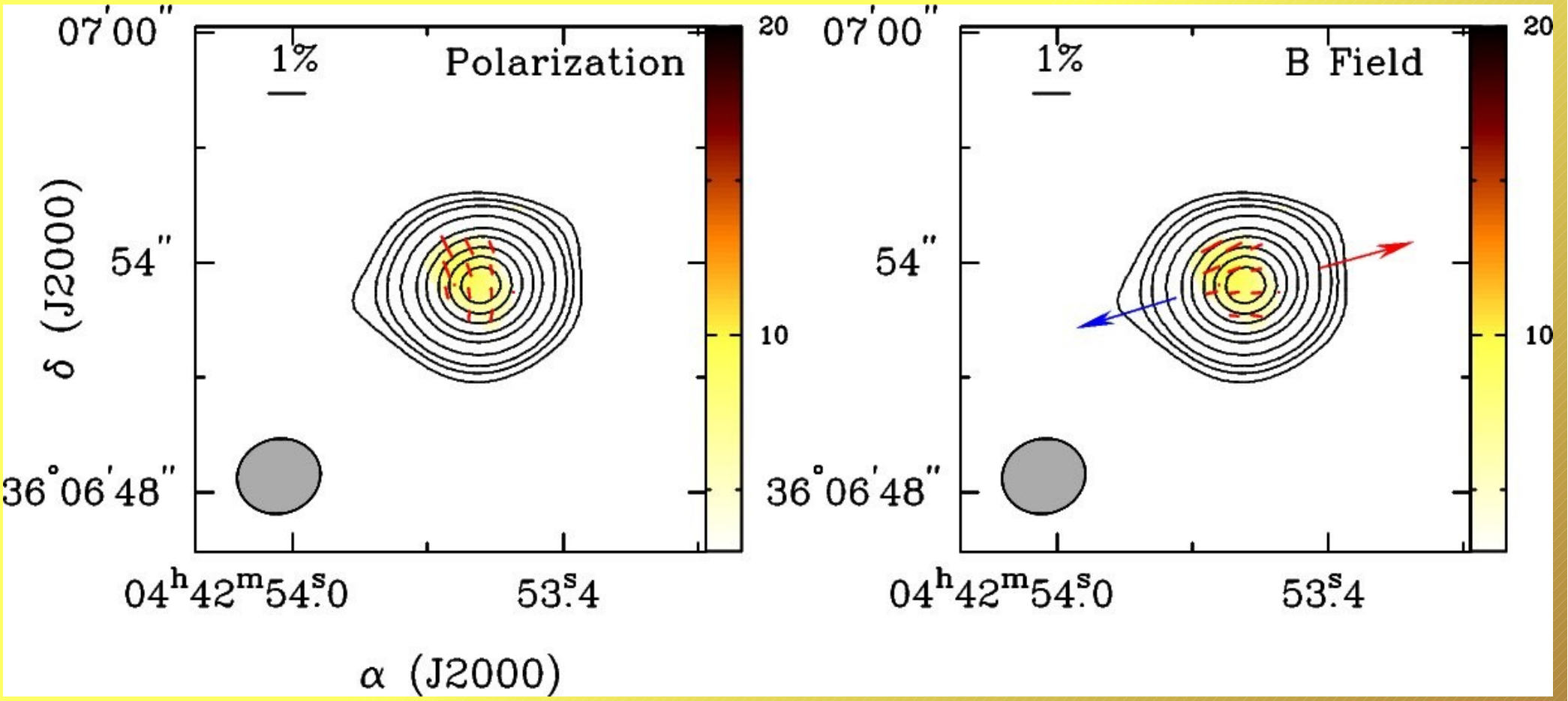
CRL 618

Continuum:
Synthesised beam: 2.2” x 1.9 “, PA= -77.6
σI=19.8 mJy/beam, σQ,U= 2.2 mJy/beam

