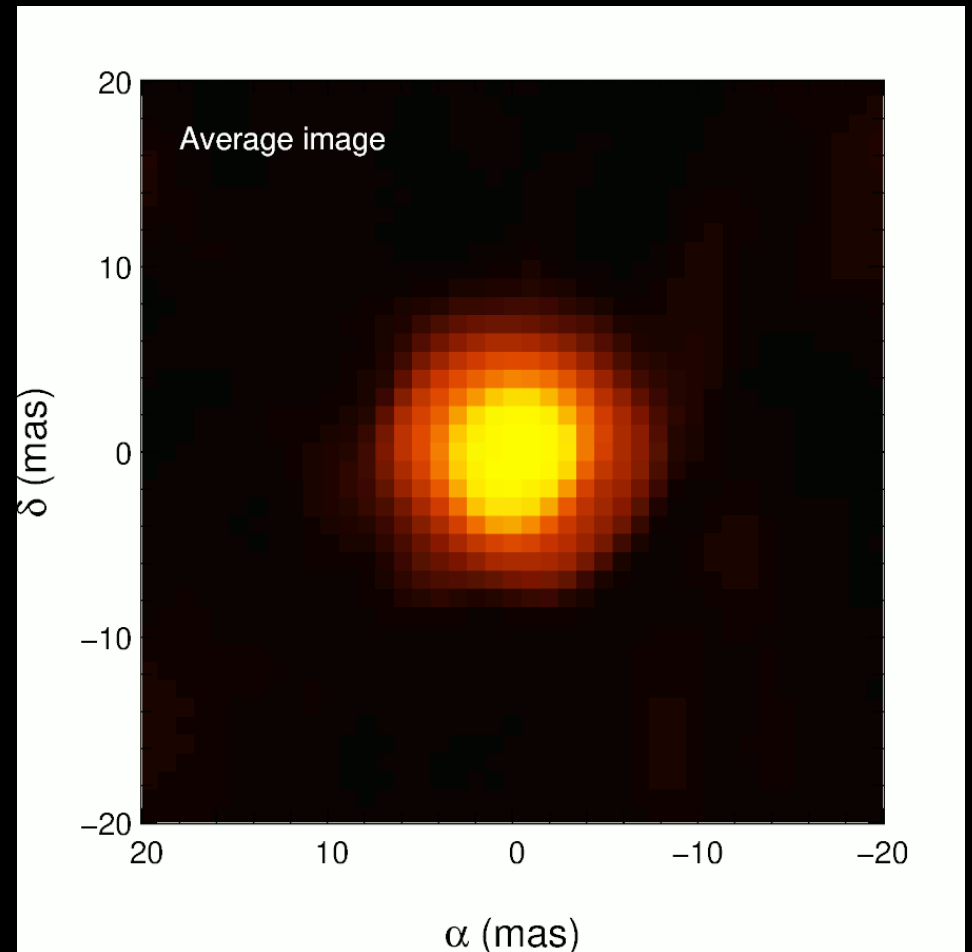
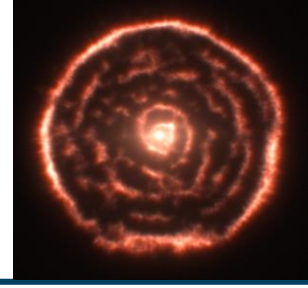


R Scl observed with MATISSE/VLTI

Julien Drevon

ESO IR 2020 Conference





Presentation

My PhD thesis :

MATISSE/VLTI instrument exploitation: imagery of evolved stars
October 2020 – September 2023



Pierre CRUZALEBES
(PhD Director thesis)

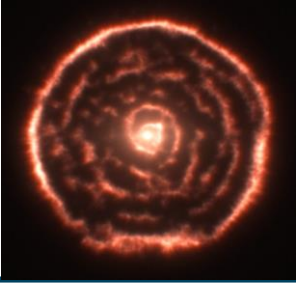


Julien DREVON
(PhD student)



