

The dusty disk and companion of L2 Puppis, a near AGB star, observed with VLT/SPHERE

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E. Lagadec (Lagrange), S. T. Ridgway (NOAO),
and many others...

Stellar End Product: The Low Mass - High Mass Connection
ESO Garching - July 8th 2015

L2 Puppis

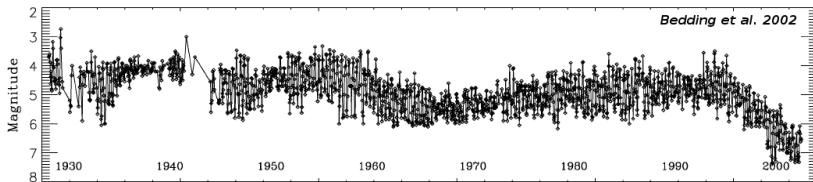


(ESO/DSS2)

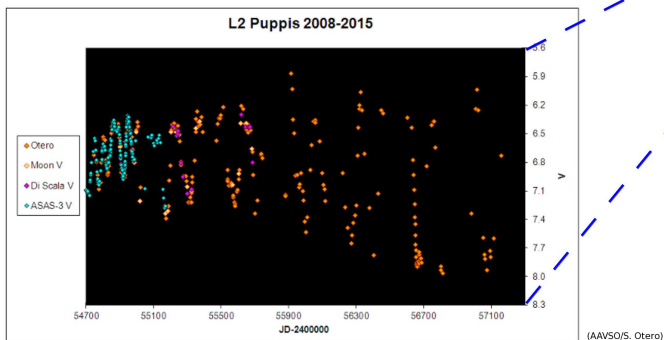
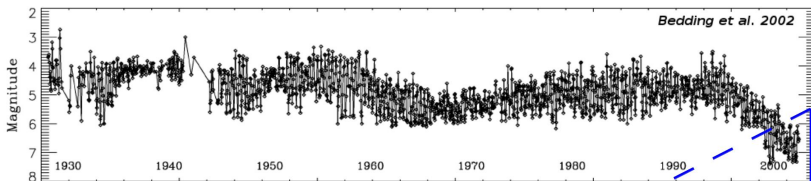
ID card

- M5III, SRa (Mira-like)
- $P = 141$ days
- $0.7 M_{\odot} < M < 2 M_{\odot}$
- Probable binary from Hipparcos astrometry
- 2nd nearest AGB star (64 ± 4 pc, $m_V \sim 5$)

Dimming event

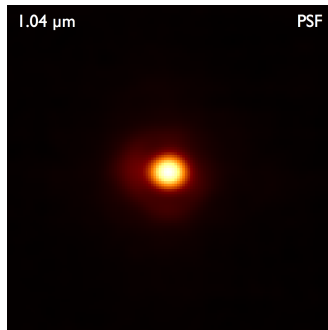
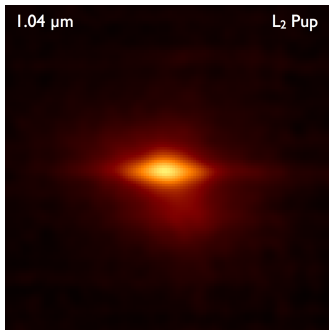


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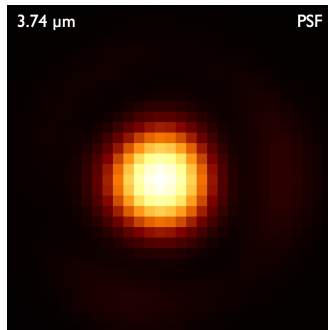
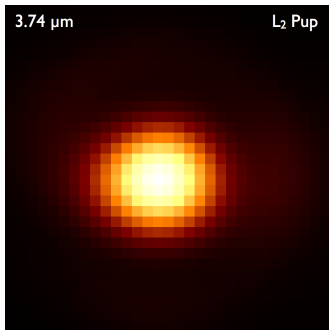
VLT/NACO 1.04 – 4.05 μm (March 2013)

- Kervella, Montargès et al. 2014, A&A, 564, A88
- AO instrument, 12 narrow band filters in *JHKL* bands
 - Lucky-imaging technique (5 000 exposures of ~ 5 ms)
 - Observation of a PSF for image deconvolution (β Col)

