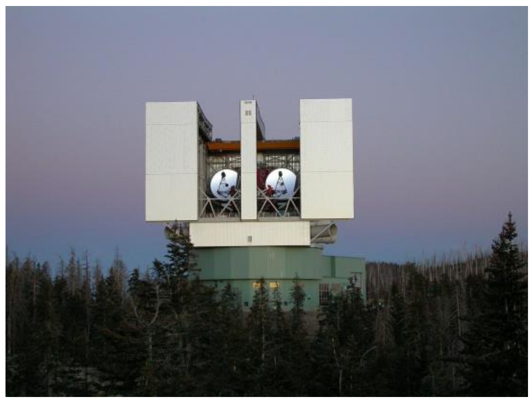
MATISSE

Bruno Lopez, on behalf of the MATISSE Team,
MATISSE-VLTI School, with emphasis of Interferometry for Planetology, June 7th-18th 2021




PEGASE
PEGASE

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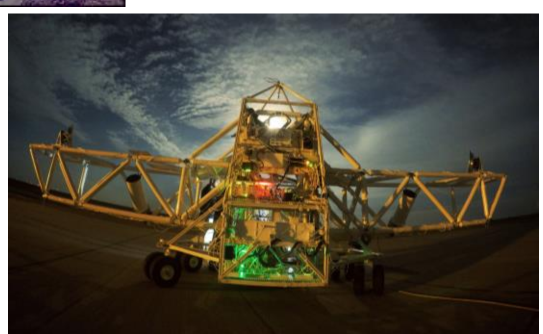
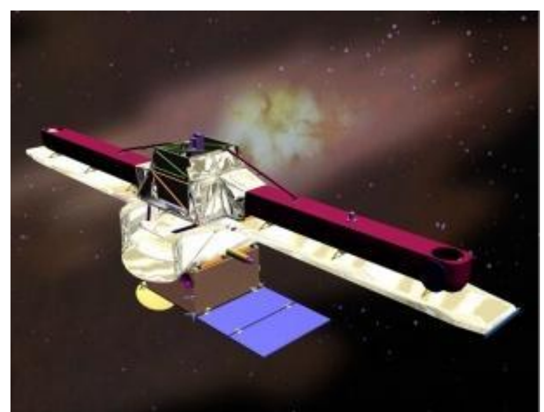



Mid-infrared interferometry has started with the pioneering work of the SOIRDETE and ISI teams

… and initiated **at the VLTI with MIDI.**

- **ISI**, 3 telescopes of 1.6 m diameter, baseline up to nearly 100 m. Spectral domain centered around 11 microns.
- **SOIRDETE**, 2 tel. of 1 m diameter, baseline of 15 m. N band spect. domain from 8 to 13 microns.
- **MIDI**, 2 tel. of the VLTI using either Auxilary Tel. or Unit Tel. Baseline up to 150 m. N band spect. domain from 8 to 13 microns.
- **MATISSE**, 4 tel. of the VLTI, UTs or ATs. L, M and N band spect. domains from 3 to 13 microns.

MATISSE has been built on those instrument expertises and also on the AMBER one.

Pionniering research conduced by SOIRDETE and ISI teams

SOIRDETE team : Jean Gay, Djamel Mékarnia, Yves Rabbia,… CERGA

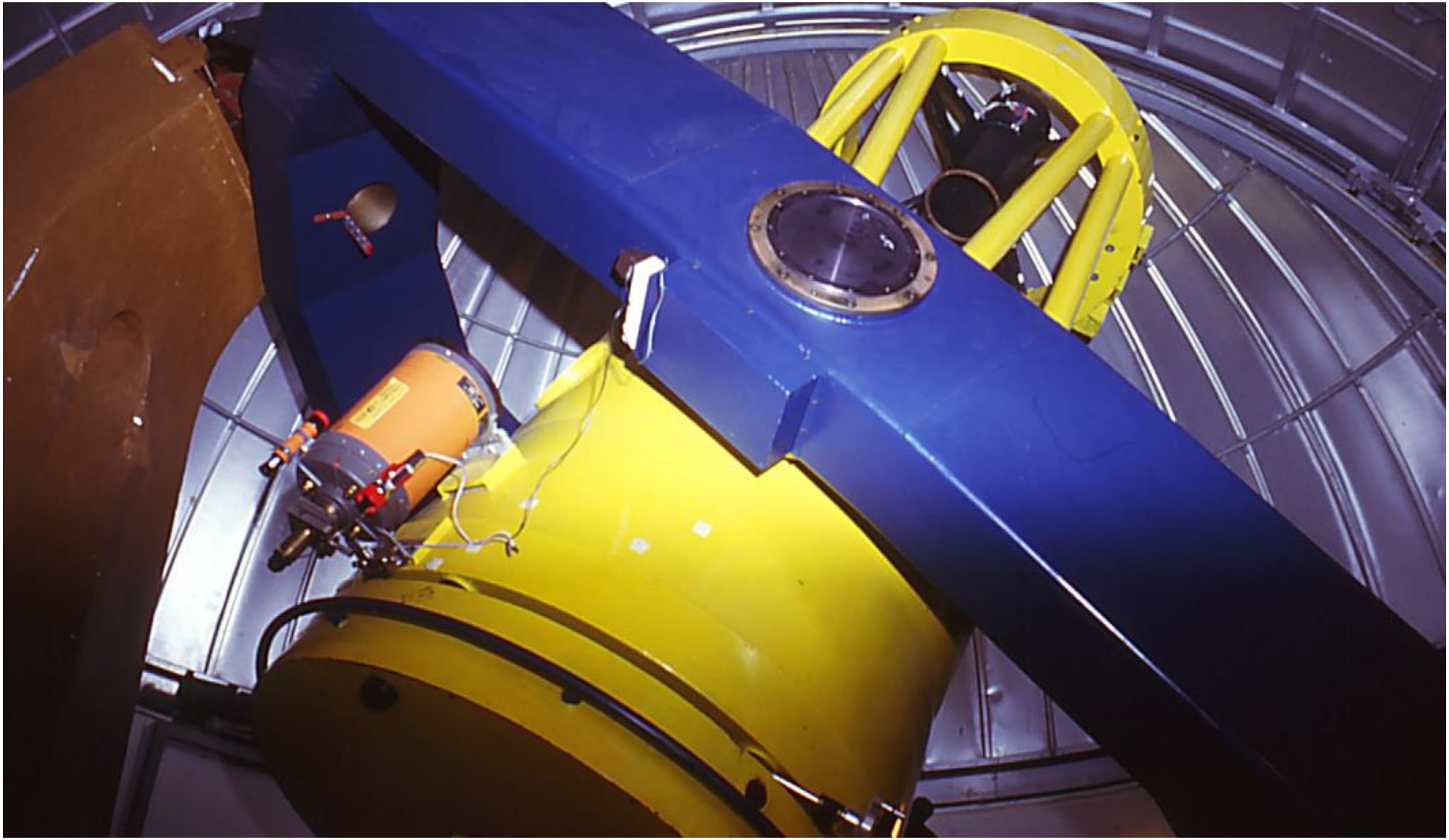
ISI Team : Charles H. Townes, William C. Danchi, … University of Berkeley

MIDI Team : Christoph Leinert, Uwe Graser, Walter Jaffe, … MPIA and Univ of Leiden

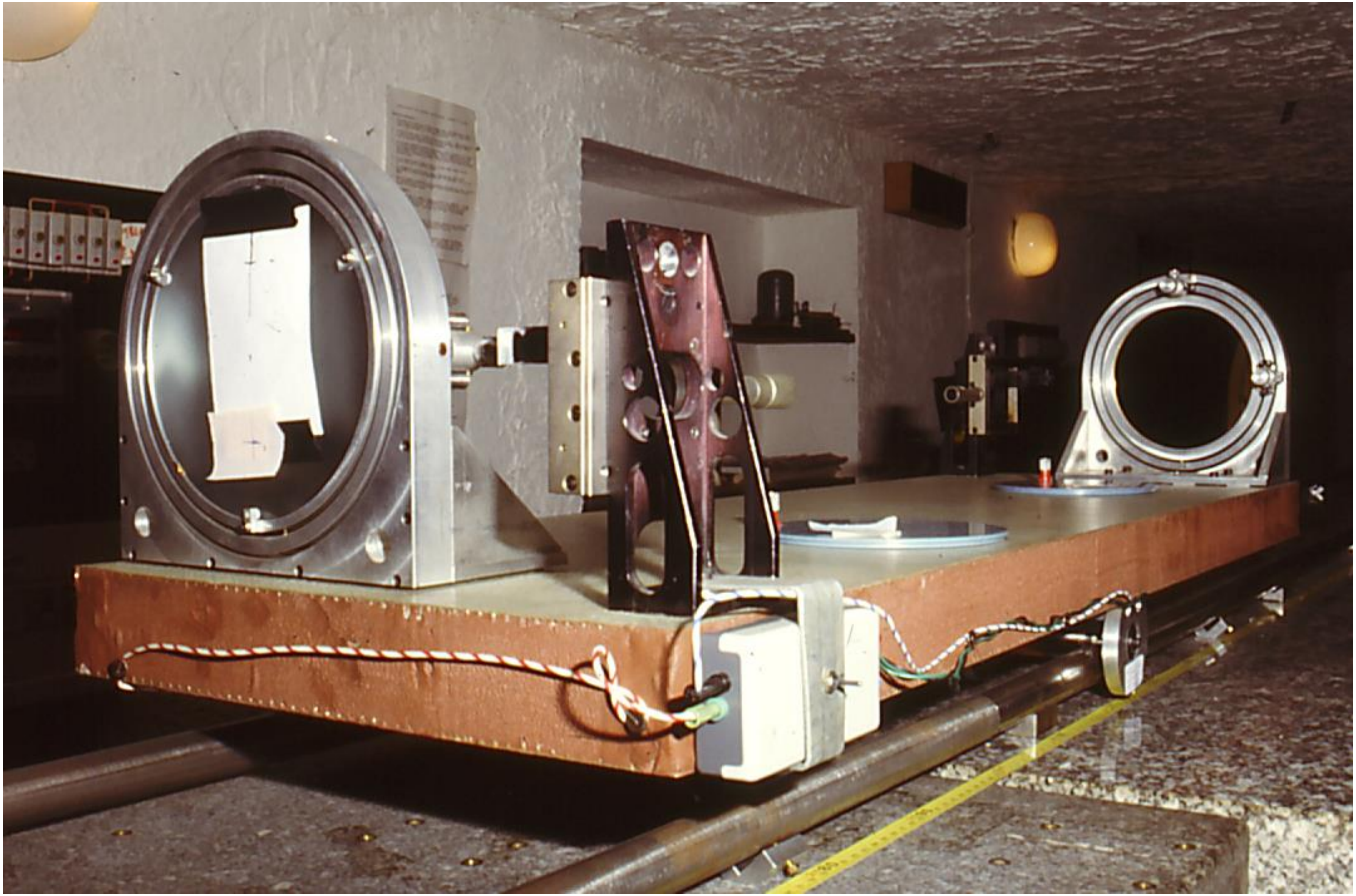
… Keck Interferometer, LBTI, Betty

The SOIRDETE Interferometer on the plateau de Calern

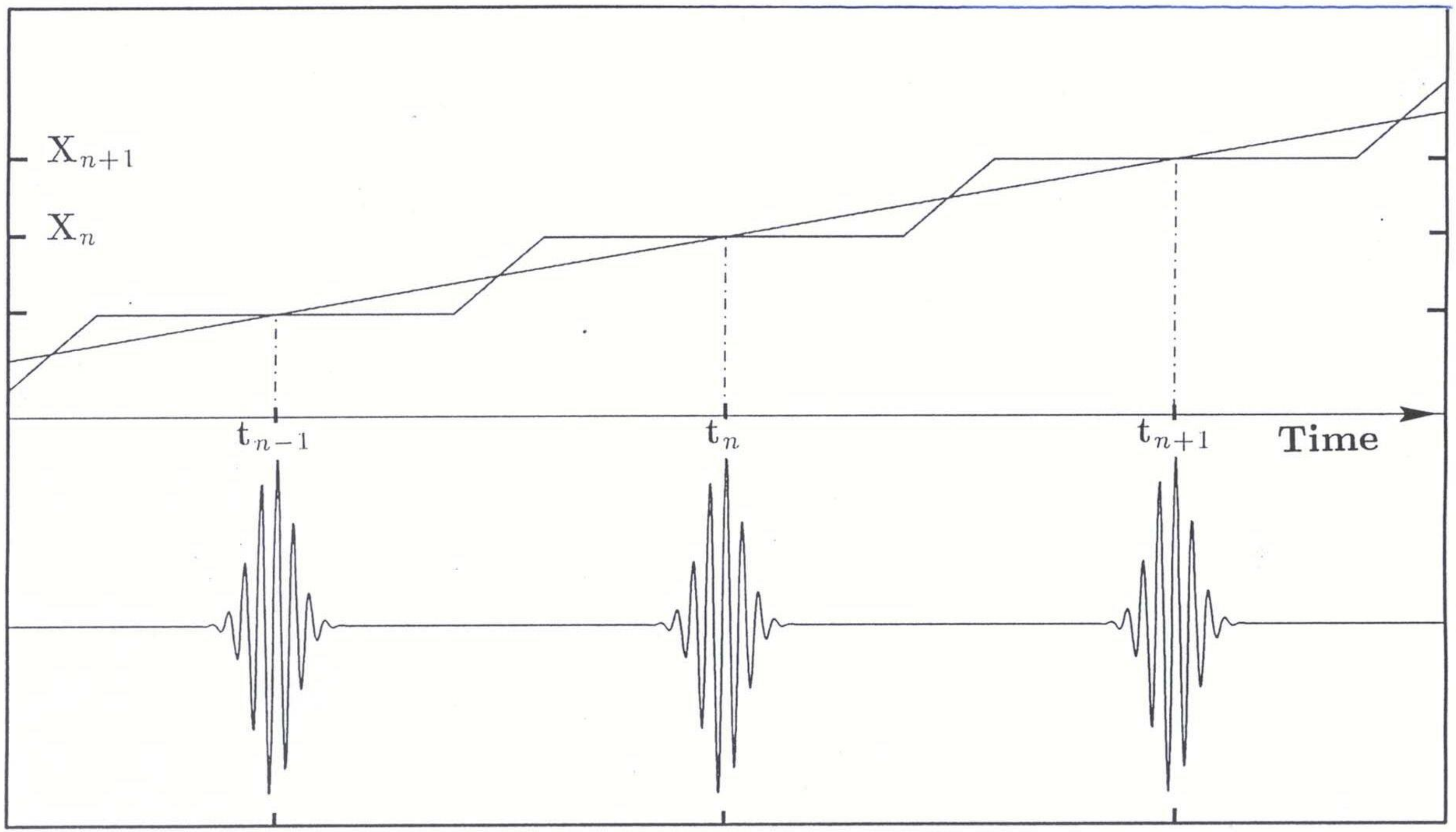
2 one meter telescopes for a 15 m baseline



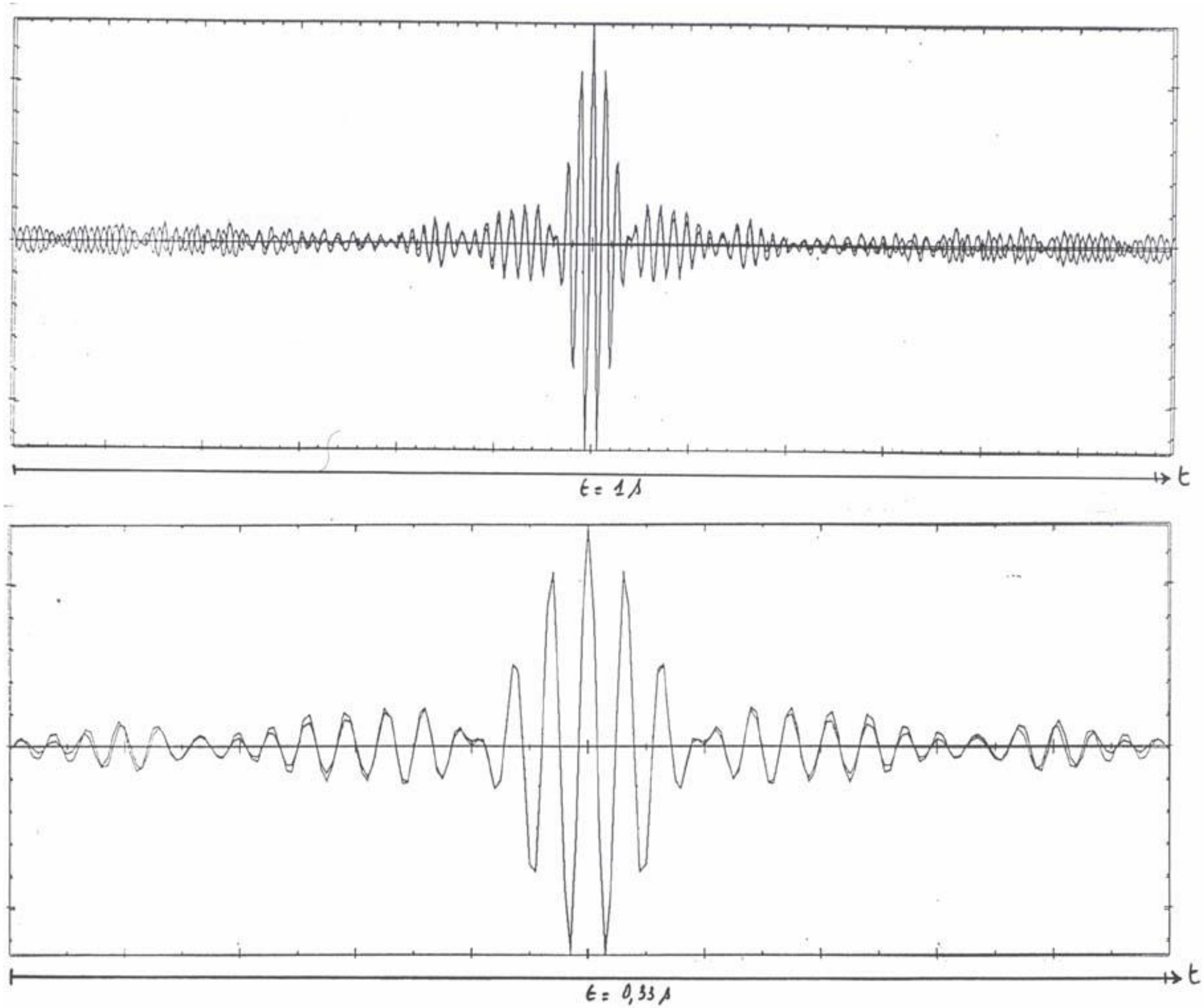
The SOIRDETE delay line moving by discret steps



The delay line movement and the passing train of fringes



Direct fringes in N band (8-13 micron)



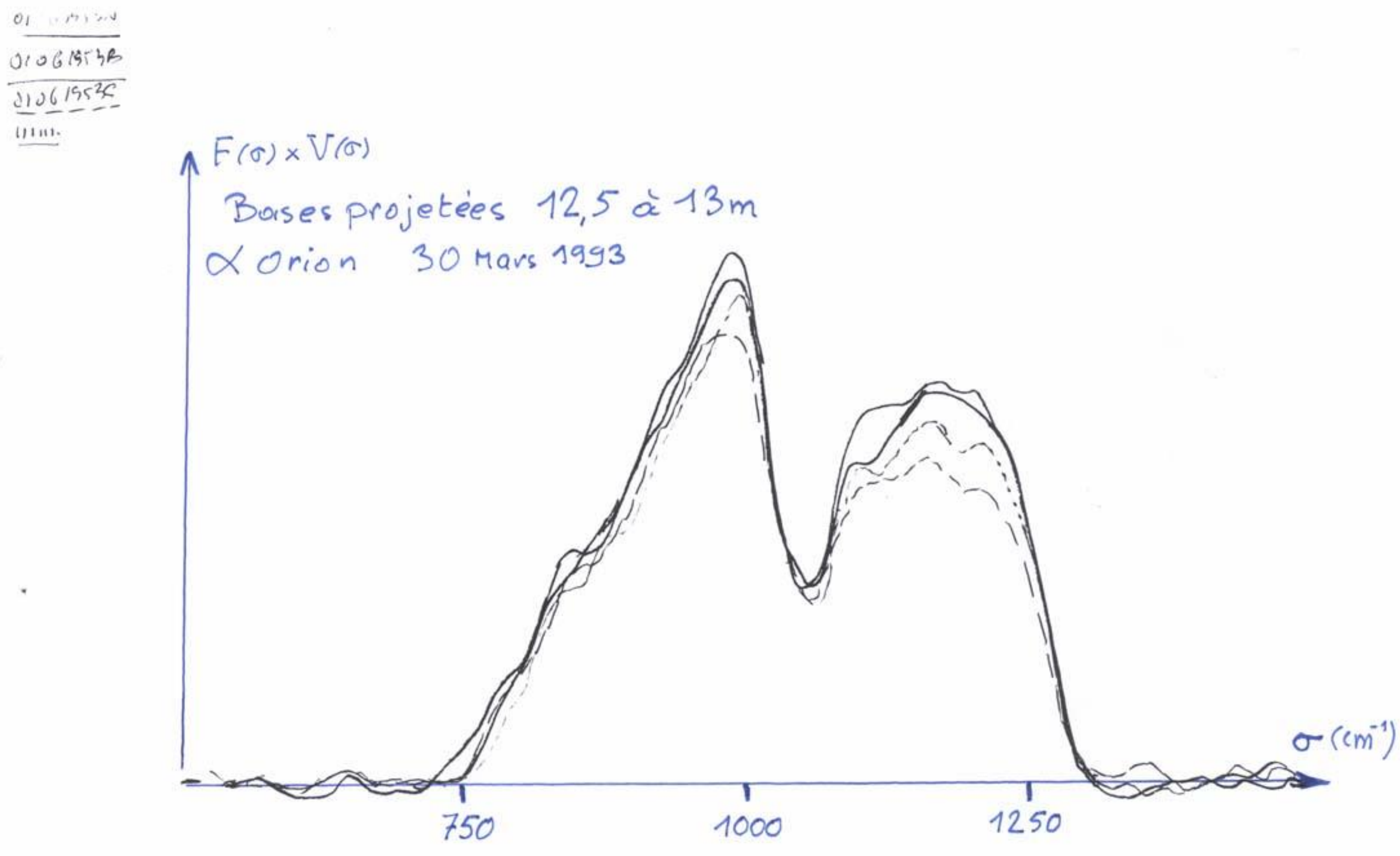
Supperposition d'un train de franges ($\lambda = 10 \mu m$, $\Delta\lambda = 3 \mu m$) avec lui-même après retournement. Les écarts d'amplitude représentent le bruit de détection qui affecte la mesure.

α Orion

11-12-87.

