The 10th VLTI School of Interferometry

Practice session I
Interferometry basics with ASPRO

Corrections

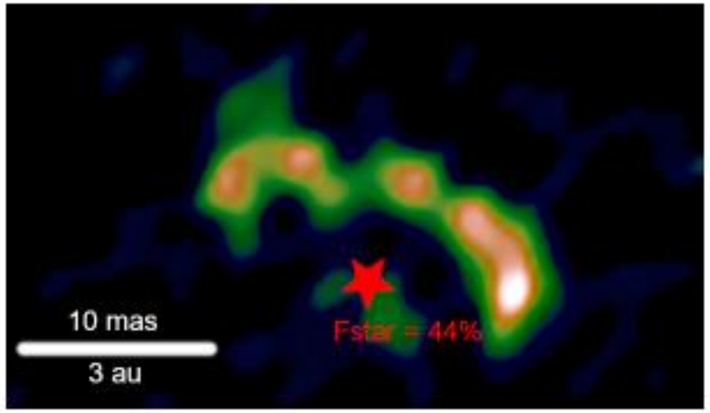

Figure 1: VLTI/PIONIER image of FS CMa. The star position (removed during the image reconstruction) and contribution to the H-band flux are shown in red (adapted from Kluska et al. (2020)

Question : What do we see in the PIONIER image? Why is it asymmetric?

Question : What do you except to see in MATISSE image in the L band? In the N band?

Question : What physical parameters could be constrained from MATISSE observations?

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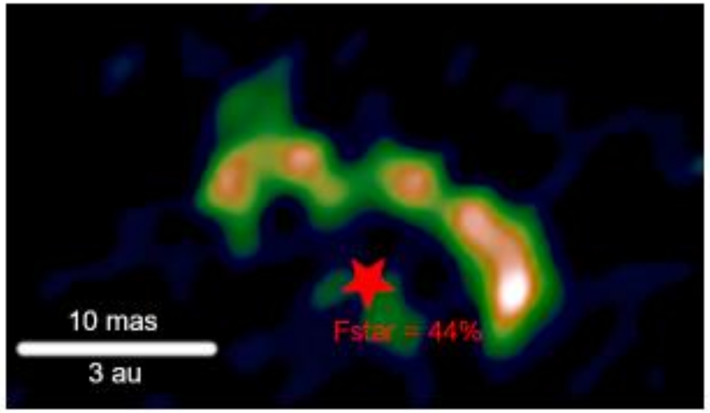

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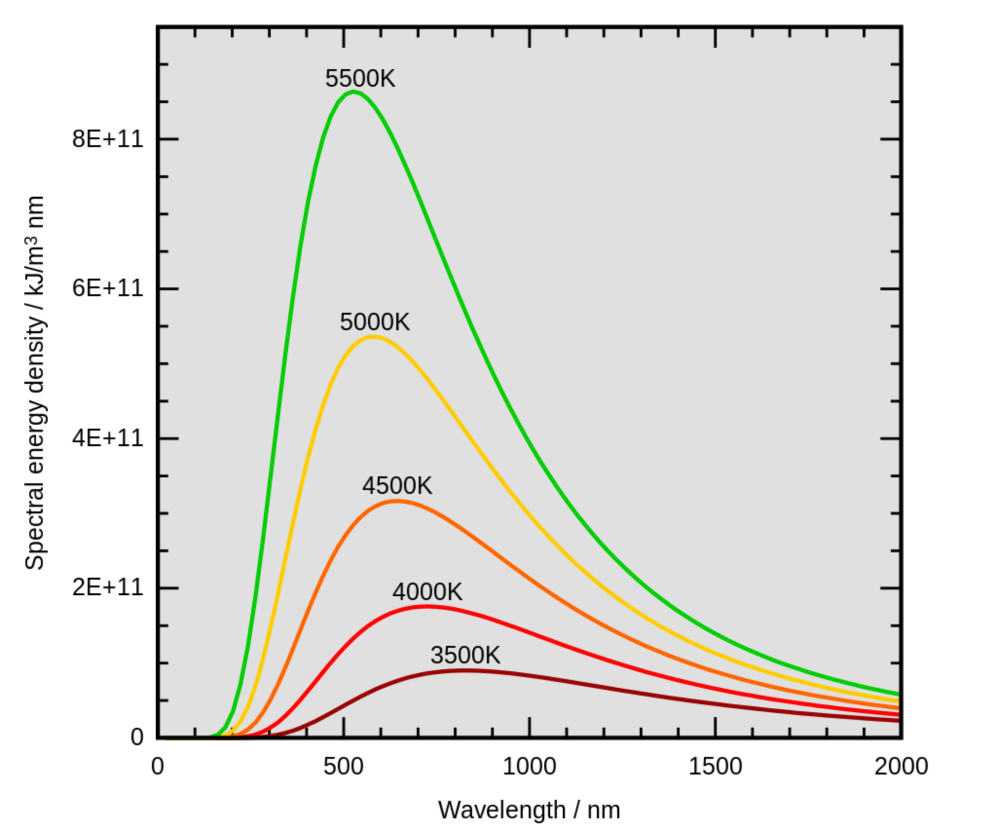
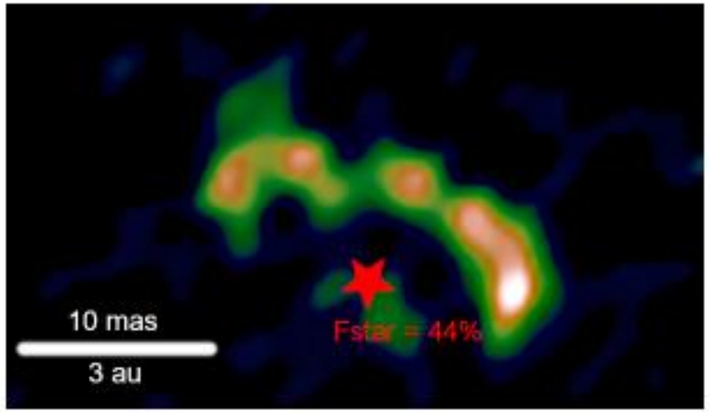
In PIONIER H-band image we mainly see the Inner-rim of FS Cma dusty disk as the H-band is mainly sensitive to material with a temperature above 1500K



Wien's displacement law:

$$\lambda_{max}(\mu m) \approx \frac{3000}{T}$$

H band ⇔ 1800K



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MATISSE wavelength is larger than PIONIER , it will probe colder material thus farther for the central source:

- L-band : material with T ≥ 800K
- N-band : material with T ≥ 300K

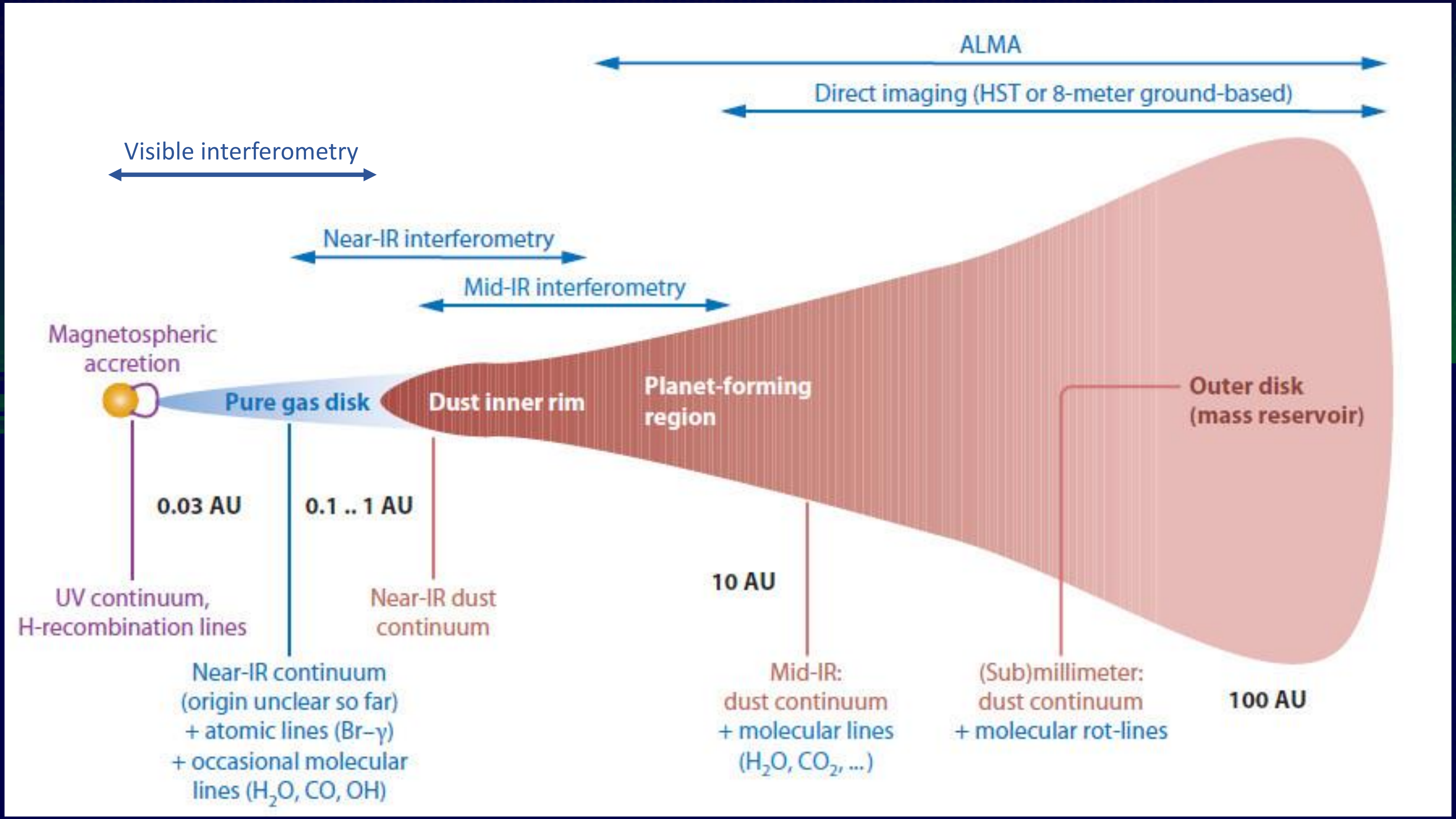
Wien's displacement law:

$$\lambda_{max}(\mu m) \approx \frac{3000}{T}$$

H band ⇔ 1800K

L band ⇔ 800K

N band ⇔ 300K



Dullemond & Monnier (2010)

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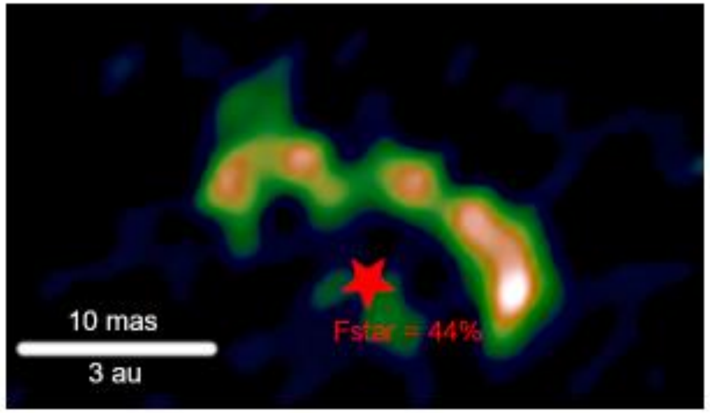

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In PIONIER H-band image we mainly see the Inner-rim of FS Cma dusty disk as the H-band is mainly sensitive to material with a temperature above 1500K

Question : What do you except to see in MATISSE image in the L band? In the N band?

MATISSE wavelength is larger than PIONIER , it will probe colder material thus farther for the central source:

- L-band : material with T>700K
- N-band : material with T>200K

Question : What physical parameters could be constrained from MATISSE observations?

The dusty disk density, temperature and chemical composition

2 Interferometric observability

Question : What are FS CMa right ascension (α) and declination (δ)?

Now go to the **Observability** tab. The star is currently not observable (in June). You can change the date of observation in the **Constraints** box on the upper right of ASPRO2 interface. Verify also that the **Min. Elevation** is set to 30^o which is a standard value for both VLTI and CHARA. Pointing lower than that is not recommended unless you cannot do otherwise.

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Question : Optimise the observing date to have the longest Observability

Question : Does this date depends on α? What about δ?

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Let's go back to our observability problem and to the **Observability** tab. Change the selected VLTI instrument to MATISSE, GRAVITY and then PIONIER and check the observability for each of them.

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Now try to change the telescope configuration.

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Question : Is the shortening of observability symmetric in time?

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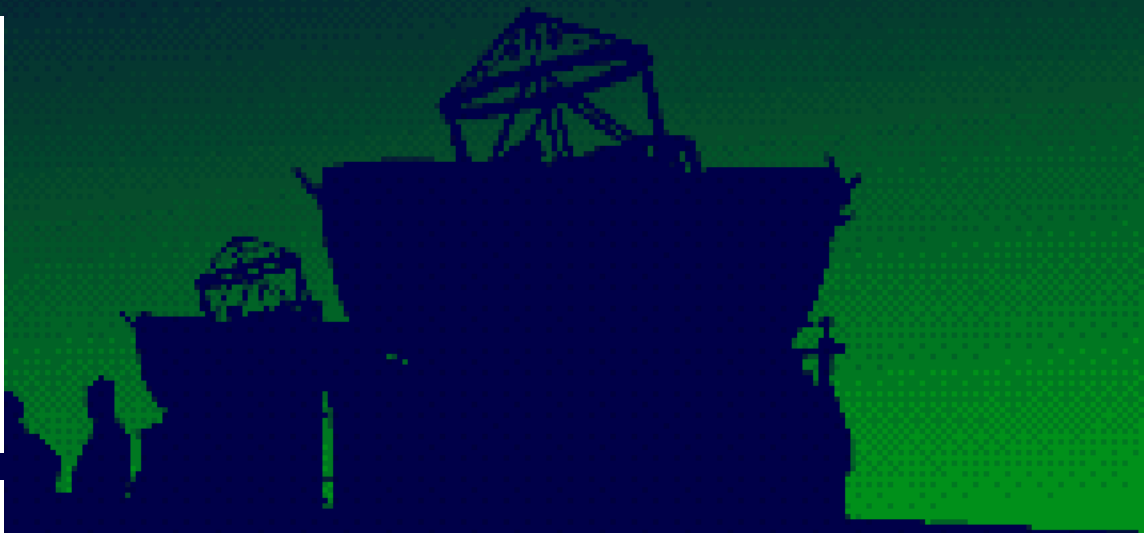

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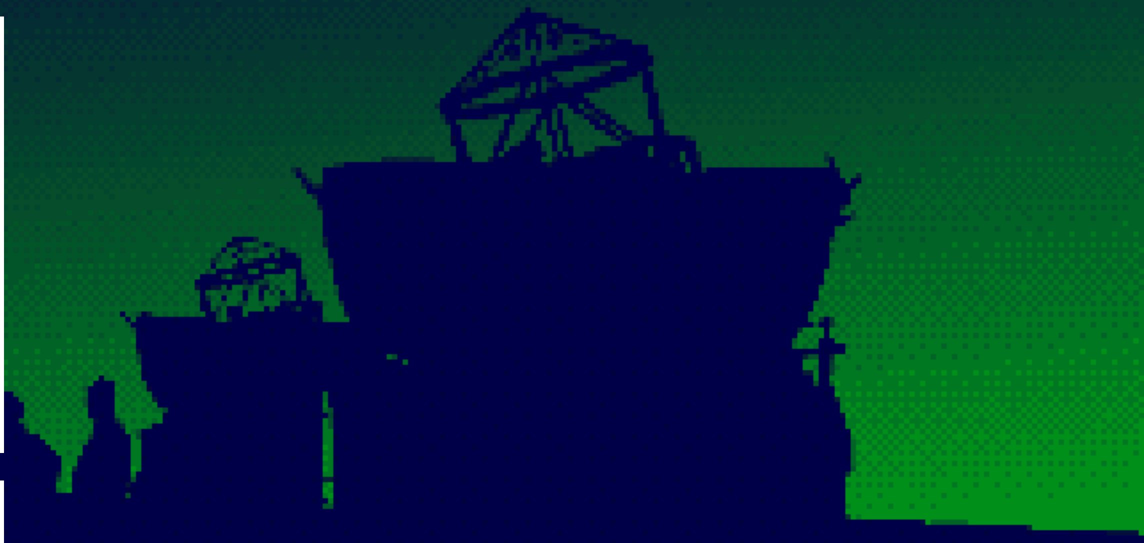