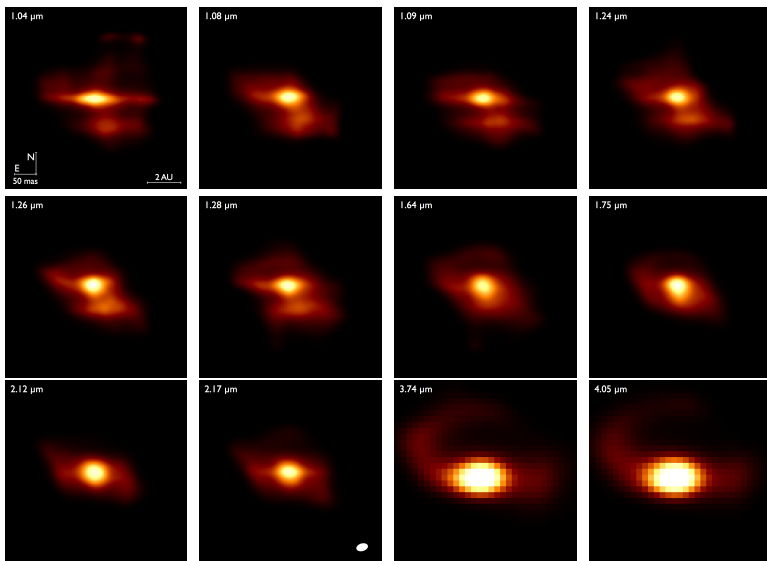


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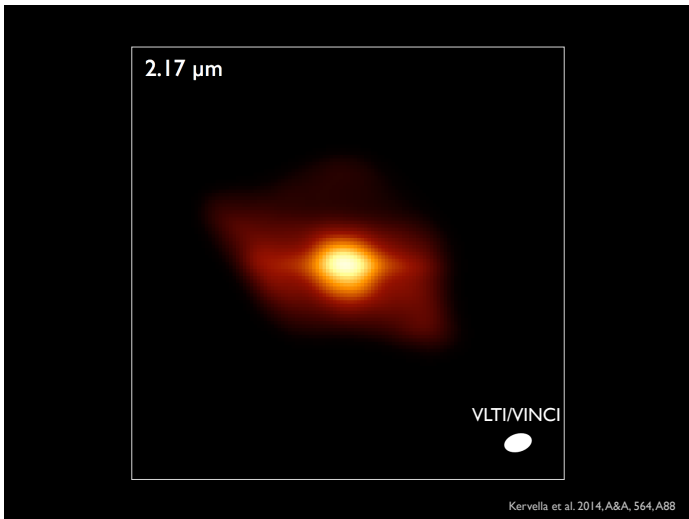
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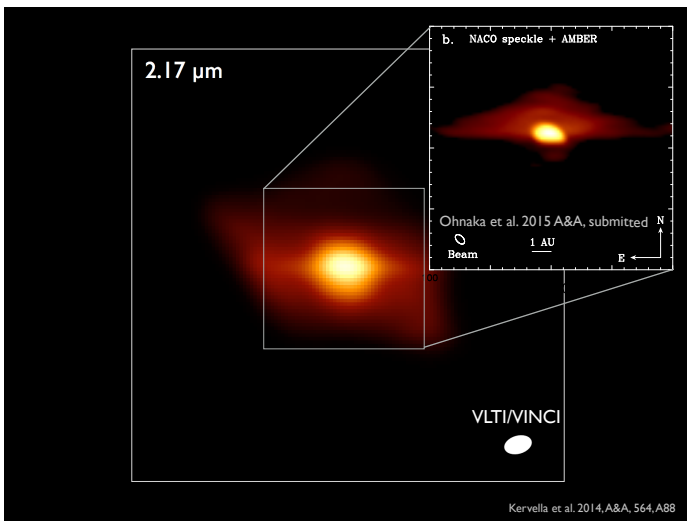
VLT/NACO (March 2013) - Deconvolved images