TU : 1h 21mn 21s

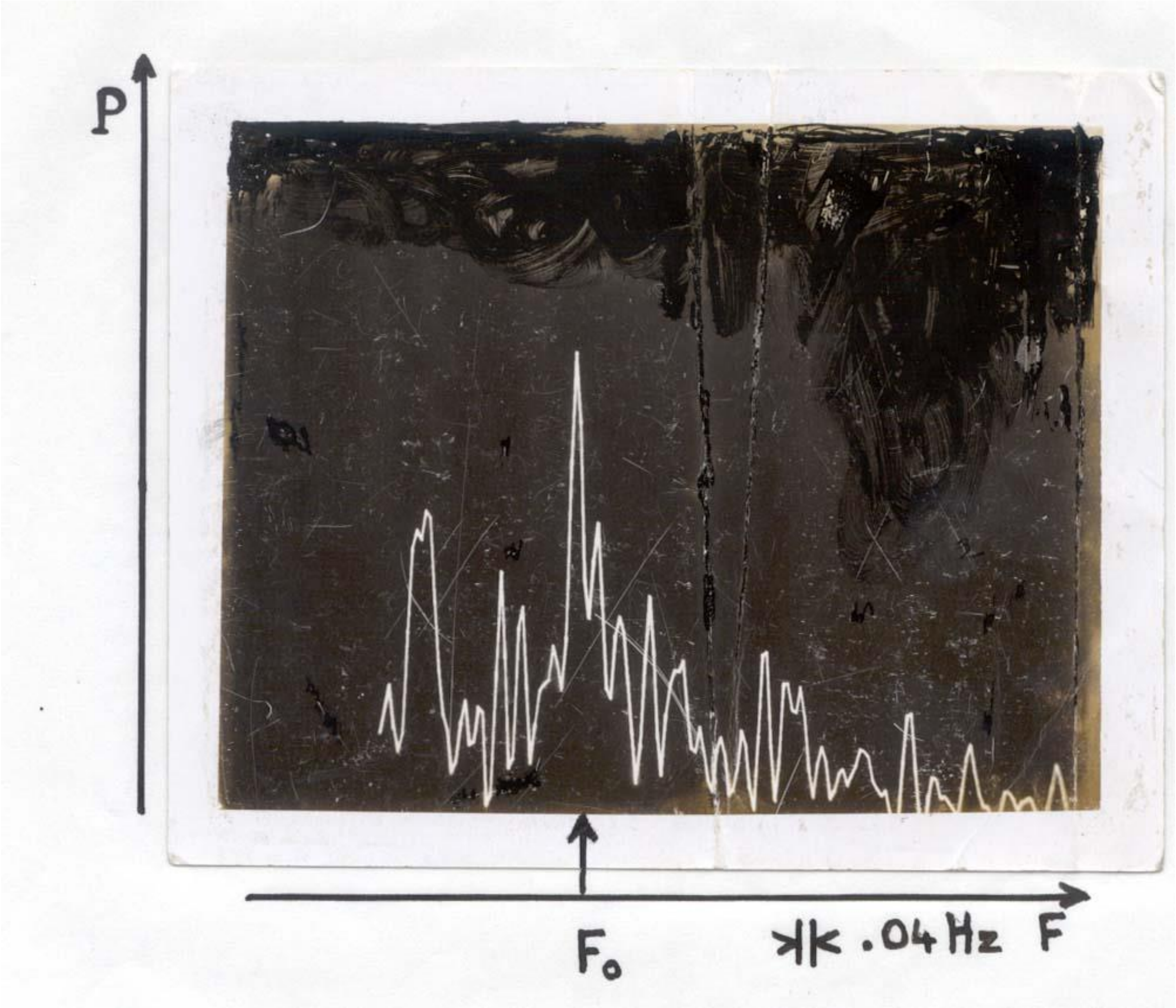
Associated spectrum with the ozone absorption band



SOIRDETE was a novative instrument

- First heterodyne fringes were obtained in 1978.
- Most important : direct interferometry was realized for the first time at SOIRDETE in 1988.

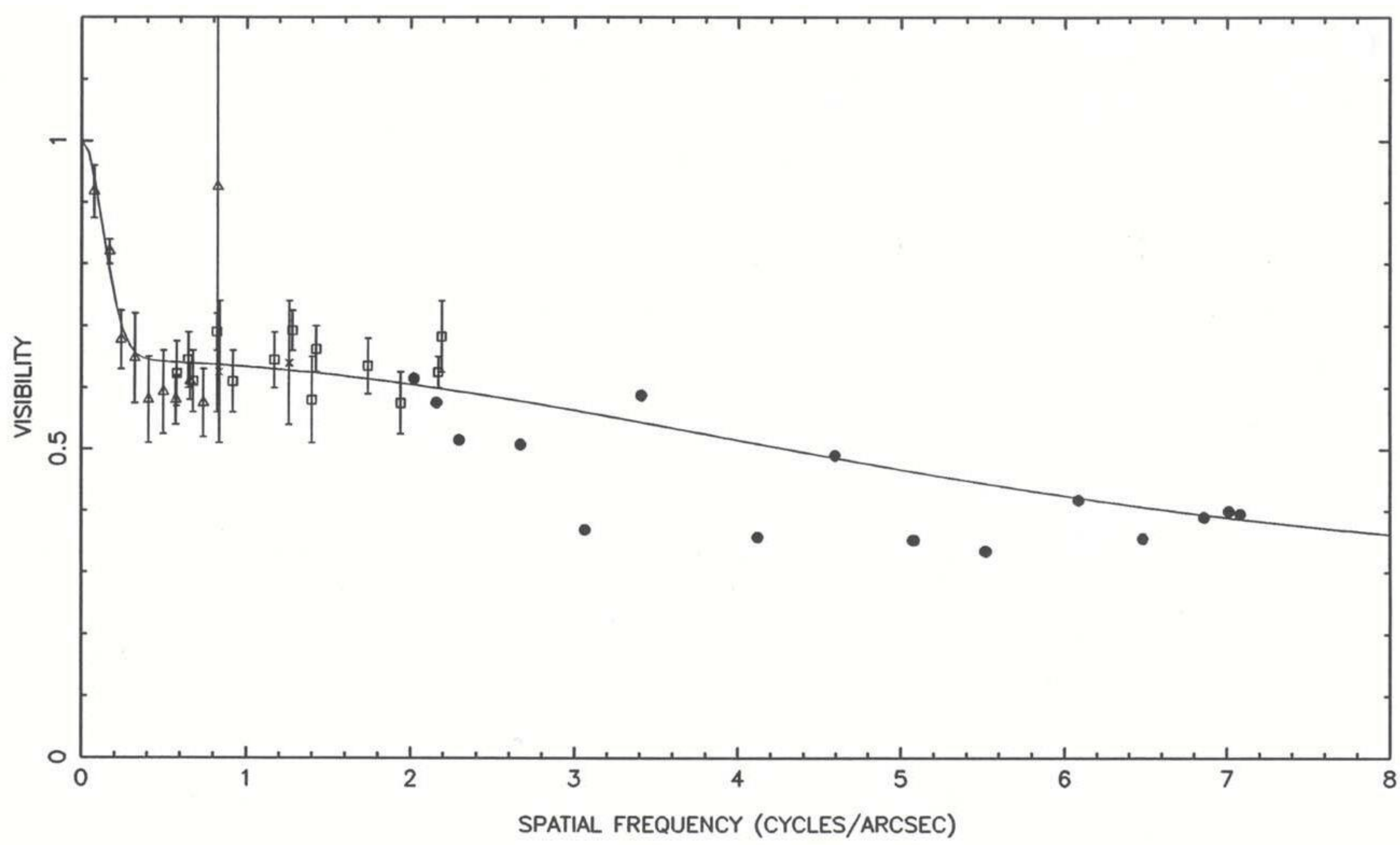
First Heterodyne fringes on Betelgeuse at SOIRDETE (August 3 1978)



Visibility Function of Betelgeuse in N band

The low frequencies are those measured by the ISI interferometer.

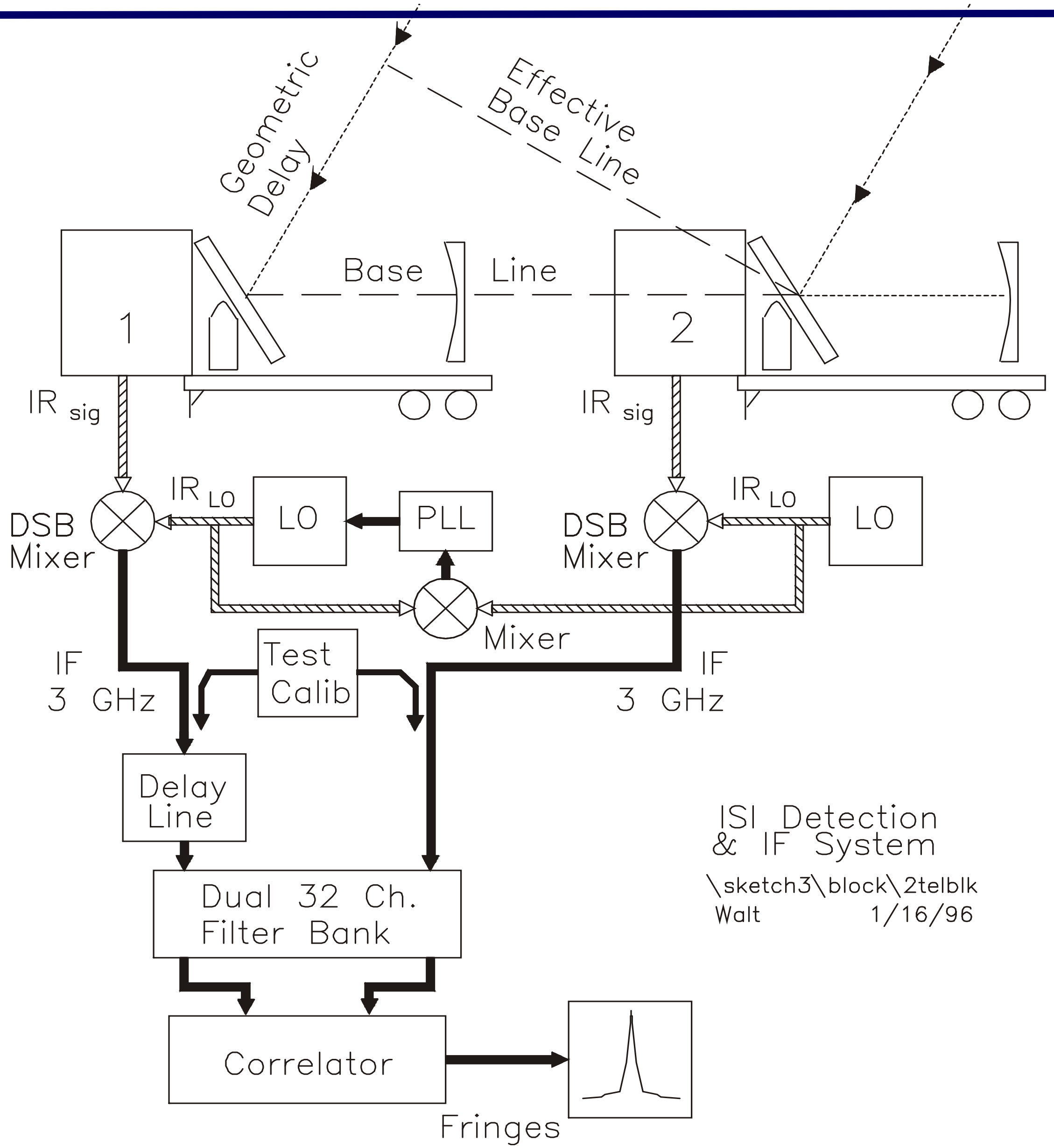
The SOIRDETE dot measurements completing the information on the dust shell surrounding the Red Supergiant star.



The ISI – Infrared Stellar Interferometer - interferometer at Mont Wilson

The ISI – Infrared Stellar/Spatial Interferometer - at Mont Wilson

ISI Detection System



ISI was a novative and reliable instrument, a large number of publications have resulted from its use

• First survey of circumstellar dusty environments by mid-infrared interferometry, Danchi et al. 1994

• Dust is very close to photospheres for oxygen-rich Mira variables and Carbon stars, typically < 5 R_* or so. Implies dust forms within a pulsation cycle or every few cycles, time scale within a few years (<10).

• Dust is far from the photosphere on average for Supergiants like α Ori, α Sco. Implies dust formation is infrequent, time scale ~50-100 yrs.

• Multi-epoch study of o Ceti, provided evidence for dust formation and destruction in clumps. Motivated imaging program (third telescope).

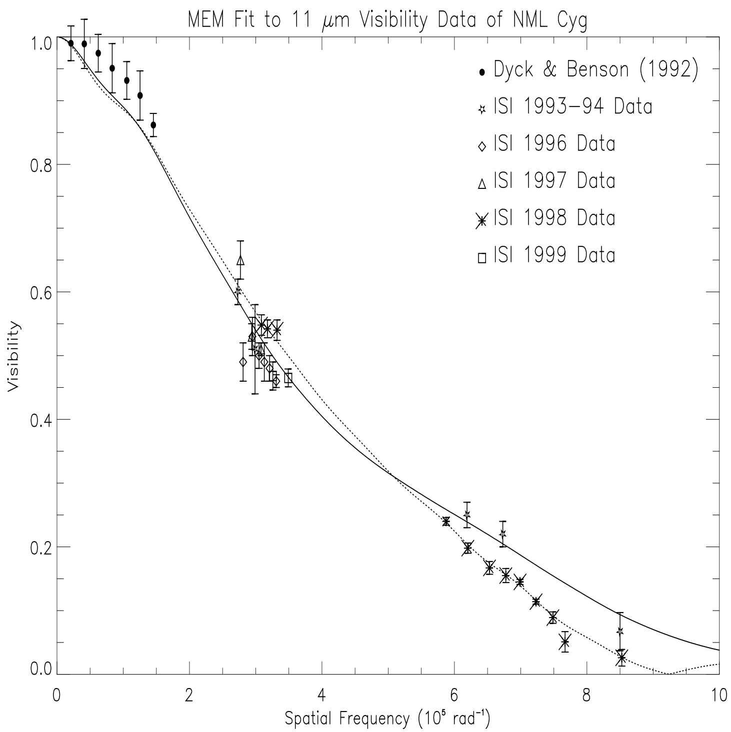
• Location of SiO masers + inner radius of dust shell allowed approximate determination of atmospheric scale height for VX Sgr.

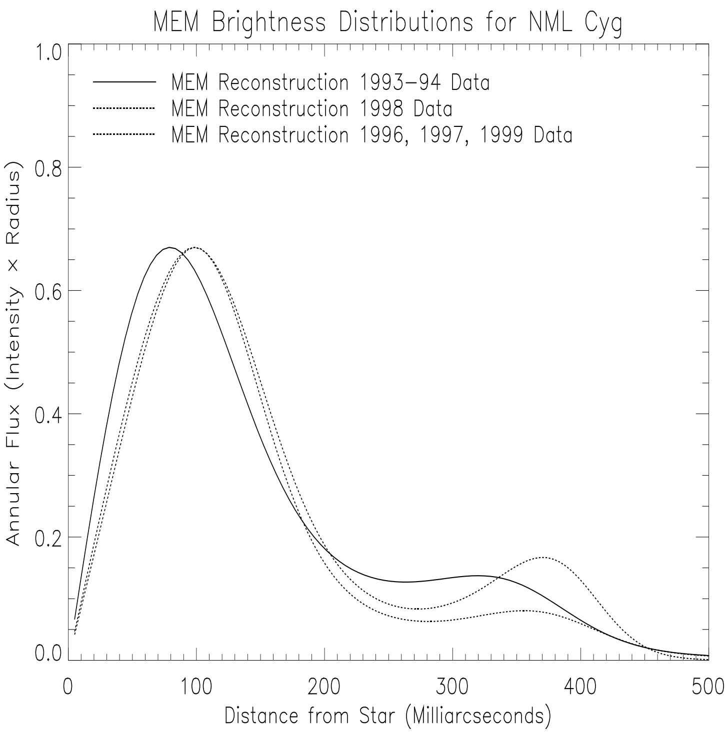
• Evidence for episodic dust formation for NML Tau and NML Cyg.

• Location of molecular shells of Silane and Ammonia relative to dust inner radius. Found R_{silane} and $R_{ammonia}$ >> R_{dust} for IRC +10216.

• Precise determination of stellar diameters, (1%), with absence of contamination from molecular blanketing and hot spots.

Proper Motion of Dust Shells Surrounding NML Cyg





- Observed change in visibility data between 1993 and 1999
- Evidence for two discrete dust shells moving away, emission of shells 65+/-14 years
- If dust velocity same as masers, distance is 1220+/-300 pc

W.C. Danchi, W. Green, D.D.S. Hale, K. McElroy, J.D. Monnier, P.G. Tuthill, and C.H. Townes, *Astrophysical Journal*, 555, 405 (2001).

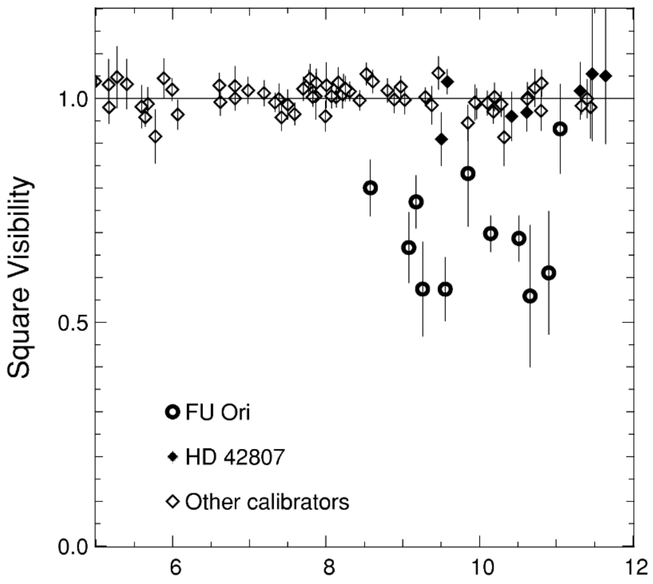
…

For several of us, the encounters with Jean Gay and with the Pr. Townes and the surrounding teams have contributed to the progress of our works and more than this.

It has also created a nice link between people.

I could say the same with the MIDI and AMBER teams.

Malbet et al. 1998, Palomar Testbed Interferometer at 2.2 microns



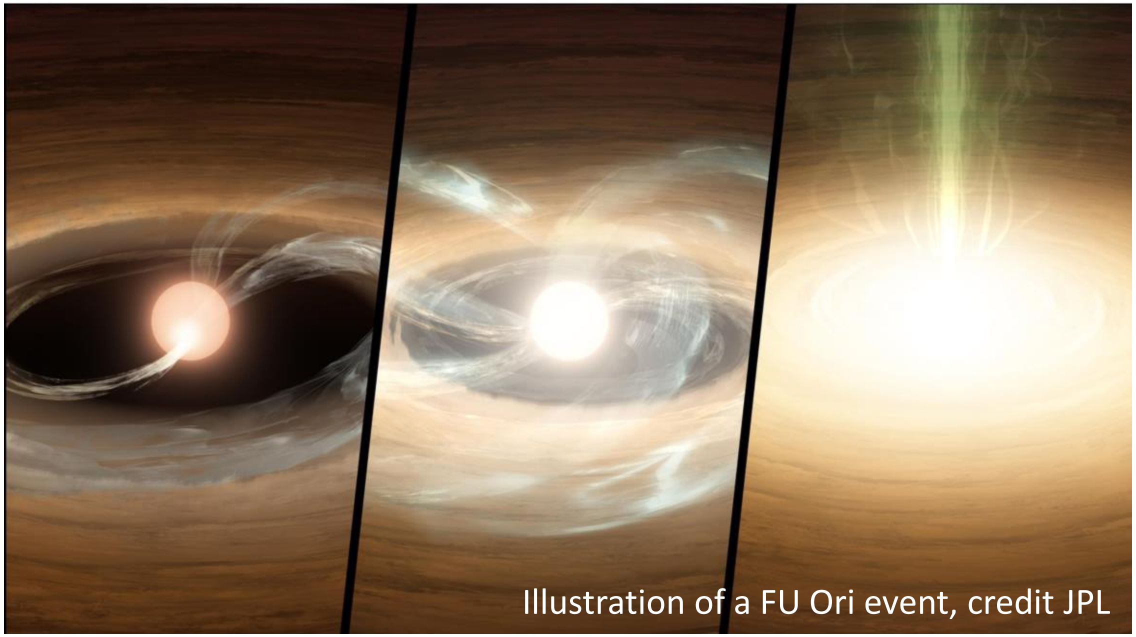
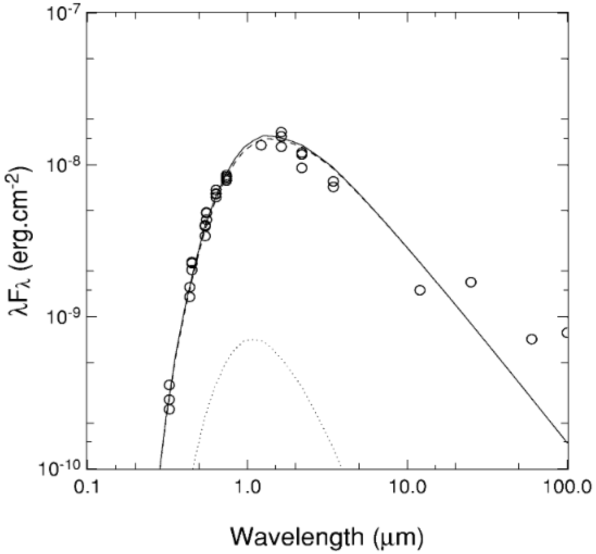
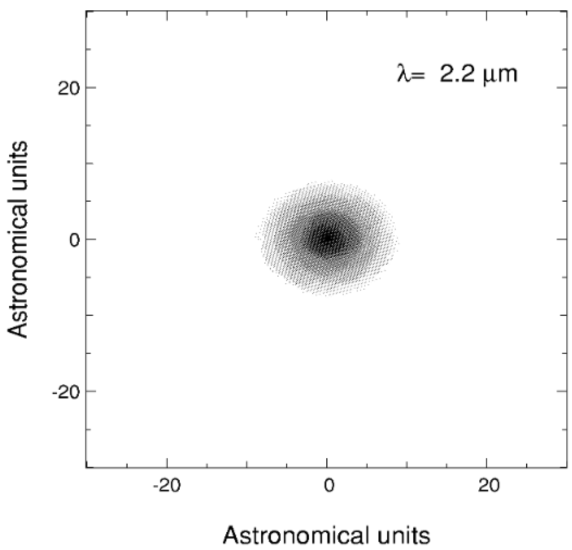
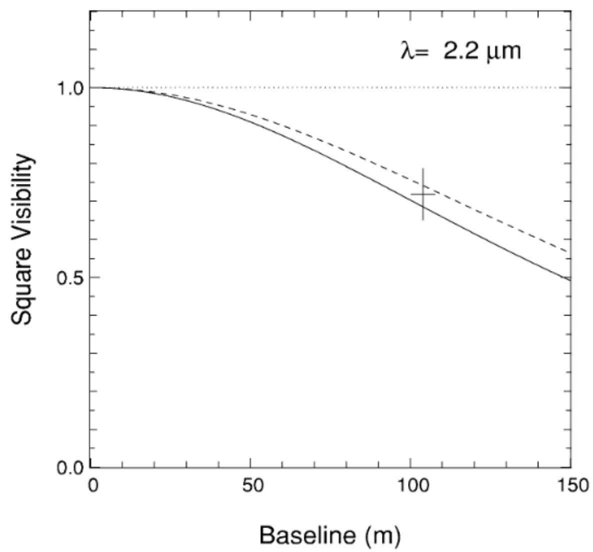