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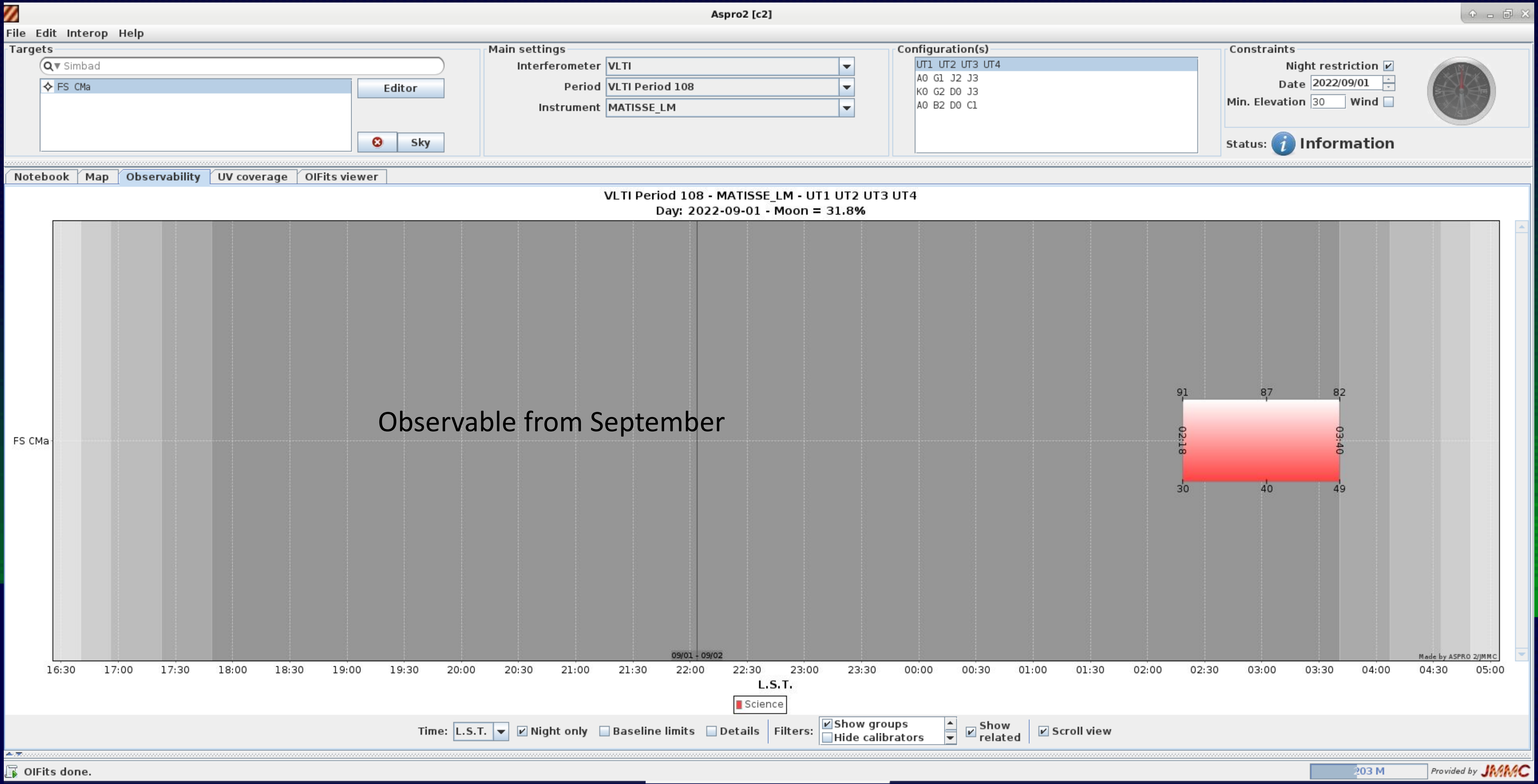

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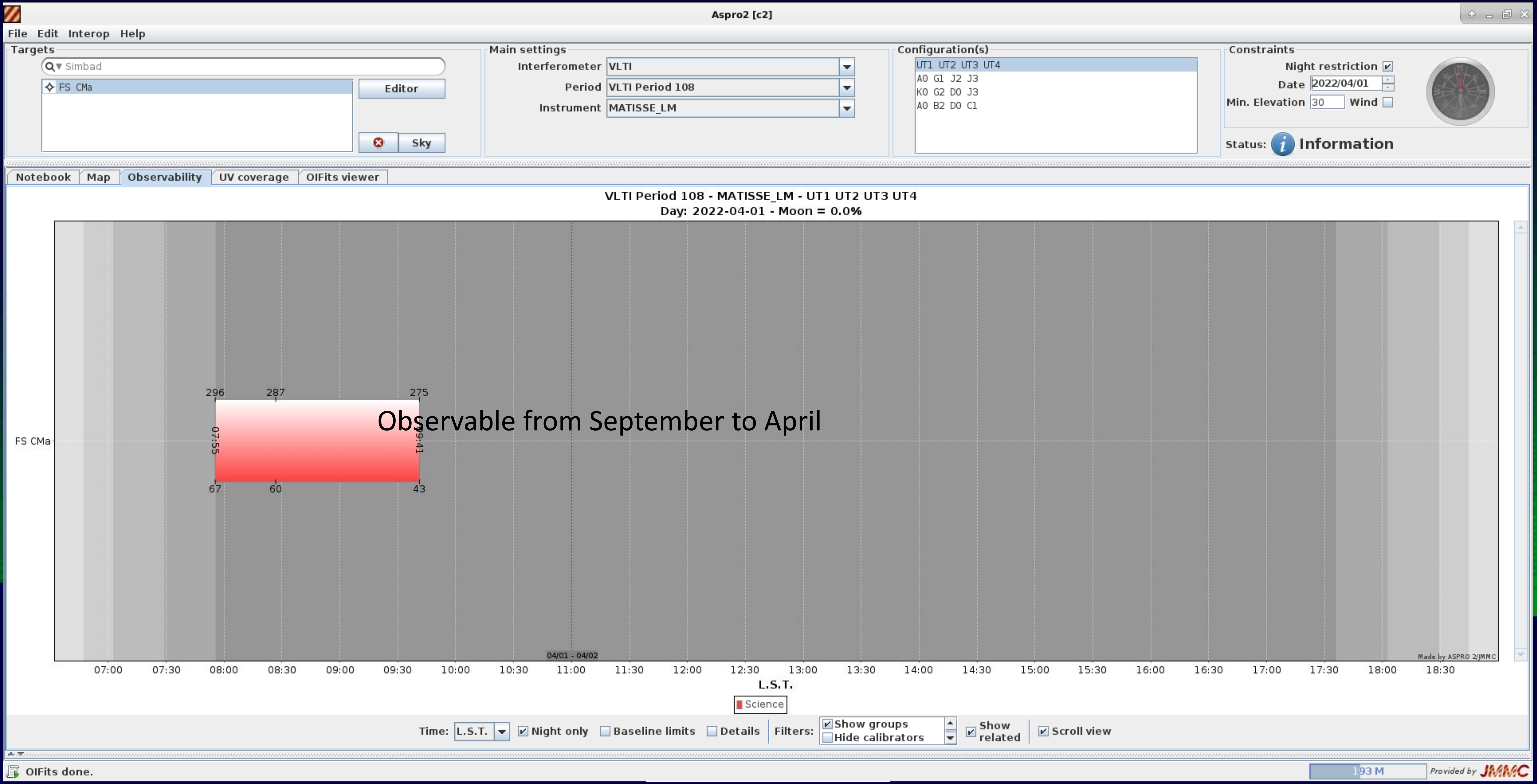

Observable from September to April

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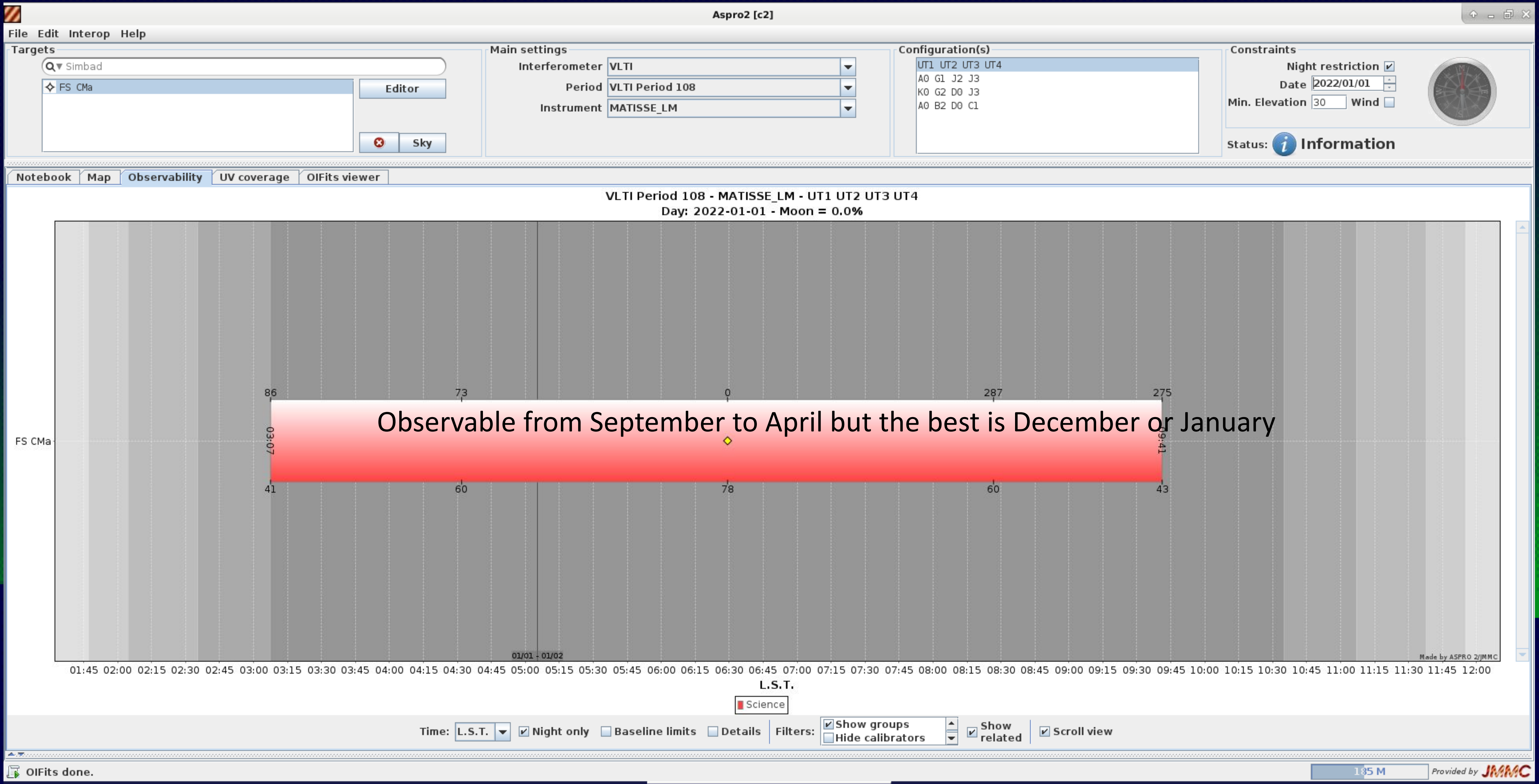

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December or January

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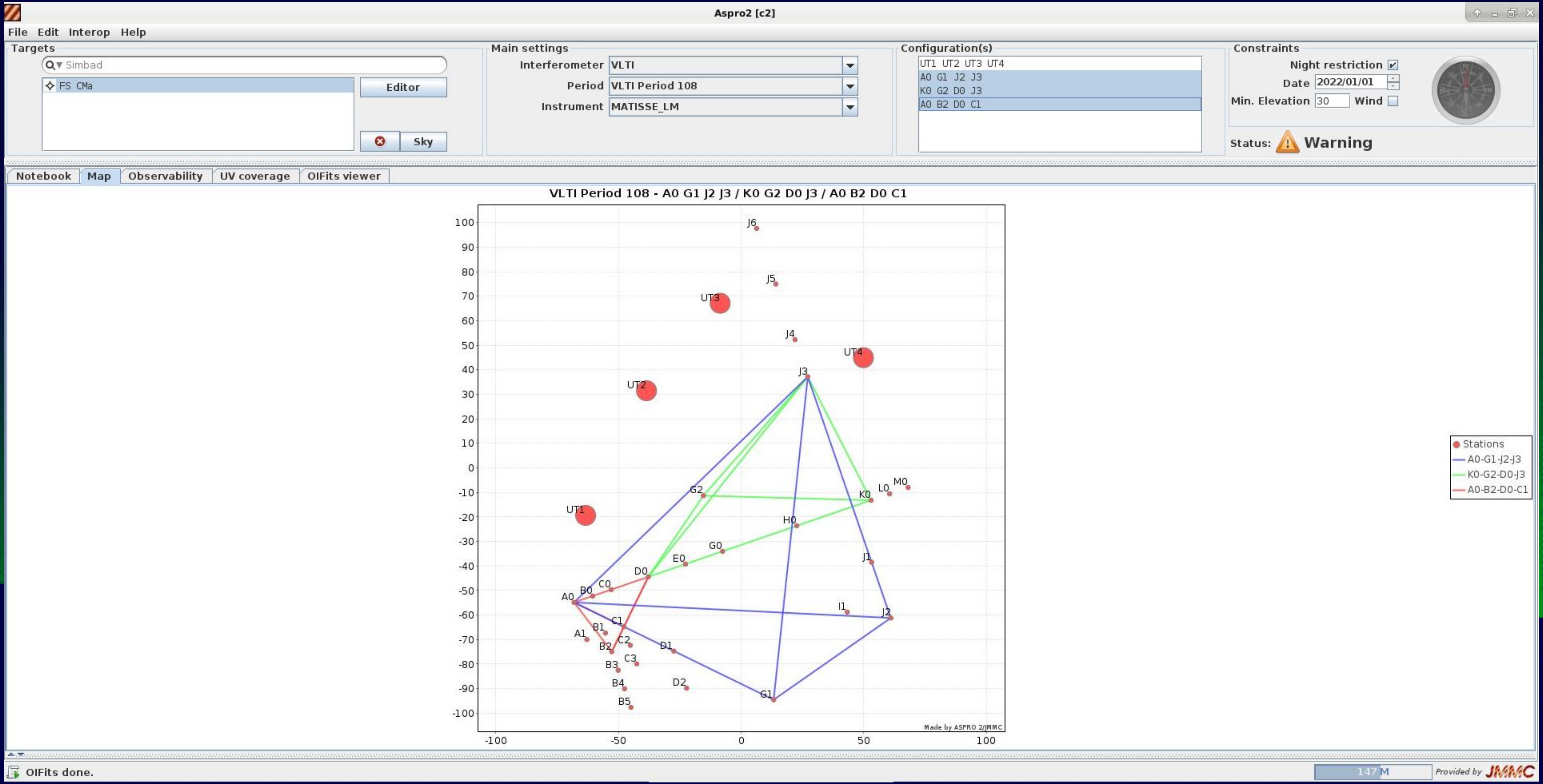
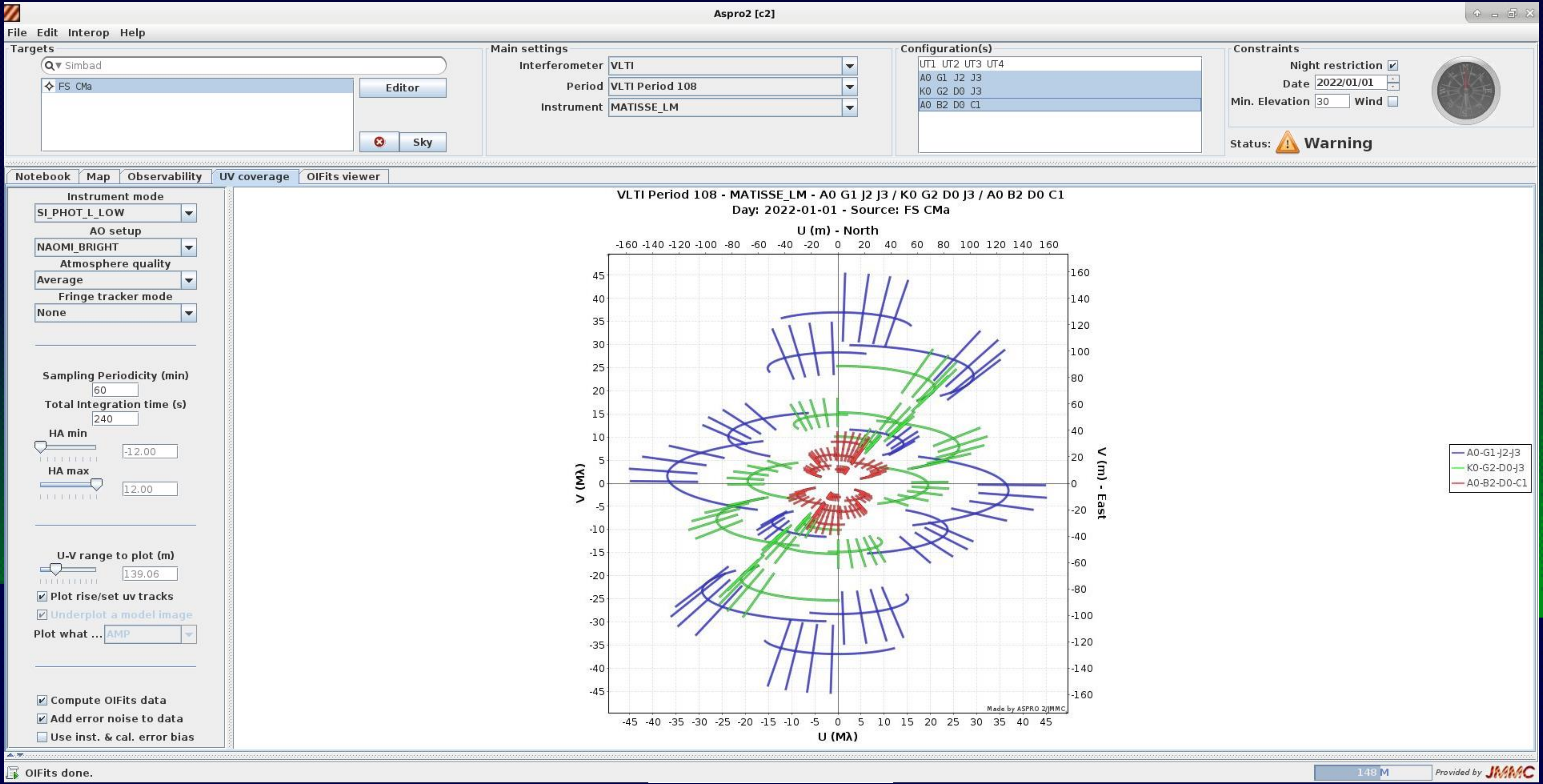


Example of the 3 ATs configurations currently offered: SMALL, MEDIUM, and LARGE



Enhanced UV coverage ⇔ very important to probe the object Fourier plan ⇔ Imaging!!