Florentin MILLOUR
(PhD Co-Director thesis)

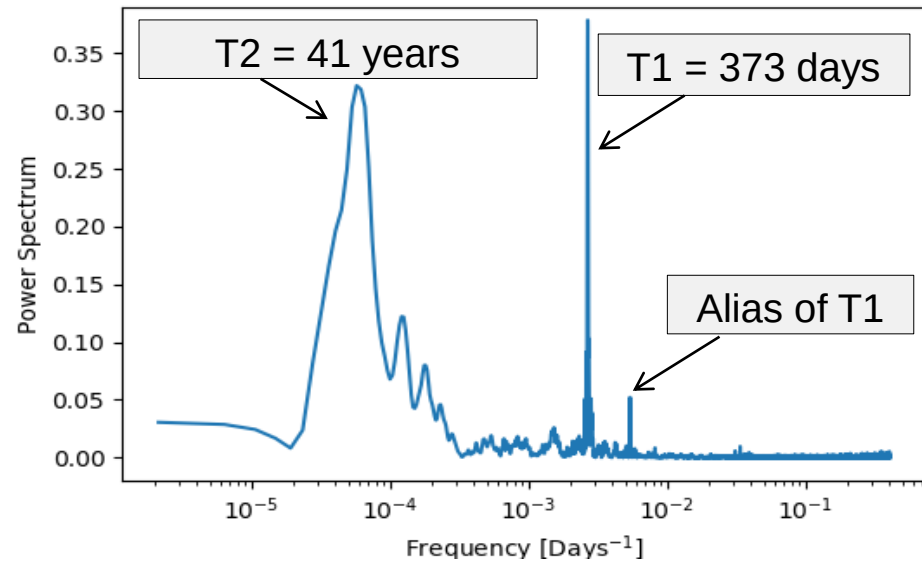
The ID Card of R Sculptoris



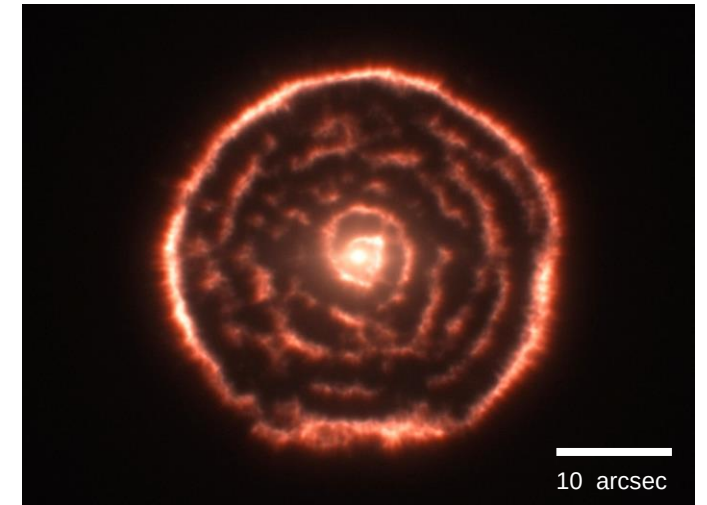
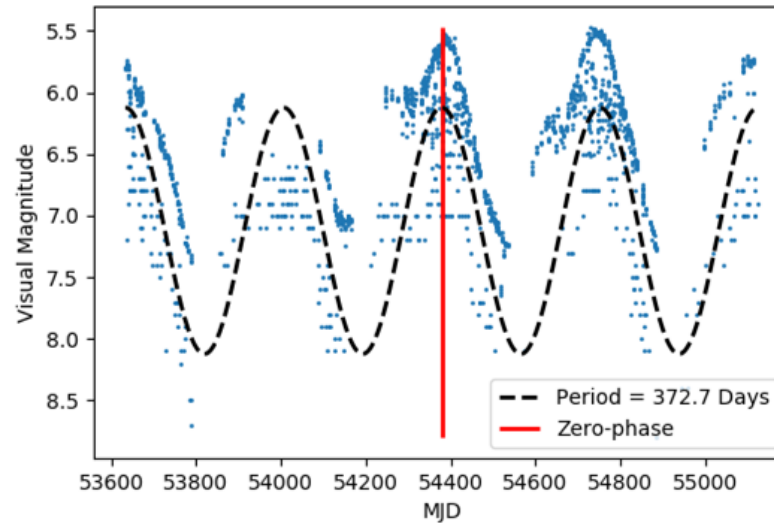
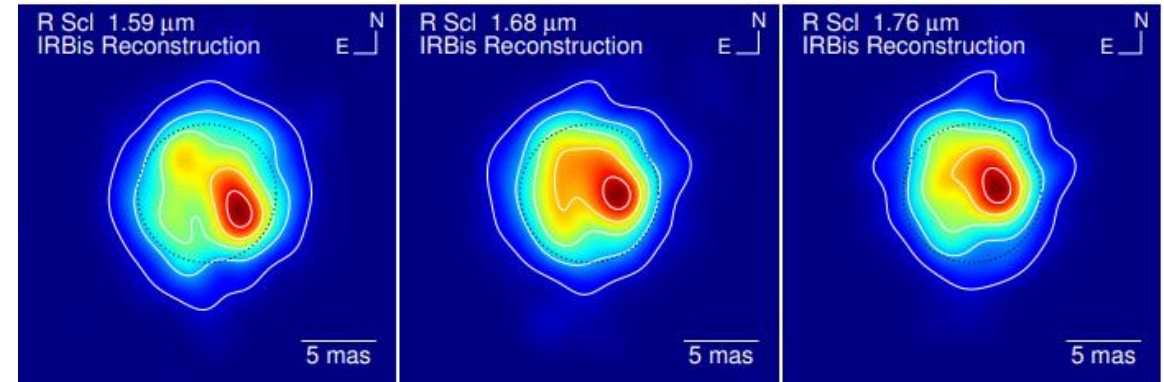
AGB star R Sculptoris:

$T = 2700$ (+/- 100) K (Sacuto et al. 2011)
 $d = 266$ (-45/+66) pc (Hipparcos)
 $M = 1M_{\odot}$ (Sacuto et al. 2011)

Lomb-Scargle periodogram of R Scl using AAVSO/ASAS data :

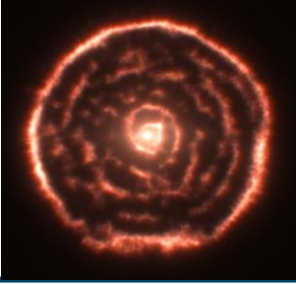


Wittkowski et al. 2017



Maercker et al.2012

MATISSE/VLTI



What is MATISSE?

Multi AperTure mid-Infrared SpectroScopic Experiment (MATISSE)

MATISSE :

L-band : 3.0 μm – 4.3 μm
 AT's LOW res (R=30) : 1 Jy*

N-band : 7.9 μm – 12.5 μm
 AT's LOW res (R=30) : 17 Jy*



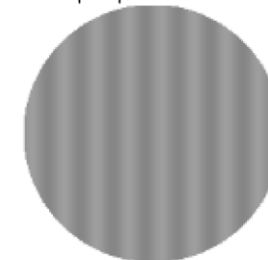
Credits : F.Millour

Visibility = Fringe contrast

$|V| = 1.0$



$|V| = 0.1$



Credits : D.Busher

The Van Cittert-Zernike Theorem

$$V = \frac{\hat{O}\left(\frac{\vec{B}}{\lambda}\right)}{\hat{O}(\vec{0})}$$

Coherent Flux \nearrow

Photometric Flux \nwarrow

* Limiting Coherent Flux == 10% error on Visibility == SNR 10 in good conditions (seeing <0.9arsec, tau0>5ms)

Model fitting on Visibilities and SED :