Peak intensity: 3.4 Jy/beam
Mean intensity: 1.2 Jy/beam



CRL 618



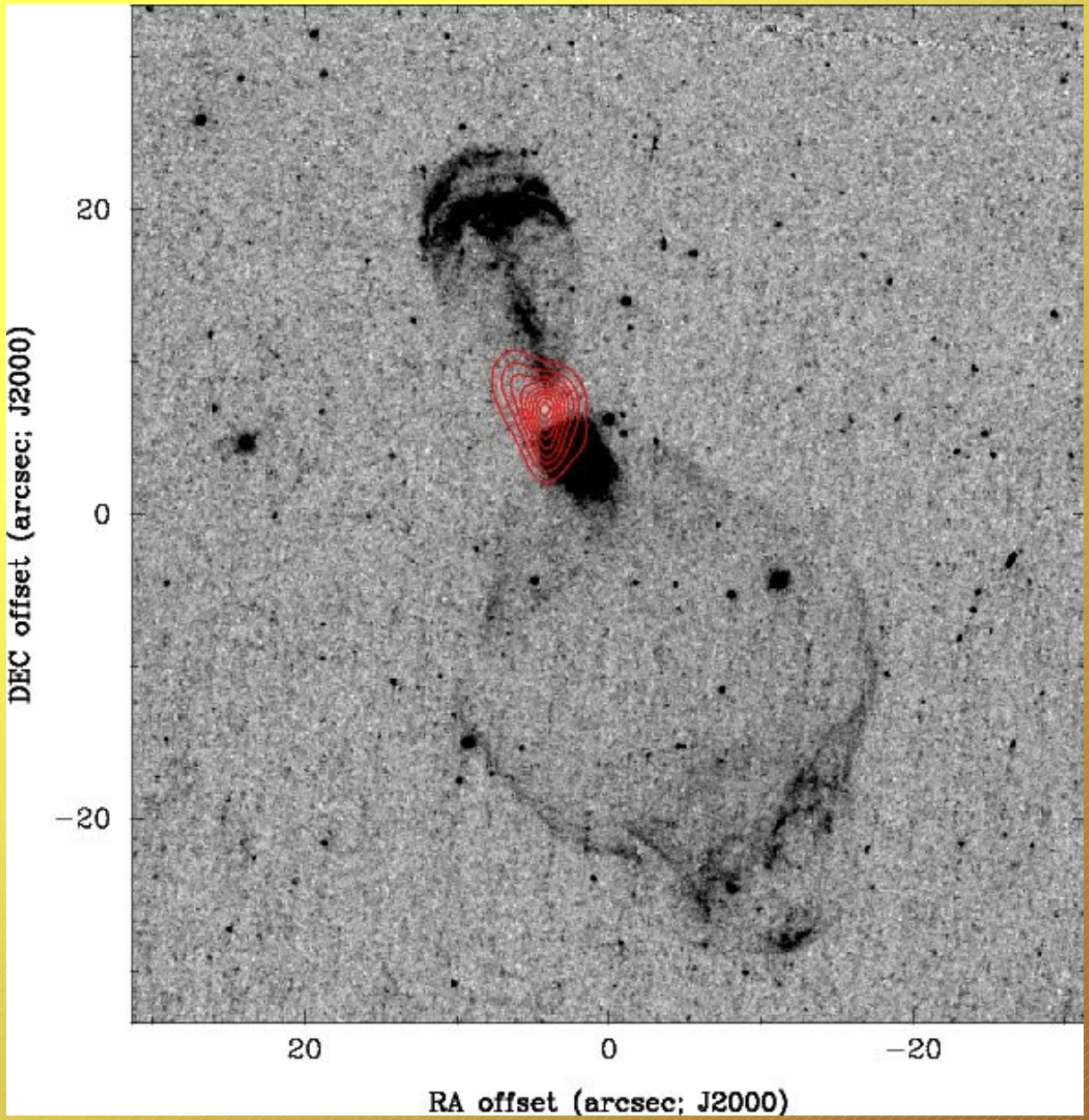
Linear polarization intensity > 3σ (peak:4.4σ)
Low P% (<~ 1%)
Mean PA = 96^{o}