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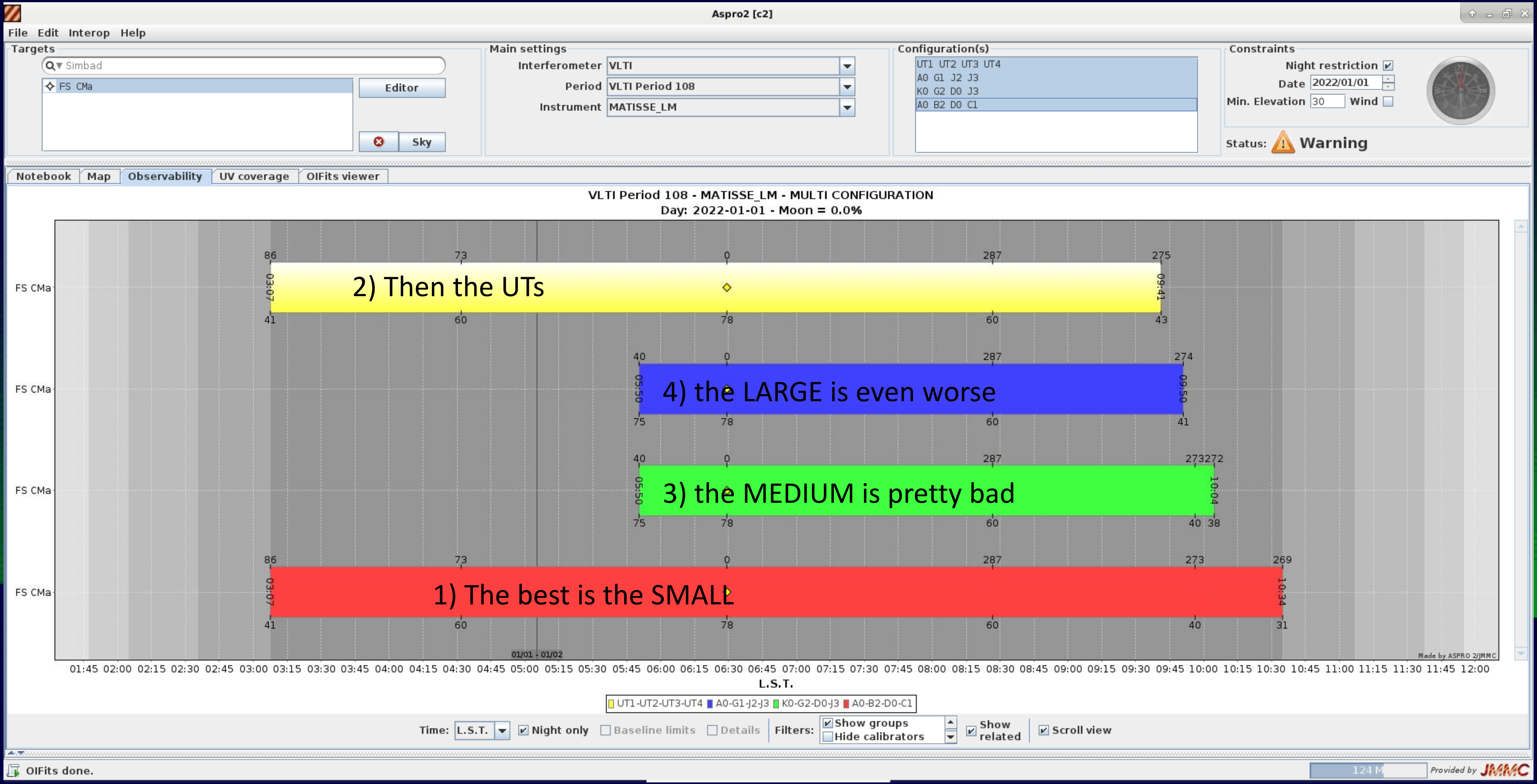

Example of the 3 ATs configurations currently offered: SMALL, MEDIUM, and LARGE

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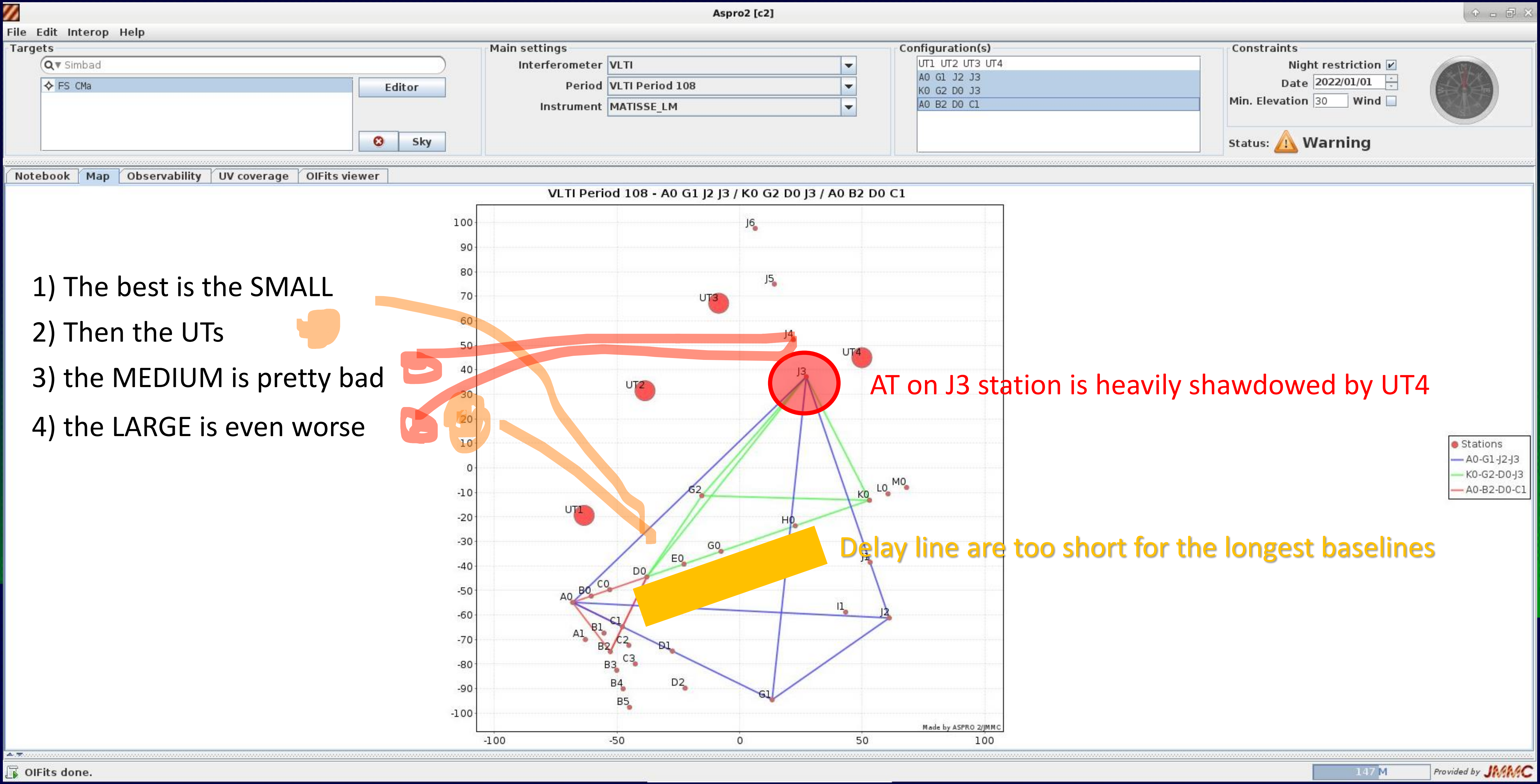

1) The best is the SMALL

2) Then the UTs

3) the MEDIUM is pretty bad

4) the LARGE is even worse

AT on J3 station is heavily shawdowed by UT4

Delay line are too short for the longest baselines

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Longest observability : A0-B2-D0-C1
Shortest observability : A0-G1-J2-J3

Question : Is the shortening of observability symmetric in time?

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1) Delay lines constraints reduce the observability on the longest baselines
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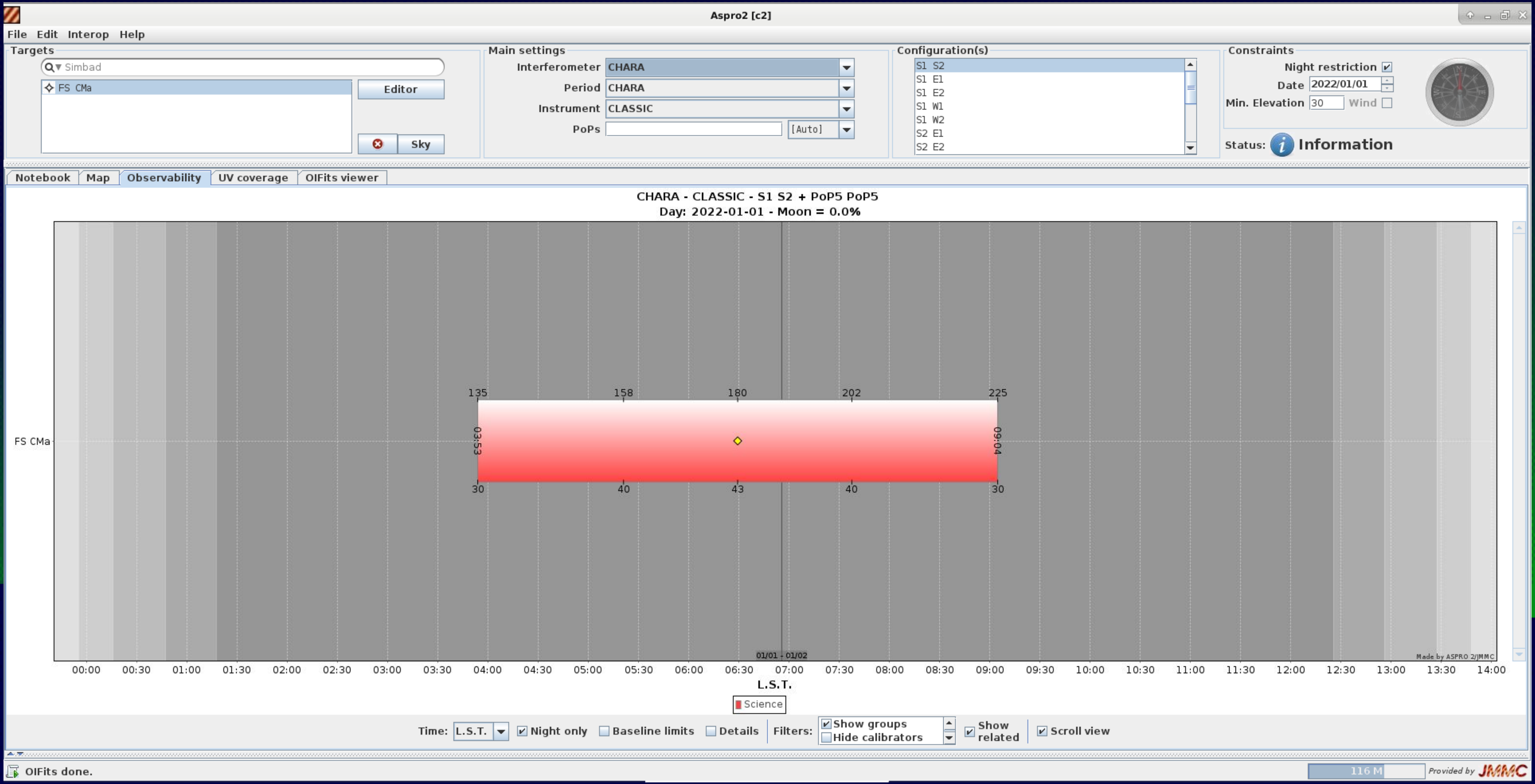

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Observability is shorter as the star is quite South for CHARA (α ≈ -13° for CHARA ≈ +35°)

Name	Right Ascension	Declination
HD 50138	06 51 33.34	-06 57 59.9
HD 62623	07 43 48.43	-28 57 17.7
HD 85567	09 50 28.54	-60 58 02.9
MWC 297	18 27 39.5	-03 49 52.0
HD 200775	21 01 36.92	+68 09 47.7

Table 1: Some Herbig and B[e] stars

Question : Without using ASPRO2 determine where and when can we observe these targets[1]?

3 UV-Coverage

Question : What is the origin of these tracks and why are the baselines length and orientation changing during the night?

The shape of the tracks are elliptic. Add two fake stars to your target list :

- a star at the equator: **06:00:00 00:00:00**
- a star close to the south pole : **06:00:00 -80:00:00**

Question : Why didn't we choose a star at the real pole (δ=-90:00:00)?

Question : Are the tracks similar for these two objects and FS CMa?

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CHARA ⇔ $\delta > -25°$ (= 35° - 60°) (observation above 30°)
VLTI ⇔ $\delta < 35°$ (= -25° + 60°)

$\alpha = 0$ is September 21 (Equinox) then +2 per Month

HD 50138 : Both January
HD 62623 : VLTI February
HD 85567 : VLTI March
MWC 297 : Both July
HD 200775 : CHARA August

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Table 1: Some Herbig and B[e] stars

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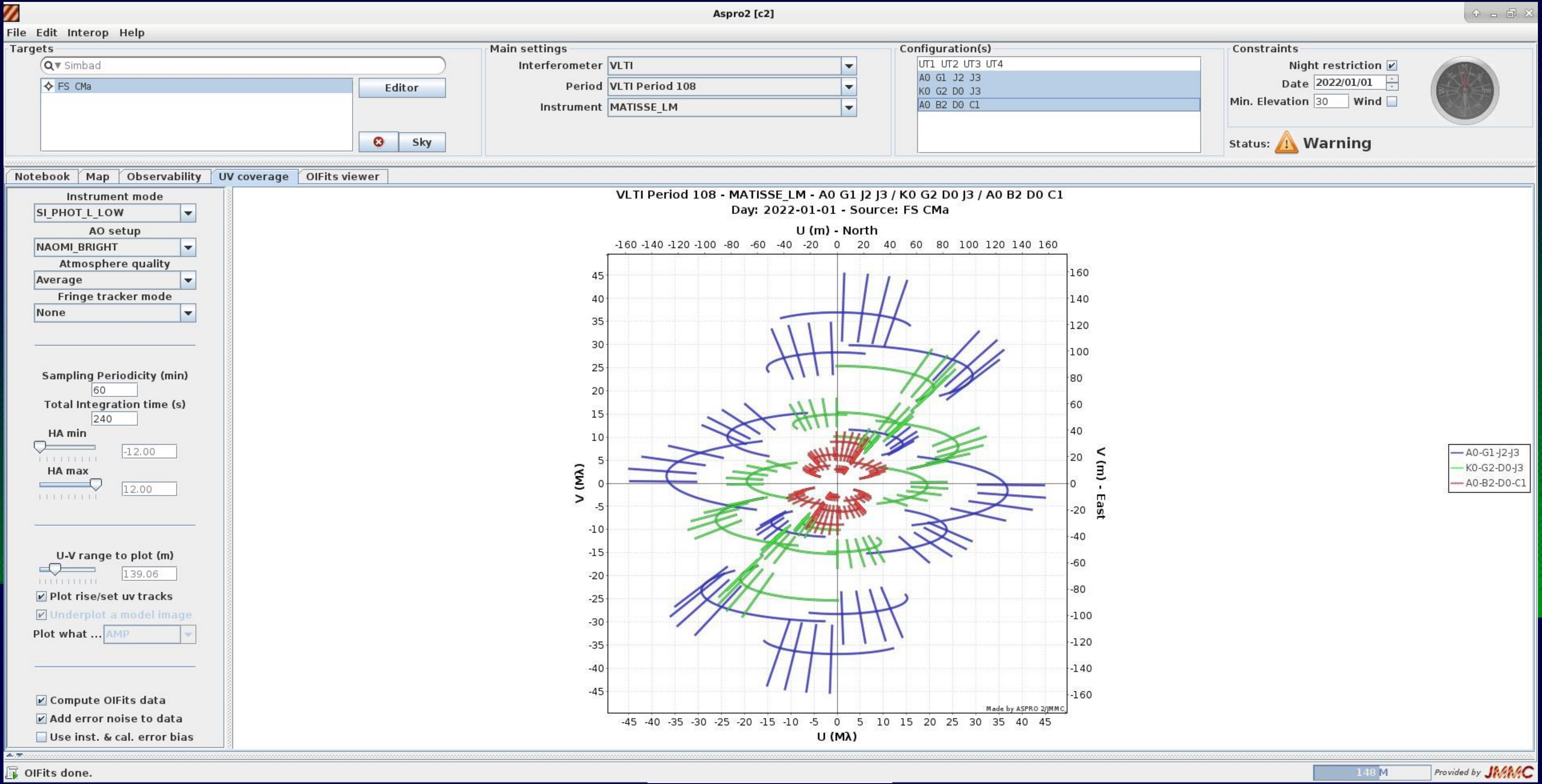

