Stellar Parameters and Images with a Cophased Array
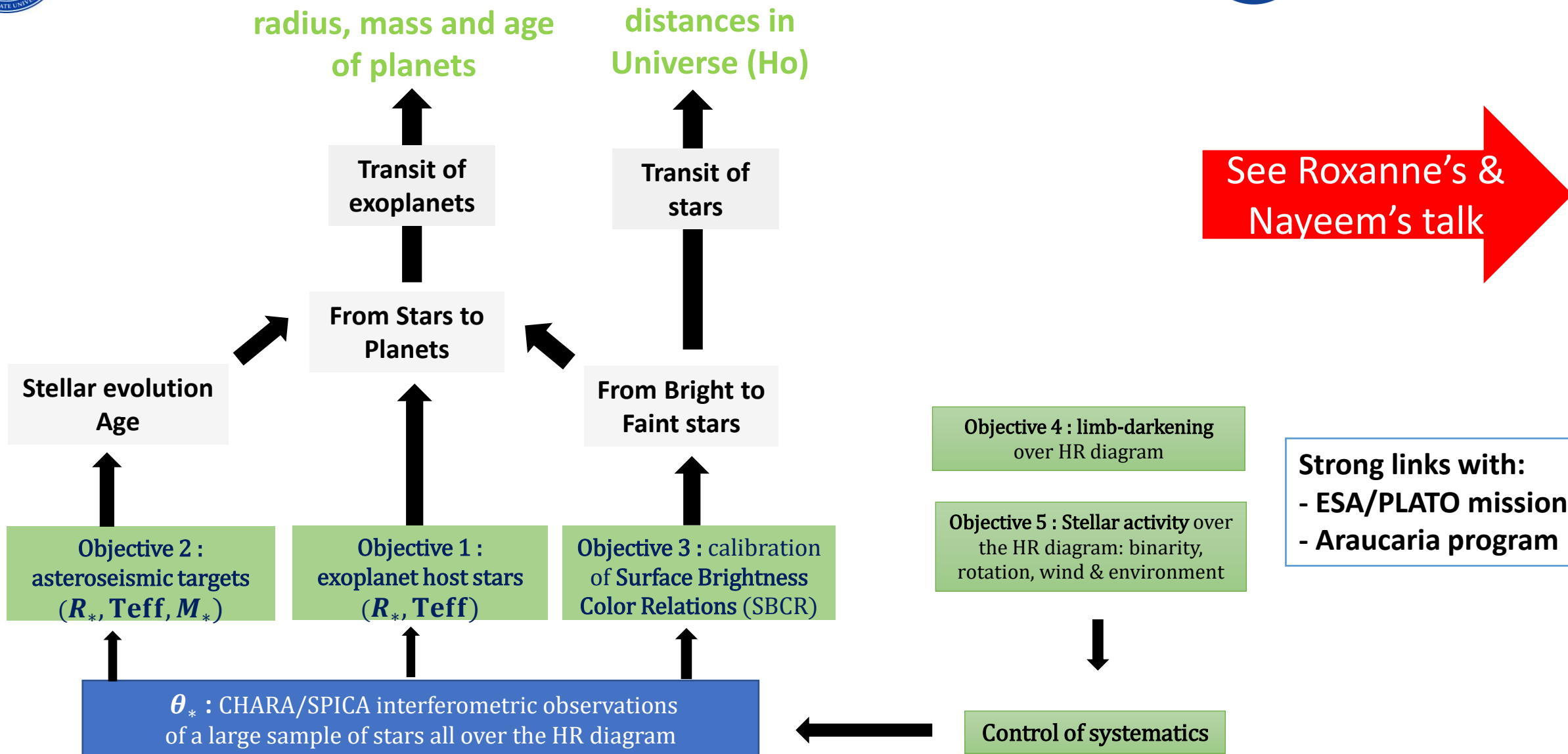## *News from the commissioning*

D. Mourard, P. Bério, O. Creevey, S. Deheuvels, J. Dejonghe, A. Domiciano, N. Ebrahimkutty (ISSP), P. Geneslay (ISSP), R. Ibañez Bustos (PostDoc), J. Jonak (PhD), D. Lecron, R. Ligi (PostDoc), F. Morand, N. Nardetto, C. Pannetier (ISSP), K. Perraut, S. Rousseau, D. Salabert (ISSP), M. Vrard (PostDoc), M. Wittkowski