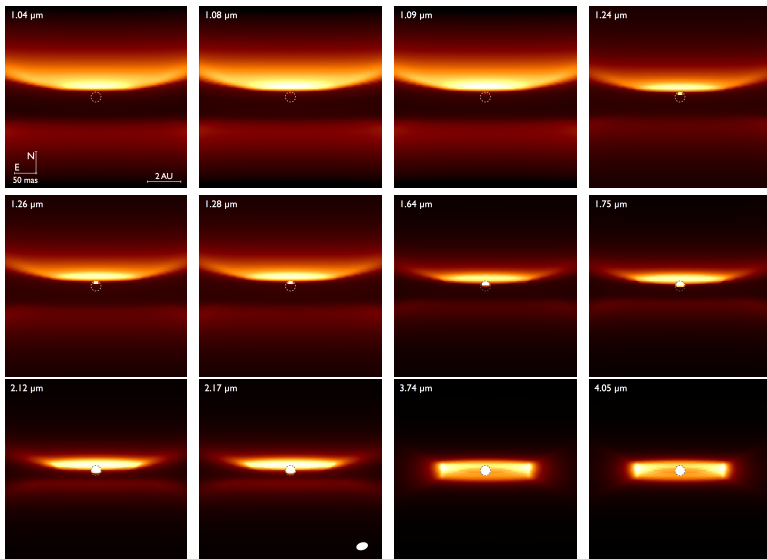
2.17 μm : VLT/NACO vs VLTI/AMBER



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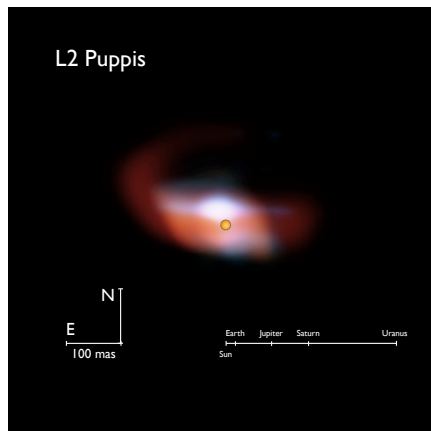
VLT/NACO (March 2013) - Model Images



VLT/NACO (March 2013) - Composite image

Results with NACO

- Dusty disk seen almost edge-on
- Modeling: photometry + shape



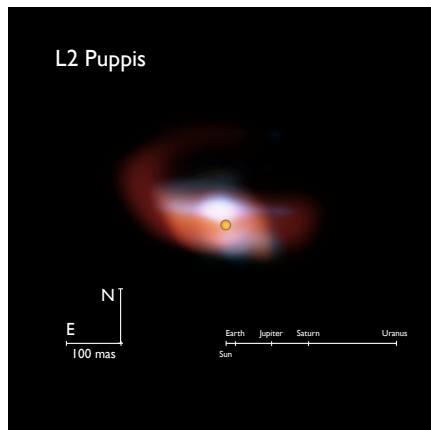
VLT/NACO (March 2013) - Composite image

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Questions

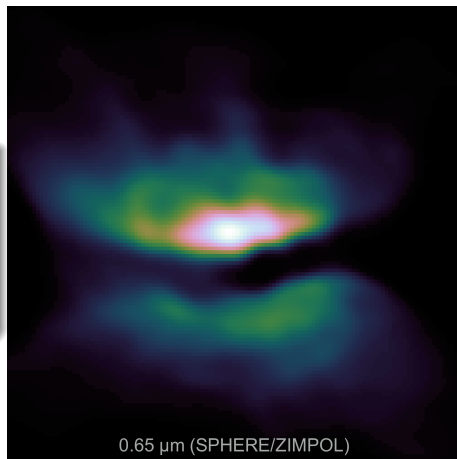
- Why a disk ?
- What are its effects on the stellar wind ?
- What is the loop in the L band ?



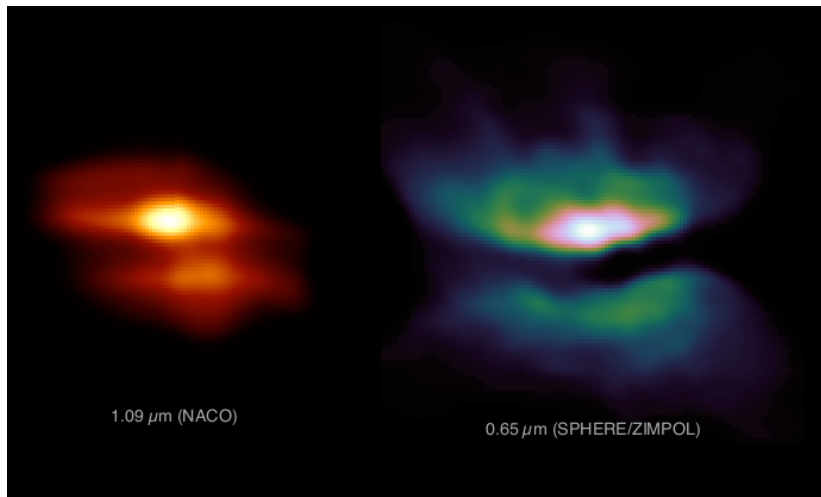
VLT/SPHERE (December 2014)