FS CMa Elliptical UV-Tracks due to earth rotation

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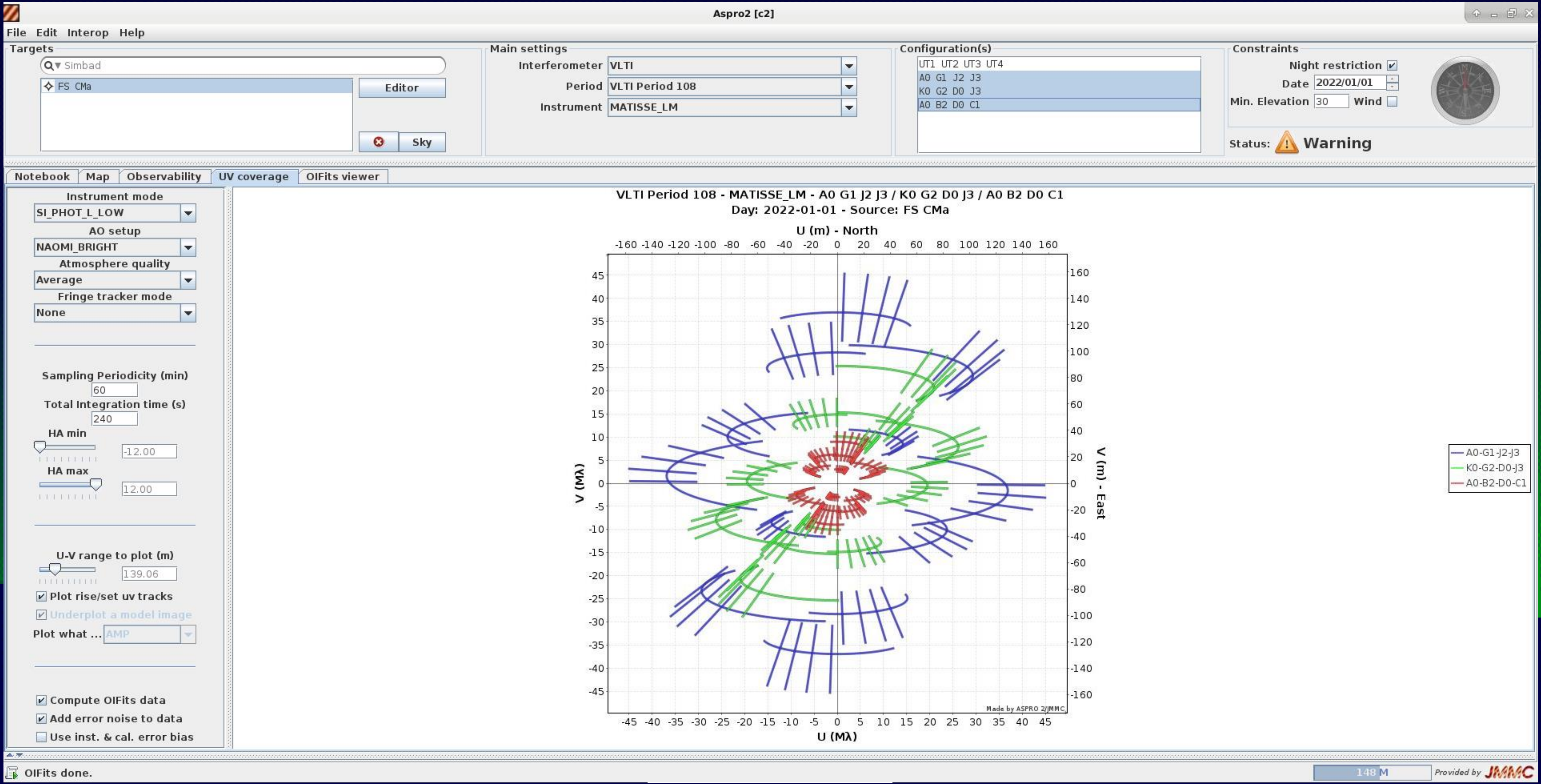
Question : Why didn't we choose a star at the real pole (δ=-90:00:00)?

Not observable at the VLTI : δ > - 85° = -25° - 60°

Question : Are the tracks similar for these two objects and FS CMa?



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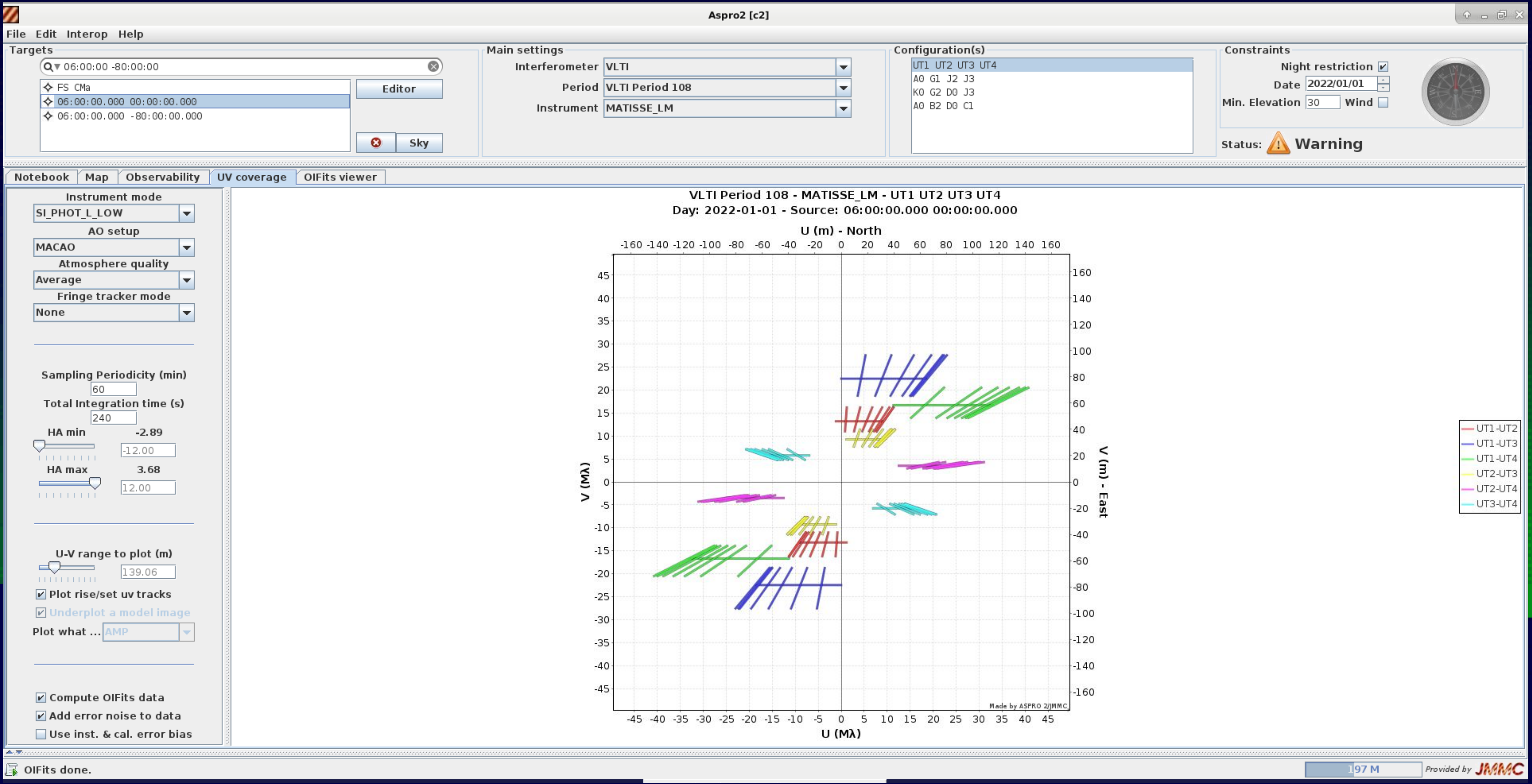
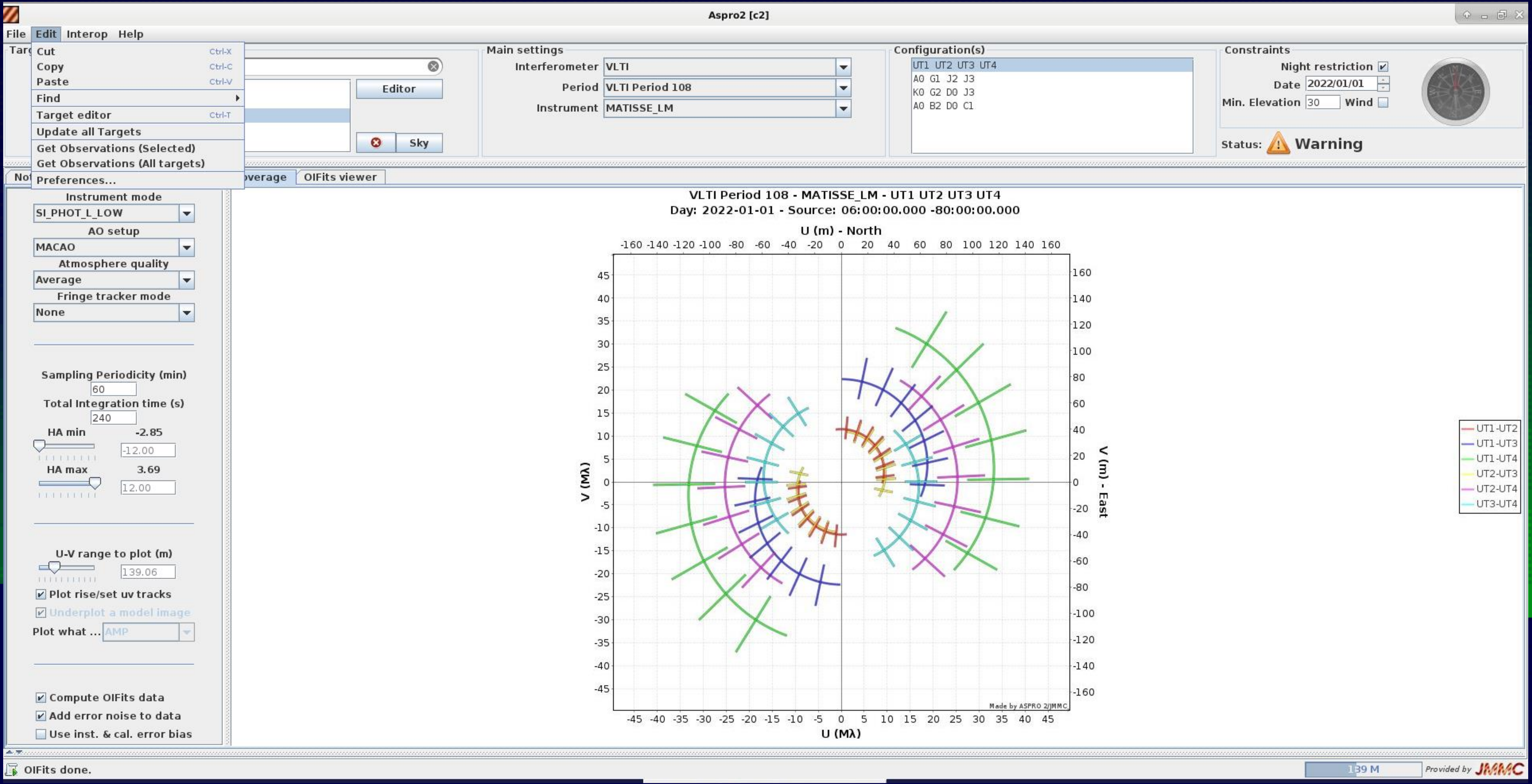


East-West ``linear'' UV-Tracks for the equatorial target (bad for imaging)

Corrections



Almost circular UV-Tracks for the almost polar target (usally better for imaging)

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HD 50138	06 51 33.34	-06 57 59.9
HD 62623	07 43 48.43	-28 57 17.7
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Question : Are the tracks similar for these two objects and FS CMa?

No
Objects at the the equator have linear UV-tracks
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4 Setting-up a model for our object

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For the ring, in the H-band, we will consider the following parameters:

- Minor-axis diameter: 10 mas
- Elongation ratio: 1.5
- Width: 4 mas
- Orientation of the major-axis: 70°

Create a model with these two components and parameters values in the **Target Editor** menu.

Question : Which of these parameters are excepted to be constant between the H-band and the N-band and which will depends on the wavelength? How?

Now go to the **OIFits Viewer** tab and plot the **VIS2DATA** & **T3PHI** (i.e. Closure phase) as a function of the **SPATIAL_FREQ**. Note that it is the default view, so normally you don't have to change it. Select the three ATs configurations simultaneously and choose **Station configuration** in the **Color by** scrolling menu (bottom right of the interface). You can also select the **Draw Lines** option in the lower right corner.

In the plot we see the visibility decreasing and then oscillating around a plateau.

Question : What is the cause of the oscillation?

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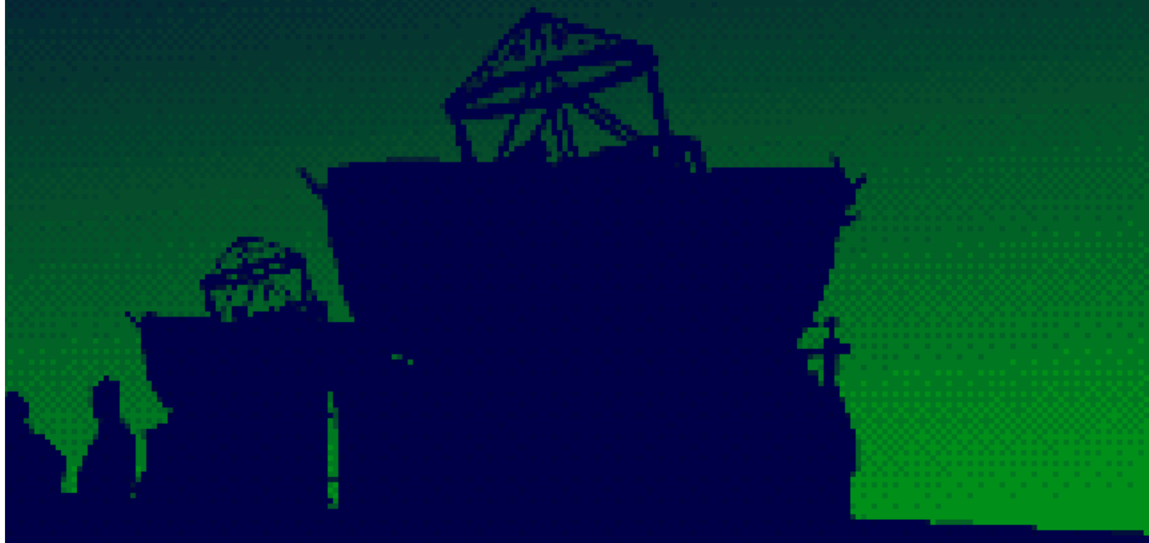

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Point source is then the most relevant.
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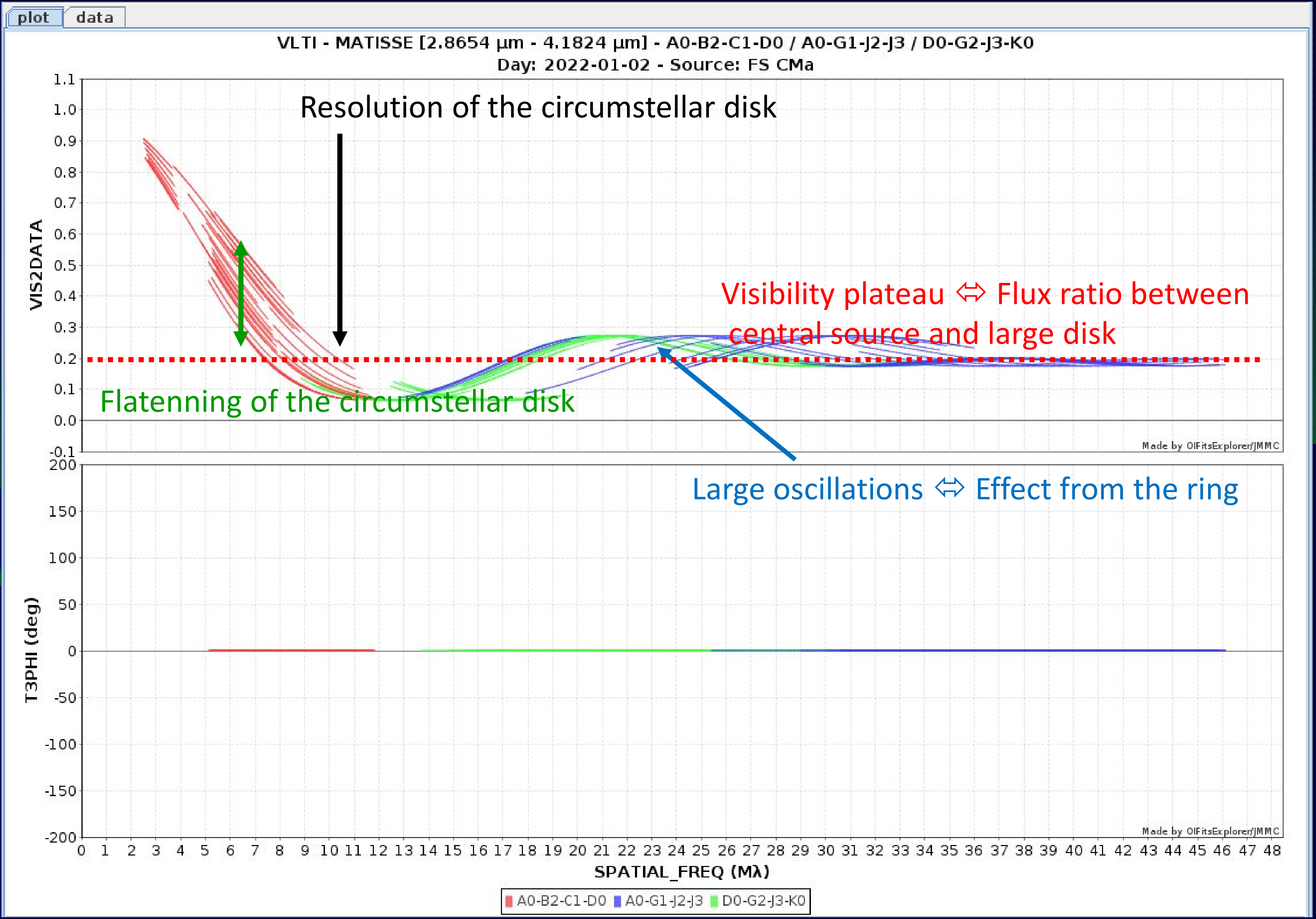