N. Anugu, T. ten Brummelaar, J. Jones, R. Ligon, D. Gies, G. Schaefer + CHARA staff

L. Bourges, G. Mella

J. Monnier + SPICA SG at large

Interferometric Survey of Stellar Parameters

radius, mass and age of planets

distances in Universe (Ho)

See Roxanne's & Nayeem's talk

Transit of exoplanets

Transit of stars

From Stars to Planets

Stellar evolution Age

From Bright to Faint stars

Objective 4 : limb-darkening over HR diagram

Strong links with:
- ESA/PLATO mission
- Araucaria program

Objective 2 : asteroseismic targets (R_*, Teff, M_*)

Objective 1 : exoplanet host stars (R_*, Teff)

Objective 3 : calibration of Surface Brightness Color Relations (SBCR)

Objective 5 : Stellar activity over the HR diagram: binarity, rotation, wind & environment

θ_* : CHARA/SPICA interferometric observations of a large sample of stars all over the HR diagram

Control of systematics

SPICA in a nutshell

- *A H-band 6T-ABCD fringe sensor (60 outputs, 6 SpCh) and a control loop aiming at performing group delay and phase delay tracking of the fringes.*

- *A All-In-One 6T combiner (600-900nm) with 3 dispersion modes and spatial filtering with monomode fibers*

MODES	Nb of SpCh	SpCh	Spectral Band	MagLim V^2=0.6	MagLim V^2=0.6 + FT	MagLim Vdiff	MagLim Vdiff+FT
LR: R=140	60	~5nm	300nm	6.5	11.5		
MR: R=4400	500	0.17nm	85nm			5.5	9.5
HR: R=13000	500	0.06nm	29nm			4.5	8.5
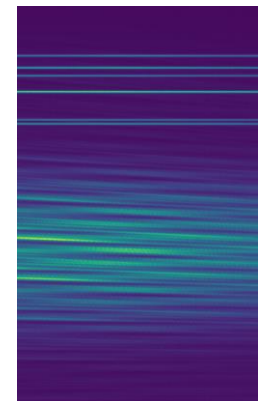
MagLim: V^2: SNR=10, 10mn of integration, for one spectral channel

Vdiff: [SNR=10, σ_ϕ<5°], V^2=0.6 in the reference channel, 30mn of integration, for one spectral channel

SNR calculator based on FRIEND calibration (Martinod+2018), CHARA-AO hypothesis SR=5% *, SPICA estimations Validation to be done on sky in 2022*

Current situation

- ➤ SPICA-FT
  - ➤ Initial tests in GD tracking in January 2020 (1st generation of the IO CHIP)
  - ➤ Then pandemic situation + development of the 2nd and 3rd generation of chip (internal closure phase, photometric balances) + software development in Nice (on testbench)
  - ➤ First on-sky results (with the MIRCx AllInOne combiner in 2022)
  - ➤ Preparation of a more robust integration of the IO Chip (fiber switcher, new OAP, new MIRCx spectrograph) in parallel to the qualification of the opd controller for group delay and phase delay tracking
  - ➡ **See Cyril's talk**

- ➤ SPICA-VIS
  - ➤ Good progresses up to July 2022 (all fringes were found), then many difficulties with:
    - ➤ The new control of the dispersion (up to November)
    - ➤ Weather: all nights lost in Nov, Dec 2022, Mar 2023
  - ➤ No quantitative information on the performance up to now
  - ➤ Delay in the start of the science programs
  - ➤ Main activities on sensitivity and H+VIS operations

Work in progress

1. Contribution to the **improvement of the TELAO stages** (Pierre Geneslay's activities together with Matt)
   1. Issues in the management of the darks
   2. Characterization of the misregistration in the TWFS, generating loss of Strehl (E2, S2 mainly)
   3. Computation, installation, and tests of synthetic interaction matrix
   4. Improvement in the AO control loop
   5. (work still in progress, day-time + night-time needed)
   6. Relation with all the current alignment issues to be checked; W2 expected soon...

2. Addition of a **focus stage on the 6 injection modules** to improve the injected flux (operational but not yet tested on sky)

3. Change of the **fiber V-groove** to correct the default of the first generation
   1. New V-groove installed during the winter with a new mechanical support for the MLA
   2. Much better diffraction pattern and superposition of beams; stability not perfect probably due to the important change of temperature in the lab.
   3. Currently under investigation by Julien

4. Optimization of the **instrumental visibility:** correction of the static chromatism with the VLDC, compensation of the polarization with our PDC.