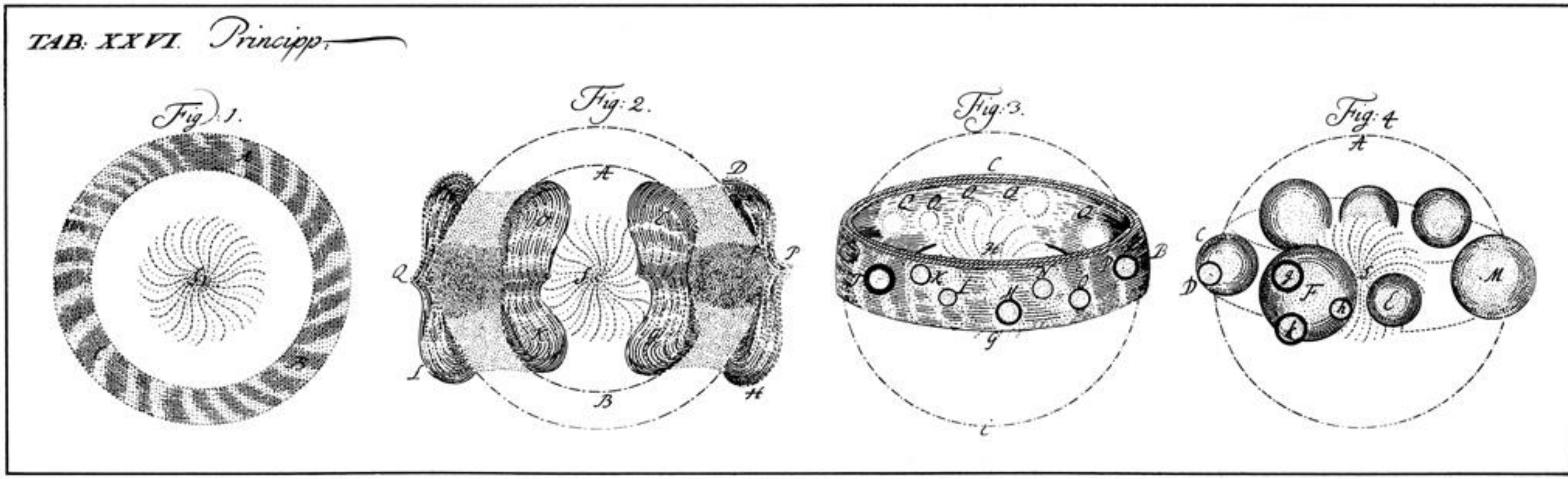
Illustration of a FU Ori event, credit JPL



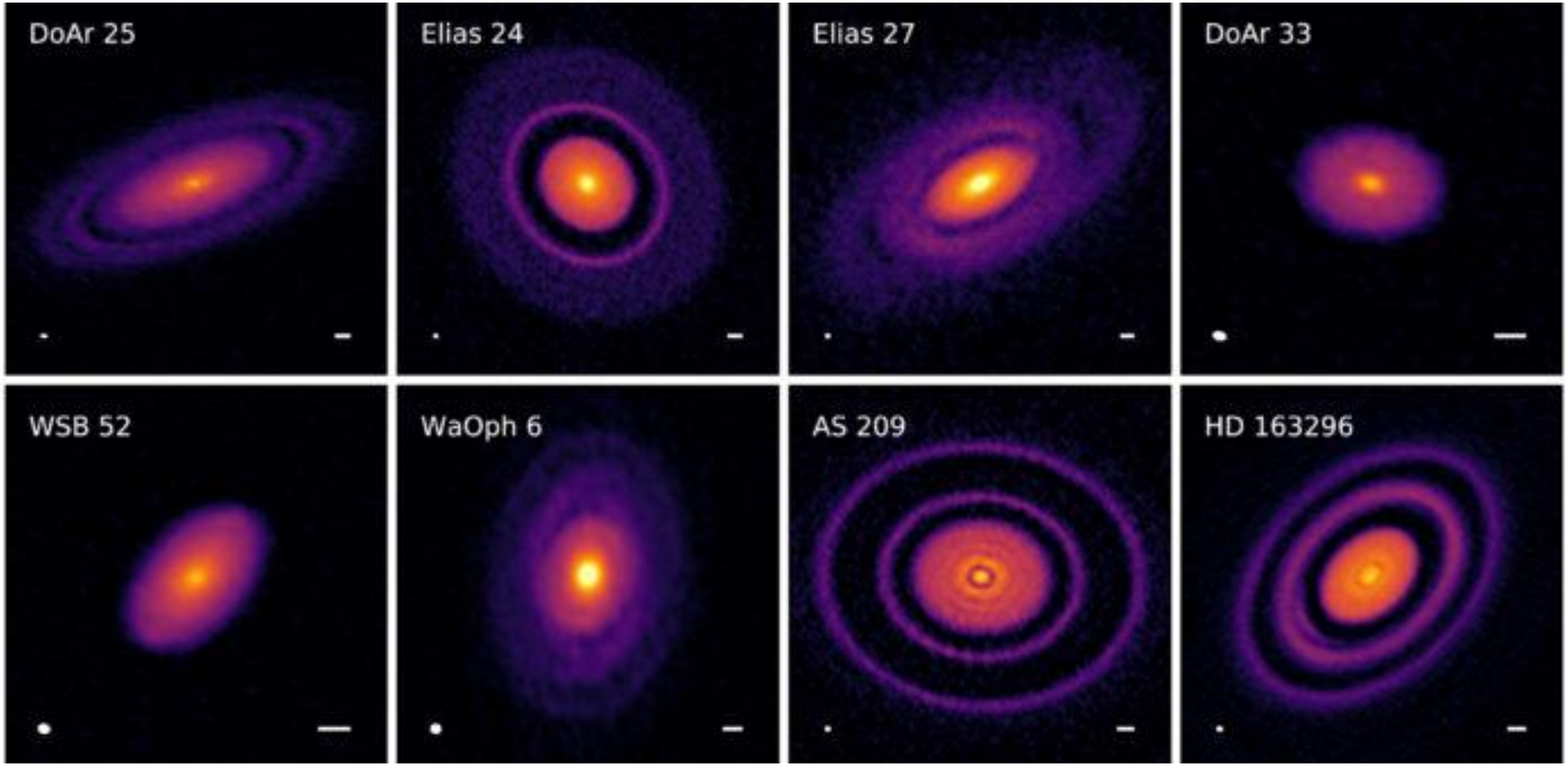




The Solar System formation according to Emanuel Swedenborg, 1734, Museum d’Histoire Naturelle, Paris

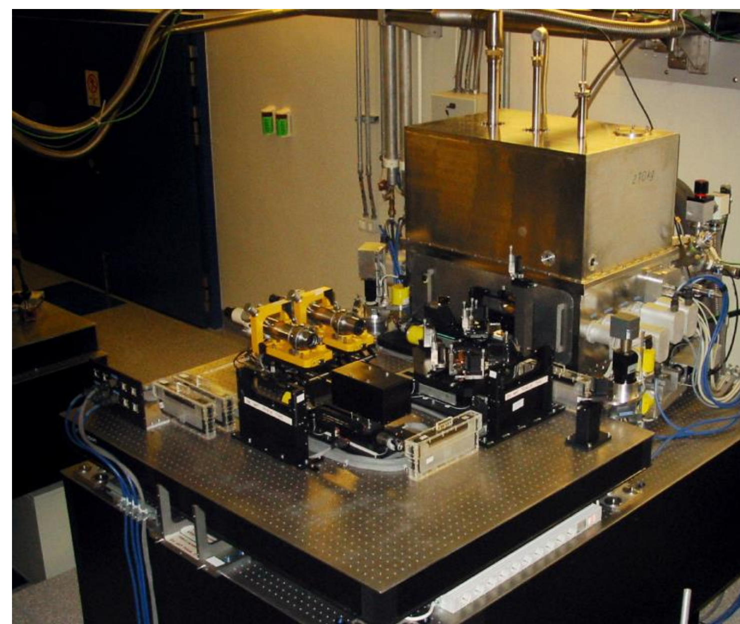


A subset of the DSHARP program protoplanetary disks, showing a variety of gaps and rings possibly generated by ice lines or planets



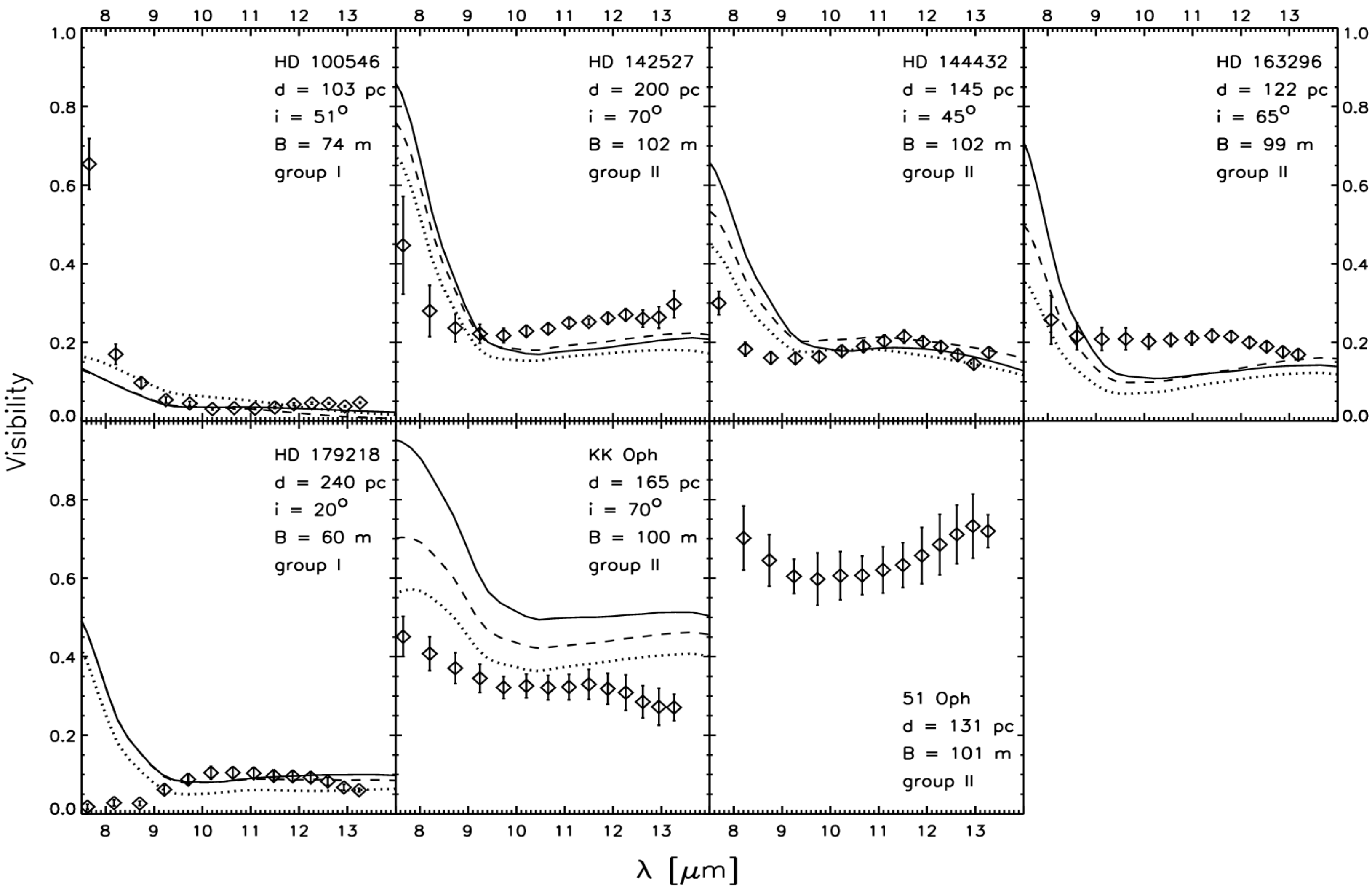
‘Tchouri’ seen by Rosetta – Credit ESA


1.5×2"
1.5×2"



The building blocks of planets within the `terrestrial' region of protoplanetary disks

Leinert et al. 2004, A&A.



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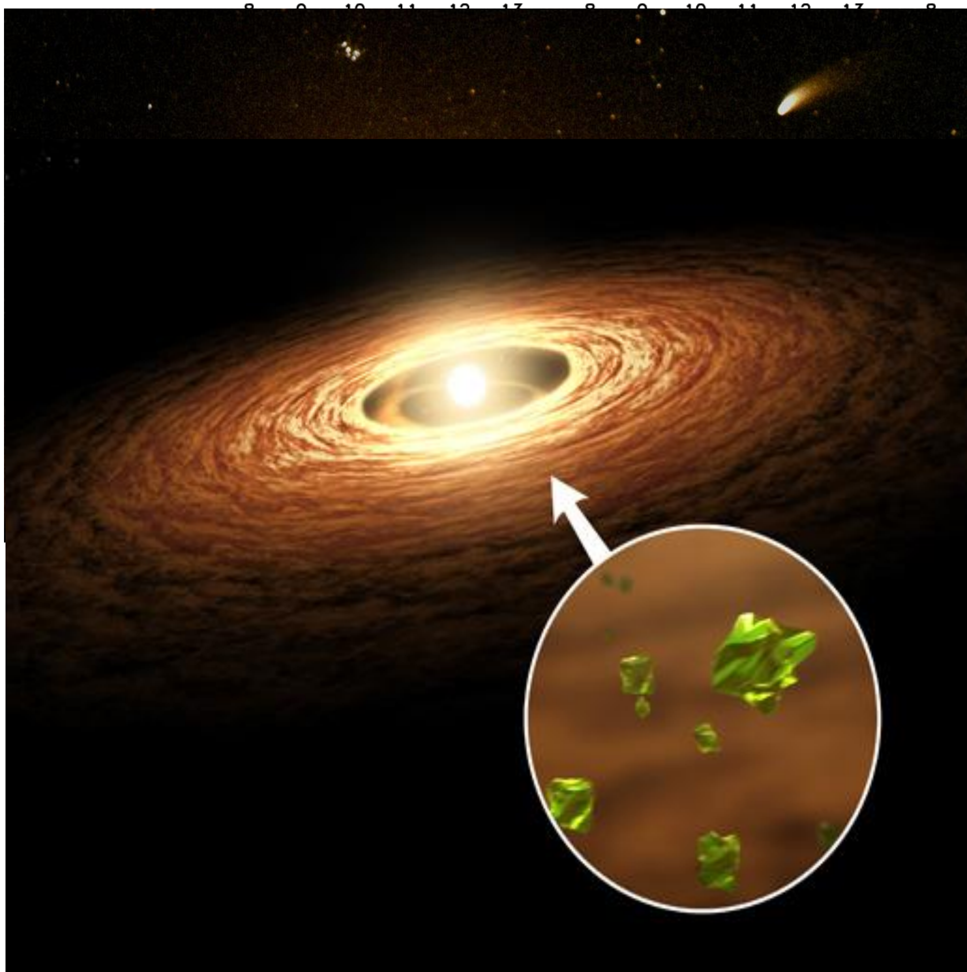

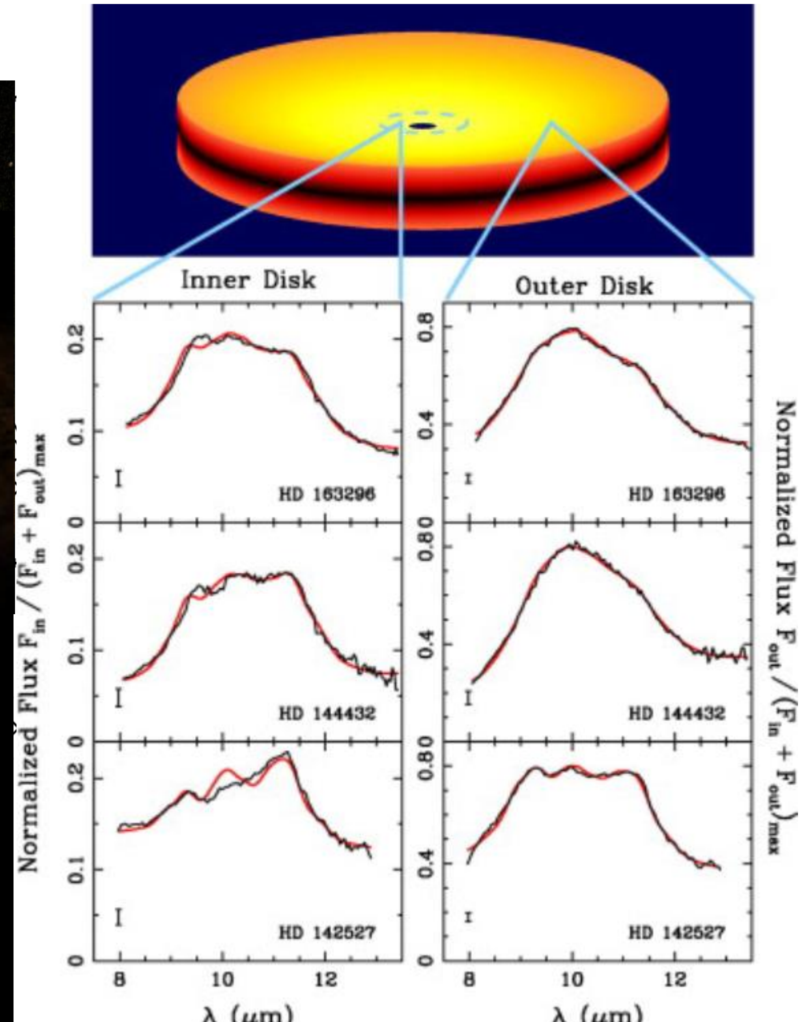

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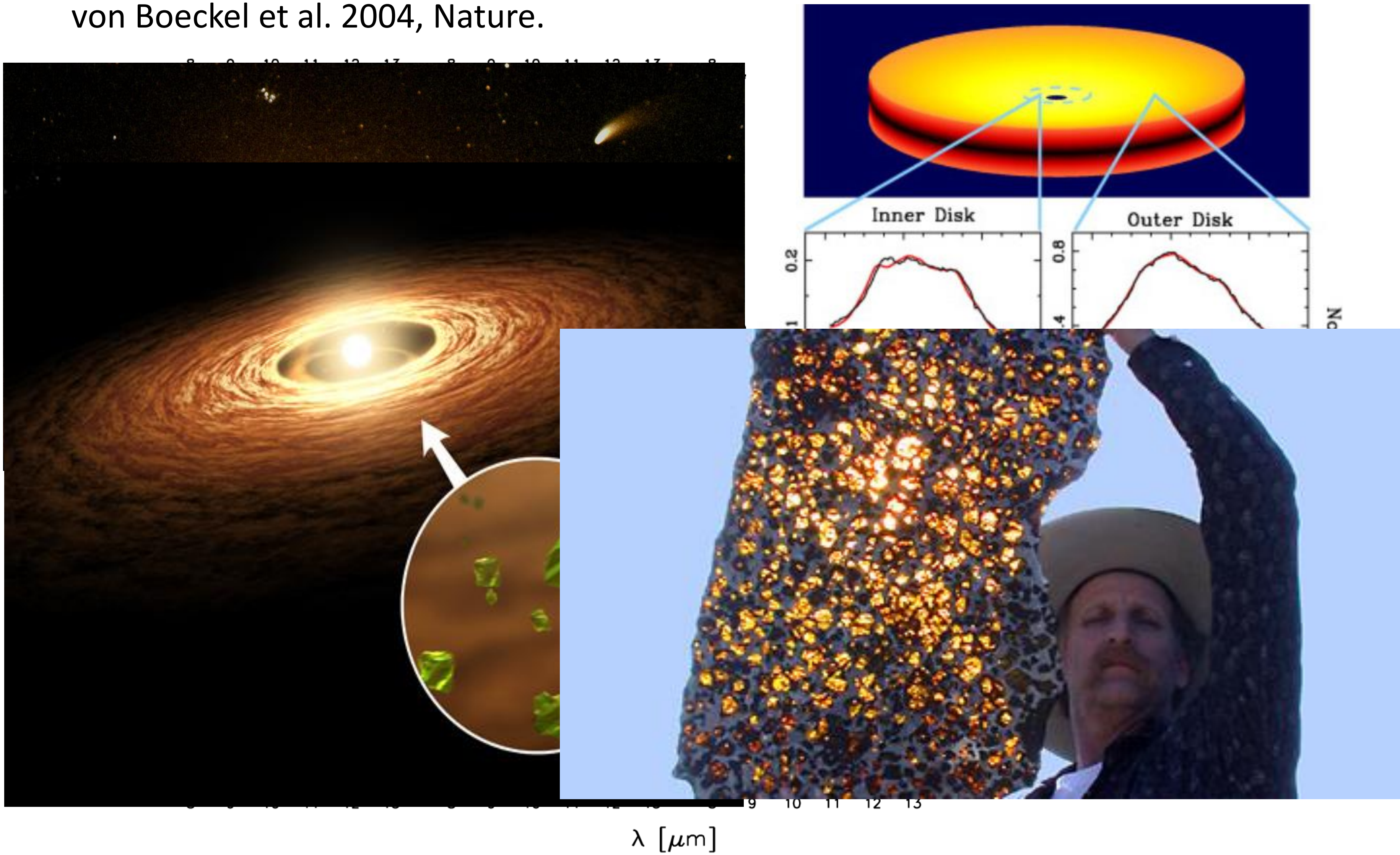
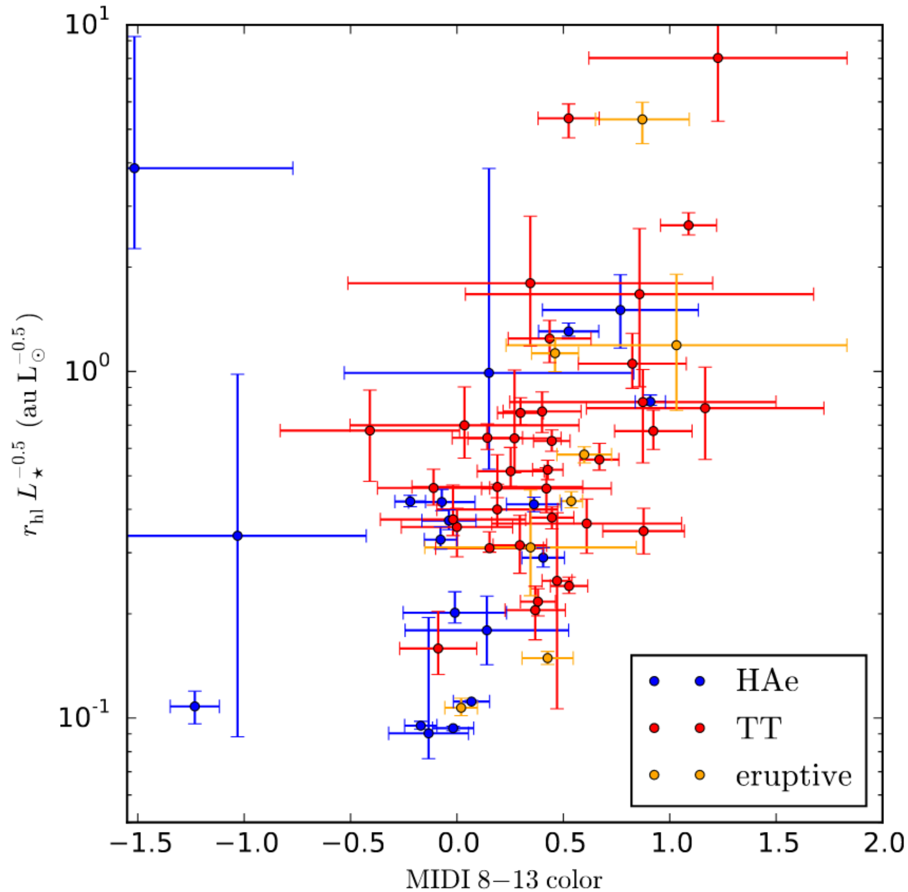