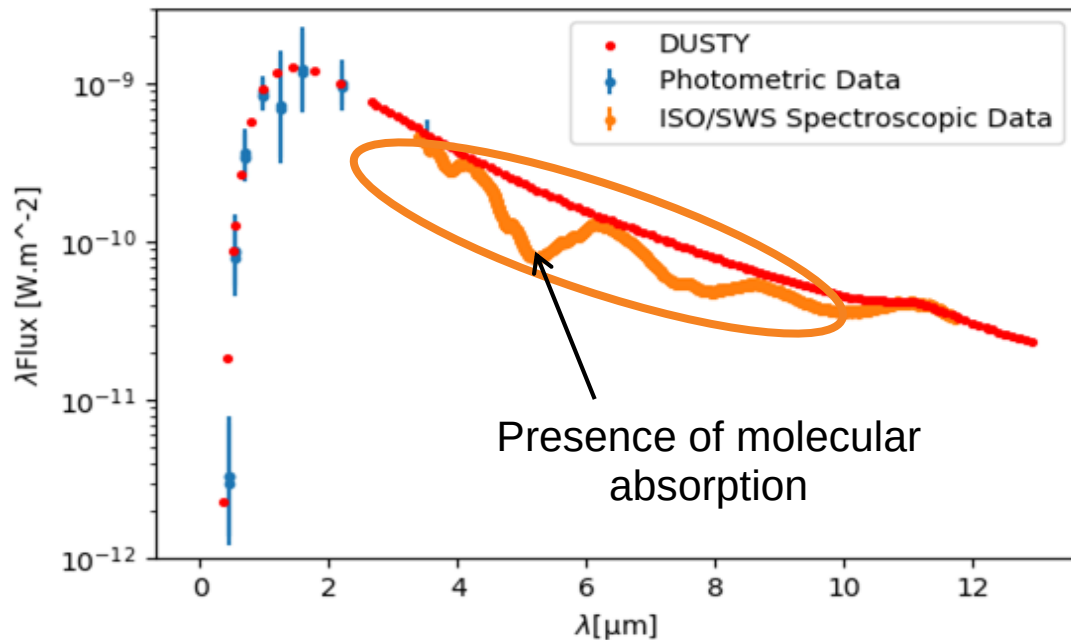


Main model ingredients for DUSTY :

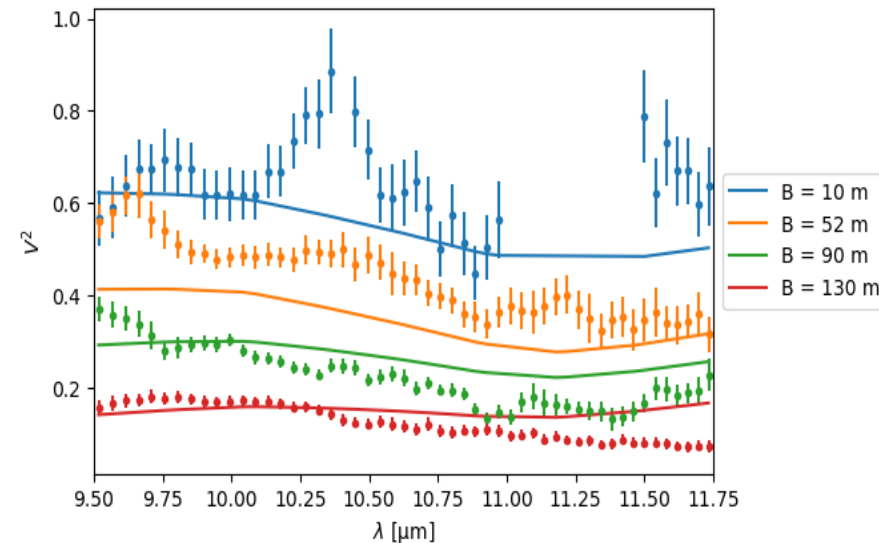
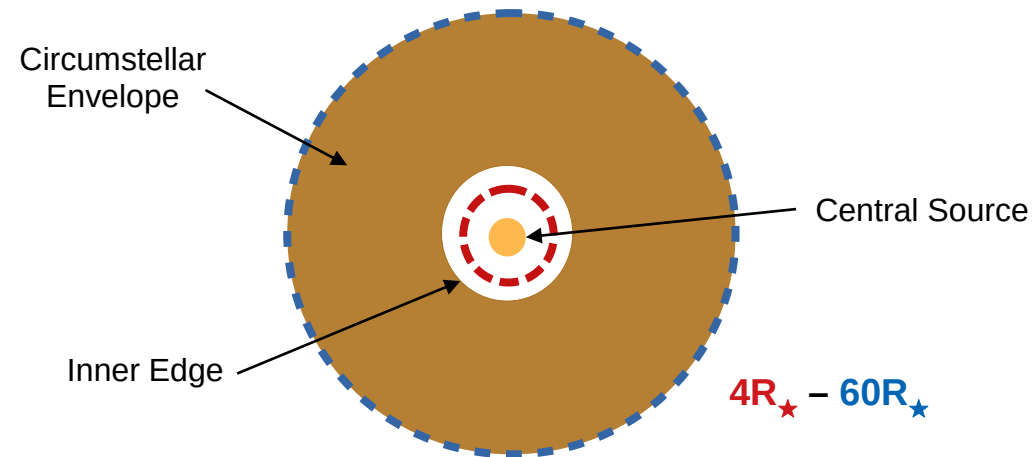
Central Source : Black Body at 2700K