Work in progress

5. Work on the **compensation of dispersion (OPLE in air)**
   - Objective:
     - Correction of the chromatic path between H and R
     - Correction of the dispersion within H band and within R band
     - 3 DoF ➔ 3 actuators: SPICA internal DDL, LDC, and VLDC
   - New spica_ople server (Narsi) but very long difficulties to solve the airpaths computation issues. Fixed in December but impossible to test it on sky because of weather (many day-time tests based on the model of dispersion)
   - Critical for SPICA first, and for future R+J+H+K operation

6. **Compensation of refraction** within the visible band thanks to variable prisms in each beam, also following the field rotation. Important for the optimization of the injection in the single mode fibers at all wavelengths over the 600-900nm band.
   - Many lab tests of the driving systems (motion of ADCs ➔ change of alignment);
   - full model of refraction and field rotation ready and tested, and combined with the ADC changes
   - no on-sky tests for the moment, except just qualitative size and orientation of the refraction.

7. Continuation of the **qualification of the opd-controller** with MIRCx AIO combiner and preparation of the comparison with the IO combiner (See Cyril's talk)
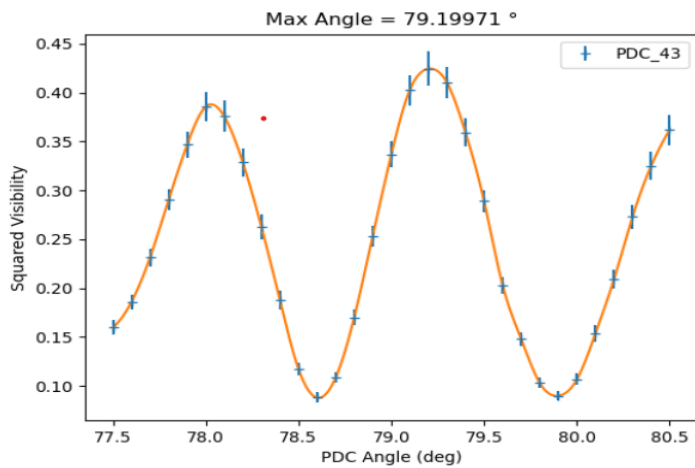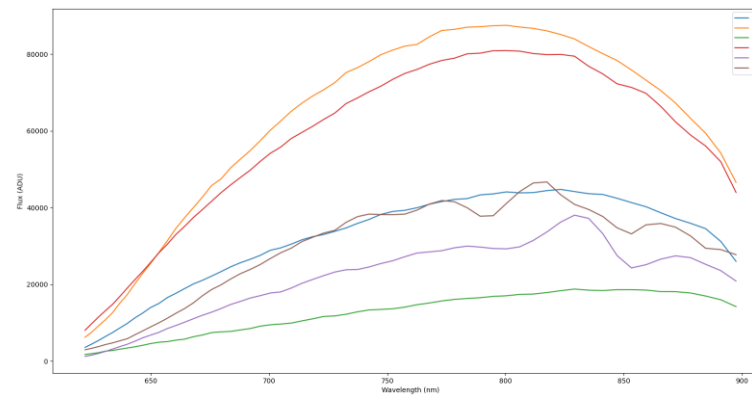
Some figures
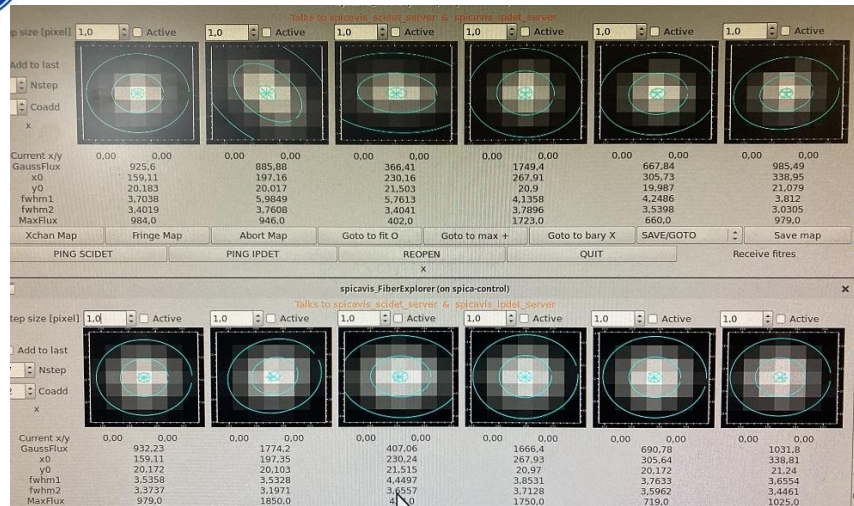
Fiber maps after focus optimization