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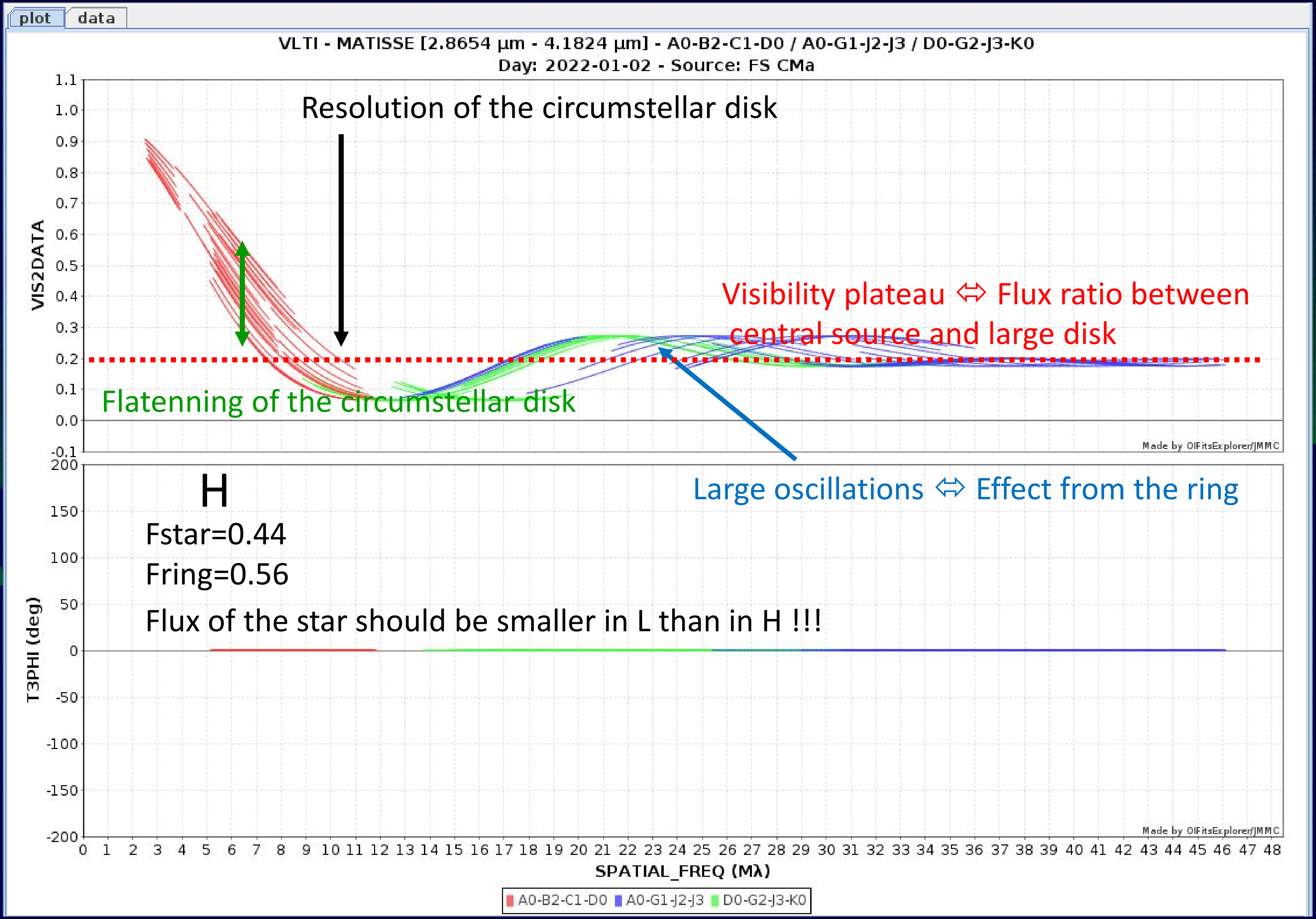
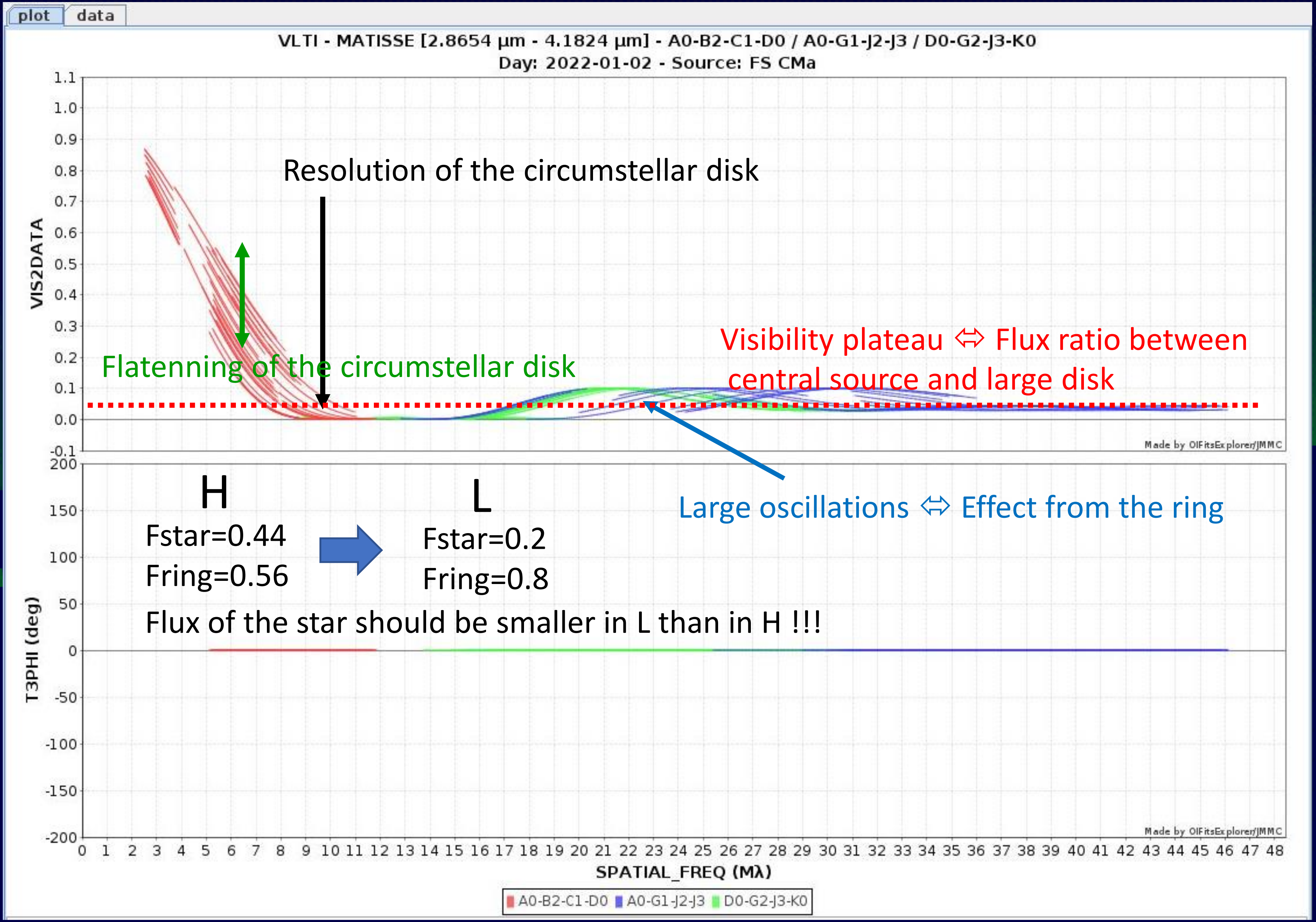
Ring lobes

Flux ratio between the star (point source) and the circumstellar disk (ring)

Corrections




plot
data
VLTI - MATISSE [2.8654 µm - 4.1824 µm] - A0-B2-C1-D0 / A0-G1-J2-J3 / D0-G2-J3-K0
Day: 2022-01-02 - Source: FS CMa
VIS2DATA
Resolution of the circumstellar disk
Flatenning of the circumstellar disk
Visibility plateau ⇔ Flux ratio between central source and large disk
Large oscillations ⇔ Effect from the ring
H
Fstar=0.44
Fring=0.56
L
Fstar=0.2
Fring=0.8
Flux of the star should be smaller in L than in H !!!
T3PHI (deg)
SPATIAL_FREQ (Mλ)
Made by OIFitsExplorer/JMMC
A0-B2-C1-D0
A0-G1-J2-J3
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Yes, as our object is centro-symmetric (0° phase) whereas the real object is highly assymetric due to the skewedness of the inner rim

Corrections

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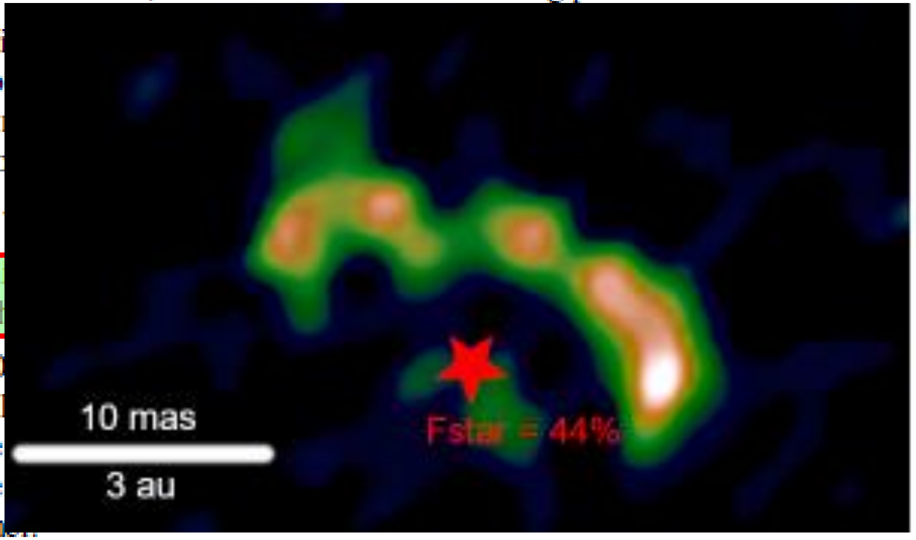

Create a model … r menu.

Question : Wh … -band and the N-band and wh

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5 About the instrumental sensitivity

Question : With such noise on the data, are the observation still useful?

You can change the **Atmosphere quality** value in the **UV Coverage** tab. When hovering a value, the definition in term of seeing and coherence time (t_0) is given. For instance, the **AVERAGE** atmosphere correspond to a seeing of 1" and t_0=3.2ms.

Question : Is there a significant gain in term of data quality for observation under GOOD atmosphere quality? What about EXCELLENT?

Question : Is the data always useful even under AWFUL quality?

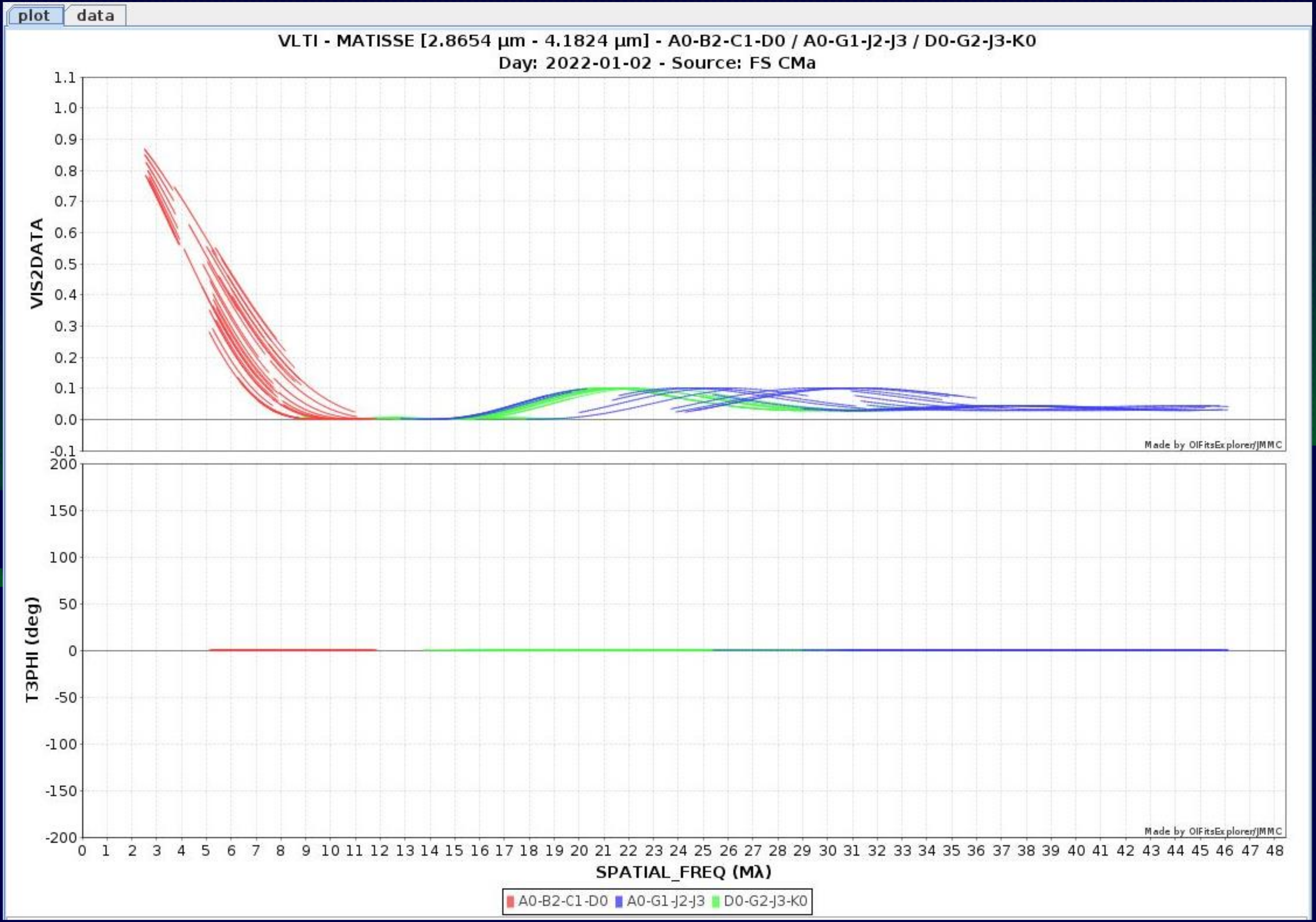
Question : Do the same with MATISSE_N instrument