Menu 2015 & Varga 2018, Mid-IR interferometric survey of Herbig sources and T Tauri



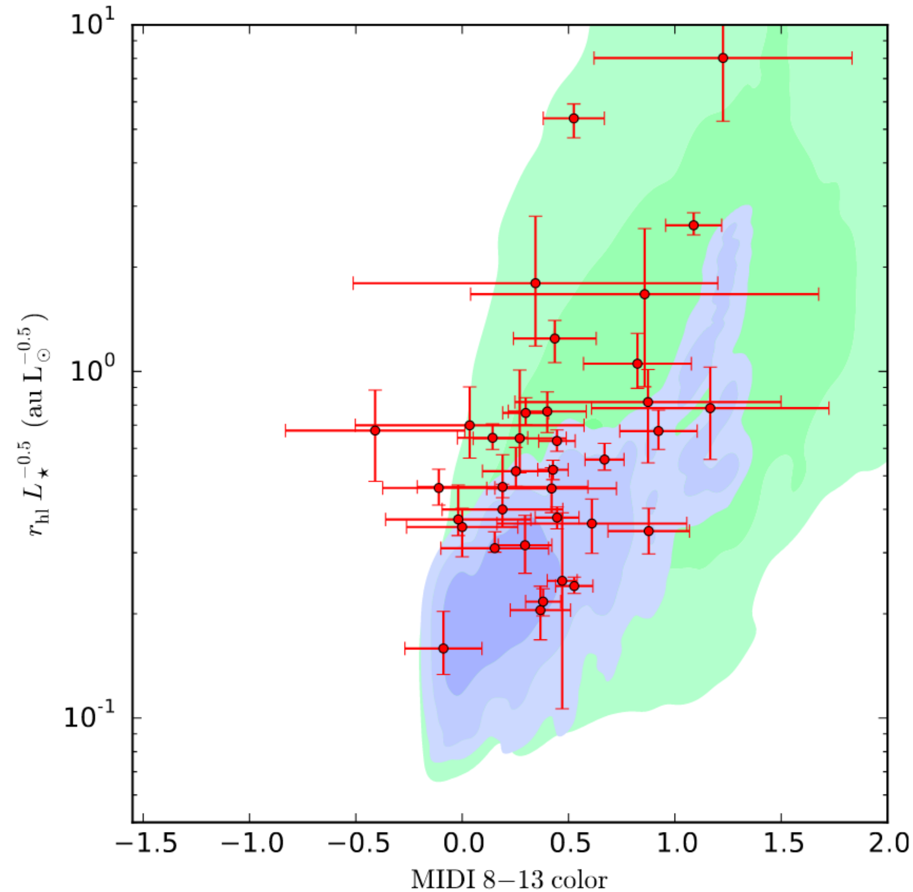
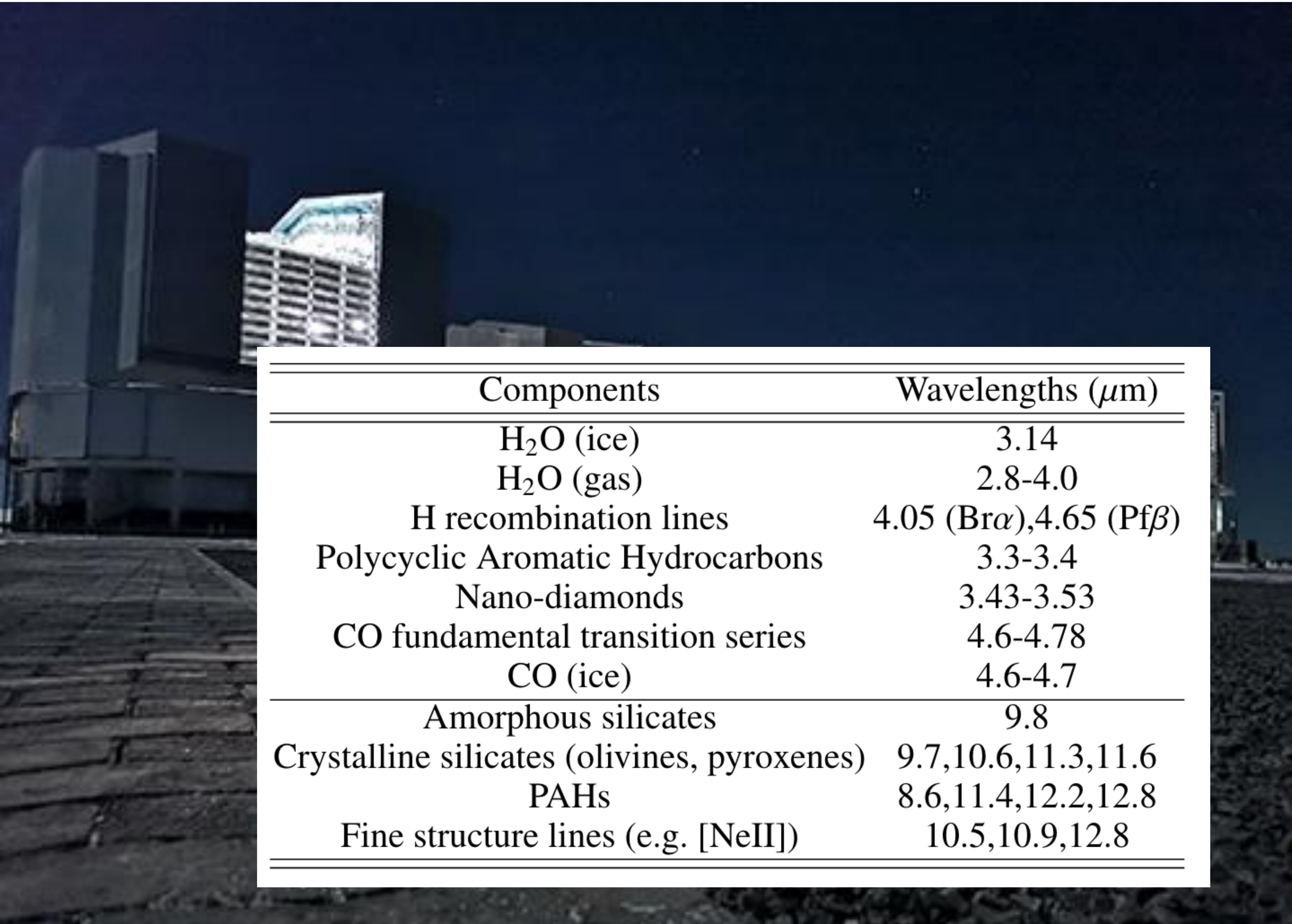


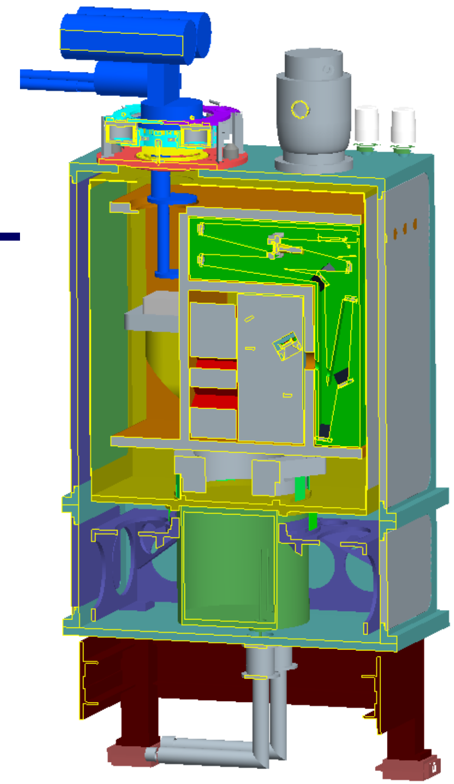
Fig. 4. Normalized mid-IR size as function of MIDI 8 – 13 color for our sample. Color of the symbols indicates the object type: Herbig Ae (blue), T Tauri (red), and eruptive (orange).

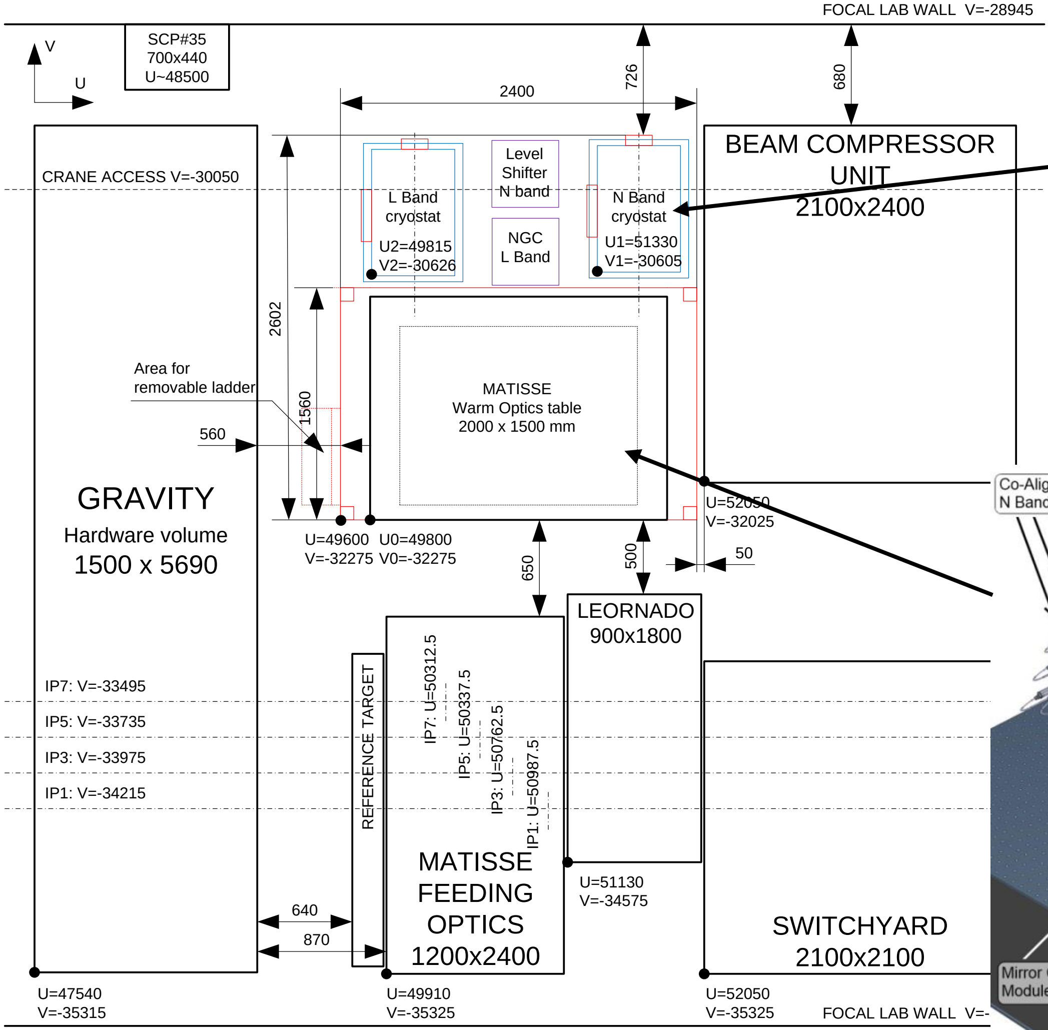
Fig. 5. Same as Fig. 4, but only for the T Tauri stars. The shaded regions represent the distribution of radiative transfer models of disks with (green area) and without (blue area) gaps. Darker shades indicate higher density of models. See the text for more details.

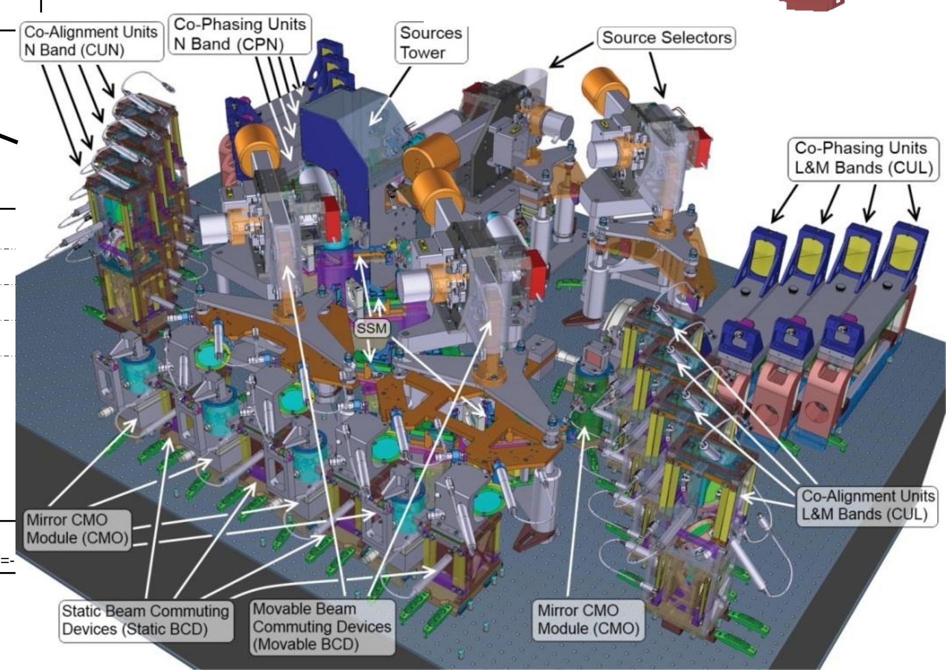


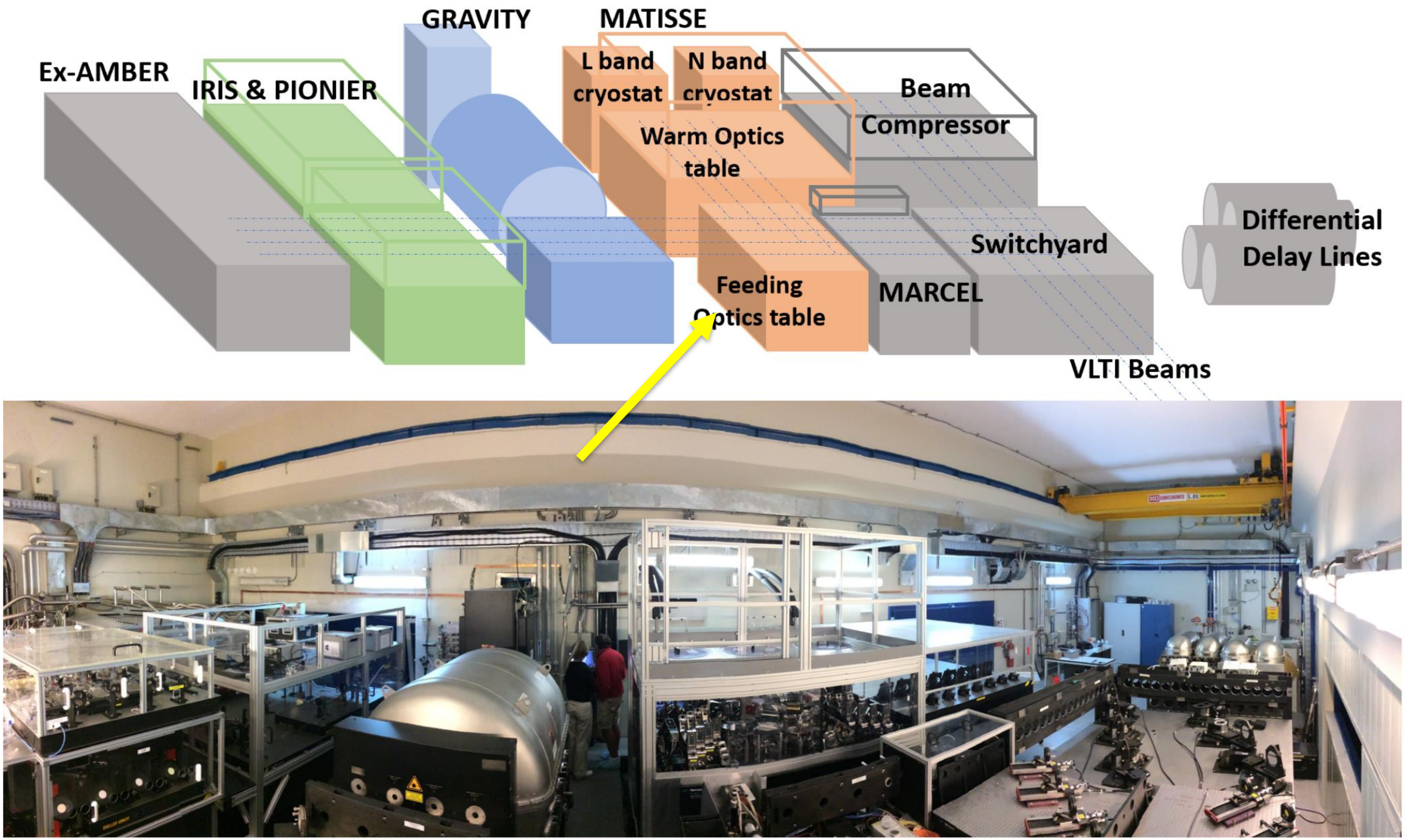
Components	Wavelengths (μm)
H_2O (ice)	3.14
H_2O (gas)	2.8-4.0
H recombination lines	4.05 (Brα),4.65 (Pfβ)
Polycyclic Aromatic Hydrocarbons	3.3-3.4
Nano-diamonds	3.43-3.53
CO fundamental transition series	4.6-4.78
CO (ice)	4.6-4.7
Amorphous silicates	9.8
Crystalline silicates (olivines, pyroxenes)	9.7,10.6,11.3,11.6
PAHs	8.6,11.4,12.2,12.8
Fine structure lines (e.g. [NeII])	10.5,10.9,12.8

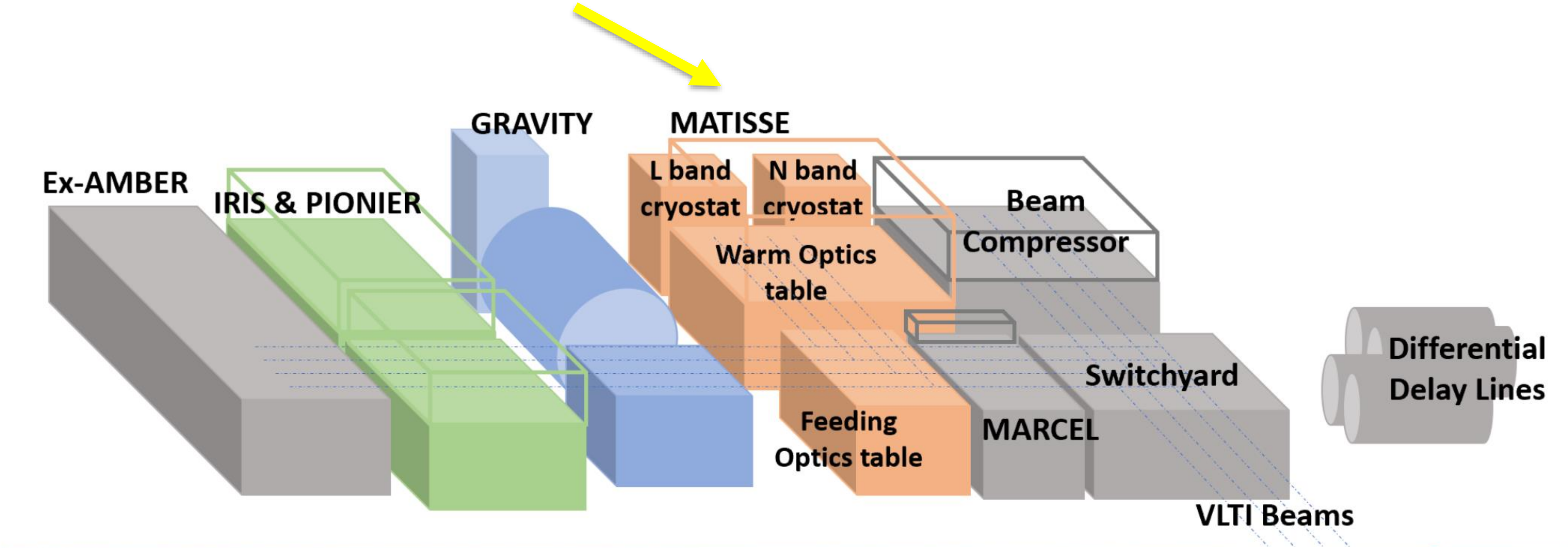
MATISSE in the VLTI focal lab








GRAVITY
MATISSE
Ex-AMBER
IRIS & PIONIER
L band cryostat
N band cryostat
Beam Compressor
Warm Optics table
Differential Delay Lines
Switchyard
Feeding Optics table
MARCEL
VLTI Beams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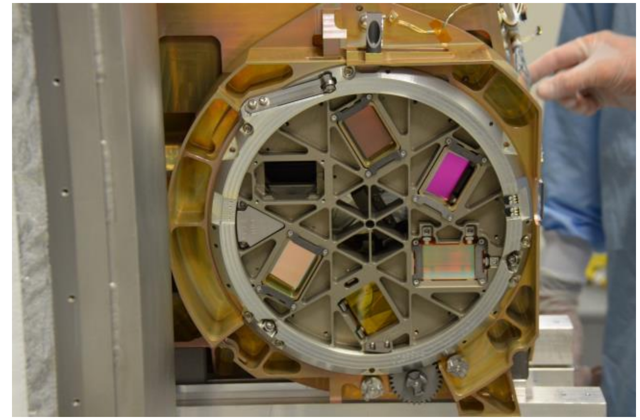
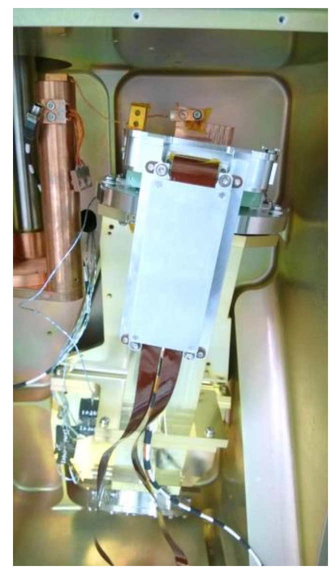
MATISSE Consortium