Circumstellar Envelope (CSE) : amC + SiC

Dust density law : Radiatively Driven Winds
(hydrodynamics equations)



N-band scanned area:



Results and literature



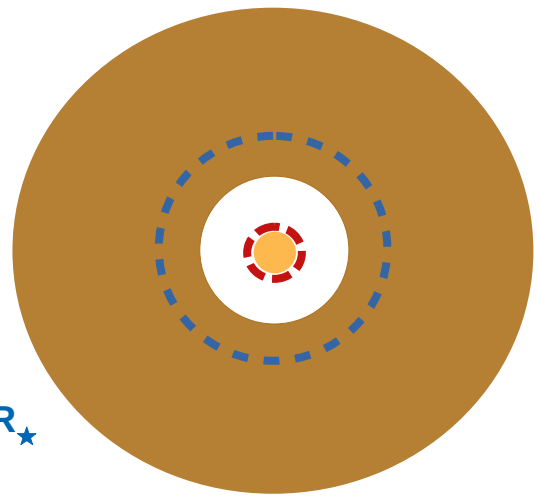
MATISSE results **CONFIRMED** with literature

Parameters	Values	Fixed (Y/N)	Literature
Central star diameter	10.15 mas	Yes	10.15 ± 0.07 mas ^{1,2}
Optical depth @ $1\mu\text{m}$	0.15	No	0.18 ± 0.05 ²
Dust distribution	MRN	Yes	MRN ^{2,5}
Composition	84% AmC 16% SiC	No	$(90 \pm 10)\%$ AmC $(10 \pm 10)\%$ SiC ²
Inner shell diameter	46.8 mas	No	44.8 mas ^{2,3}
Inner shell temperature	1200 K	No	(1200 ± 100) K ^{2,3}
Geometrical thickness	$1000 r_{in}$	Yes	$1000 r_{in}$ ²
Limb darkening coeff.	0	No	<0.01 ⁴