VLT/SPHERE: ZIMPOL

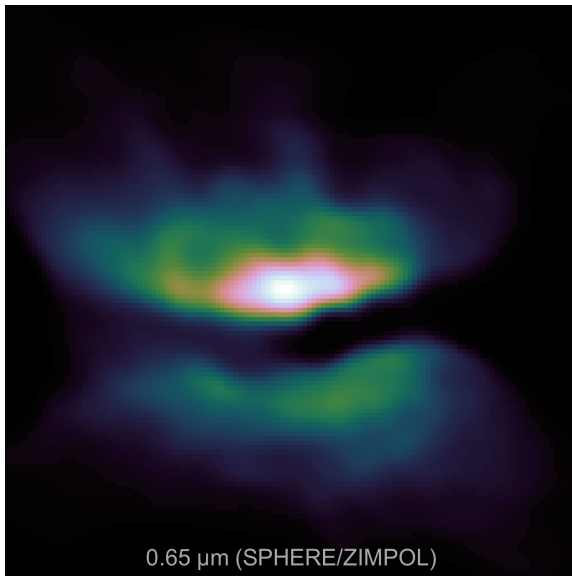
- Extreme adaptive optics instrument
- Access to visible spectral domain
- 2 filters at the same time
- Q, U polarimetric measurements



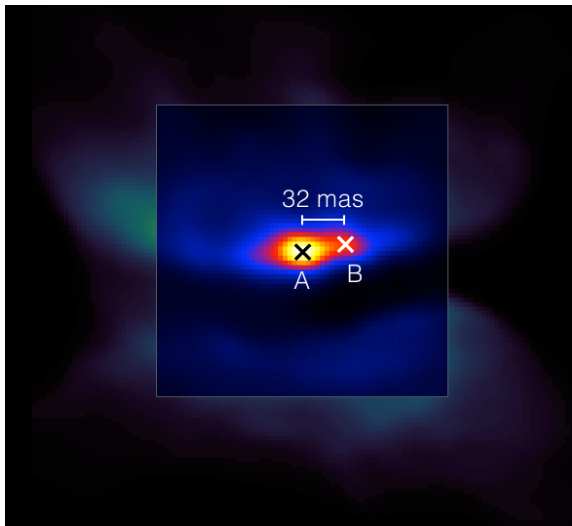
VLT/SPHERE (December 2014)



VLT/SPHERE (December 2014) - L2 Pup B

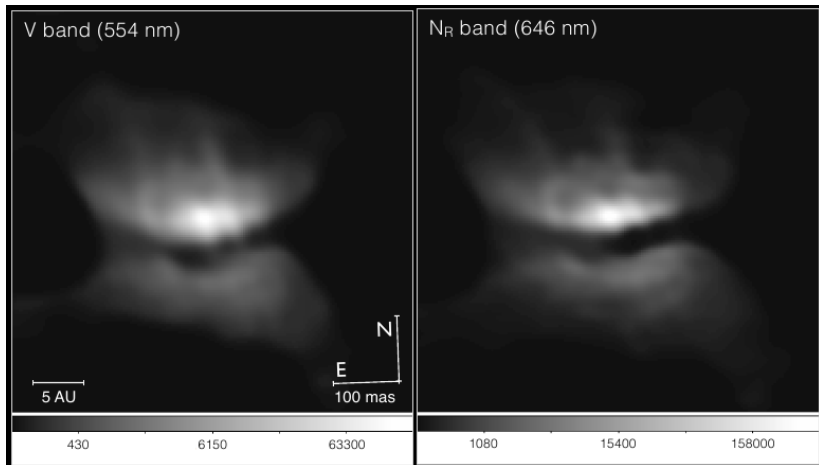


VLT/SPHERE (December 2014) - L2 Pup B



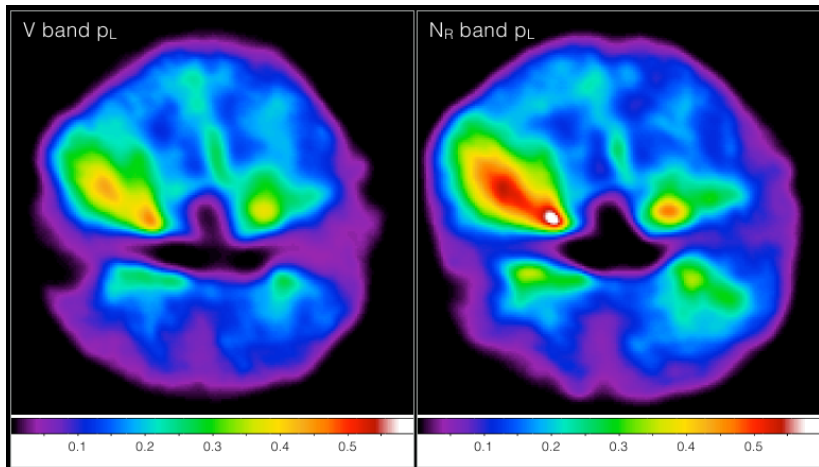
→ Kervella, Montargès et al. 2015, A&A, 578, A77