MPIA Heidelberg



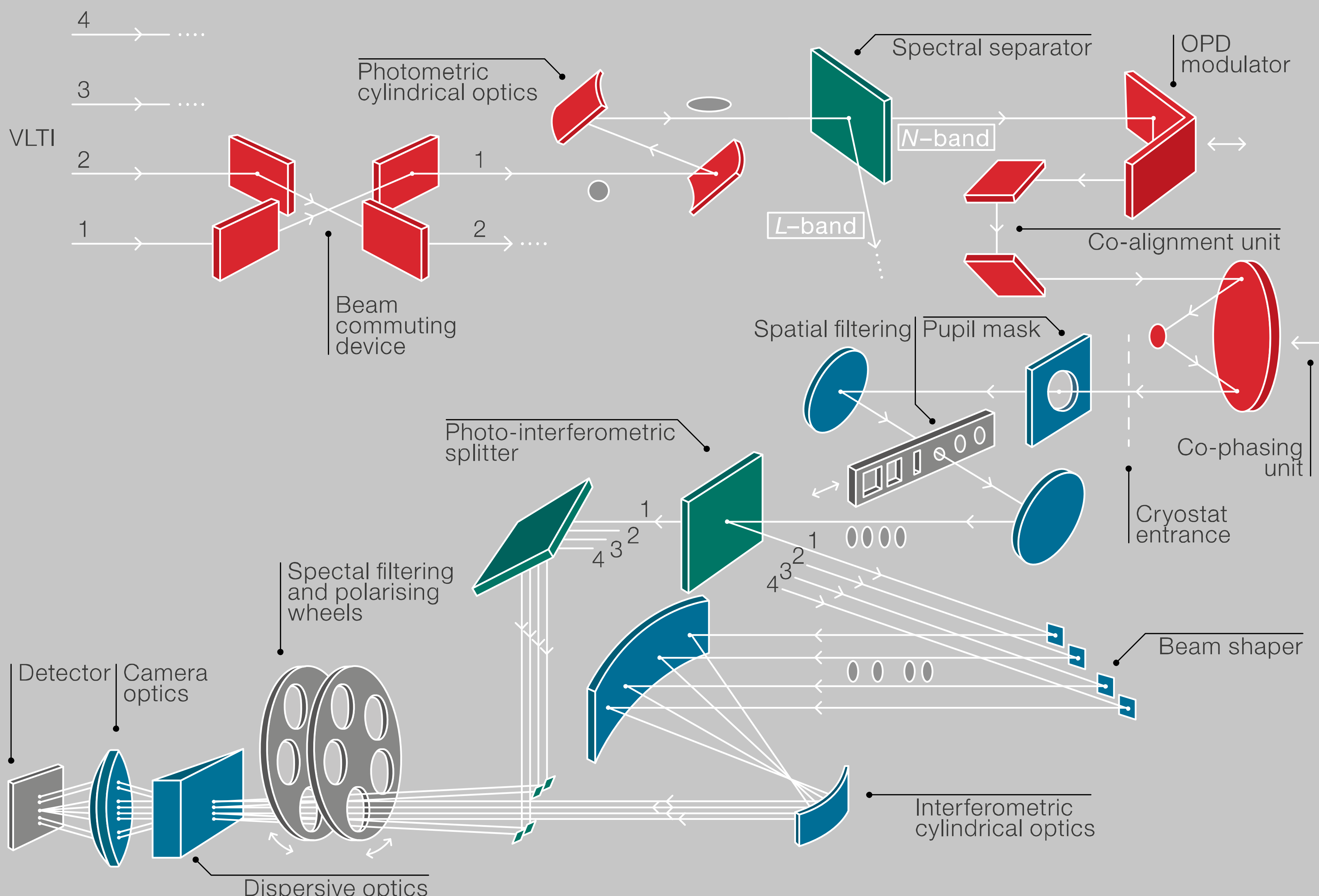
NOVA - ASTRON

OCA/LAGRANGE



MPIfR Bonn

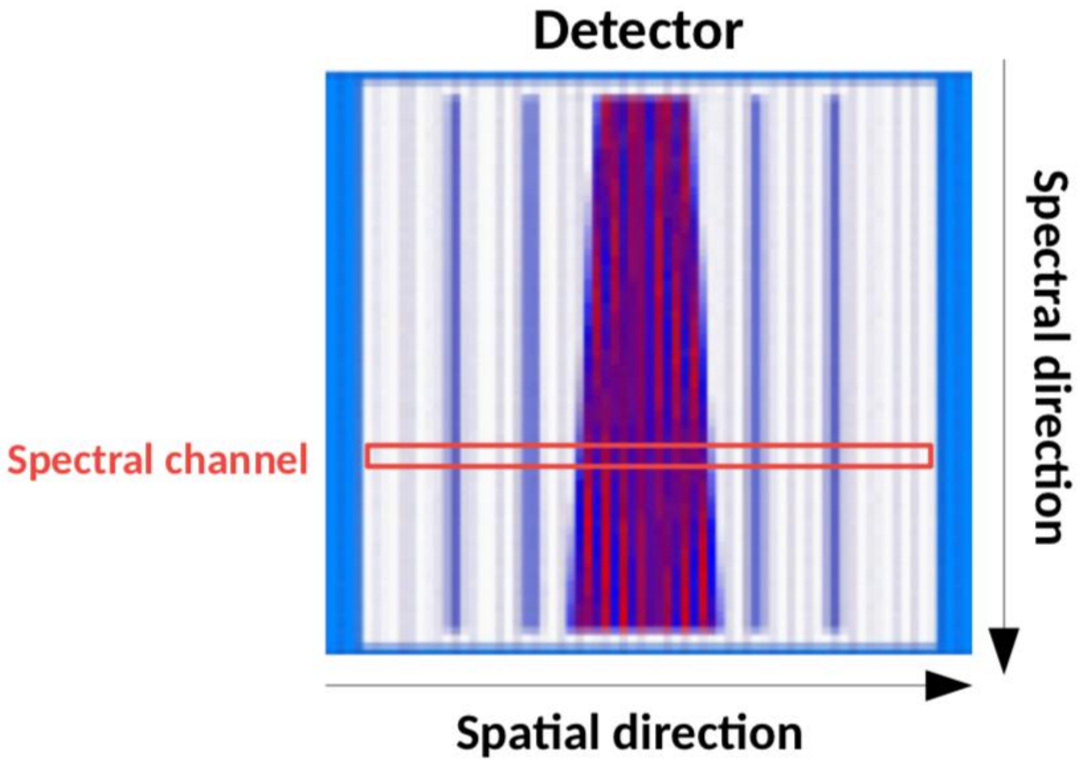
ESO



4
3
VLTI
2
1
Photometric cylindrical optics
Spectral separator
OPD modulator
N–band
L–band
1
2
Beam commuting device
Co-alignment unit
Spatial filtering
Pupil mask
Co-phasing unit
Cryostat entrance
Photo-interferometric splitter
1
2
3
4
1
2
3
4
Spectal filtering and polarising wheels
Beam shaper
Detector
Camera optics
Interferometric cylindrical optics
Dispersive optics

The signal on the detector(s)

Sky + Object



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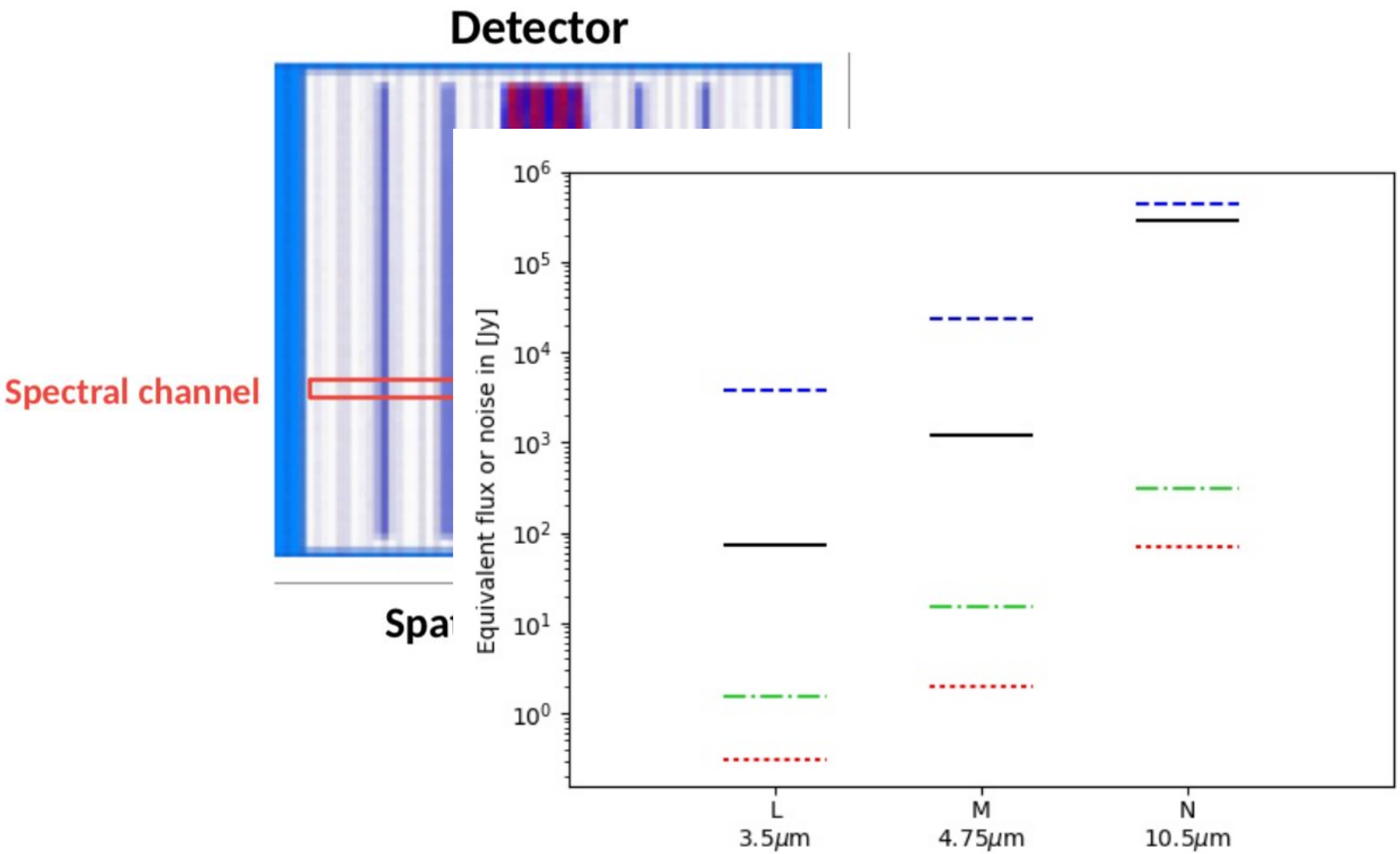
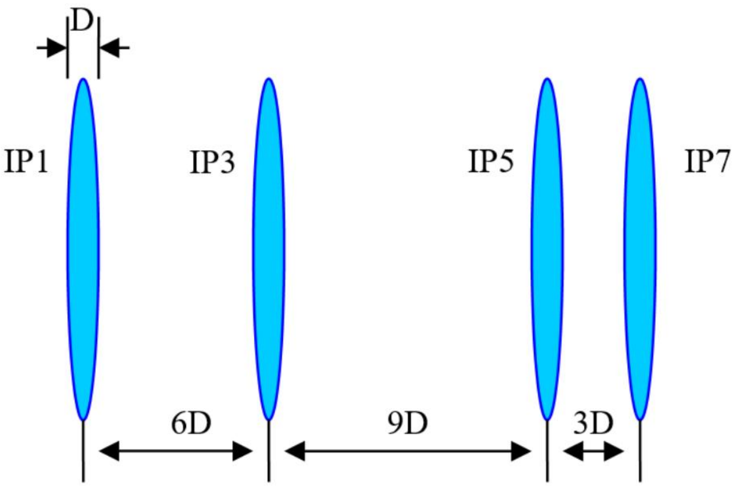
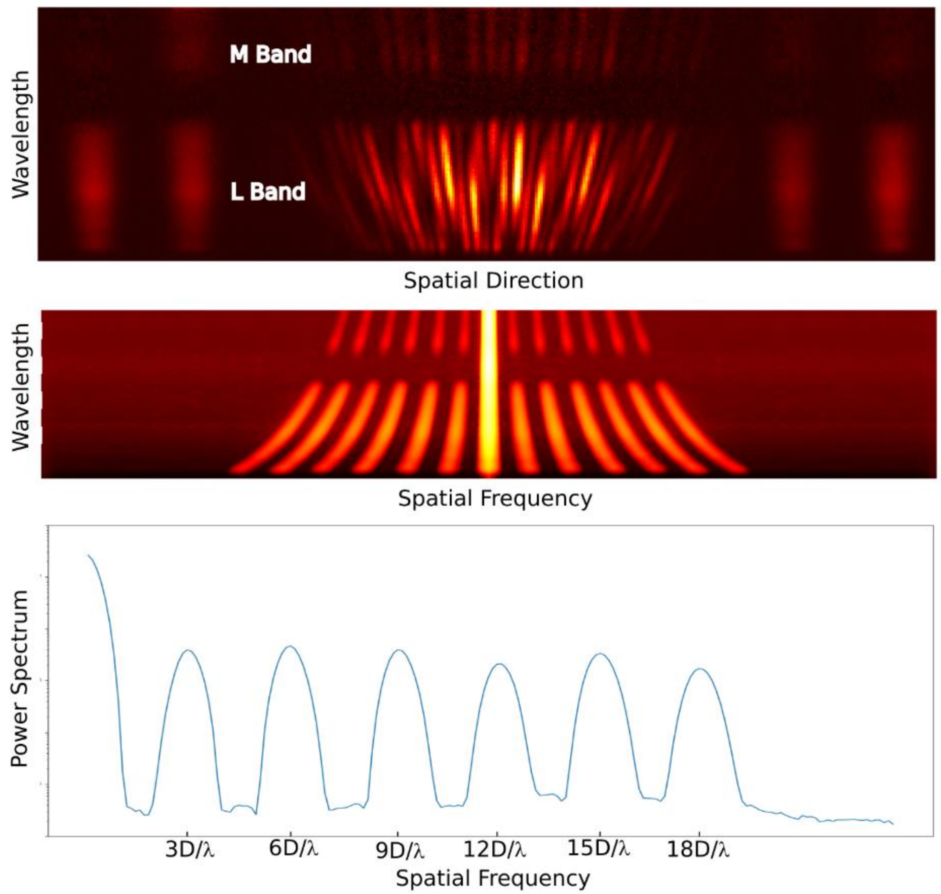
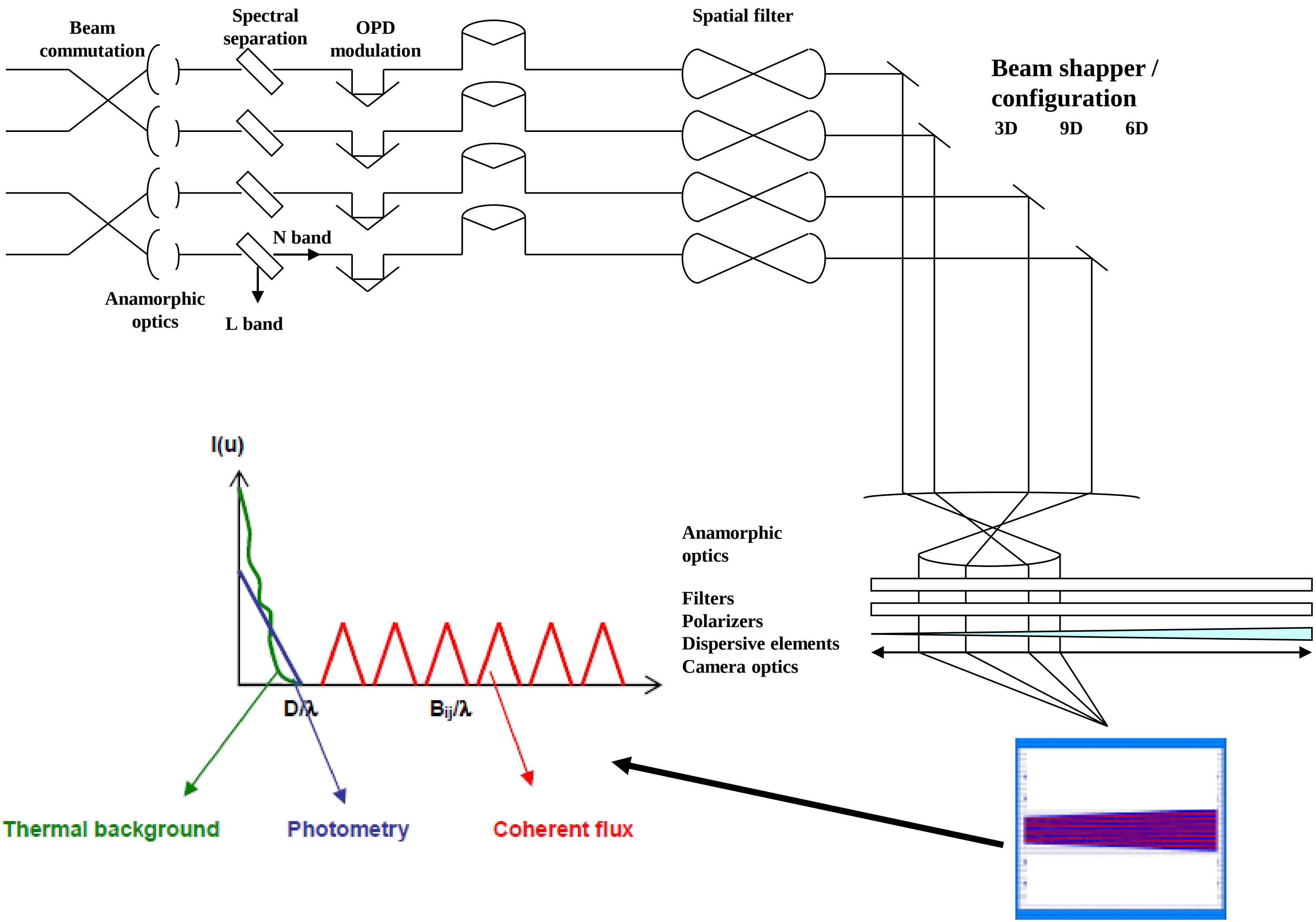


The pupil configuration and the shaping of the signal





The fringes and their Fourier transform



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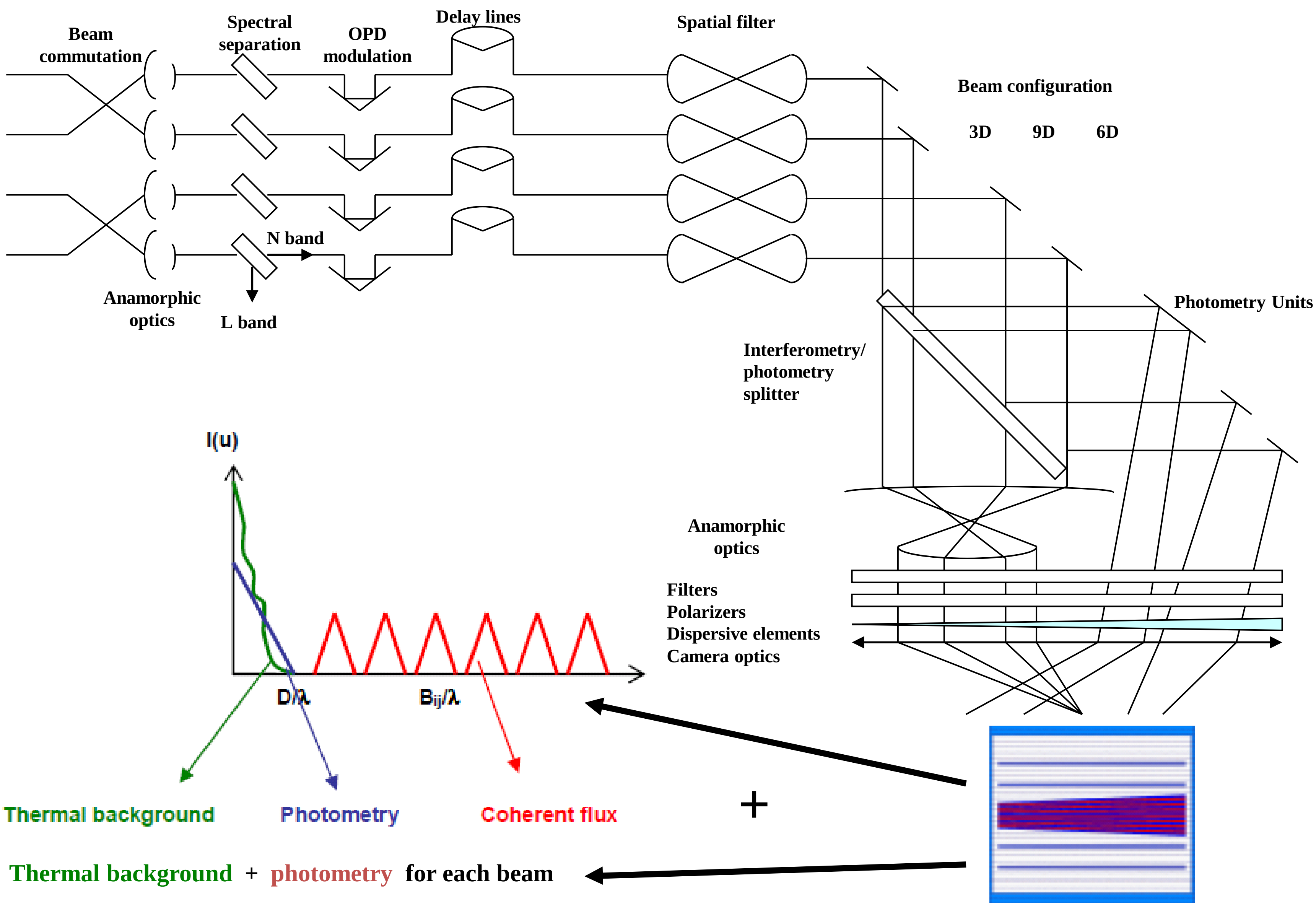
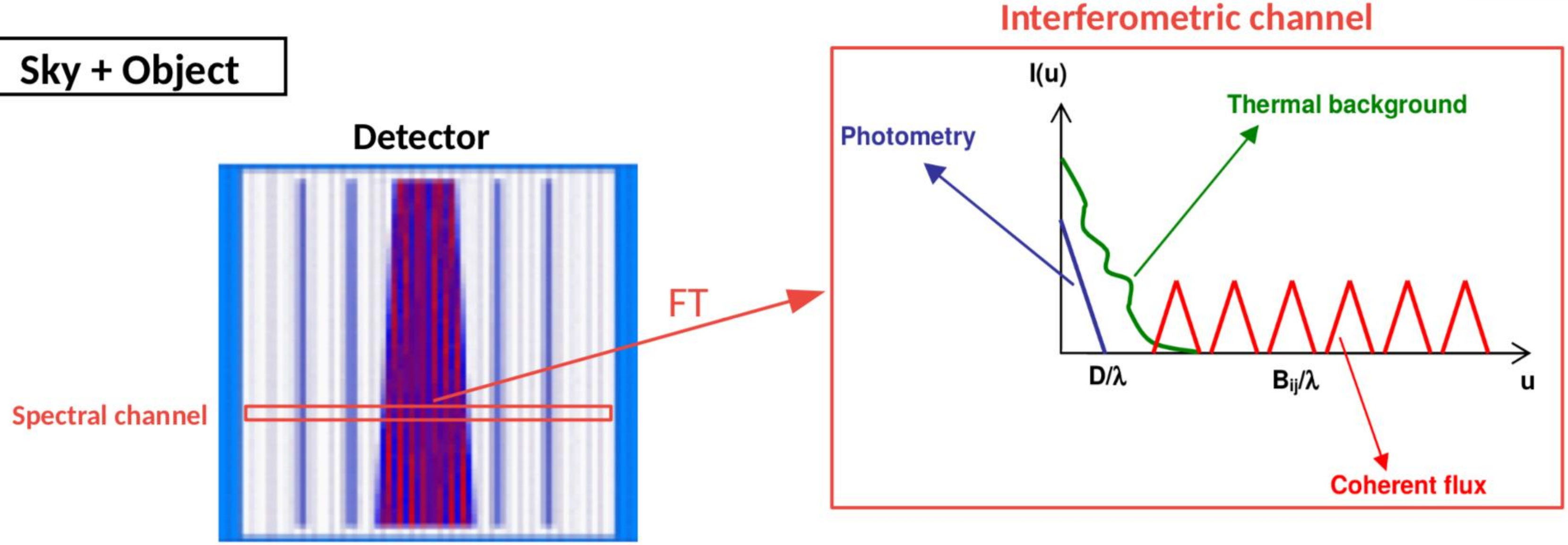