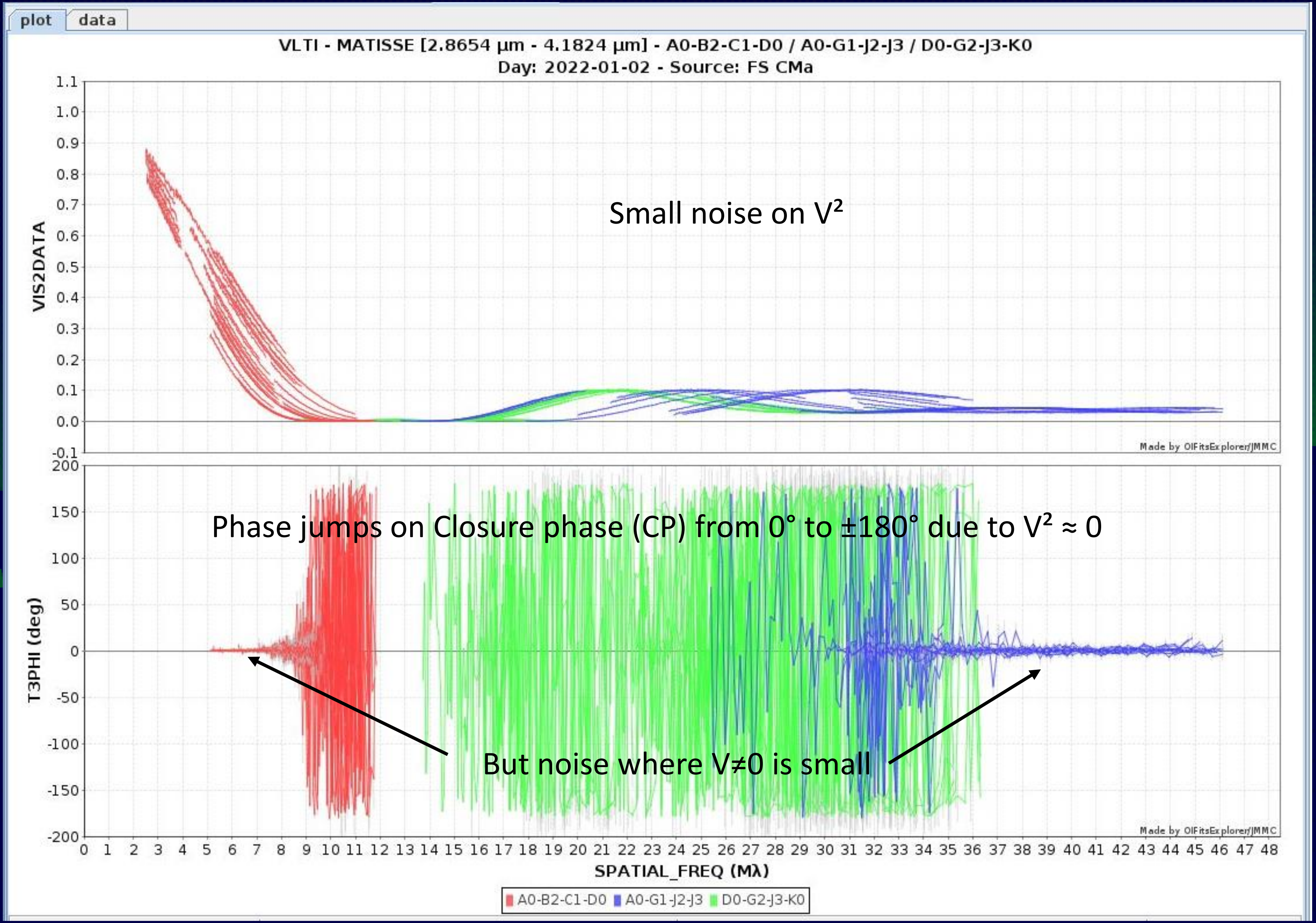
Finally, let's assume a much dimmer target, for instance with a L_band flux of 1 Jy. Change the Flux in the **Target Editor** menu. Don't forget to switch back to MATISSE_LM.

Question : Under which atmospheric quality will the data be useless?

Before continuing, put back the 39.7Jy flux for the L band and a GOOD atmosphere quality.

Corrections




plot
data
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Day: 2022-01-02 - Source: FS CMa
VIS2DATA
T3PHI (deg)
SPATIAL_FREQ (Mλ)
Small noise on V²
Phase jumps on Closure phase (CP) from 0° to ±180° due to V² ≈ 0
But noise where V≠0 is small
Made by OIFitsExplorer/JMMC
A0-B2-C1-D0
A0-G1-J2-J3
D0-G2-J3-K0

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Question : Is there a significant gain in term of data quality for observation under GOOD atmosphere quality? What about EXCELLENT?

Question : Is the data always useful even under AWFUL quality?

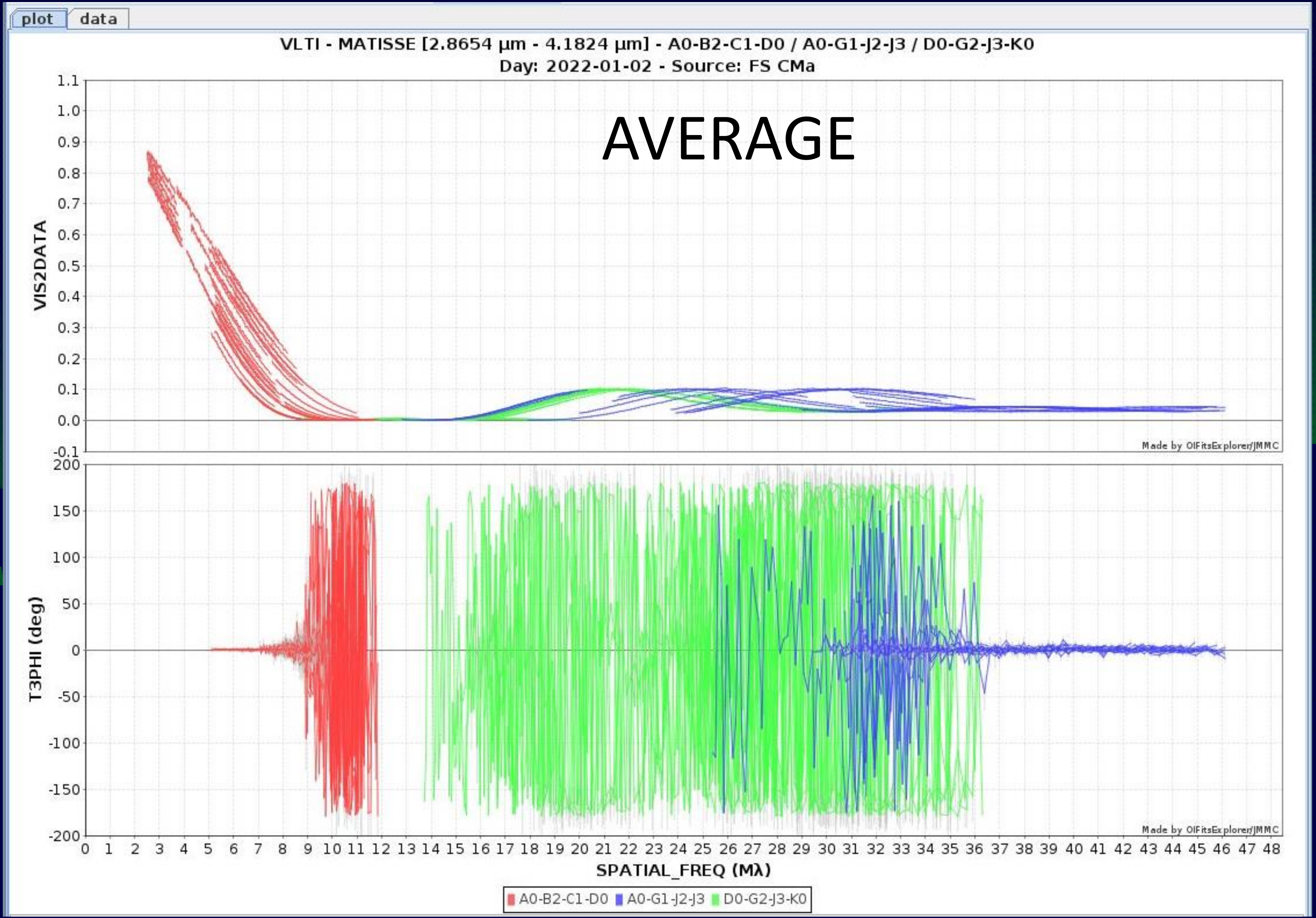
Question : Do the same with MATISSE_N instrument

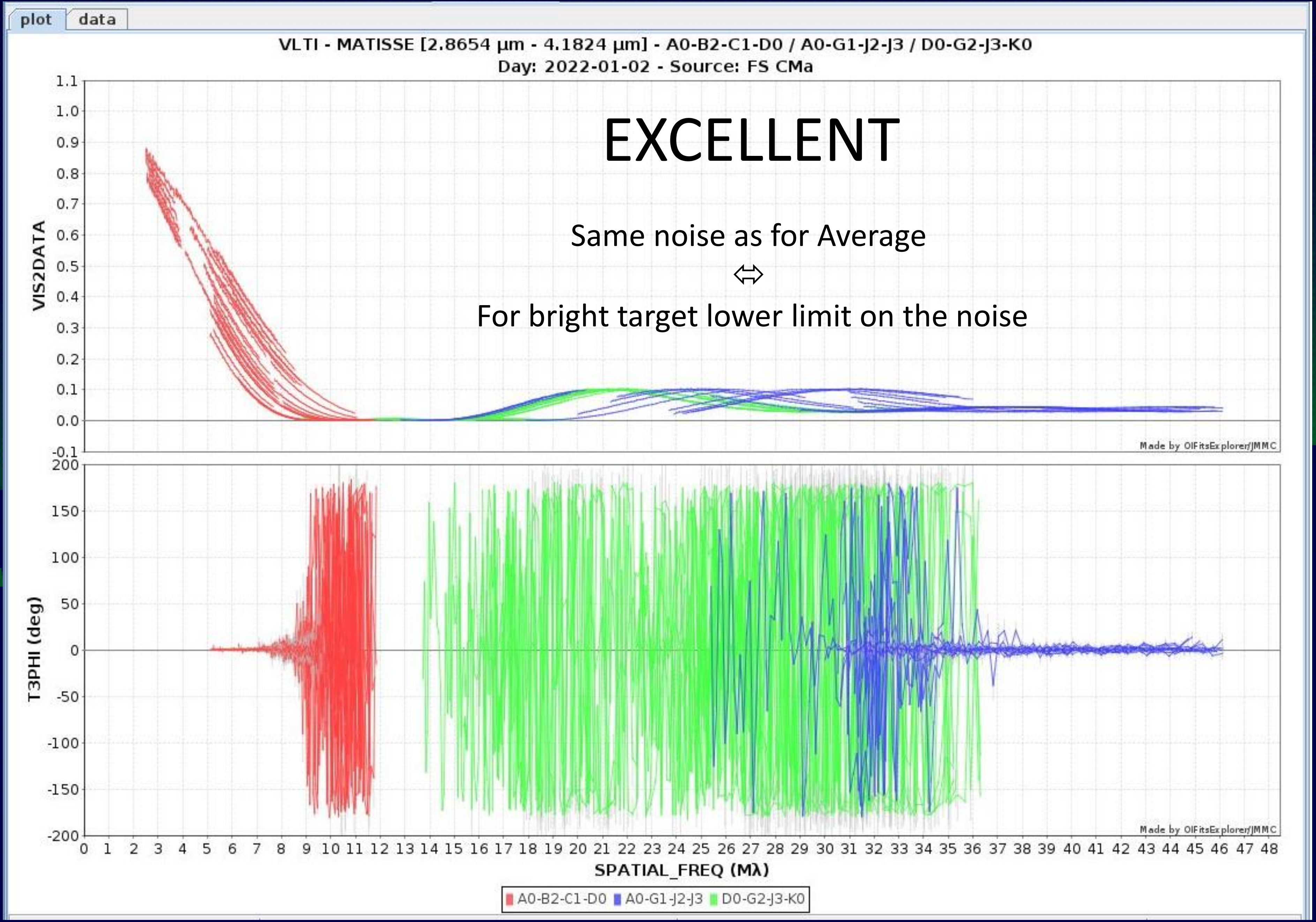
Finally, let's assume a much dimmer target, for instance with a L_band flux of 1 Jy. Change the Flux in the **Target Editor** menu. Don't forget to switch back to MATISSE_LM.

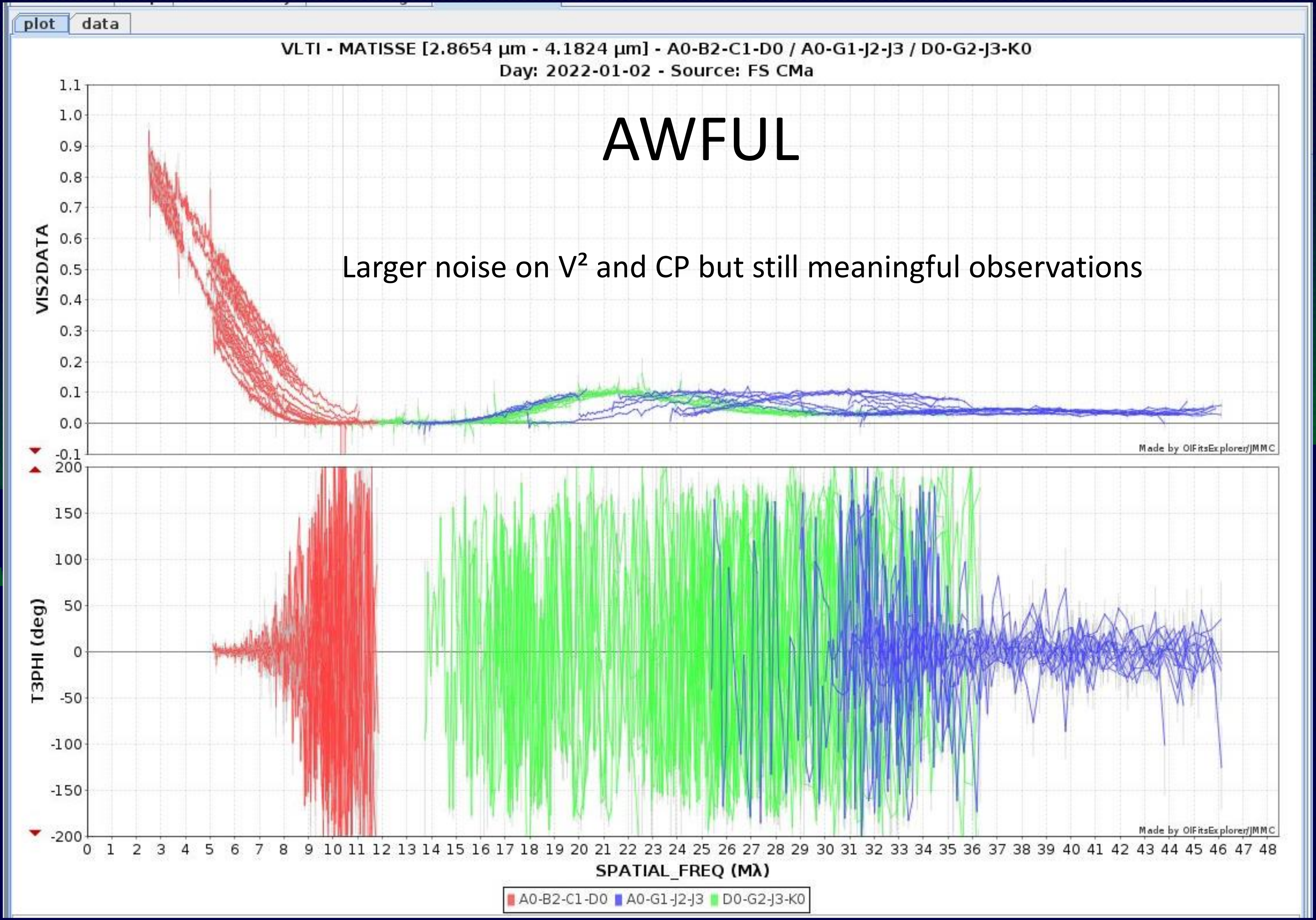
Question : Under which atmospheric quality will the data be useless?

Before continuing, put back the 39.7Jy flux for the L band and a GOOD atmosphere quality.

Corrections




plot
data
VLTI - MATISSE [2.8654 µm - 4.1824 µm] - A0-B2-C1-D0 / A0-G1-J2-J3 / D0-G2-J3-K0
Day: 2022-01-02 - Source: FS CMa
VIS2DATA
T3PHI (deg)
SPATIAL_FREQ (Mλ)
Made by OIFitsExplorer/JMMC
A0-B2-C1-D0
A0-G1-J2-J3
D0-G2-J3-K0
EXCELLENT
Same noise as for Average
⇔
For bright target lower limit on the noise



AWFUL

Larger noise on V² and CP but still meaningful observations

5 About the instrumental sensitivity

Question : With such noise on the data, are the observation still useful?

Yes the noise is very small actually.
This is due to the brightness of the source compared to MATISSE sensitivity.

You can change the **Atmosphere quality** value in the **UV Coverage** tab. When hovering a value, the definition in term of seeing and coherence time (t_0) is given. For instance, the **AVERAGE** atmosphere correspond to a seeing of 1" and t_0=3.2ms.

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Not really because the star is very bright.

Question : Is the data always useful even under AWFUL quality?