- **Well defined and organised polar magnetic field.**

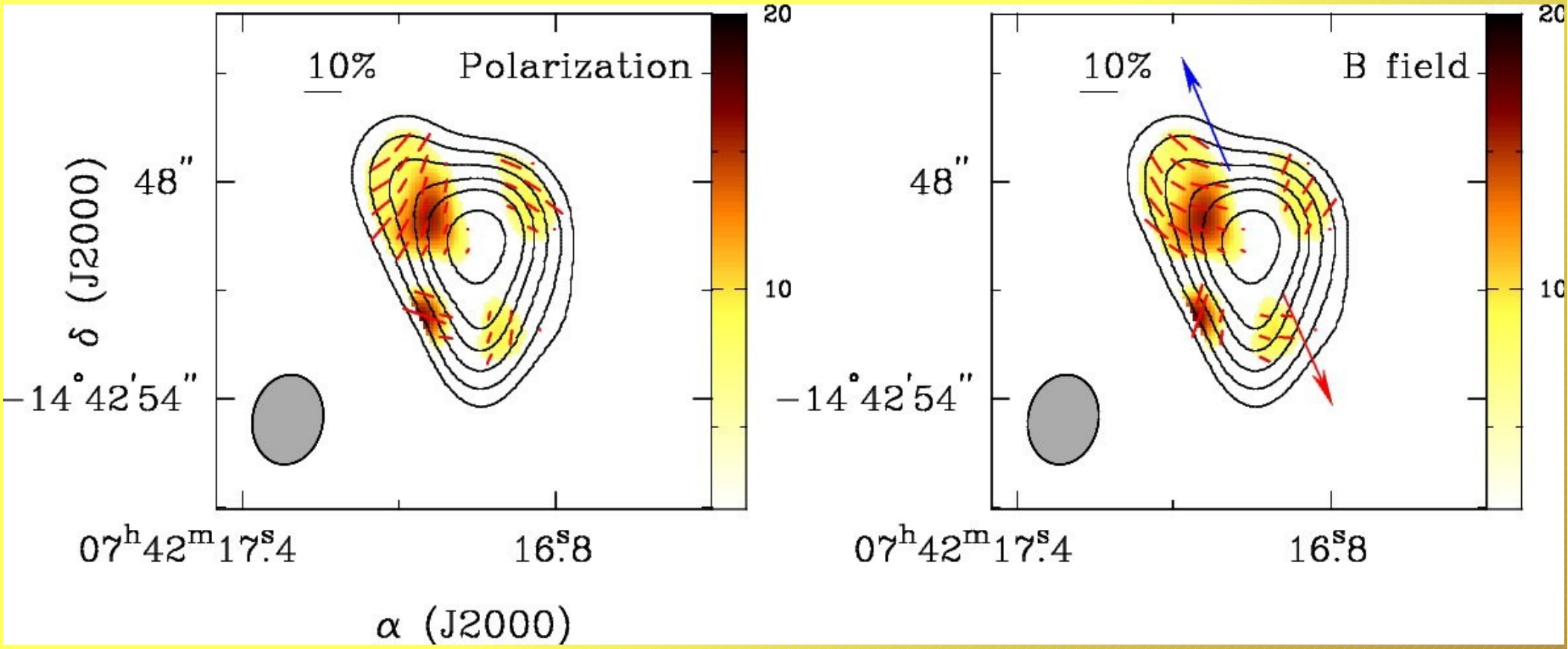
OH 231.8+4.2

Continuum:
Synthesised beam: 2.5” x 1.9 “, PA= -77.6
σI=20.5 mJy/beam, σQ,U= 4 mJy/beam