The fringes and their Fourier transform

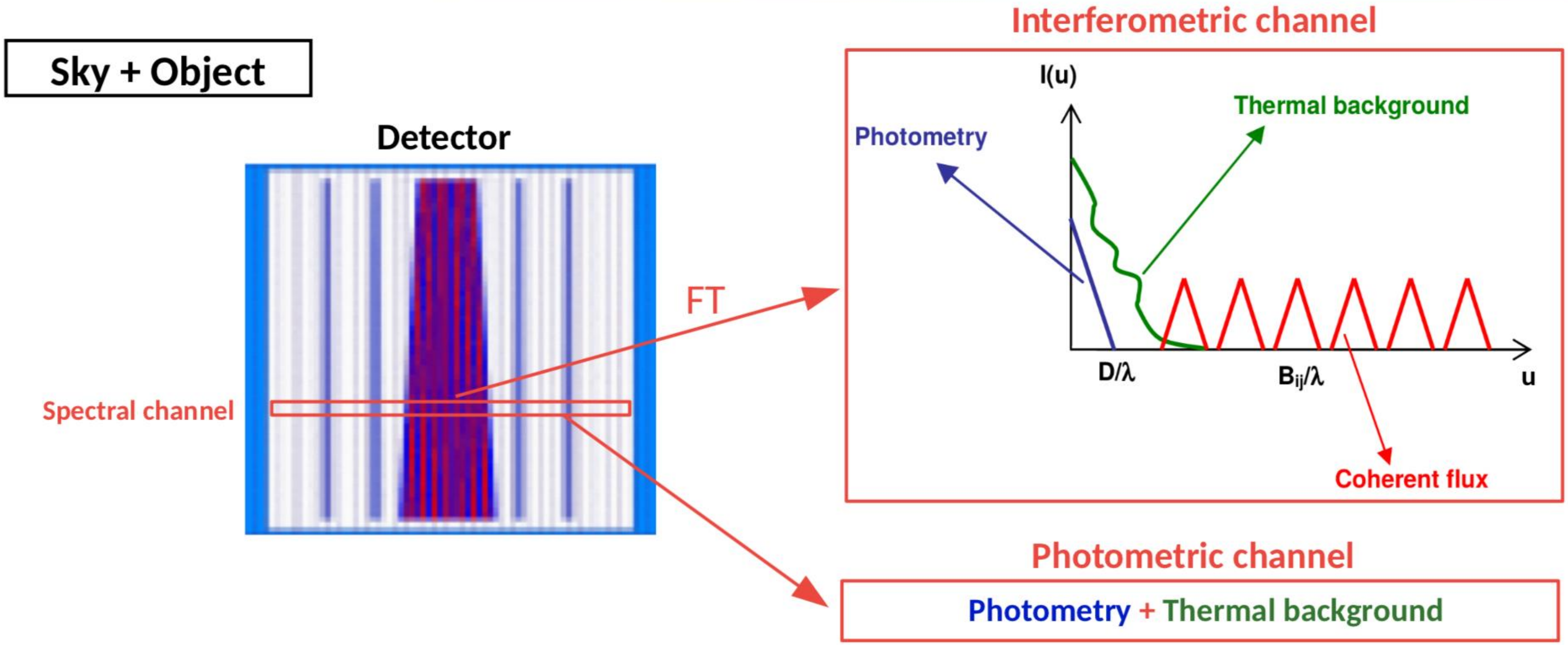
Sky + Object



Thermal background   Photometry   Coherent flux

Interferogram: $$I(u) = M_b(u).\sum_{i=1}^{4} n^I{}_{bi} + M(u).\sum_{i=1}^{4} n^I{}_i + \sum_{i=1}^{4}\sum_{\substack{j=2\\ j>i}}^{4} M(u - u_{ij}).\sqrt{n^I{}_i . n^I{}_j}\, V_{ij}$$

The fringes and their Fourier transform



Thermal background Photometry Coherent flux

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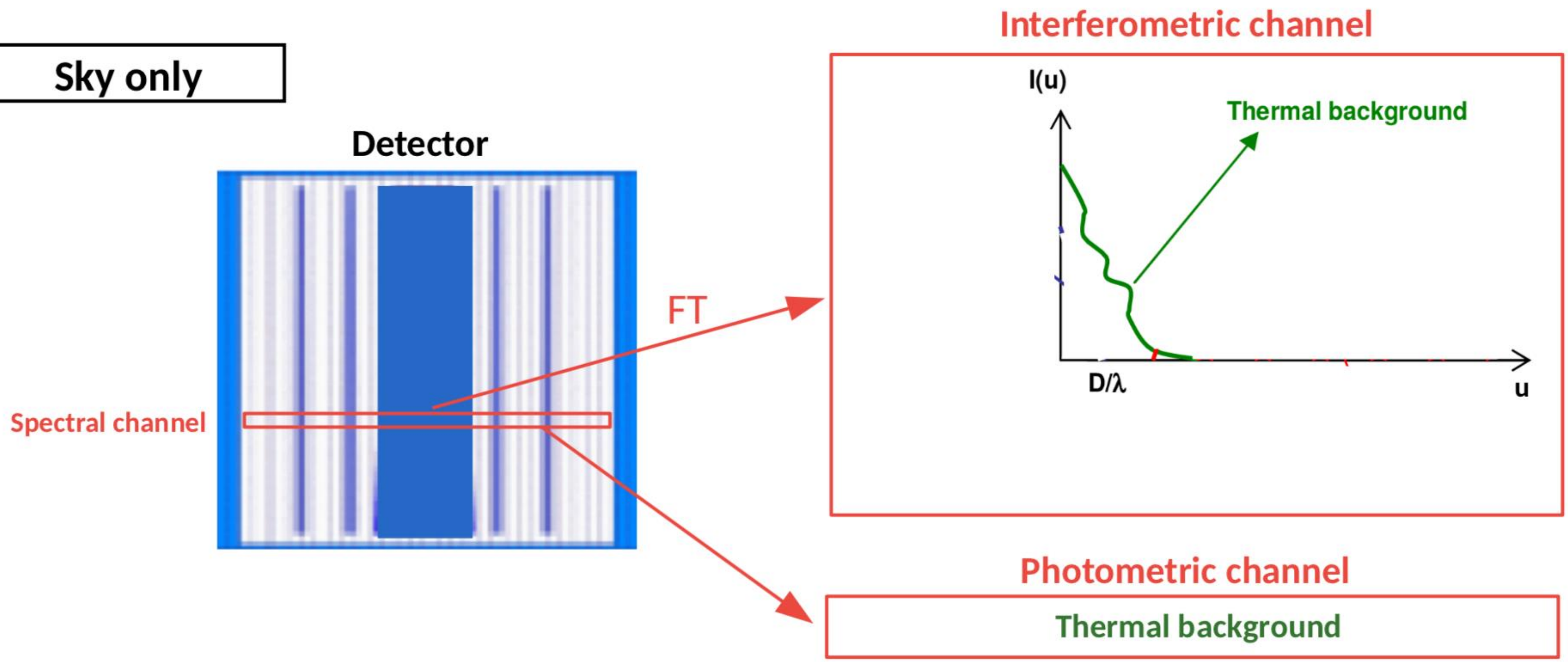
Photometry: $$P_i(u) = [M_b(u).n^P{}_{bi} + M(u).n^P{}_i]$$

The fringes and their Fourier transform

Sky only

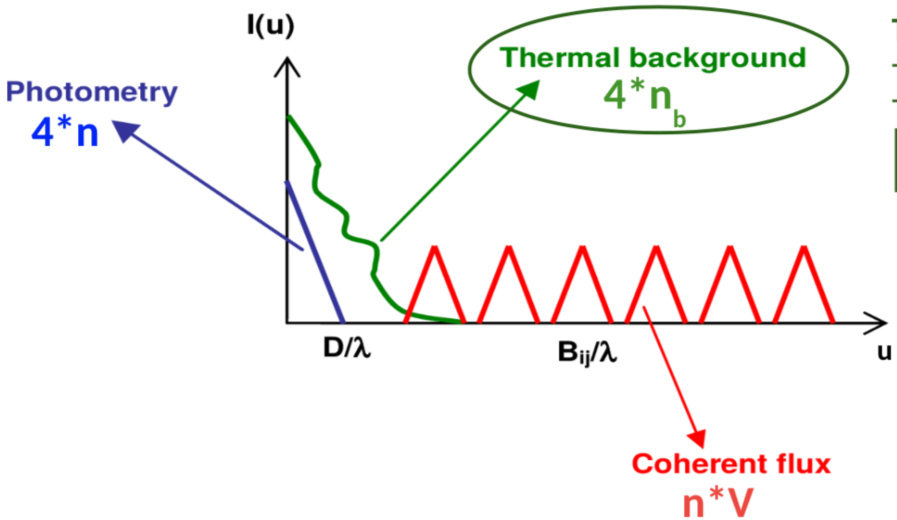


Thermal background

« **Interferogram** » : $$I_S(u) = M_b(u).\sum_{i=1}^{4} n^{I}{}_{bi}$$

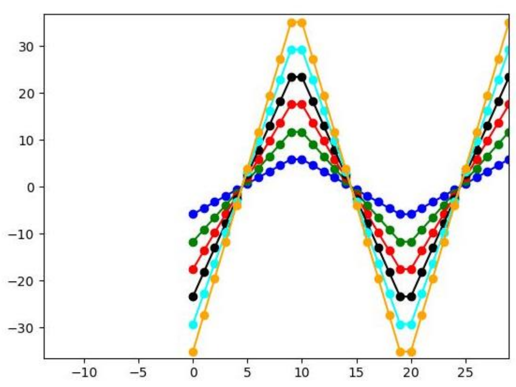
Photometry : $$S_i(u) = M_b(u).n^{P}{}_{bi}$$

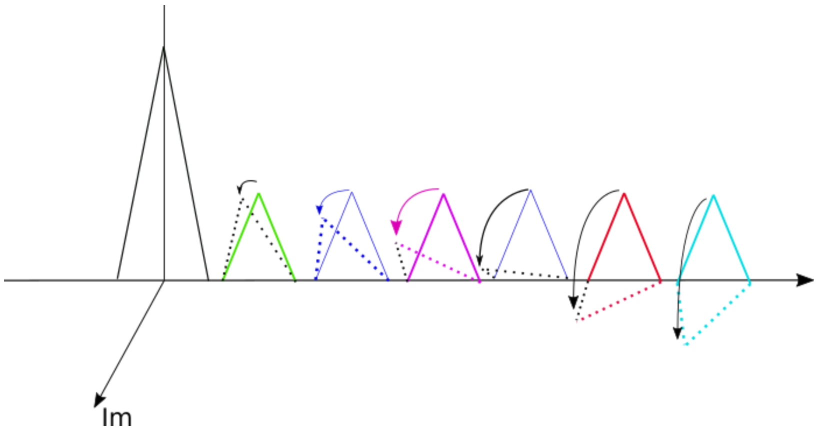
The role of the OPD – Optical Path Difference - modulation



Thermal background peak suppression at a given spatial frequency
→ Multi-axial recombination
→ OPD modulation

However, residual contamination of the fringe peaks (Detector windowing effect)





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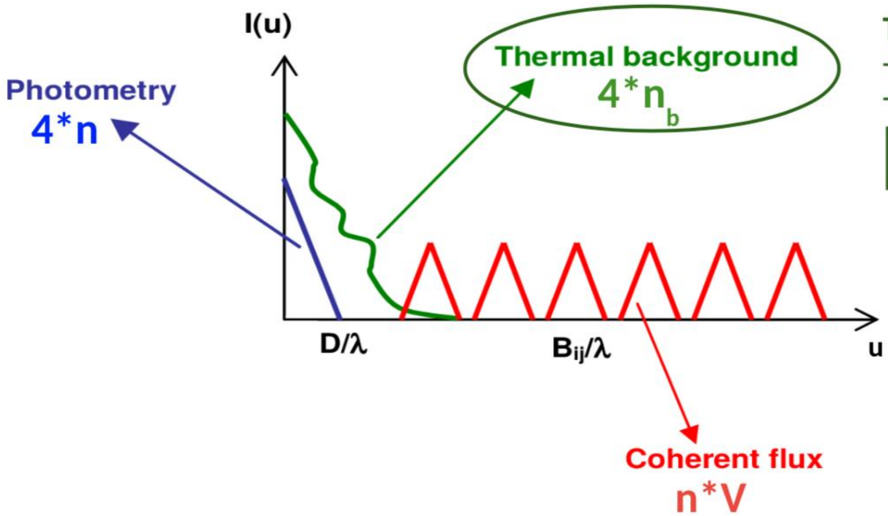


Thermal background peak suppression at a given spatial frequency
→ Multi-axial recombination
→ OPD modulation

However, residual contamination of the fringe peaks (Detector windowing effect)

Coherent flux

$$SNR_C = \frac{n\,V}{\sqrt{4n_b + 4n + n_p RON^2 + 16\gamma^2 n_b^2}}$$

(Per frame)

Thermal background photon noise

Science target photon noise

Detector read out noise

Thermal background contamination in fringe peak

MATISSE ETC

https://www.eso.org/observing/etc/bin/gen/form?INS.NAME=MATISSE+INS.MODE=CFP

Instrument Properties

Observing Mode: Hybrid / LowLM / LowN / LinternalFringeCoherencer

LM central wavelength μm

Target Properties

Target Spectrum:

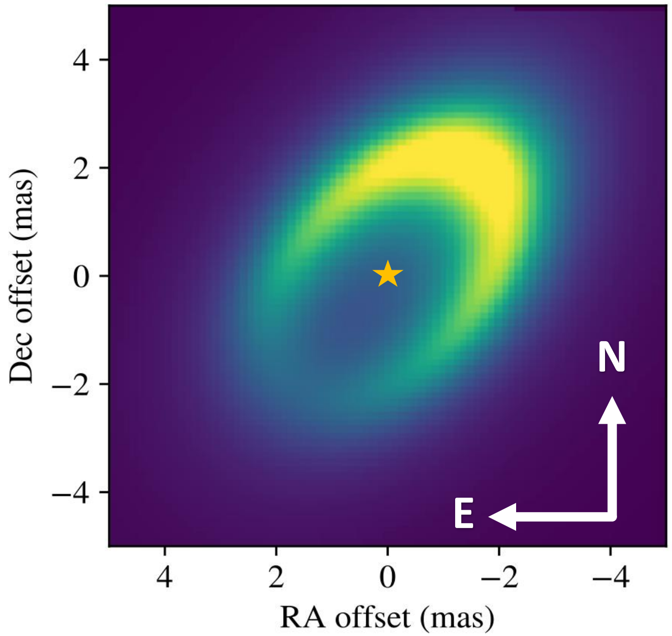
◉ Blackbody:	Temperature: 1000.00 K	Target Flux: 1.0 Jy in L
○ Power Law	Index: 0.000 $F(\lambda) \propto \lambda^{index}$	

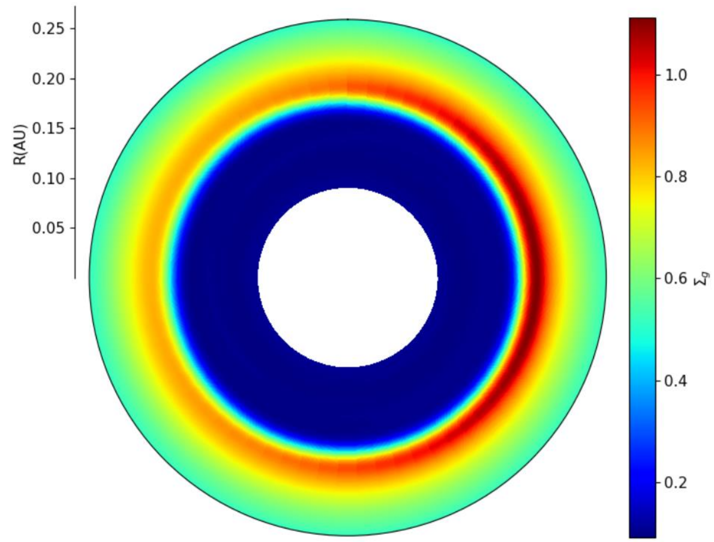
Target geometry:

◉ Uniform Disc:	Diameter:	1.0	mas
○ Gaussian:	FWHM:	1.0	mas
○ Elliptical Gaussian:	Major axis:	1.3	mas
	Minor axis:	0.9	mas
	Position Angle:	0	deg *(*)*
○ Binary:	Diameter, Primary:	1.0	mas
	Diameter, Secondary:	1.0	mas
	Separation:	1.5	mas
	Position Angle:	0	deg *(*)*
	Flux Fraction, Primary:	0.5	*(**)*

The asymmetric inner disk of the young star HD 163296

J. Varga et al., 2021, A&A.





Mid-infrared circumstellar emission resolved around the Cepheid ℓ Carinae with VLTI/MATISSE

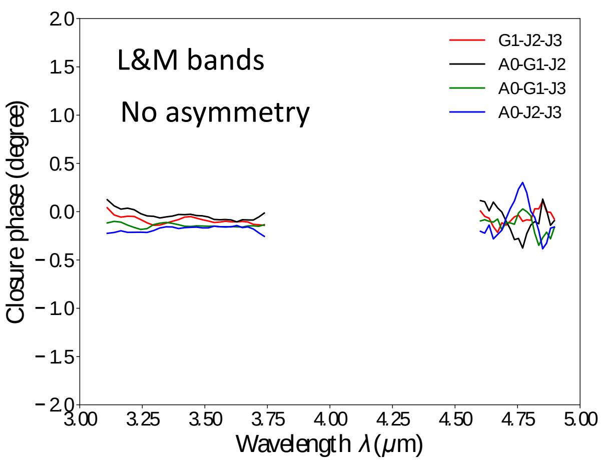
V. Hocdé et al., 2021, A&A.

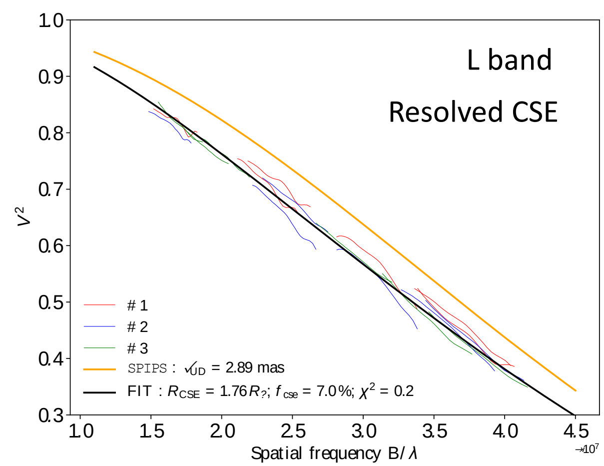
Nature of the circumstellar envelopes of Cepheids

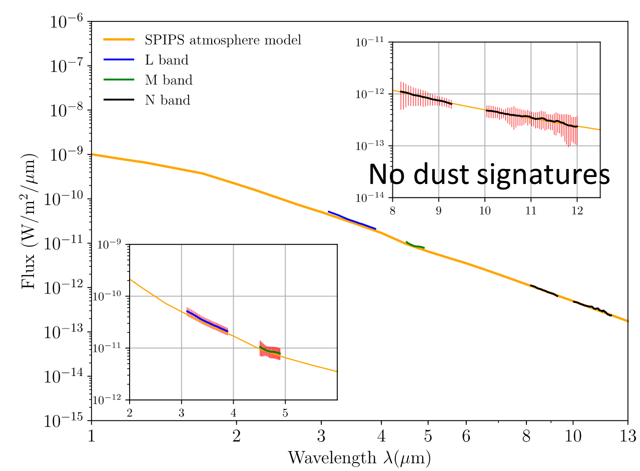
Shell of ionized gas at 1.15 R_{star} ? (Hocdé et al. 2020a)
Chromosphere at 1.50 R_{star} ? (Hocdé et al. 2020b)

- From closure phase : no asymmetry in L, M and N
- From total and coherent fluxes : No dust signature
- From V^2 : Resolved environment in L band

  (CSE model : Gaussian)
  R_{CSE} = 1.76 +/-0.28 R_{star}
  f_{CSE} = 7.0 +/-1.4%





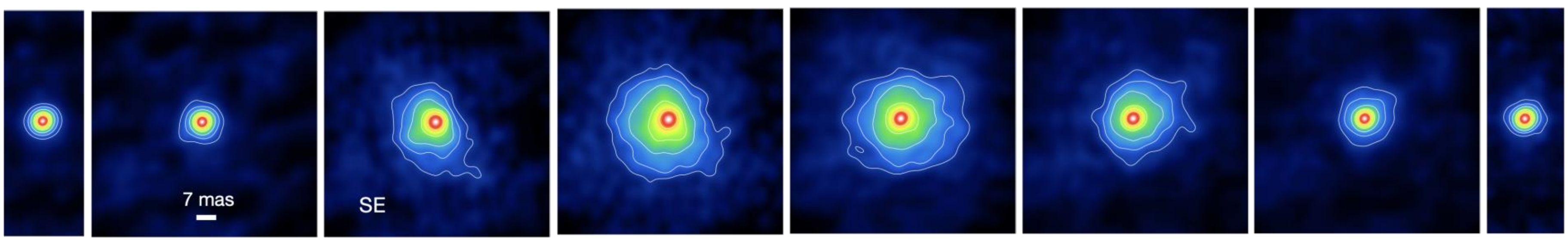


Imaging of Eta Car's wind collision cavity at periastron passage (Feb 2020):

Velocity-resolved images across the Br α 4.05 µm line (G. Weigelt et al., submitted to A&A)

MATISSE

Velocity-resolved images at LOS radial velocities from -927 to +685 km/s (FOV = 80 mas; resolution = 7 mas; R = 959)