VLT/SPHERE (December 2014) - Polarimetric signatures



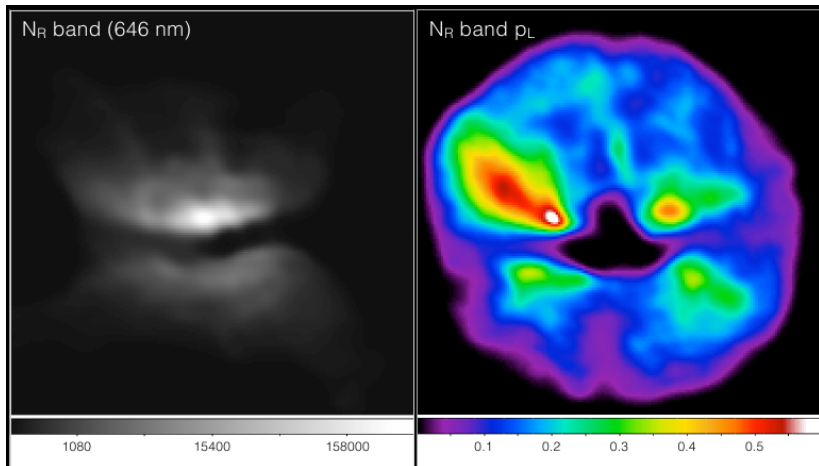
(Kervella, Montargès et al. 2015, A&A, 578, A77)