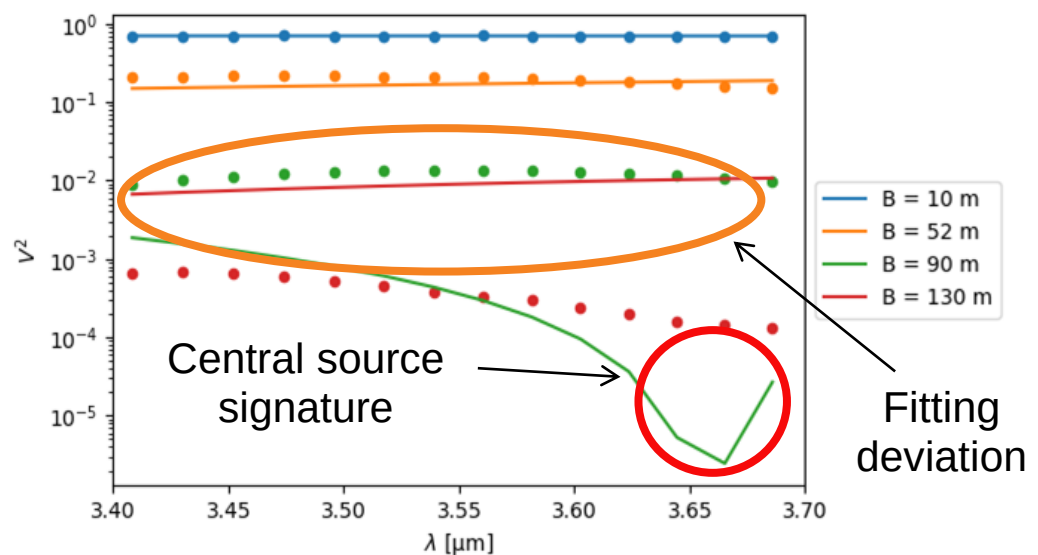
Discrepancies and modeling improvements?



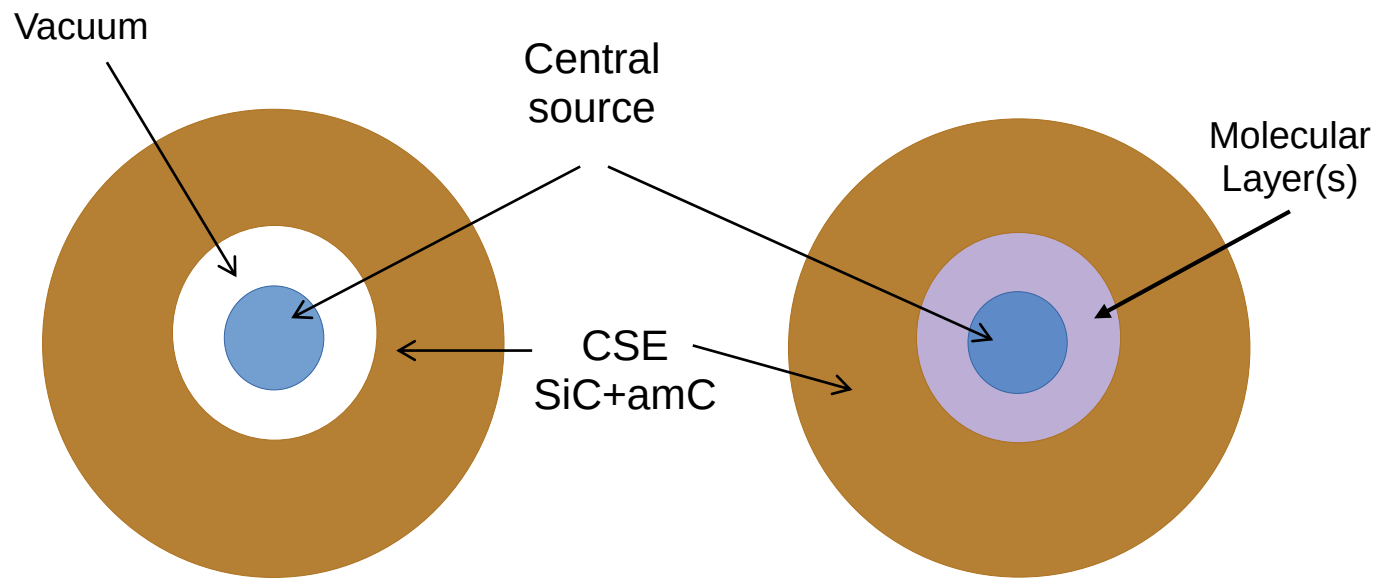
L-band scanned area:



$1.3R_{\star}$ - $18.3R_{\star}$



Molecular layers filling the gap ?