Polarization compensation
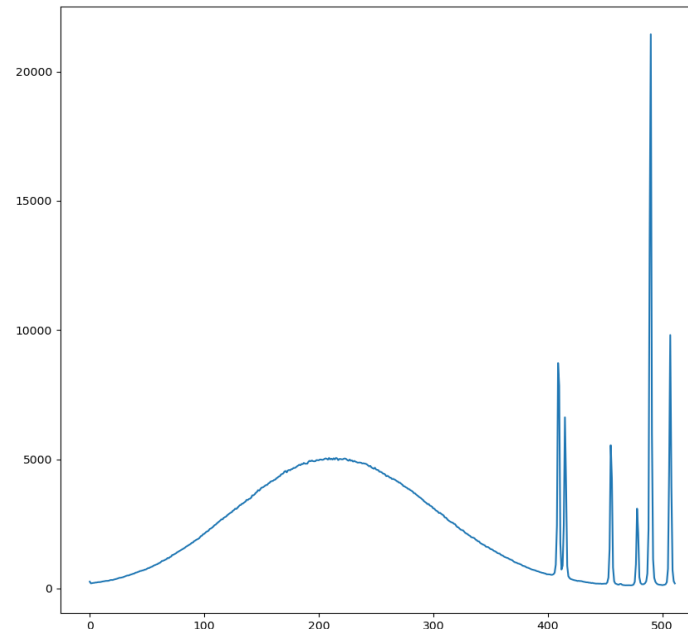
V-groove 2 Mar 2023
sigInt = 77 (+10%...)
PosInter=210 (+20px)
(around 750nm)