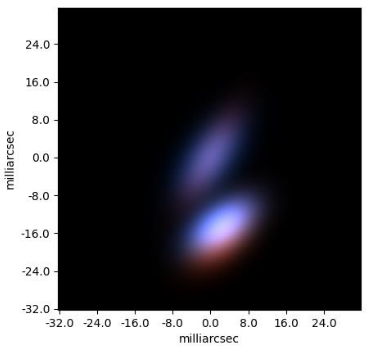
-927 km/s -693 km/s -443 km/s -222 km/s -8 km/s +207 km/s +439 km/s +685 km/s

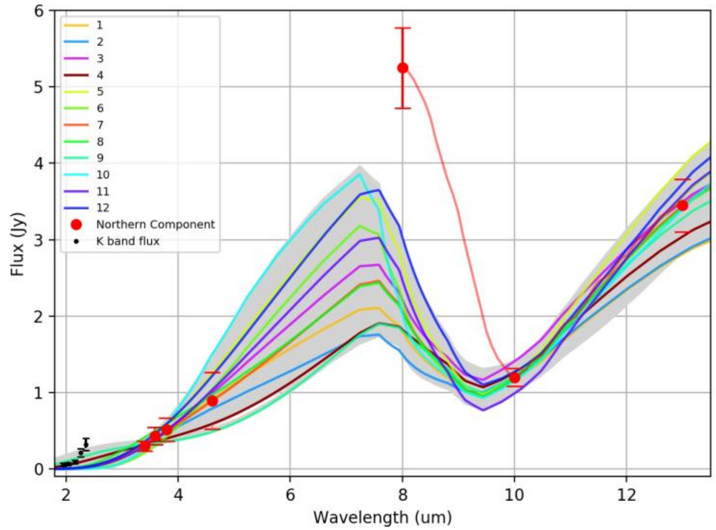
LOS radial velocities

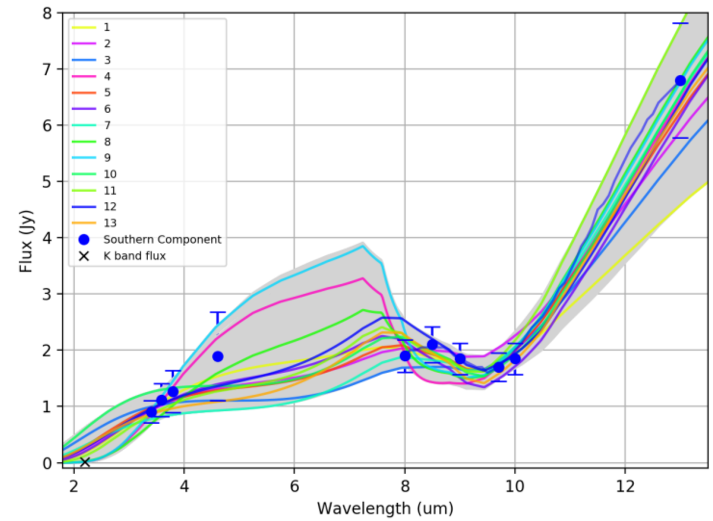
- Dependence of the intensity distributions of the wind-wind collision cavity on LOS radial velocity
- Diameter of the spatially and spectrally resolved wind collision region: ~ 40 mas (~ 94 au; 1 mas = 2.35 au)
- In blue-shifted light (e.g. -443 km/s): Extension of the images to the SE in agreement with wind collision models
- Diameter of the resolved stellar wind of the primary star: ~ 2 mas (for comparison, the radius of the primary is ~ 0.20 mas)
- The MATISSE observations allow us to constrain stellar wind and wind collision models (Hillier + 2001, Madura + 2013)

Models of the nuclear emission from NGC 1068 constructed from MATISSE data

V. Gamez et al. in preparation.







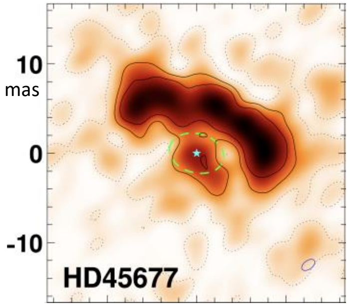
The image at left shows a color representation of a 2-component gaussian fit to the multiwavelength data.

We provisionally identify the Northern component with the disk found by MIDI and GRAVITY.

The color shifts of the Southern component indicate a temperature gradient. The plots show 2-blackbody fits to the emission spectra of the Northern (left) and Southern components, with MIDI and GRAVITY data also indicated.

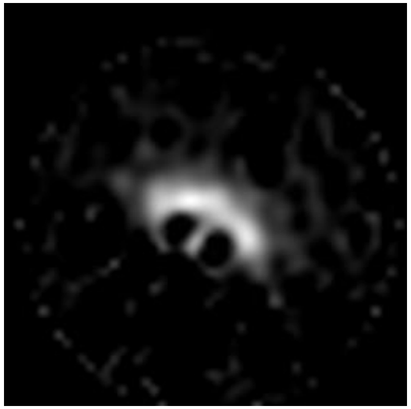
Imaging of the unclassified B[e] star FS CMa (HD 45677) in the L- & N-bands

(K.-H. Hofmann et al., in preparation)

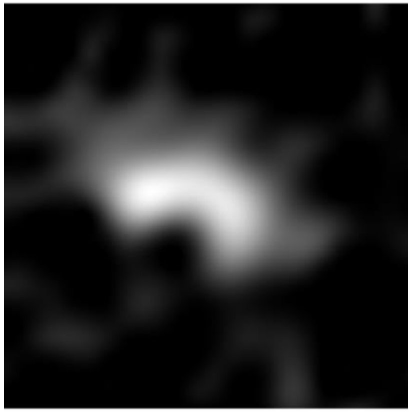


1.6 µm PIONIER image (Kluska + 2020)

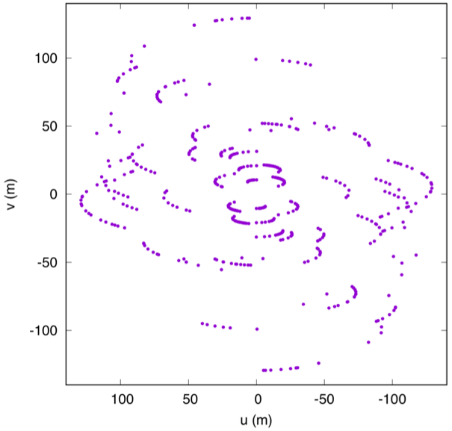
3.4 - 3.8 µm L-band image



8.6 - 9.0 µm N-band image



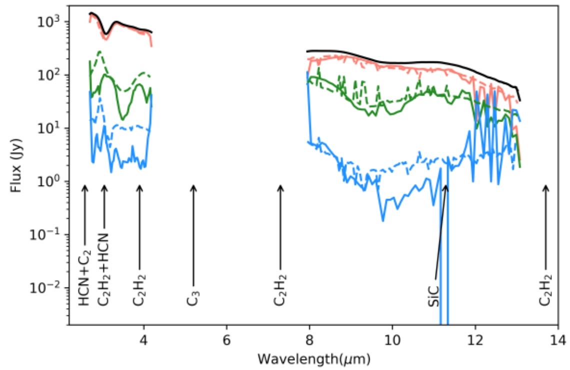
uv coverage



- L- and N-band aperture-synthesis images of FS CMa reconstructed in the wavelength bands of 3.4 - 3.8 and 8.6 - 9.0 µm (FOV: 64x64 mas; North is up, and East is to the left).
- The size of the resolved inner dark disk gap in the L-band image is about 6x12 mas.
- In the bright, inner north-western disk region, we are directly looking at the inner disk rim wall, which is not in the disk shadow as the south-eastern rim region.
- The N-band image shows only the north-western disk region. The disk is much more extended to larger radii than in the L band.

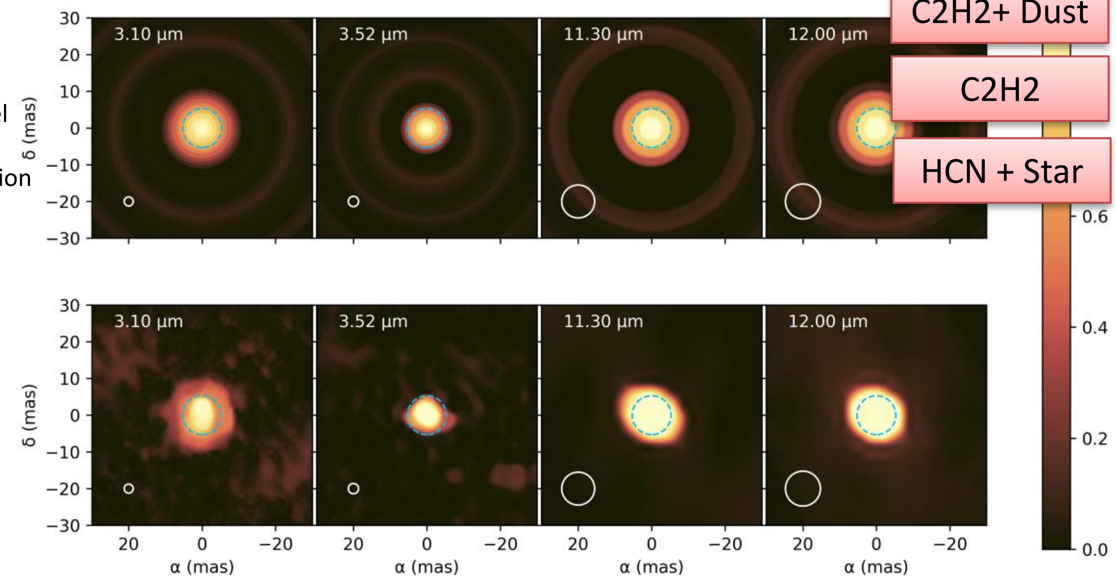
Imaging of the carbon star R Scl (J.Drevon et al., in preparation)

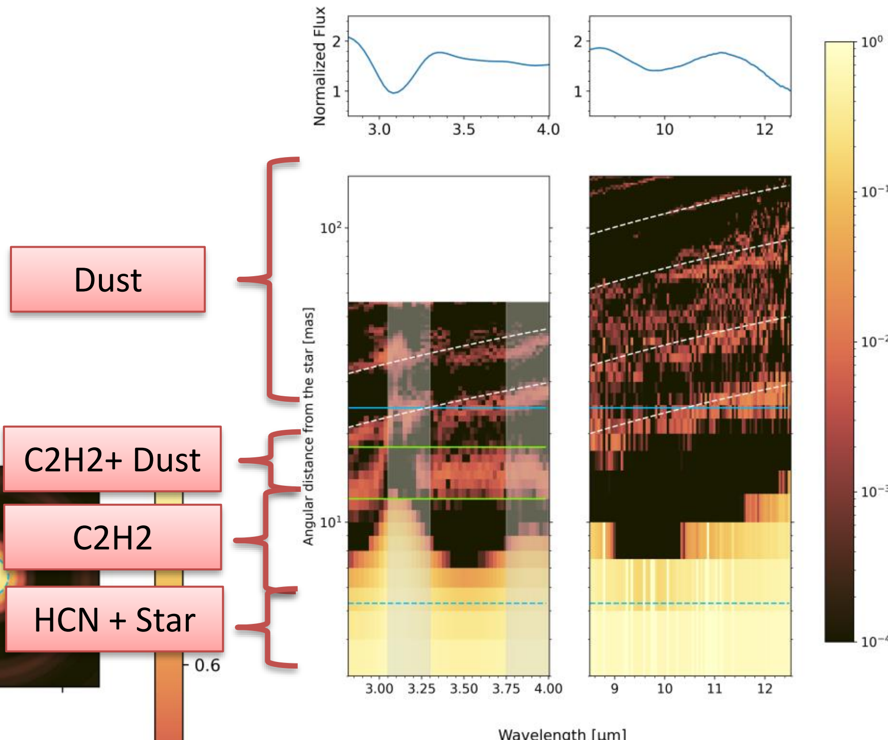
Locating molecules and dust ➔

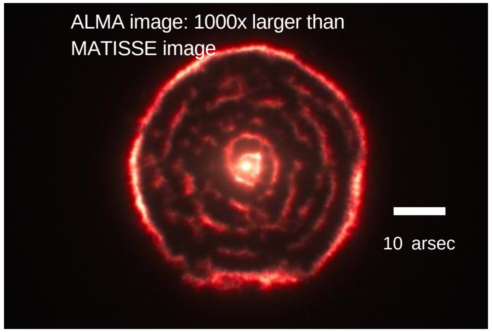


1D Hankel Profile reconstruction

MIRA image reconstruction



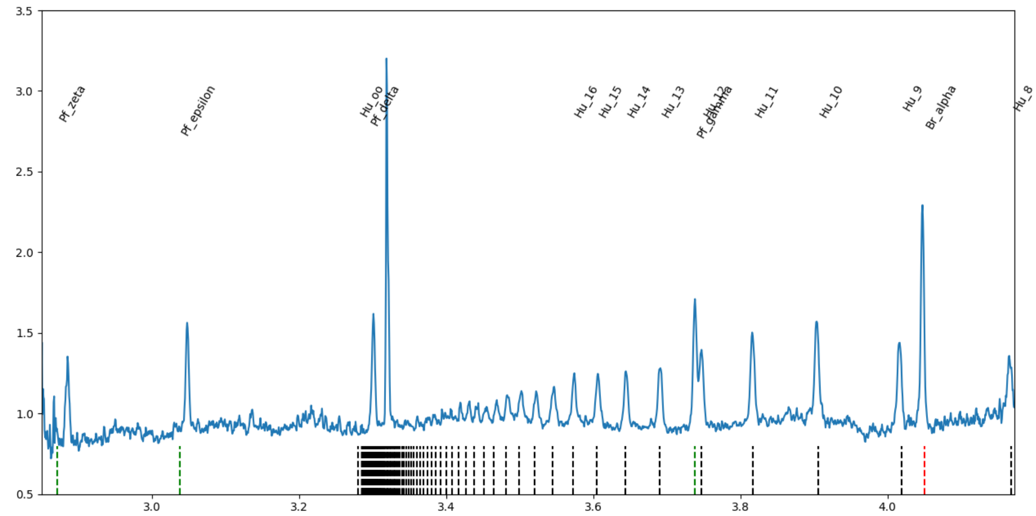




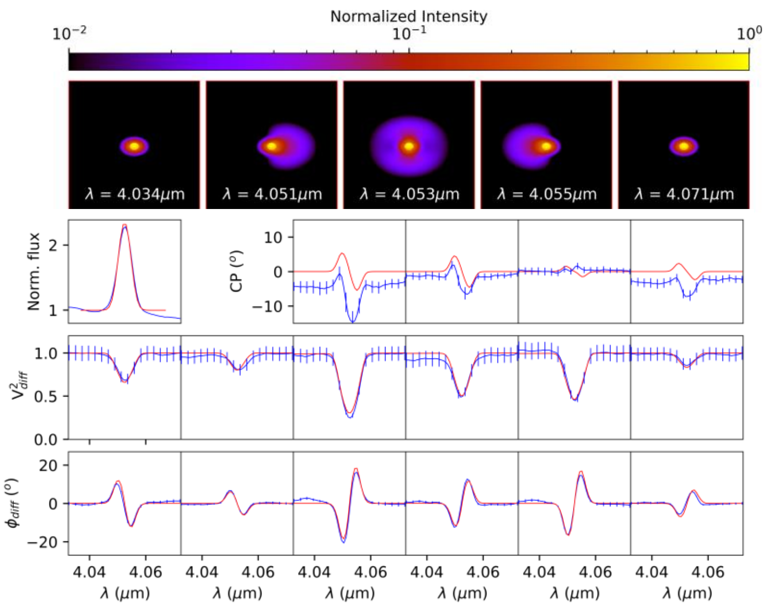
α Ara and other Classical Be stars

(A. Meilland et al., in preparation)

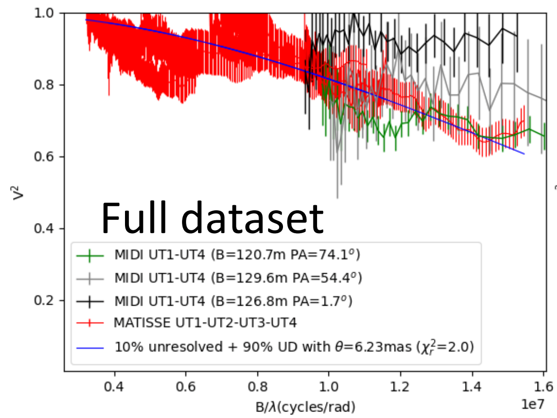
The many emission lines of the L band

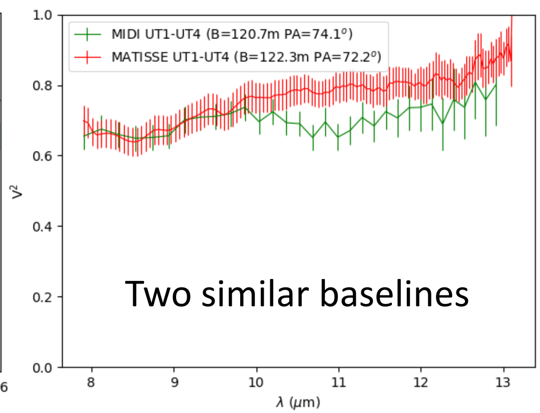


MATISSE High resolution (R≈1000) spectrum in L



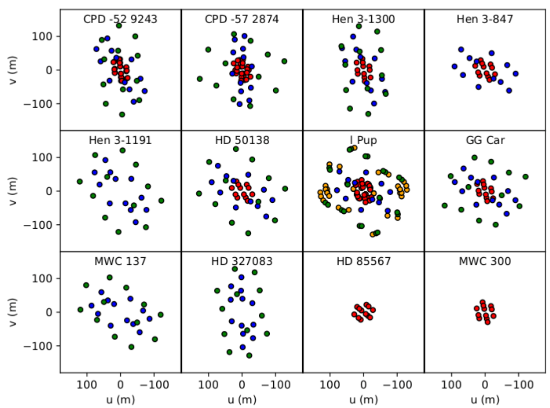
Rotating disk toy-model in the Brα lines



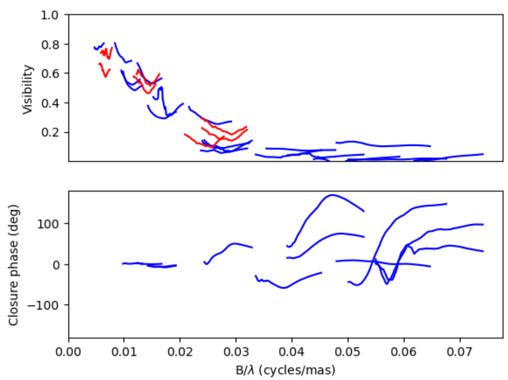


MIDI and MATISSE visibility comparison

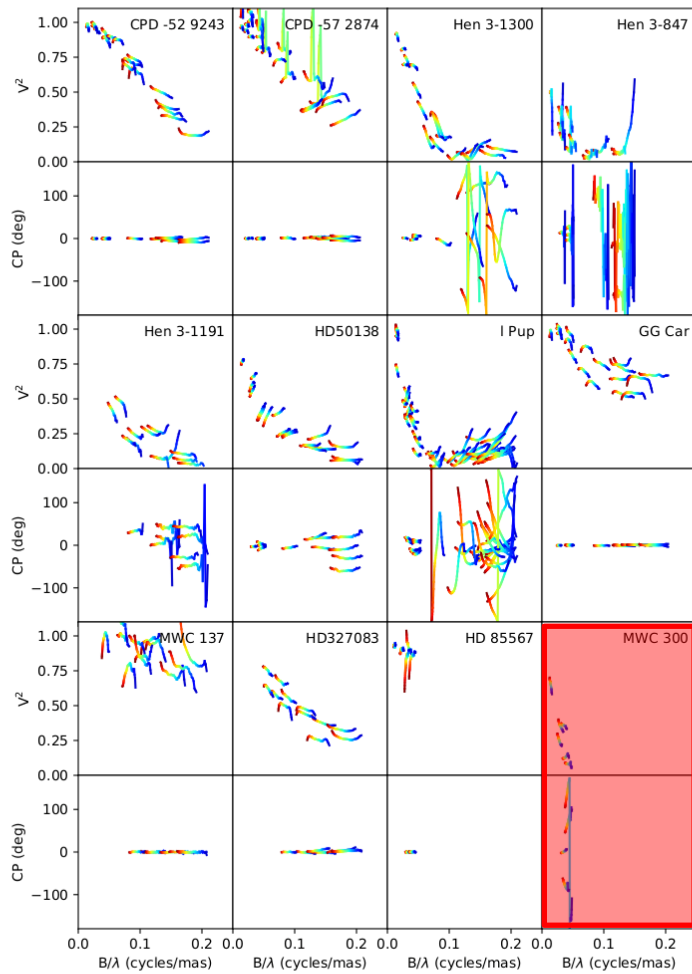
Survey on B[e] stars (A. Meilland et al., in preparation)



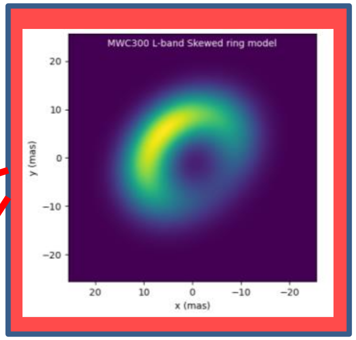
''Good'' u-v plan on 12 B[e] stars
Observations In February 2020