DUSTY modeling
Clear defined star edges
→ Zero of visibility

Observations
No clear defined star edges
→ No zero of visibility

Discrepancies and modeling improvements?

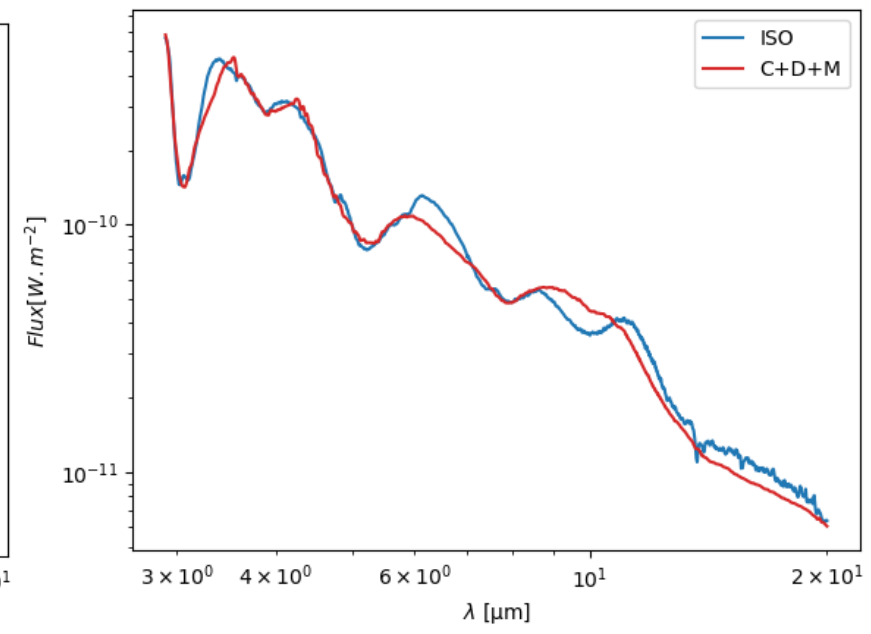
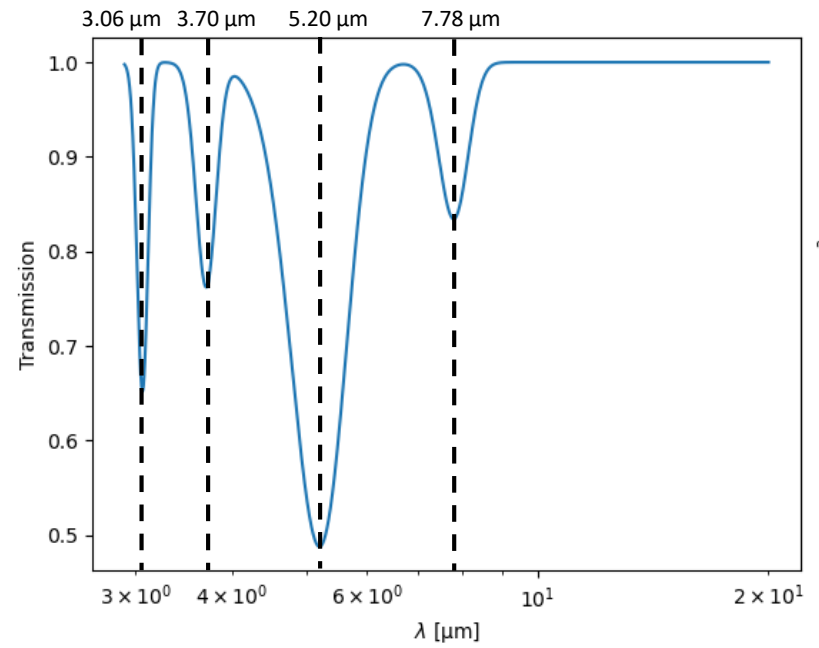
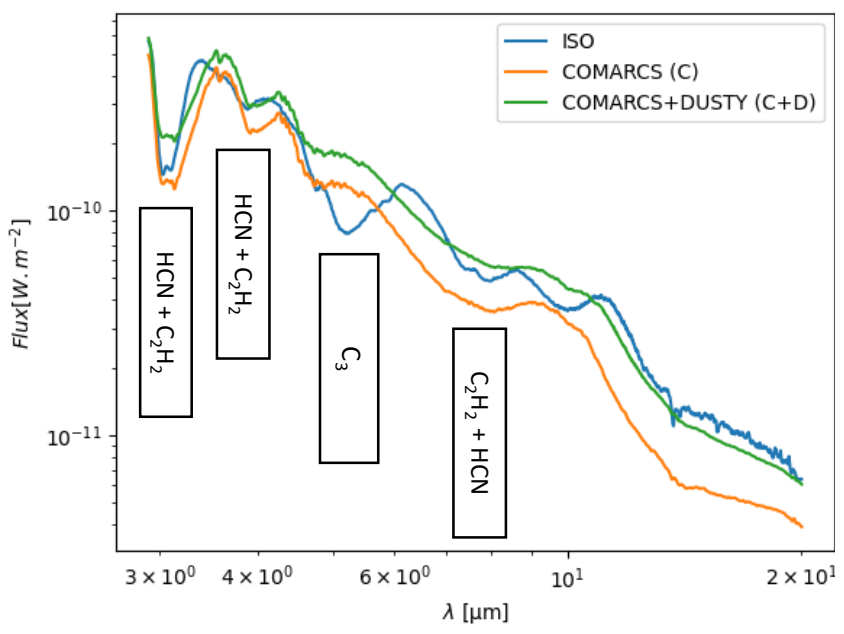