E1W2W1S2S1E2
Low to High Freq

S1E2 **W2W1** **E1W2** S2W1 **E1W1** S2W2 S1S2 S2E2 E1S2 S1W1 **E2W1** W2S1 **W2E2** E1S1 **E1E2**

HD58715 – UT12h10 – 6/11/2022 E1E2W1W2

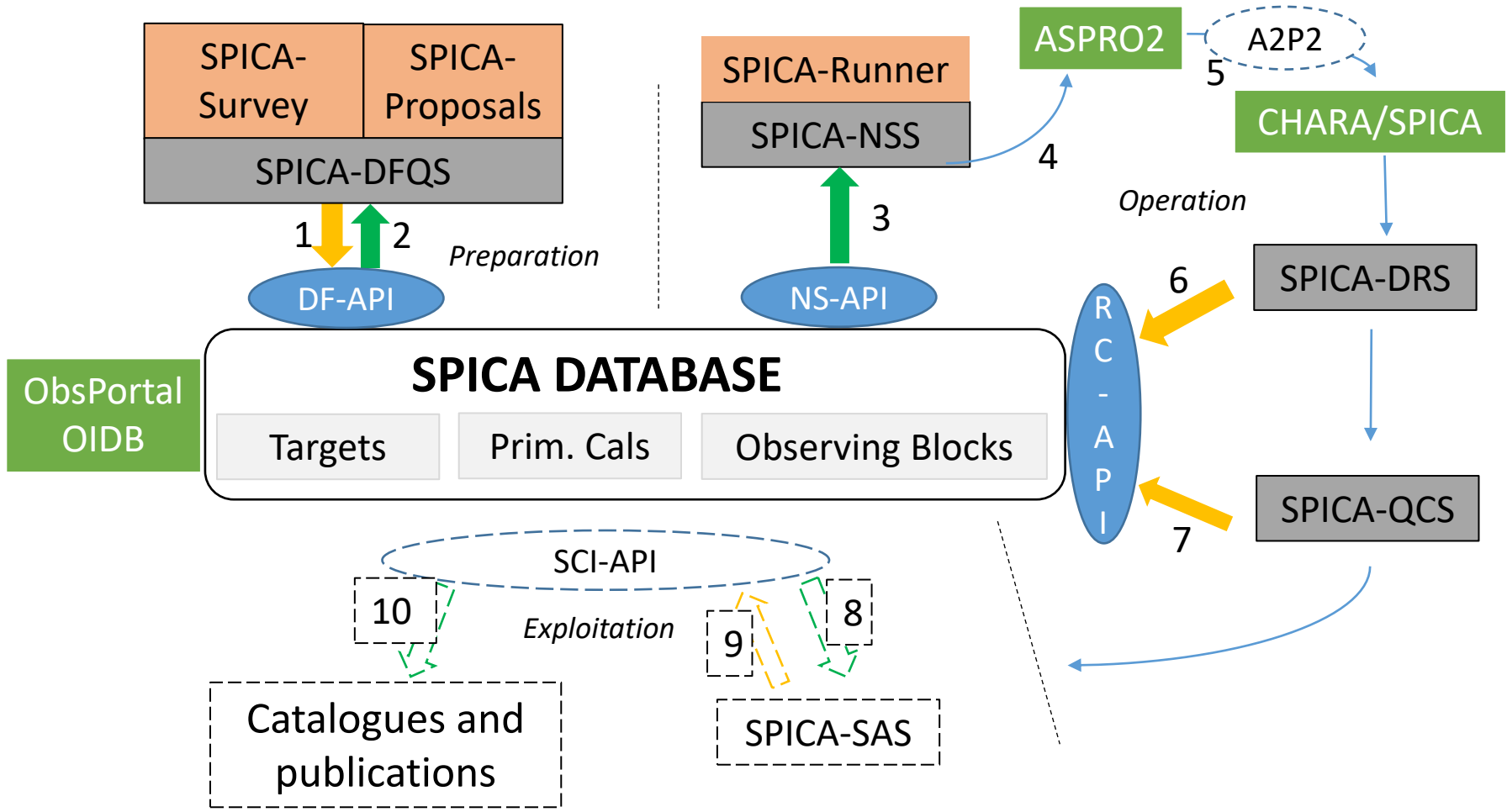| V²	0,81	0,54	0,24	0,05	0,0002	0,015
	E1E2	W1W2	E2W2	E1W2	E2W1	E1W1