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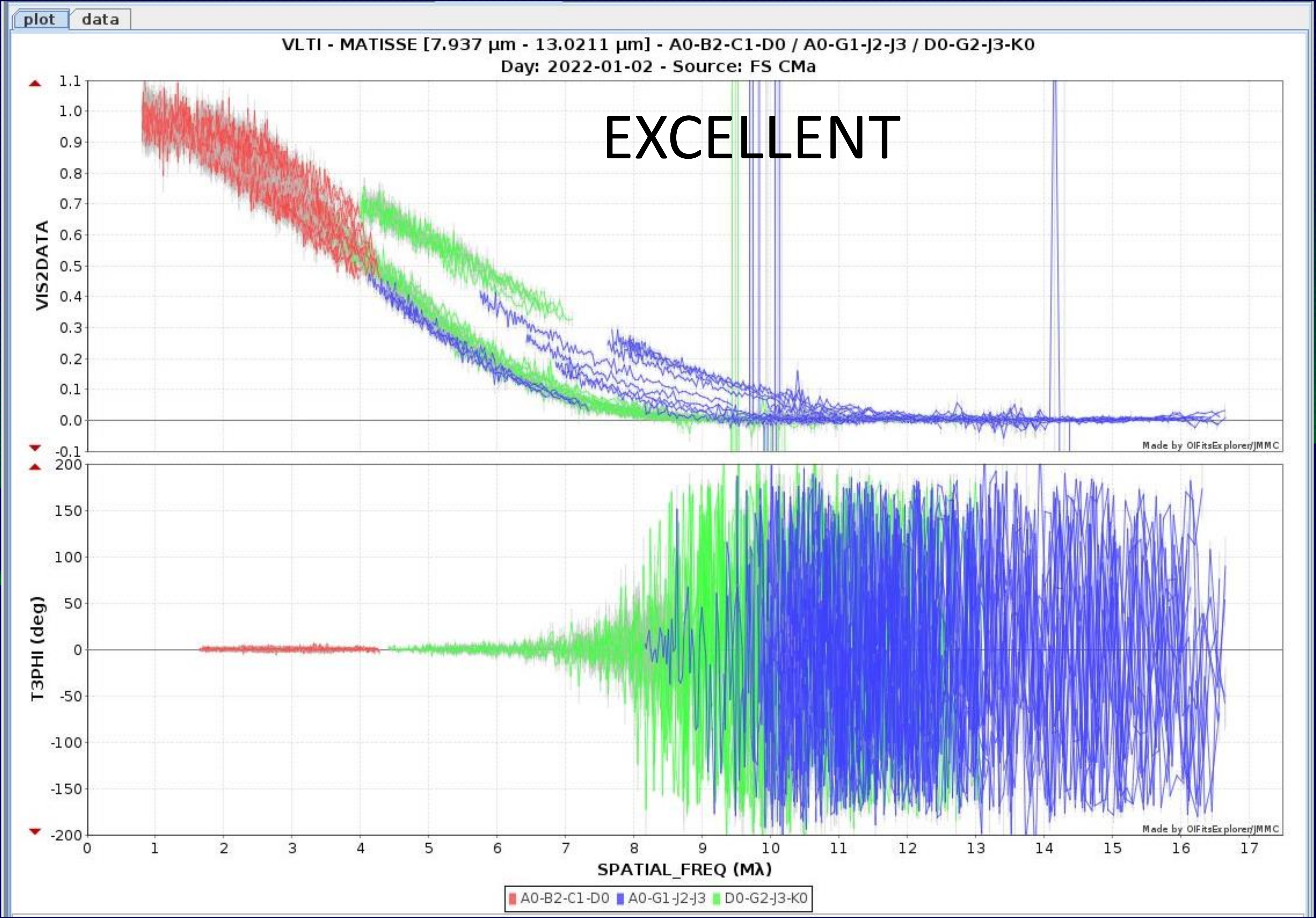
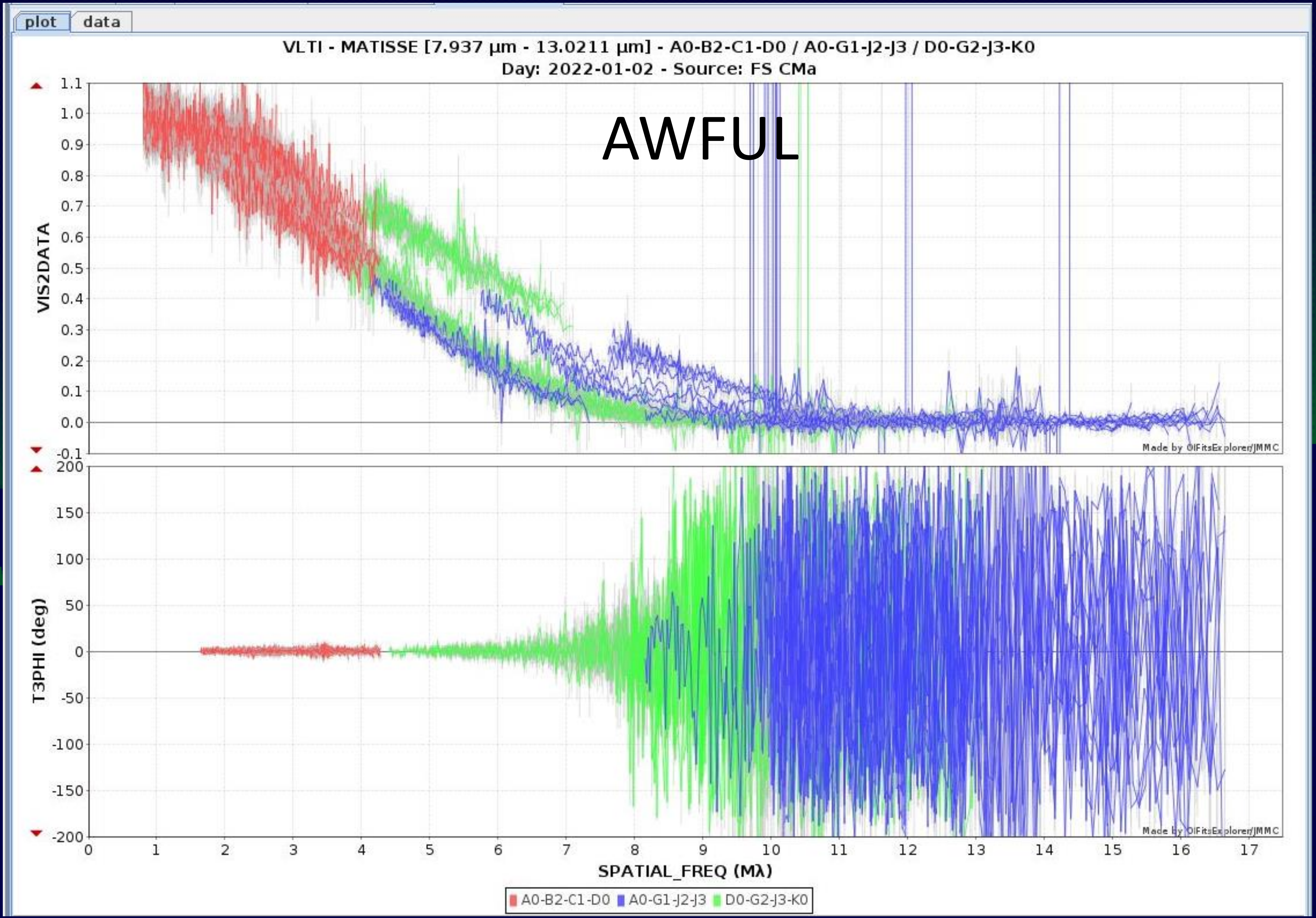
Corrections




plot
data
VLTI - MATISSE [7.937 µm - 13.0211 µm] - A0-B2-C1-D0 / A0-G1-J2-J3 / D0-G2-J3-K0
Day: 2022-01-02 - Source: FS CMa
AWFUL
VIS2DATA
T3PHI (deg)
SPATIAL_FREQ (Mλ)
Made by OIFitsExplorer/JMMC
A0-B2-C1-D0
A0-G1-J2-J3
D0-G2-J3-K0

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Errors are larger on the N band (instrument is less sensitive + problem with sky emission)
However, the star is still very bright and observable under every atmospheric conditions.

Finally, let's assume a much dimmer target, for instance with a L_band flux of 1 Jy. Change the Flux in the **Target Editor** menu. Don't forget to switch back to MATISSE_LM.

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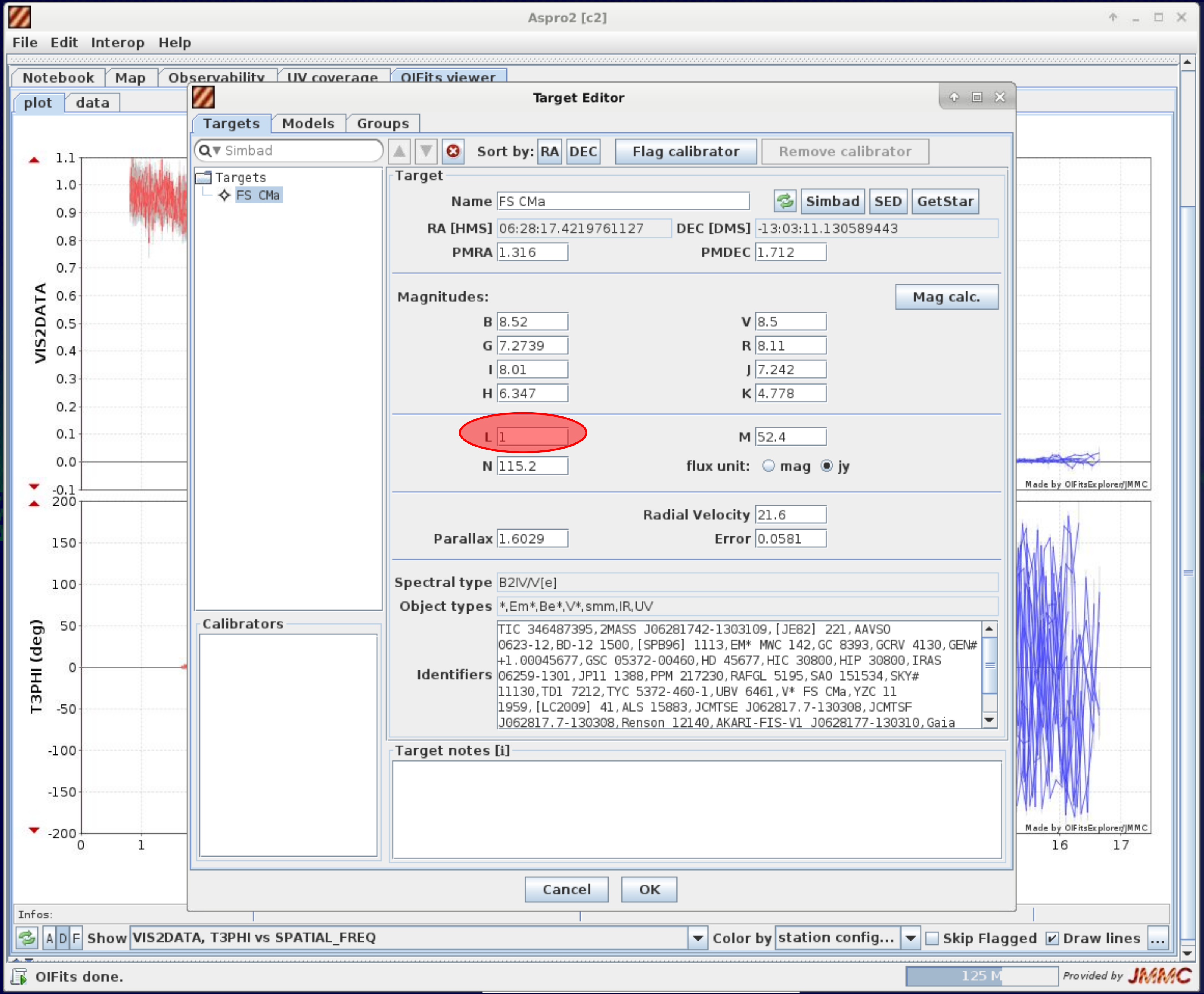
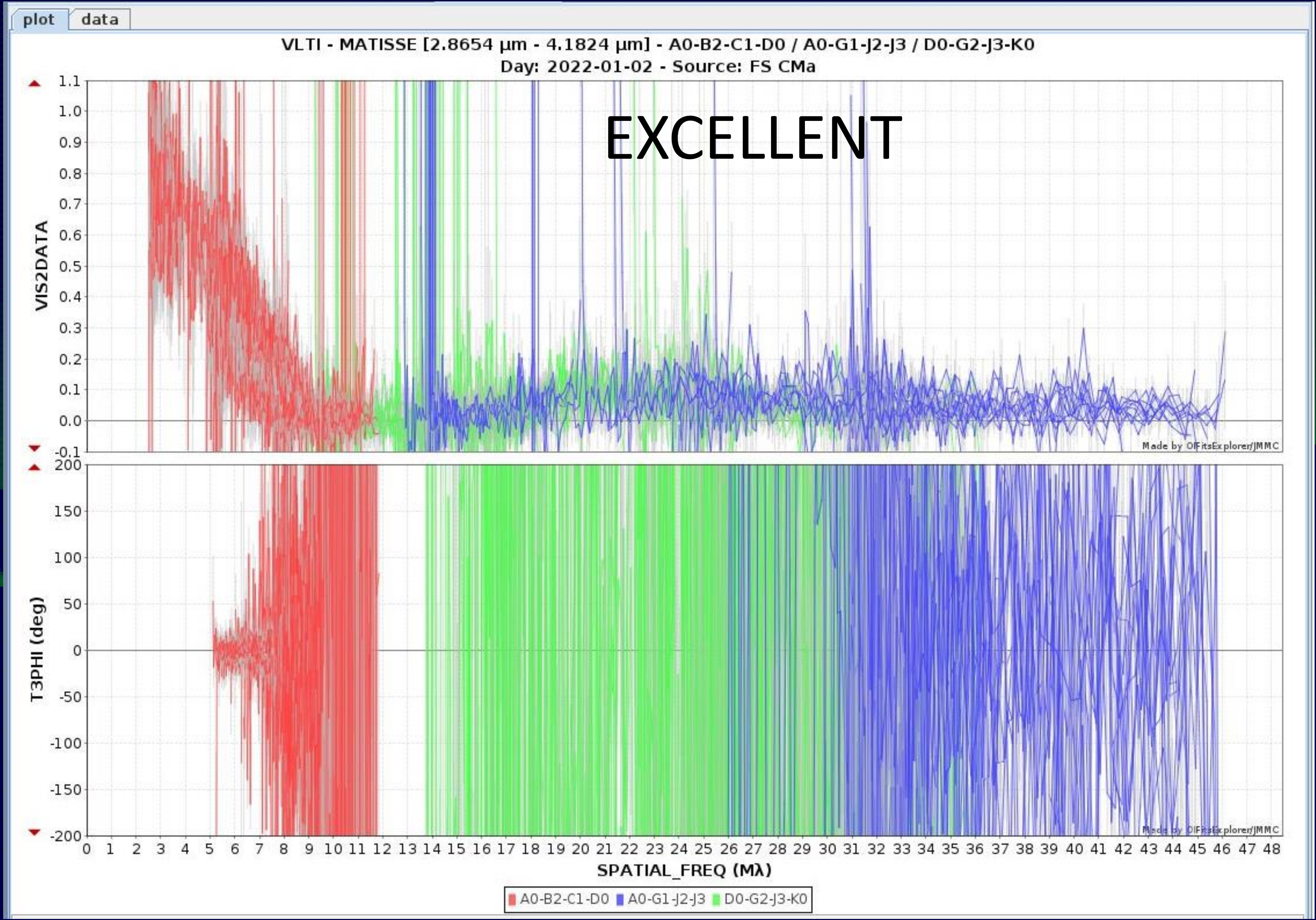
The 10th VLTI School of Interferometry