Identifying the nature of the molecules

1/ Black Body → Stellar atmosphere

2/ Transmission function (Gaussian fitting)

3/ Molecular features characteristics

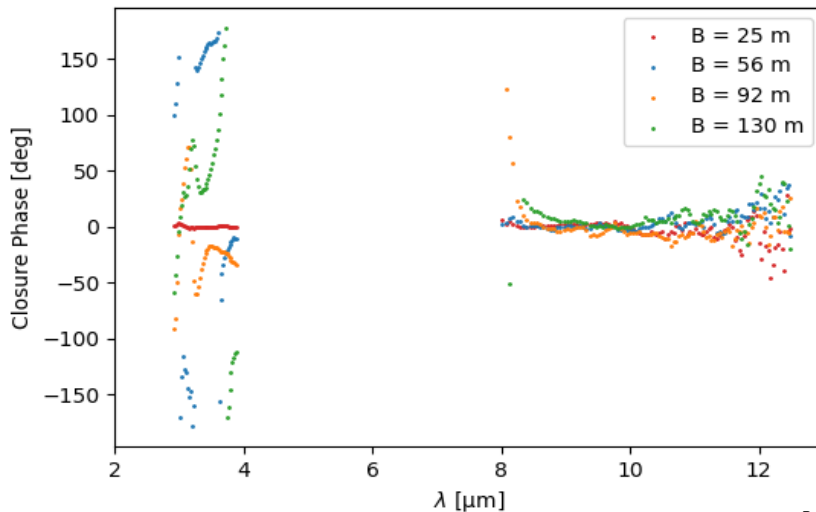


Conclusion & Perspectives



Conclusion:

- MATISSE results **CONFIRMED** with literature
 - Building a model with molecules



Perspectives:

- Image reconstruction
- Non-zero closure phase (asymmetries)
- Several other targets analysis are coming...