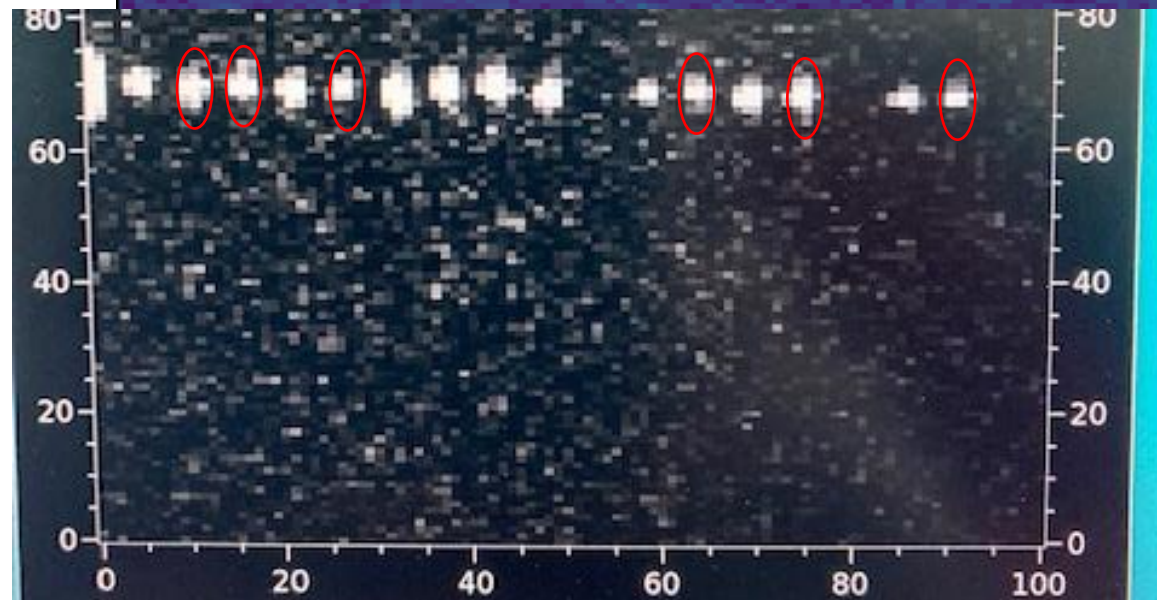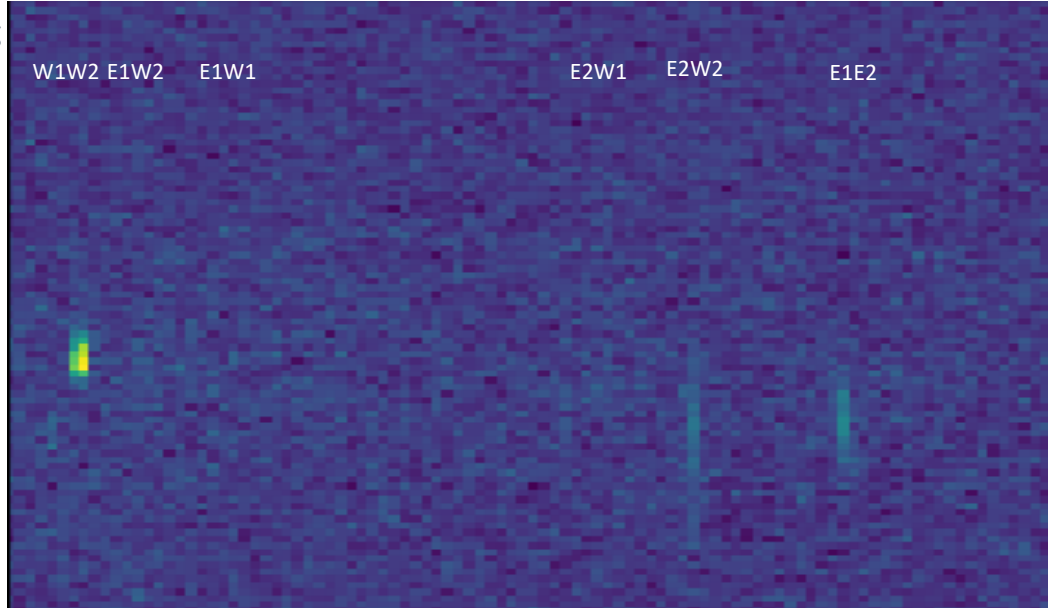
β tri SPICA 2022-10-10 measurements
Work done by Juraj JONAK (PhD)
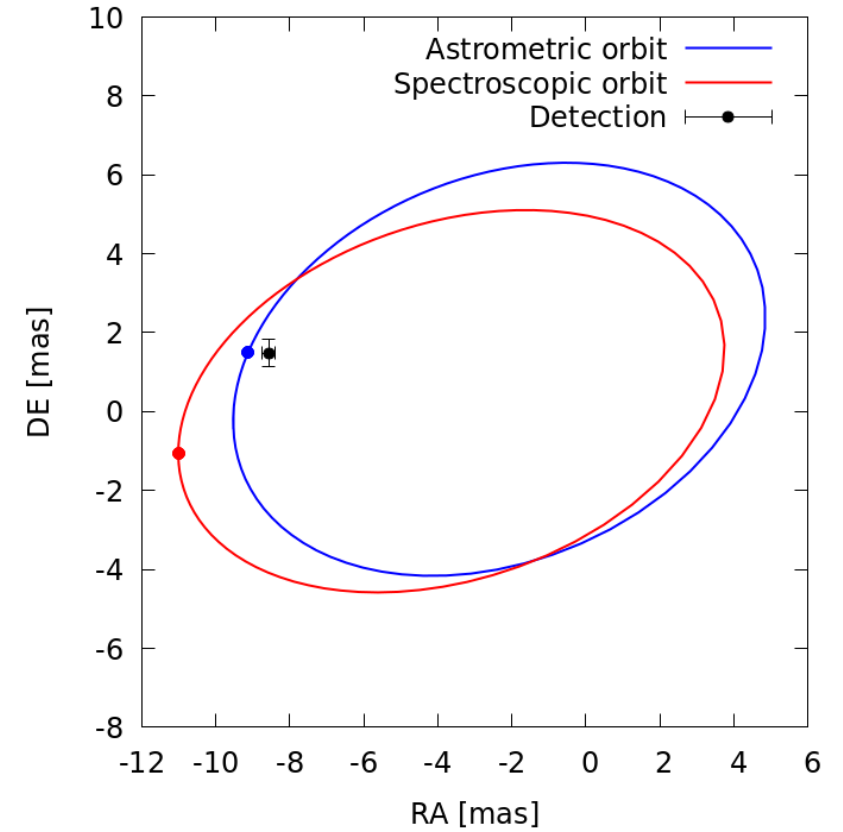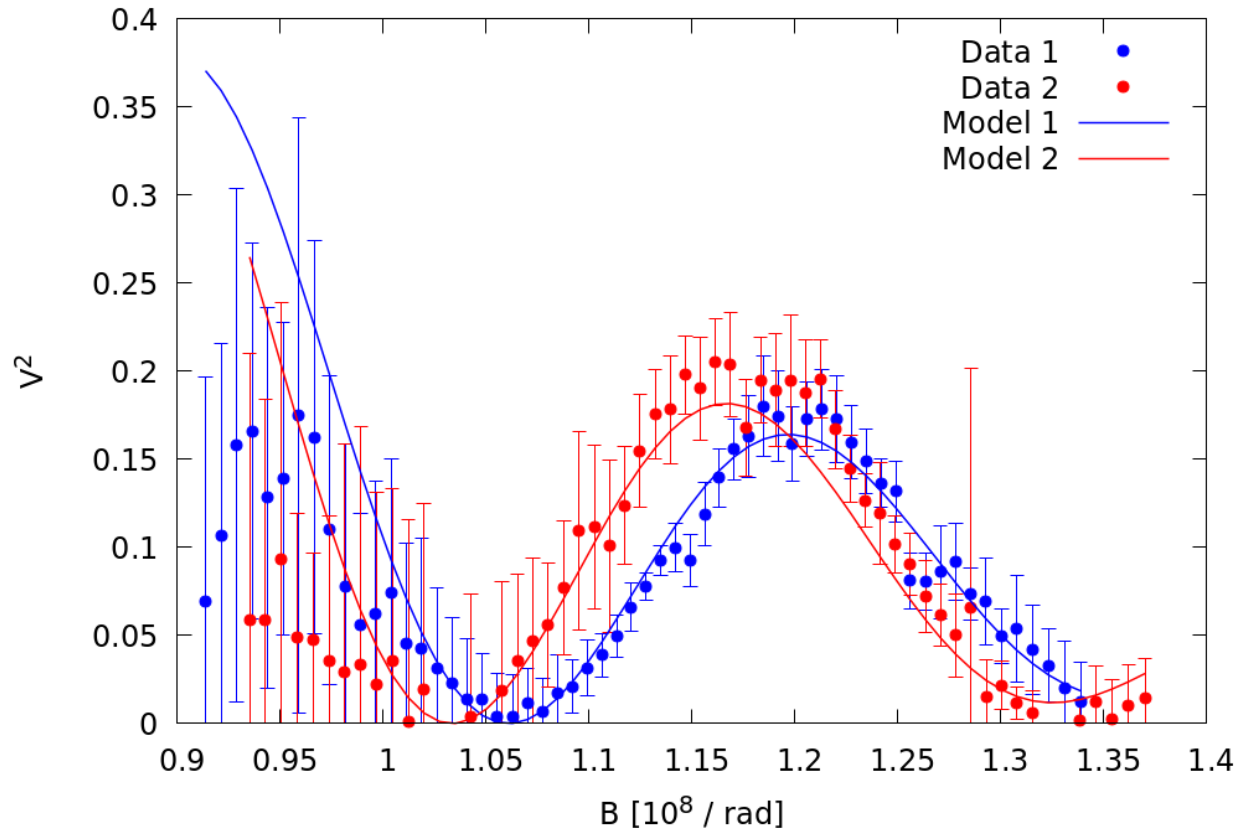
Science operation (JMMC collaboration)

1. Feeding the database with new programs or updating the information about recent observations.

2. Querying the database about recent observations.

3. Querying the database for preparing new observations.

4. Interop NSS-ASPRO2

5. Interop ASPRO2-SPICA via A2P2 (in devpt)

6. Feeding SPICA-DB, OiDB, ObsPortal with L0/L1 data

7. Feeding SPICA-DB with L2, Transfer function, Quality controls, flags