Peak intensity: 0.78 Jy/beam
Mean intensity: 0.31 Jy/beam



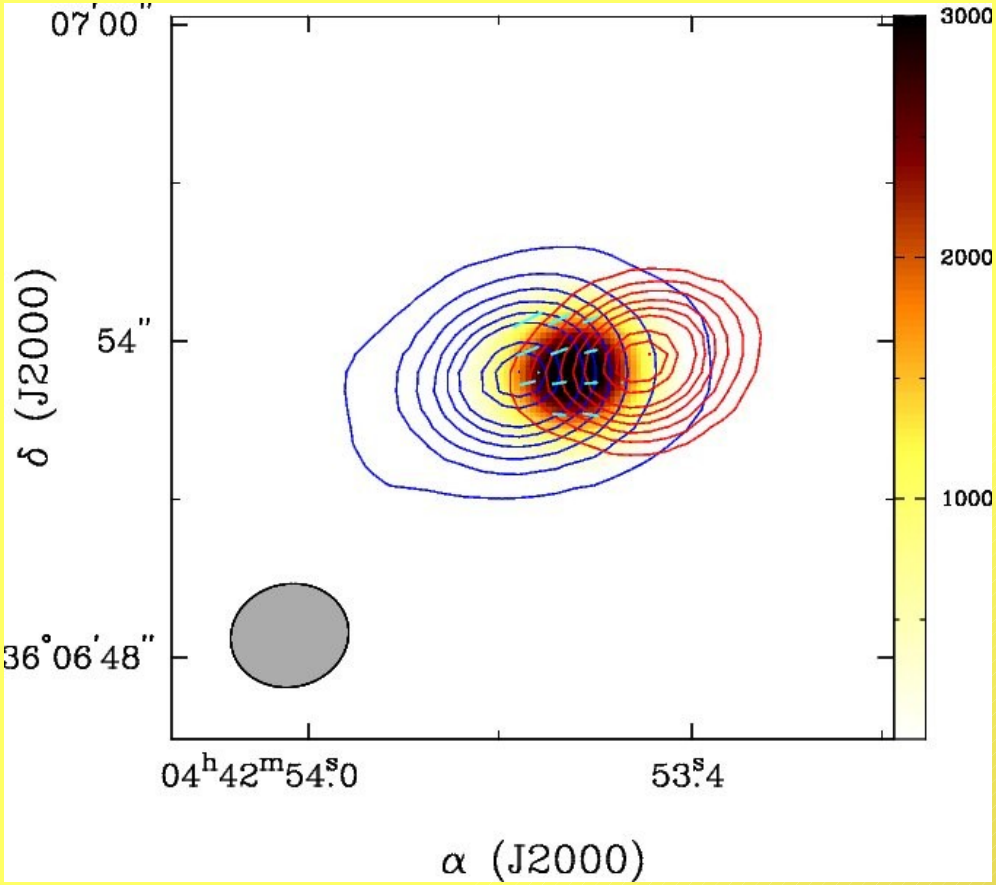
OH 231.8+4.2

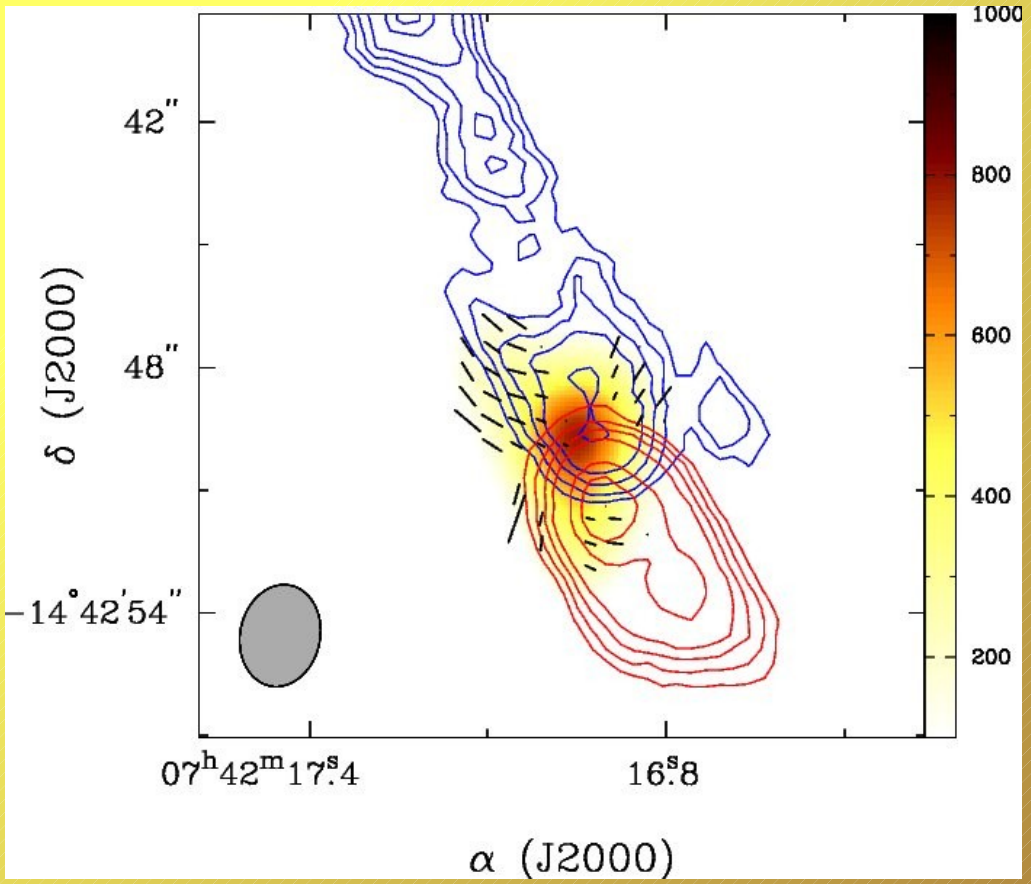


Four polarised areas.
Linear polarization intensity > 3σ (peak: 4σ)
Higher P% with Peak: 15.6 %, Mean: ~4.3%
X-shaped distribution -> dipole configuration
Possible toroidal configuration.

- **Well defined and organised dipole/poloidal magnetic field.**

A magnetic launching mechanism ?