L Pup MIDI (red) MATISSE (blue) comparison

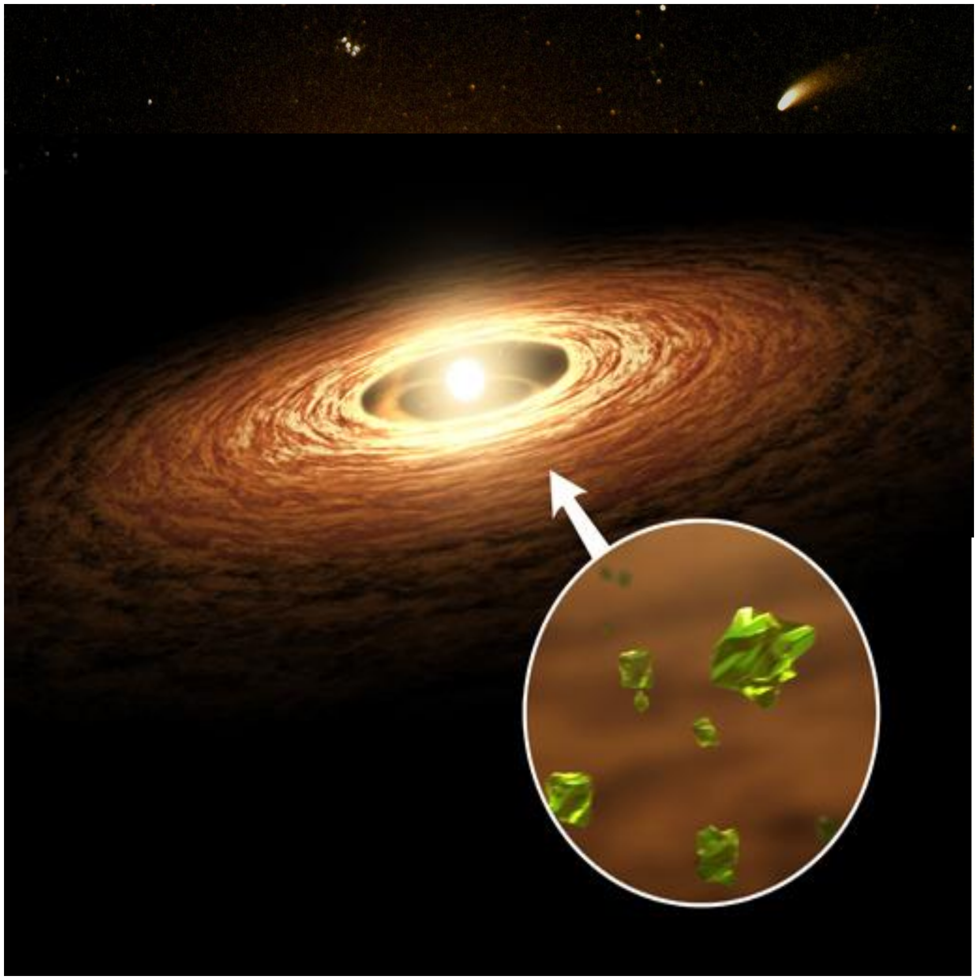


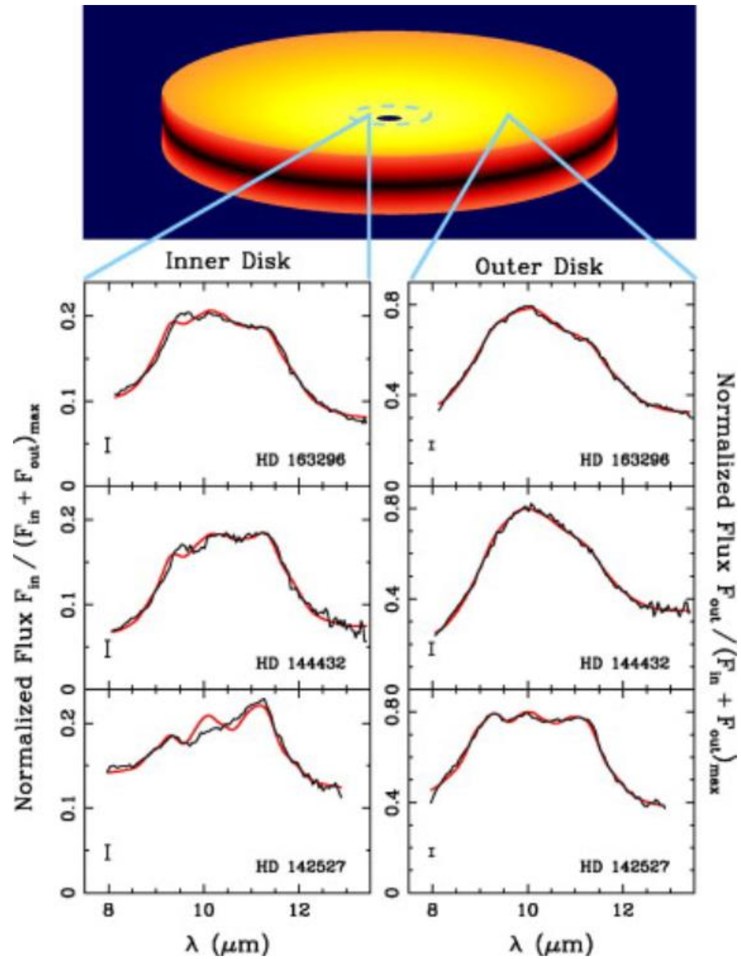
L-band data
All objects at least partially resolved



Example of constraints on inner rim (MWC300)

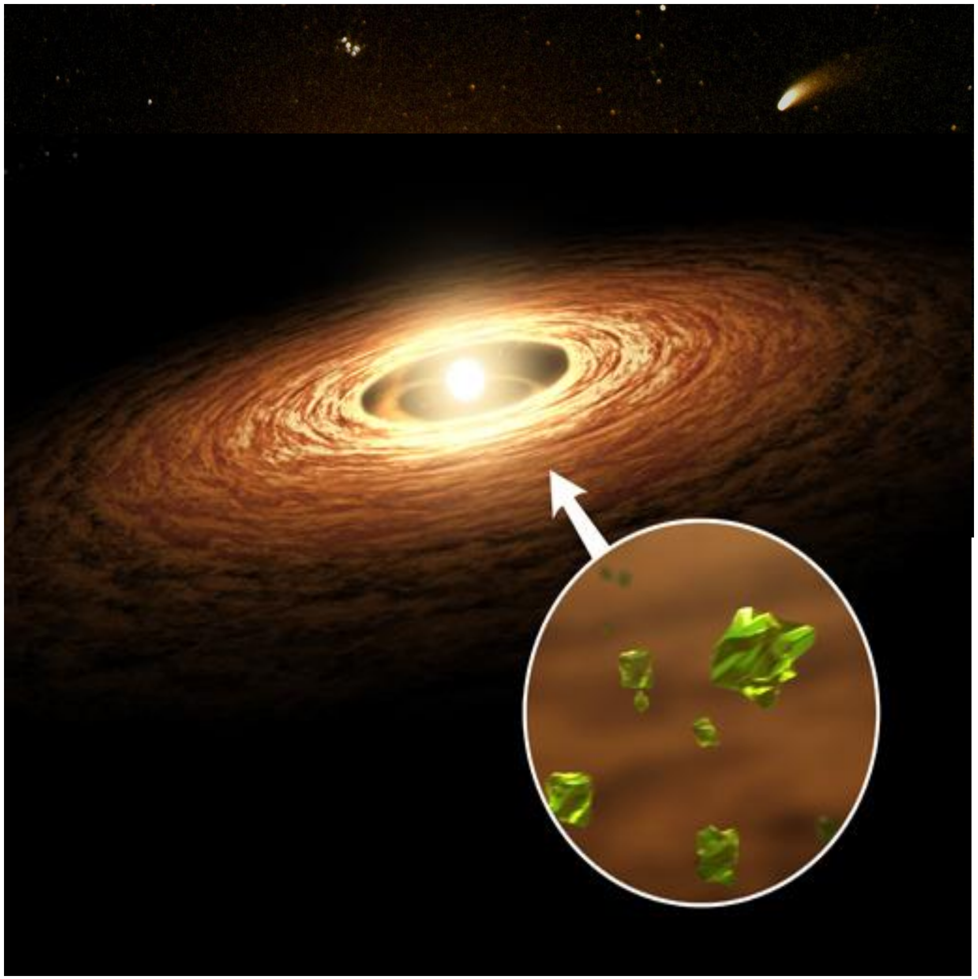
From mineralogy of silicate to carbon solid material

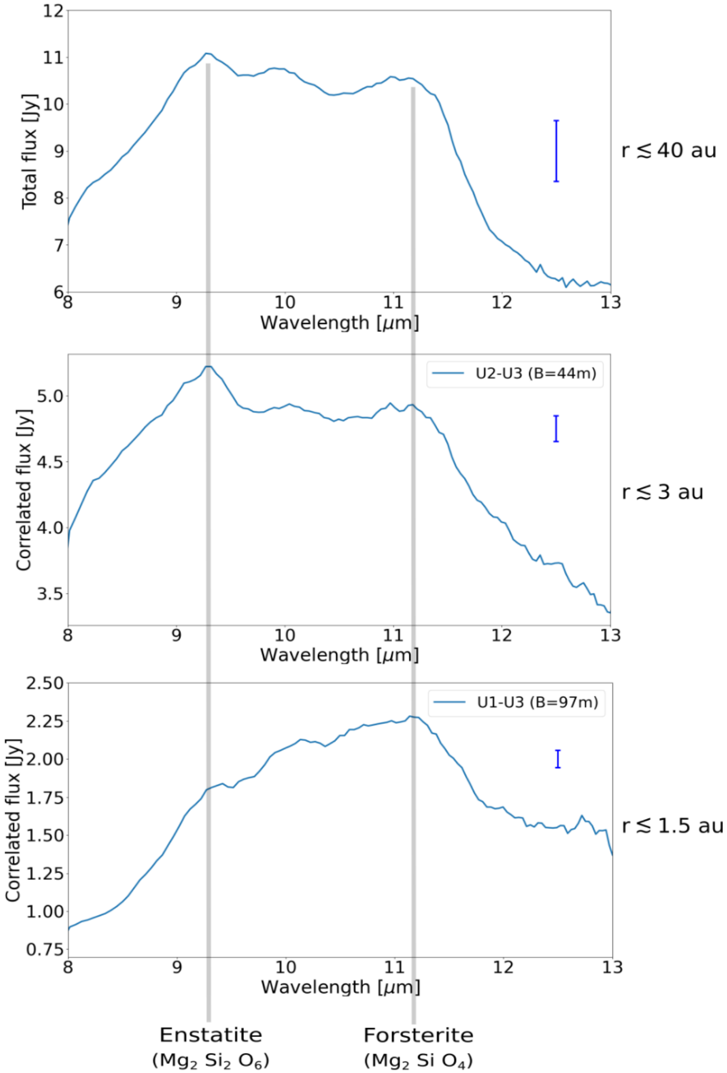




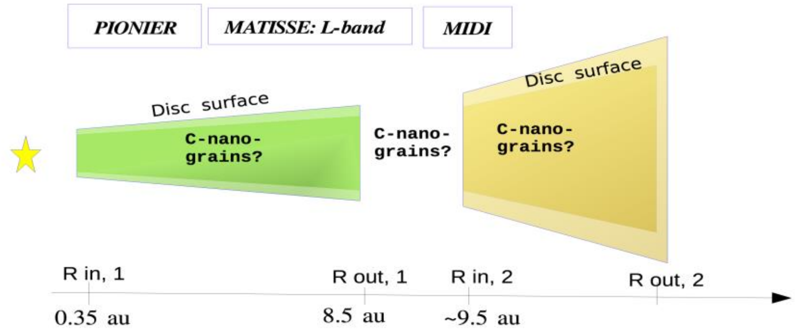
Van Boekle et al. 2004

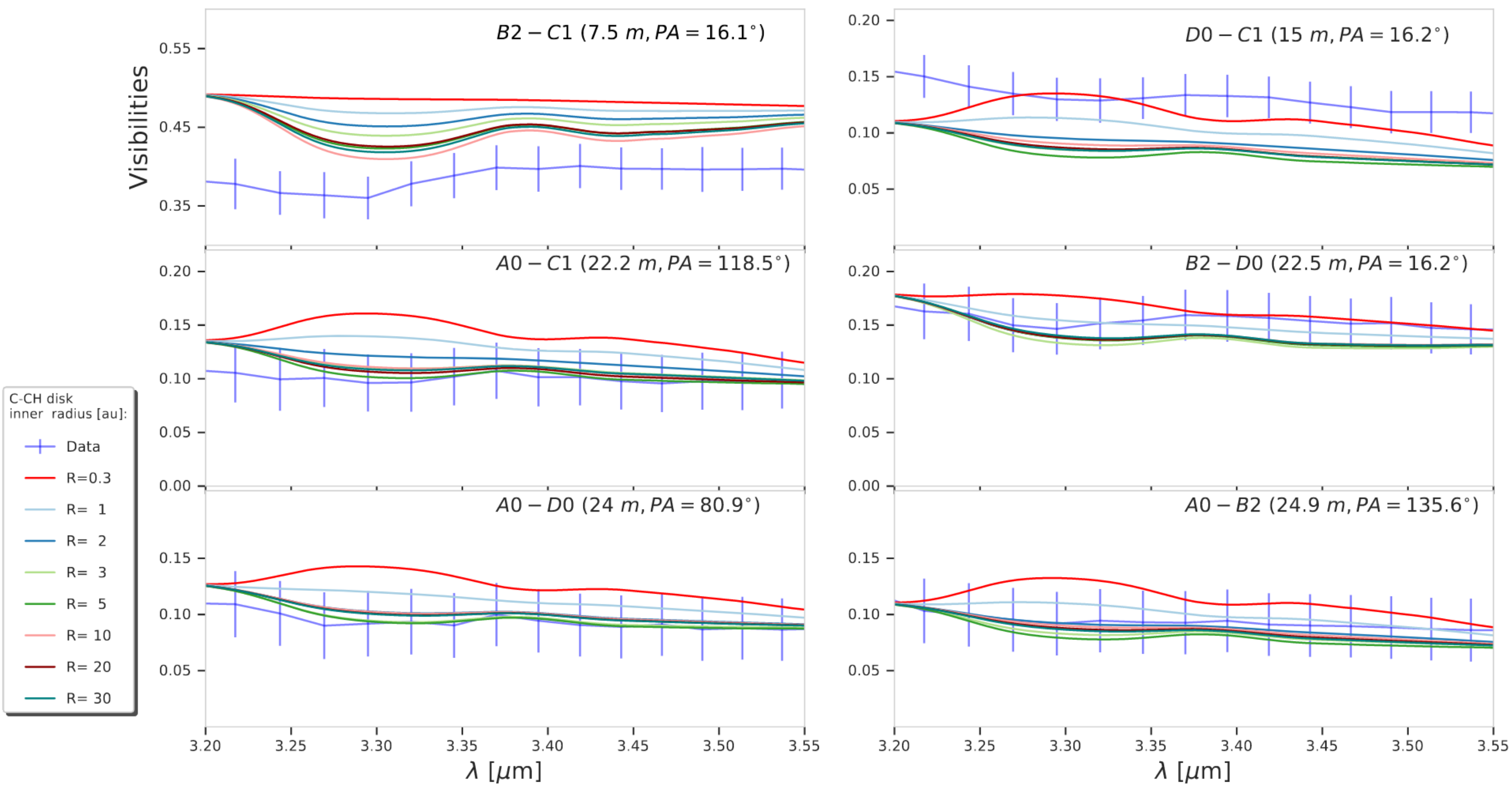
From mineralogy of silicate to carbon solid material





First MATISSE L-band observations of HD 179218. Is the inner 10 au region rich in carbon dust particles? E. Kokoulina et al., accepted for A&A, under revision





https://www.eso.org/sci/facilities/paranal/instruments/matisse/doc.html

MATISSE Documentation

In this page, you will find all the manuals needed to prepare and analyze your observations with MATISSE Please be sure to download that corresponding to the period in which the observations will take place.

All the manuals are in Adobe's Acrobat format.

- **MATISSE User Manual**
  Informations about the instrument itself, its modes and their characteristics.
  - MATISSE User Manual for Periods 103 to 104
  - MATISSE User Manual for Periods 105
  - MATISSE User Manual for Periods 106 to 108
- The **VLTI User Manual** is to be used in addition to the MATISSE manuals for VLTI aspects and limits common to all instruments:
  - VLTI user manual for Period 102
  - VLTI user manual for Period 103
  - VLTI user manual for Period 104
  - VLTI user manual for Period 105
  - VLTI user manual for Period 106
  - VLTI user manual for Period 108
- **MATISSE Template Manual**
  Detailed information on the acquisition, observation, and calibration templates.
  - MATISSE Template Manual for Periods 103 to 104
  - MATISSE Template Manual for Period 105
  - MATISSE Template Manual for Period 106 to 108
- **MATISSE Pipeline Manual**
  The latest version of the pipeline manual for MATISSE can be found on the VLT instrument pipelines webpage.
- **Data Reduction Frequently Asked Questions**
  A list of Frequently Asked Questions on data reduction is also available.

Sensitivity at https://www.eso.org/sci/facilities/paranal/instruments/matisse/inst.html

Setup	AT		UT	
	T≤ 30% Seeing ≤ 0.8" τ_0 > 4.1 ms	T≤ 70% Seeing ≤ 1.15" τ_0 > 2.2 ms	T≤ 30% Seeing ≤ 0.8" τ_0 > 4.1 ms	T≤ 70% Seeing ≤ 1.15" τ_0 > 2.2 ms
Low L-band	1 Jy	1.5 Jy	0.1 Jy	0.15 Jy
Low M-band	5 Jy	9 Jy	0.5 Jy	1 Jy
Medium L-band	8 Jy	10 Jy	0.6 Jy	0.7 Jy
Medium M-band	30 Jy	40 Jy	3 Jy	6 Jy
Low N-band, full visibilities	25 Jy	30 Jy	1 Jy	1.3 Jy
Low N-band, correlated flux				

Setup	
	T Seei τ_0 >
Low M-band	1.5 J
Medium L-band	3 Jy
Medium M-band	7.5 J

spectral mode	lowest L flux (Jy)		lowest M flux (Jy)		lowest N flux (Jy)	
	corr. Flux & diff phase	closure phase	corr. Flux & diff phase	closure phase	corr.Flux & diff phase	closure phase
LOW (R~35)	0.2	0.25	0.7	1	3	5
MED (R~500)	1	1.5	11	16	not offered	not offered
HIGH (R~1000)	2	3	not offered	not offered	26 (R ~ 220)	30 (R~220)
HIGH+ (R~3300)	20	25	17	25	not offered	not offered

The Limiting magnitude for GRAVITY's Fringe Tracker depends on the atmospheric conditions as follows:

Occurence probability	10%	30%	70%
Seeing	<0.6"	<0.8"	<1.15"
Coherence Time	>5.2 ms	>4.1 ms	>2.2 ms
K mag	<8.5	<8.0	<7.0

MATISSE Pipeline

ftp://ftp.eso.org/pub/dfs/pipelines/instruments/matisse/matisse-reflex-tutorial-1.6.0.pdf

EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral

Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

VERY LARGE TELESCOPE

Reflex MATISSE Tutorial and Cookbook

VLT-MAN-ESO-19500-....

Issue 1.6.0

Date 20.05.2021


50

MATISSE first fringes! Are you Sirius?

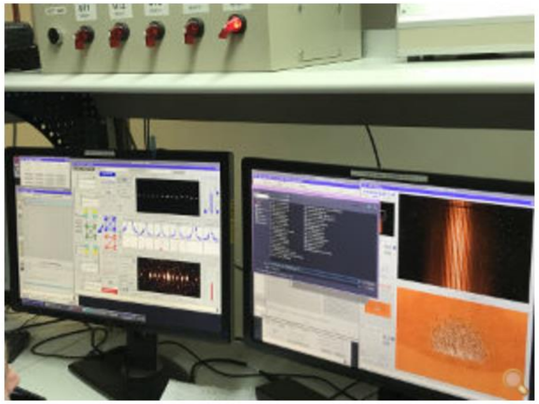
Details

19 February 2018

"MATISSE made its first fringes on the star Sirius during the night between 18 and 19 February, with 4 telescopes, simultaneously in the L- and N-bands (atmospheric windows at 3 microns and 10 microns).

This major milestone of the project marks the end of the instrument integration, and the start of the commissionning period, that will last from now up to early 2019. The commissioning will fully qualify the instrument's performances, before its grand opening by ESO to the whole scientific community.
Bruno Lopez and the MATISSE consortium"

Click image to enlarge



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Journey Diary

MATISSE first fringes! Are you Sirius?	19 February 2018	Edit
first ligth	14 February 2018	Edit
First Fringes of MATISSE at Paranal	19 January 2018	Edit
MATISSE has found back all its bits and pieces!	10 December 2017	Edit
News from Paranal after a dense week	09 December 2017	Edit
MATISSE electronics cabinets have been installed.	07 December 2017	Edit
The two electronics cabinets of MATISSE waiting on a truck	05 December 2017	Edit
Wind and e-cabinets tomorrow	03 December 2017	Edit
Detectors installed in the MATISSE cryostats	01 December 2017	Edit

MATISSE, the VLTI mid-infrared imaging spectro-interferometer

B. Lopez[1], S. Lagarde[1], R.G. Petrov[1], W. Jaffe[2], P. Antonelli[1], F. Allouche[1], P. Berio[1], A. Matter[1], A. Meilland[1], F. Millour[1], S. Robbe-Dubois[1], T. Agocs[4], Ch. Bailet[1], U. Beckmann[3], F. Bettonvil[4], R. van Boekel[5], P. Bourget[7], Y. Bresson[1], P. Bristow[6], P. Cruzalèbes[1], E. Eldswijk[4], Y. Fanteï Caujolle[1], A. Glindemann[6], J.C. González Herrera[6], U. Graser[5], P. Guajardo[7], M. Heininger[5], Th. Henning[5], K.-H. Hofmann[3], G. Kroes[4], W. Laun[5], M. Lehmitz[5], C. Leinert[5], K. Meisenheimer[5], S. Morel[1], U. Neumann[5], C. Paladini[7], I. Percheron[6], M. Riquelme[7], M. Schoeller[6], Ph. Stee[1], L. Venema[4], G. Weigelt[3], J. Woillez[6], G. Zins[6,7], P. Ábrahám[8], S. Abadie[7], R. Abuter[6], M. Accardo[6], T. Adler[5], J. Alonso[7], J.-C. Augereau[9], A. Böhm[5], G. Bazin[6], J. Beltran[7], A. Bensberg[26], W. Boland[2], R. Brast[6], L. Burtscher[2], R. Castillo[7], A. Chelli[1], C. Cid[7], J.-M. Clausse[1], C. Connot[3], R.D. Conzelmann[6], W.-C. Danchi[10], M. Delbo[1], J. Drevon[1], C. Dominik[11], A. van Duin[4], M. Ebert[5], F. Eisenhauer[12], S. Flament[1], R. Frahm[6], V. Gámez Rosas[2], A. Gabasch[6], A. Gallenne[13,14,15], E. Garces[7], P. Girard[1], A. Glazenborg[4], F.Y.J. Gonté[7], F. Guitton[1], M. de Haan[4], H. Hanenburg[4], X. Haubois[7], V. Hocdé[1], M. Hogerheijde[2,11], R. ter Horst[4], J. Hron[16], C. Hummel[6], N. Hubin[6], R. Huerta[7], J. Idserda[4], J. W. Isbell[5], D. Ives[6], G. Jakob[6], A. Jaskó[4,8], L. Jochum[7], L. Klarmann[5], R. Klein[5], J. Kragt[4], S. Kuindersma[4], E. Kokoulina[1], L. Labadie[17], S. Lacour[18], J. Leftley[1], R. Le Poole[2], J.-L. Lizon[6], M. Lopez[7], A. Mérand[6], A. Marcotto[1], N. Mauclert[1], T. Maurer[5], L.H. Mehrgan[6], J. Meisner[2], K. Meixner[5], M. Mellein[5], J.L. Menut[19], L. Mohr[5], L. Mosoni[20,8], R. Navarro[4], E. Nußbaum[3], L. Pallanca[7], E. Pantin[21], L. Pasquini[6], T. Phan Duc[6], J.-U. Pott[5], E. Pozna[6], A. Richichi[22], A. Ridinger[5], F. Rigal[4], Th. Rivinius[7], R. Roelfsema[4], R.-R. Rohloff[5], S. Rousseau[1], D. Salabert[1], D. Schertl[3], N. Schuhler[7], M. Schuil[4], K. Shabun[6], A. Soulain[23], C. Stephan[7], P. Toledo[7], K. Tristram[7], N. Tromp[4], F. Vakili[1], J. Varga[2,8], J. Vinther[6], L.B.F.M. Waters[24,25], M. Wittkowski[6], S. Wolf[26], F. Wrhel[5], and G. Yoffe[5]

Room for the maximisation of the MATISSE performance

Next steps for pushing the instrument performance :

- Final Commissioning of MATISSE 19th-23rd of June
- Ongoing Commissioning of GRA4MAT+MATISSE
- MATISSE Wide in the context of VLTI+ and GRAVITY+
- New generation Fringe Tracker through the Vermillon J band visitor instrument