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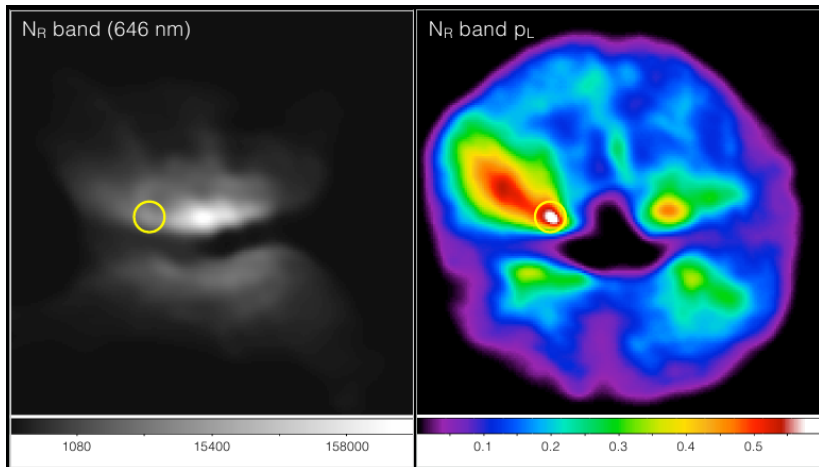
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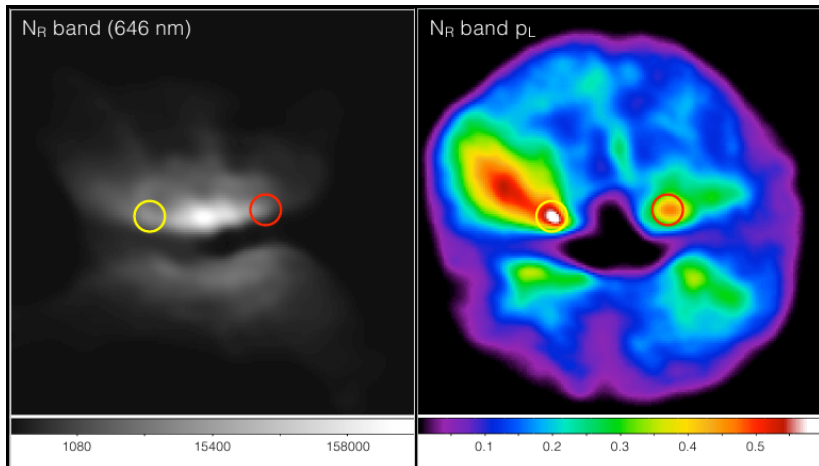
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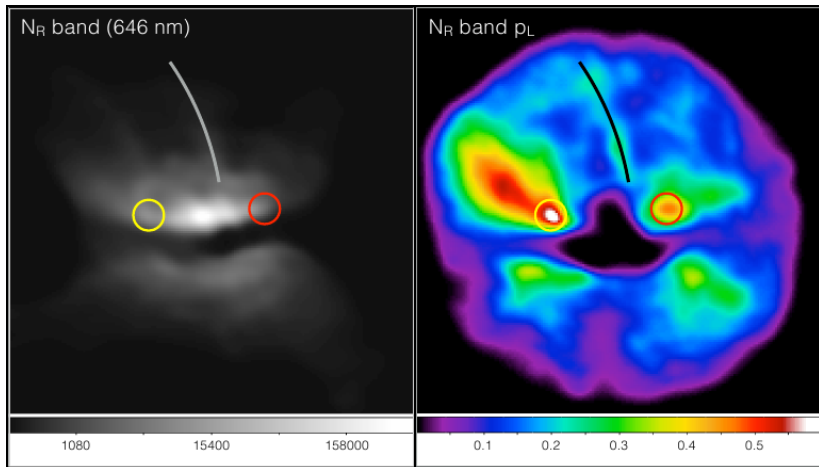
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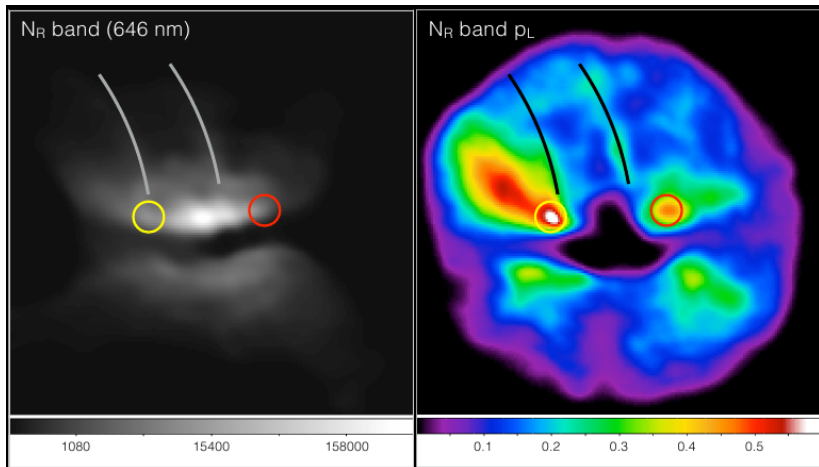
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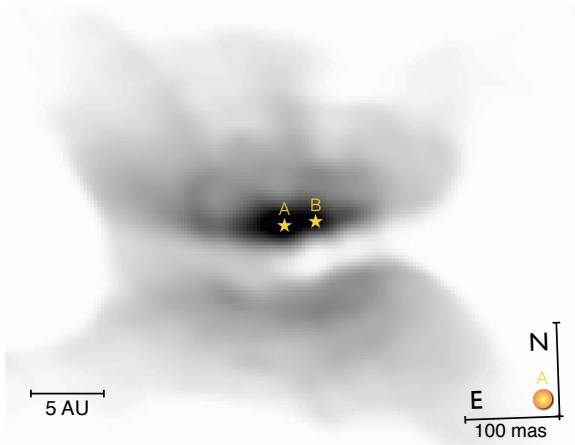
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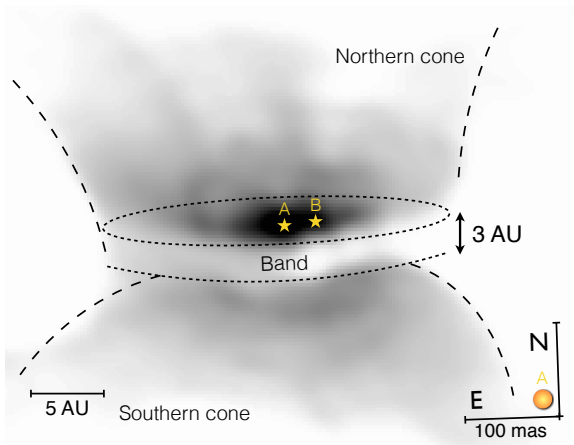