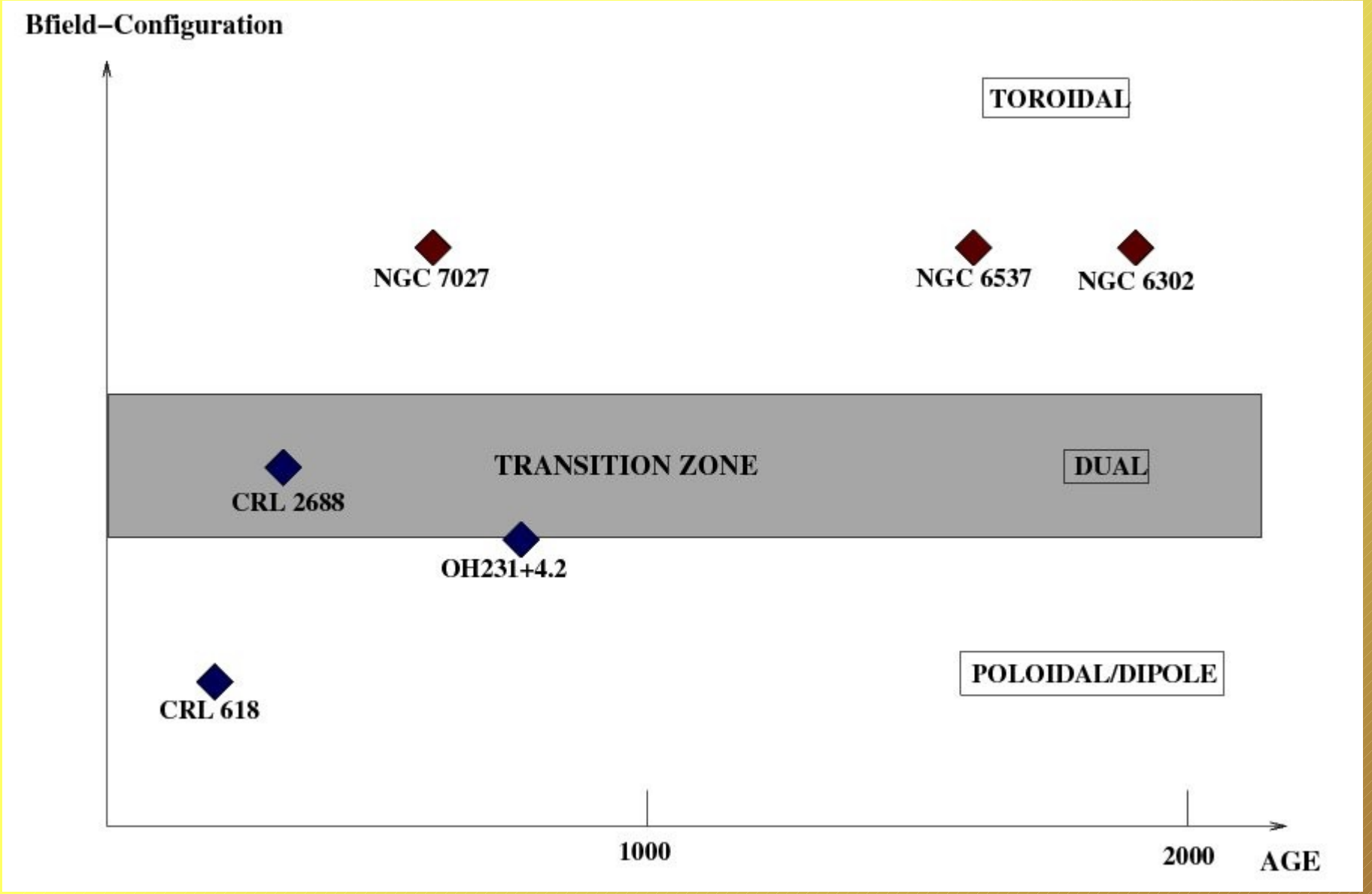


- Good alignment of the B-Field vectors with CO outflows in both PPNe.
- Dynamical poloidal field at small scale (close to CS) ► outflow launching !?
- Whether the field is dragging and collimating the flow or is dragged is still unclear with the actual data.

Main Findings & Conclusions (I)

- Well organised poloidal magnetic fields are found in CRL 618 and OH 231.8+4.2 (X-shaped)
- P% higher in O-rich than C-rich ► Chemistry dependant (nature and size of the dust grains)
- No detection of molecular line polarisation (Goldreich-Kylafis effect) above 3σ.
- An “evolutionary pattern” of the Bfield configuration is observed ►

Findings & Conclusions (II)



Future works

- More detailed polarimetric observations.
- ALMA in polarisation mode: Depth and Speed
- Accurate measurements of magnetic strength.
  - In the CS via spectropolarimetry ?
  - Via masers ?

THANKS !