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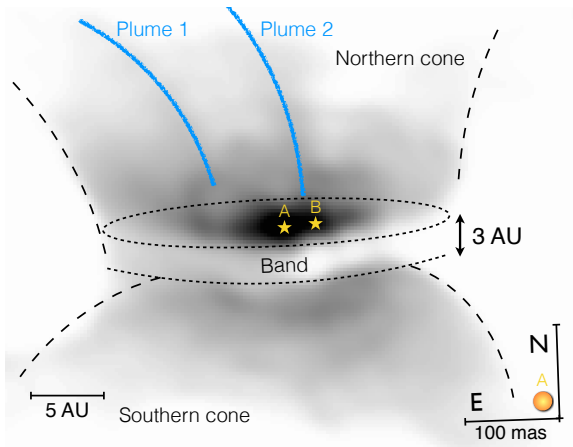
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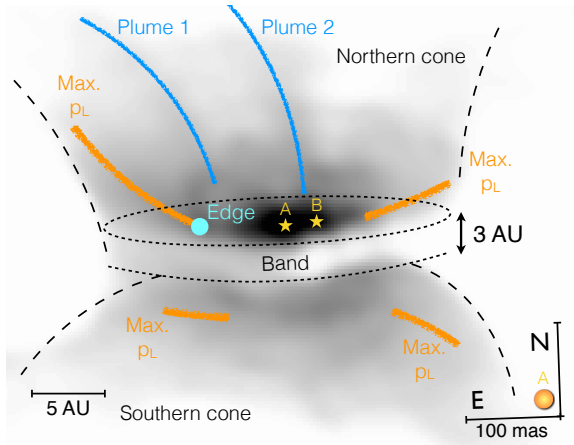
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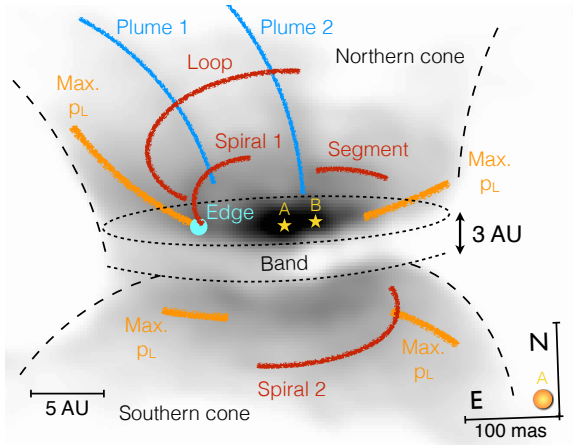
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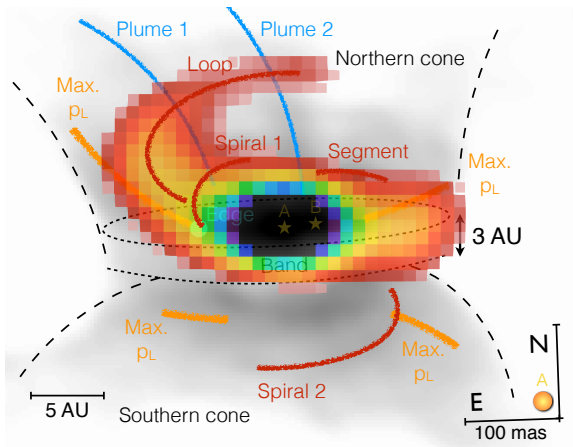
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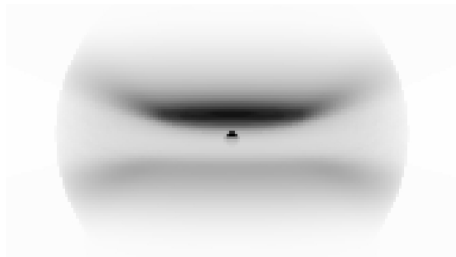
VLT/SPHERE (December 2014) - Polarimetric signatures



(Kervella, Montargès et al. 2015, A&A, 578, A77)

VLT/SPHERE - Radiative transfer modeling

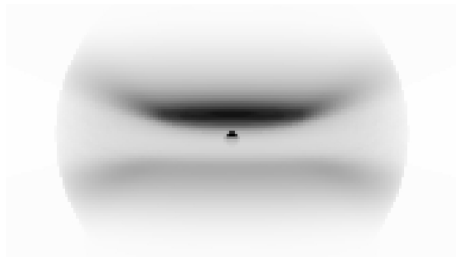
- 3D dust distribution model:
RADMC-3D code (Dullemond 2012)
- Dusty disk seen almost edge-on
- AGB stellar disk partly hidden



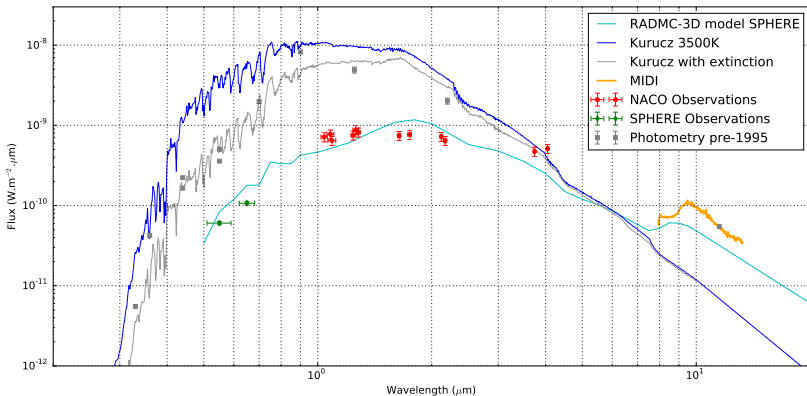
VLT/SPHERE - Radiative transfer modeling

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→ Photometry and general morphology well reproduced



VLT/SPHERE - Radiative transfer modeling (photometry)

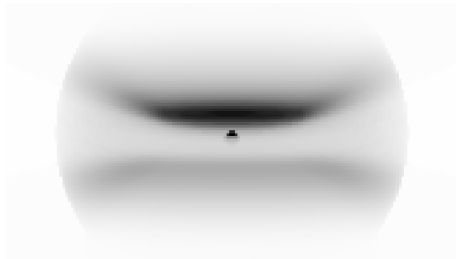
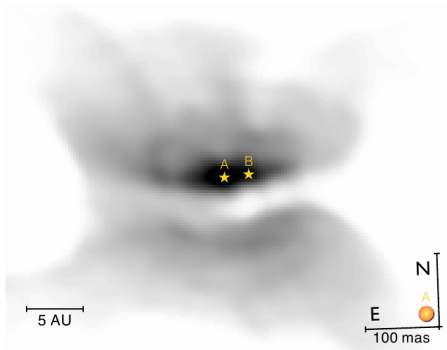


Dusty disk model

- $R_{\text{in}} = 6 \text{ AU}$
- Incl. = 82°
- $\text{MgFeSiO}_4 + \text{MgFeSi}_2\text{O}_3$
- $M_{\text{dust}} = 2.4 \cdot 10^{-7} M_{\odot} = 0.08 M_{\oplus}$

Open questions

- Formation of:
 - the plumes ?
 - the streamers ?
- Interaction AGB wind/dusty disk ?
- Nature of companion ?
- Dynamics ?



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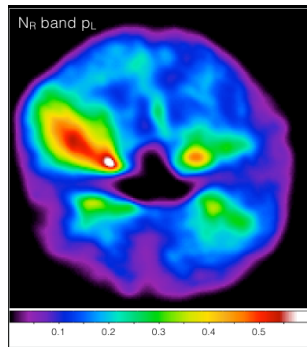
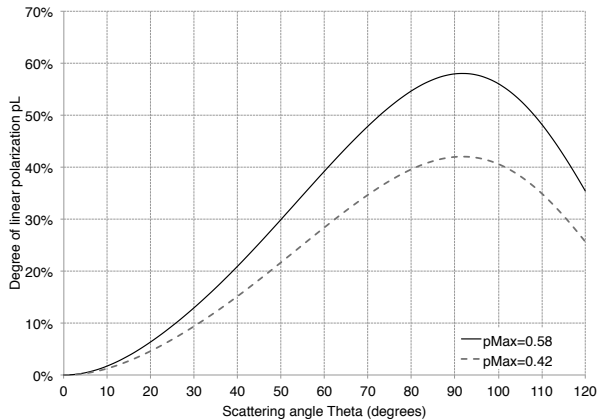


(NACO L band + SPHERE R band)

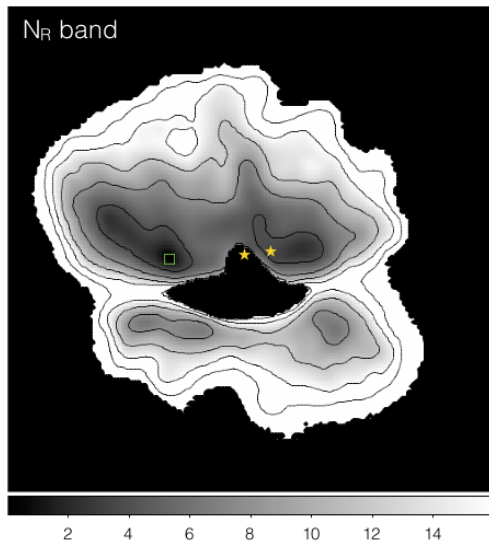
Thank you for your attention !

Backups

Polarization law



Altitude relatively to the plane of the sky



Mass loss collimation