Practice session I: Interferometry basics with ASPRO

Corrections

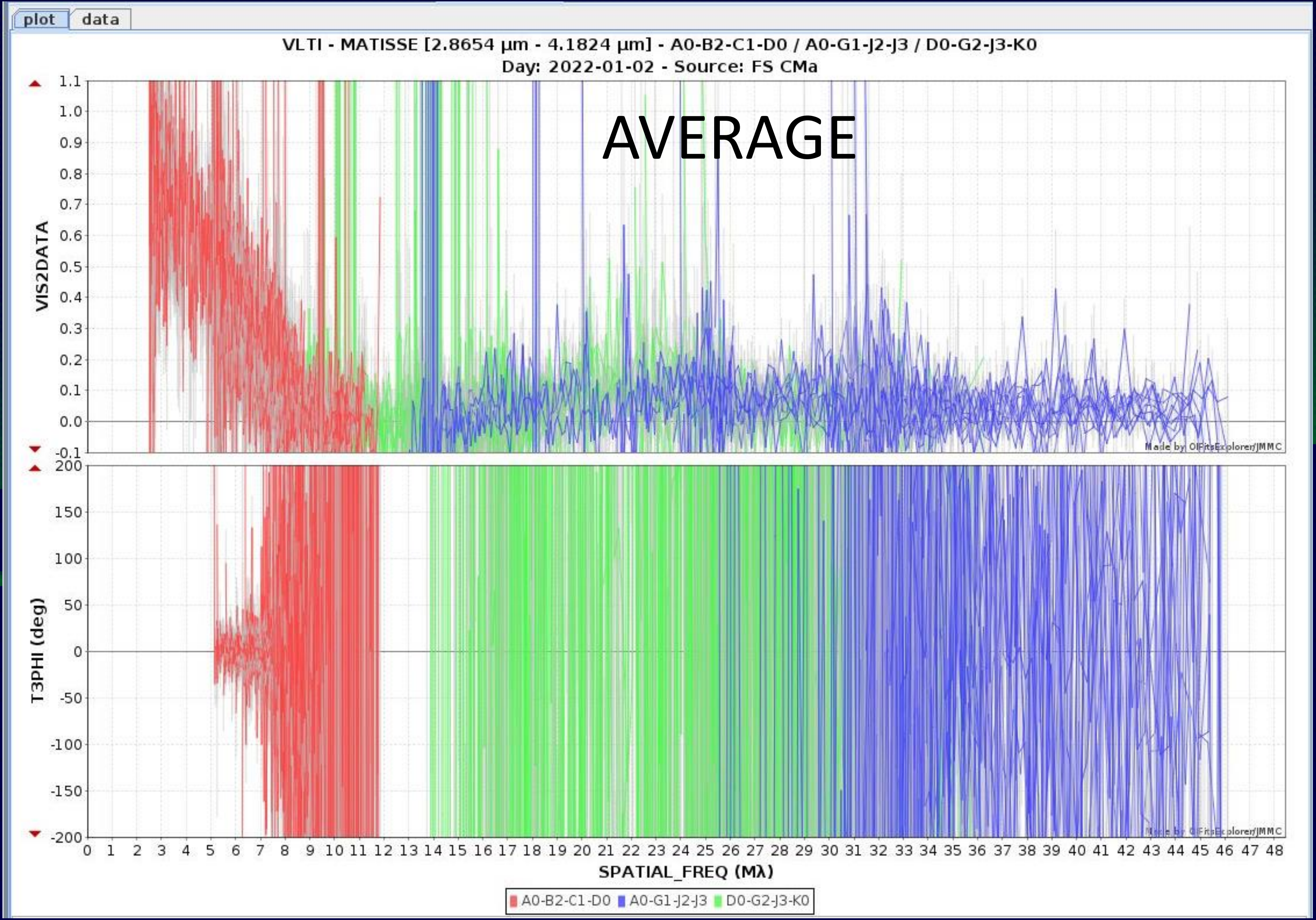


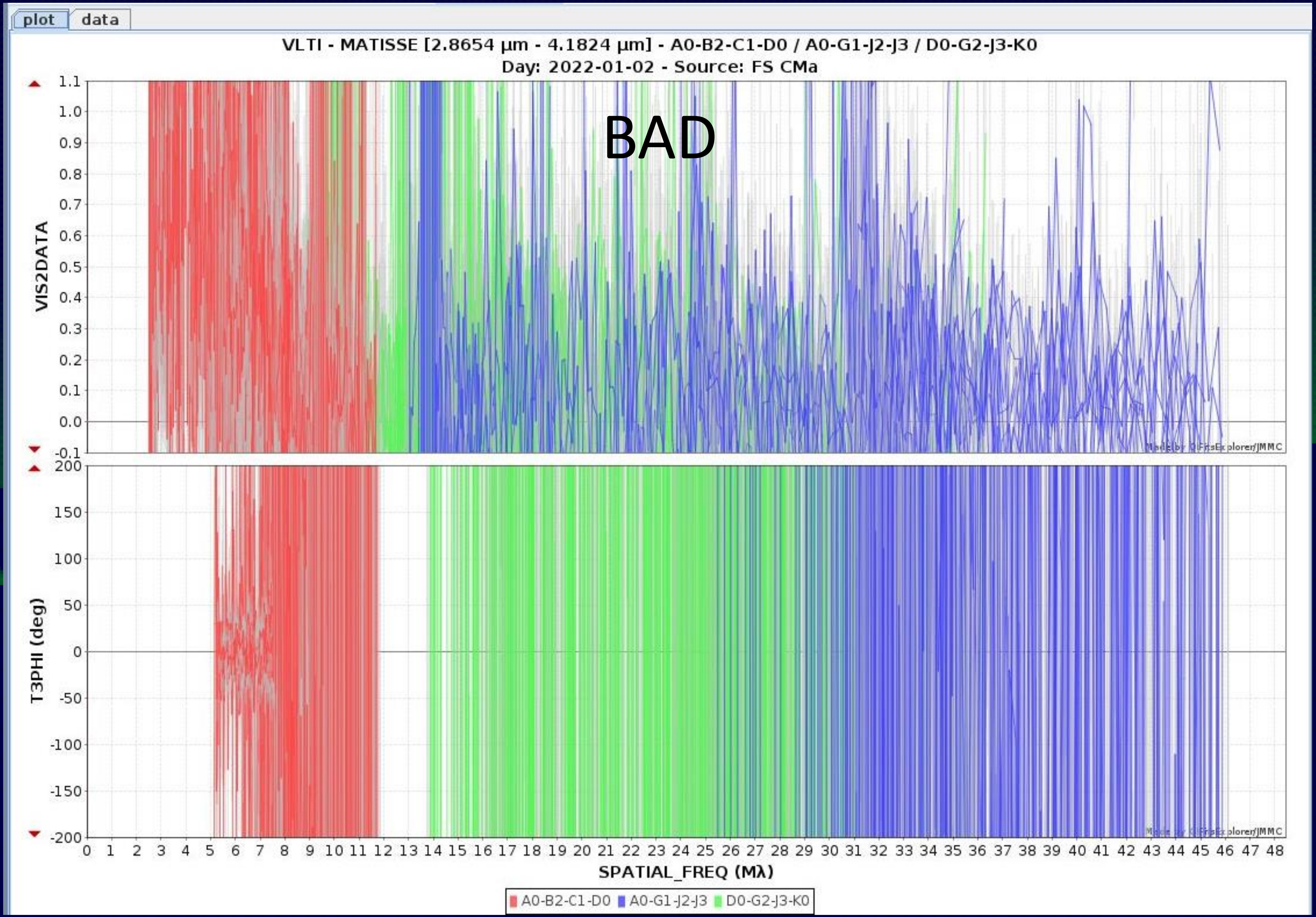
Corrections



EXCELLENT

Corrections




plot
data
VLTI - MATISSE [2.8654 µm - 4.1824 µm] - A0-B2-C1-D0 / A0-G1-J2-J3 / D0-G2-J3-K0
Day: 2022-01-02 - Source: FS CMa
BAD
VIS2DATA
T3PHI (deg)
SPATIAL_FREQ (Mλ)
A0-B2-C1-D0
A0-G1-J2-J3
D0-G2-J3-K0
Made by OIFitsExplorer/JMMC

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Yes, even if the errors are larger

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Errors are larger on the N band (instrument is less sensitive + problem with sky emission)
However, the star is still very bright and observable under every atmospheric conditions.

Finally, let's assume a much dimmer target, for instance with a L_band flux of 1 Jy. Change the Flux in the **Target Editor** menu. Don't forget to switch back to MATISSE_LM.

Question : Under which atmospheric quality will the data be useless?

Now the data is completely useless under BAD and AWFUL atmospheric conditions (WORSE is kind of limit too)

Before continuing, put back the 39.7Jy flux for the L band and a GOOD atmosphere quality.

6 Finding Calibrators

6 Finding Calibrators for our observations with SearchCal

Question : Find a good calibrator for MATISSE L&M bands (the best one might not be the first in the list)

You can send the selected calibrator (right click on it first) back to ASPRO2 using the SearchCal **Interop** menu.

Question : Is this calibrator a good calibrator for MATISSE N band observation? (Check in the OIFits viewer tab. Why?)

Let's now find a N-band calibrator. Select **MATISSE_N** in ASPRO2 **Instrument** scrolling menu, verify that FS CMa is still selected in the **Targets** list and send it again to SearchCal

Question : What has change in the SearchCal interface?

Question : Find a good calibrator for that band and send it back to ASPRO2

Now you have two calibrators, one for the L&M bands, and one for the N-band. You can plot their excepted visibility curve in ASPRO2 **OIFits Viewer** tab.

Question : Is the N-band calibrator a good calibrator for MATISSE L band observation? Why?

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Question : Is the N-band calibrator a good calibrator for MATISSE L band observation? Why?

Corrections

SearchCal [c1]

File Edit Query Calibrators Interop Help

Query Parameters

1) Instrumental Configuration

Magnitude Band : L
Wavelength (L) [µm] : 3.522
Max. Baseline [m] : 137.646

2) Science Object

Name : FS CMa
RA 2000 [hh:mm:ss] : 06:28:17.422
DEC 2000 [+/-dd:mm:ss] : -13:03:11.131
Magnitude (L) : 2.1577

3) SearchCal Parameters

Min. Magnitude (L) : 0.1577
Max. Magnitude (L) : 4.1577
Scenario : Bright Faint
RA Range [mn] : 240.0
DEC Range [deg] : 20.0

Default ⇔ ordering by distance ot the source

Progress :

Get Calibrators

Found Calibrators (1086 sources, 507 filtered)

Index	dist	HD	RAJ2000	DEJ2000	vis2	vis2Err	diam_chi2	LDD	e_LDD_rel	GroupSize	SIMBAD	SpType	ObjTypes	L	M	N	UD_L	UD_M
1	1.118	46034	06 30 33.2114	-12 04 51.7548	0.957	0.008	0.273	0.710	8.924	0	HD 46034	K0III	,Star,IR,*,	4.089	3.844	4.036	0.700	0.702
2	1.243	45401	06 26 38.1029	-11 52 39.0684	0.935	0.004	1.007	0.885	3.244	0	HD 45401	M0/1(III)	,Star,IR,*,	4.138	3.989	4.087	0.870	0.877
3	1.597	45420	06 26 42.6571	-14 36 12.3444	0.923	0.013	1.000	0.964	8.602	0	HD 45420	K0/1III	,Star,IR,*,	3.528	3.180	3.457	0.950	0.953
4	1.960	44462	06 21 20.1989	-14 02 46.8672	0.834	0.030	0.268	1.445	9.691	0	HD 44462	M1III	,Star,IR,*,	2.991	2.725	2.994	1.420	1.431
5	2.015	44999	06 24 24.0926	-14 50 00.1284	0.950	0.008	0.462	0.771	8.418	0	HD 44999	K3III	,Star,IR,*,	4.051	3.888	4.035	0.759	0.763
6	2.246	44378	06 21 01.0087	-11 40 39.4176	0.945	0.004	1.657	0.810	3.232	0	HD 44378	K4III	,Star,IR,*,	4.031	3.864	4.025	0.797	0.801
7	2.535	47163	06 36 43.7414	-11 34 37.3224	0.925	0.013	0.027	0.950	8.865	0	HD 47163	M1III	,Star,IR,*,	3.834	3.748	3.800	0.934	0.941
8	2.586	46284	06 31 58.7950	-15 28 46.2684	0.946	0.009	0.176	0.803	8.798	0	HD 46284	K3III	,Star,IR,*,	4.044	3.876	4.011	0.791	0.795
9	2.627		06 22 42.0084	-15 18 14.0616	0.919	0.005	1.465	0.991	3.265	0	BD-15 1363	M3III	,Star,IR,*,	4.024	3.929	3.972	0.973	0.981
10	3.010	44621	06 22 06.1075	-15 39 48.3660	0.934	0.012	0.216	0.885	9.114	0	HD 44621	K0III	,Star,IR,*,	3.524	3.266	3.524	0.873	0.875
11	3.255	44040	06 18 59.9436	-15 24 13.1508	0.918	0.015	0.350	0.999	9.500	0	HD 44040	M1III	,Star,IR,*,	3.782	3.727	3.763	0.982	0.989
12	3.832	48599	06 43 41.8409	-13 51 32.1156	0.901	0.013	1.000	1.102	6.781	0	HD 48599	M1/2(III)	,Star,IR,*,	3.750	3.618	3.664	1.083	1.091
13	4.077	48869	06 44 59.2301	-13 23 13.9272	0.925	0.011	0.069	0.950	7.289	0	HD 48869	M1III	,Star,IR,*,	3.921	3.835	3.886	0.934	0.941
14	4.122	44889	06 23 58.8079	-09 04 07.6620	0.913	0.016	1.000	1.027	9.370	0	HD 44889	K2/3III	,Star,IR,*,	3.465	2.918	3.411	1.011	1.016
15	4.683	42883	06 12 50.9076	-10 17 21.1164	0.923	0.013	0.352	0.962	8.482	0	HD 42883	K4III	,Star,IR,*,	3.662	3.430	3.633	0.947	0.952
16	4.783	48625	06 43 41.8222	-16 02 59.8200	0.948	0.010	1.000	0.783	9.498	0	HD 48625	K2/3III	,Star,IR,*,	3.945	3.746	3.928	0.771	0.775
17	4.852	49458	06 48 02.8390	-12 28 32.1492	0.906	0.015	0.829	1.069	8.234	0	HD 49458	M2III	,Star,IR,*,	3.506	3.290	3.433	1.051	1.059
18	5.085	46308	06 31 55.6546	-18 03 44.1396	0.876	0.019	0.044	1.234	7.912	0	HD 46308	K3III	,Star,IR,*,	3.223	2.901	3.163	1.215	1.221
19	5.129	41971	06 07 41.2042	-12 02 14.5932	0.914	0.018	0.365	1.019	10.970	0	HD 41971	M1III	,Star,IR,*,	3.620	3.421	3.570	1.001	1.009
20	5.305	41839	06 06 55.8502	-12 03 54.3456	0.923	0.013	0.155	0.960	8.670	0	HD 41839	K2III	,Star,IR,*,	3.429	3.195	3.853	0.946	0.950

Filters

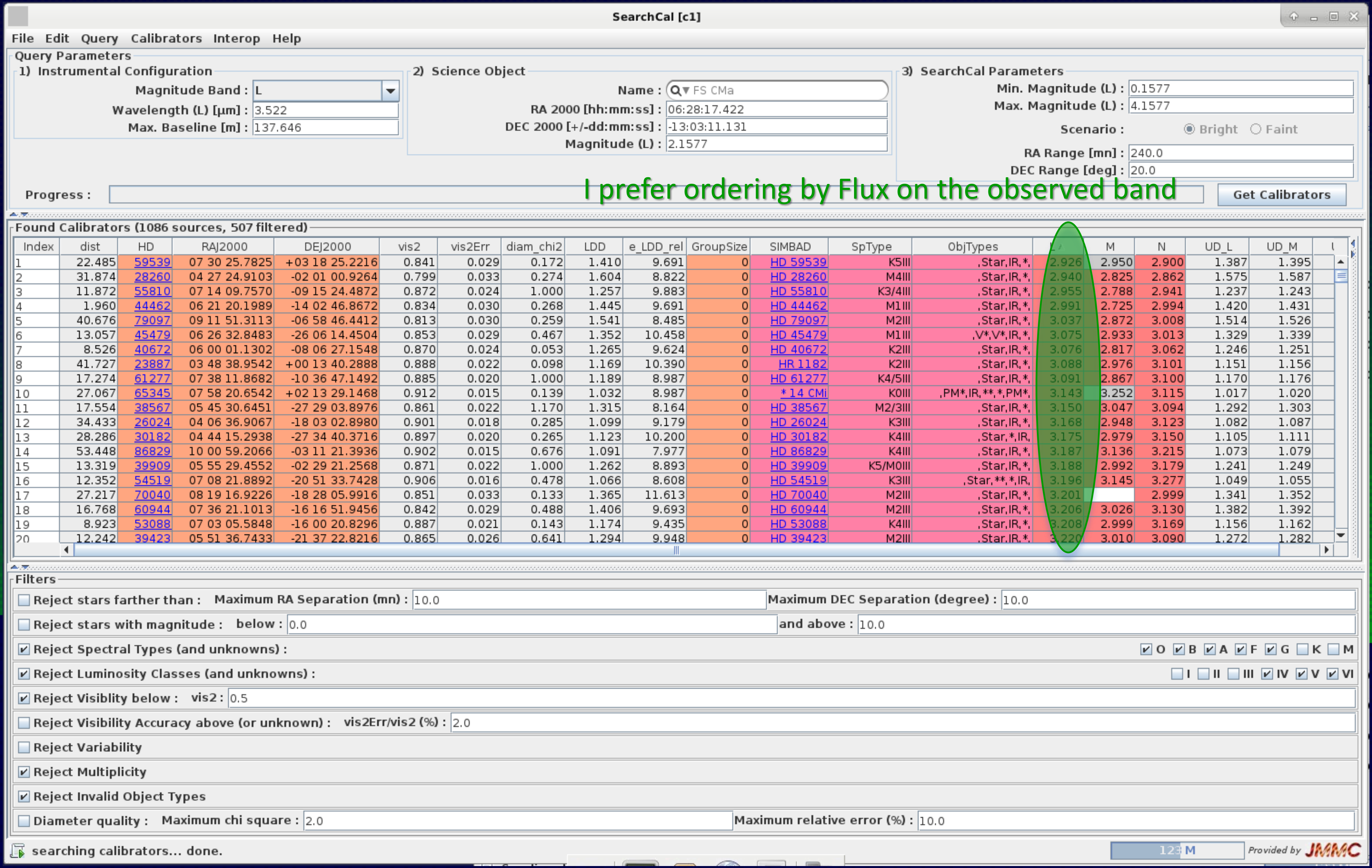
- [ ] Reject stars farther than : Maximum RA Separation (mn) : 10.0 Maximum DEC Separation (degree) : 10.0
- [ ] Reject stars with magnitude : below : 0.0 and above : 10.0
- [x] Reject Spectral Types (and unknowns) : [x] O [x] B [x] A [x] F [x] G [ ] K [ ] M
- [x] Reject Luminosity Classes (and unknowns) : [ ] I [ ] II [ ] III [x] IV [x] V [x] VI
- [x] Reject Visiblity below : vis2 : 0.5
- [ ] Reject Visibility Accuracy above (or unknown) : vis2Err/vis2 (%) : 2.0
- [ ] Reject Variability
- [x] Reject Multiplicity
- [x] Reject Invalid Object Types
- [ ] Diameter quality : Maximum chi square : 2.0 Maximum relative error (%) : 10.0

searching calibrators... done.

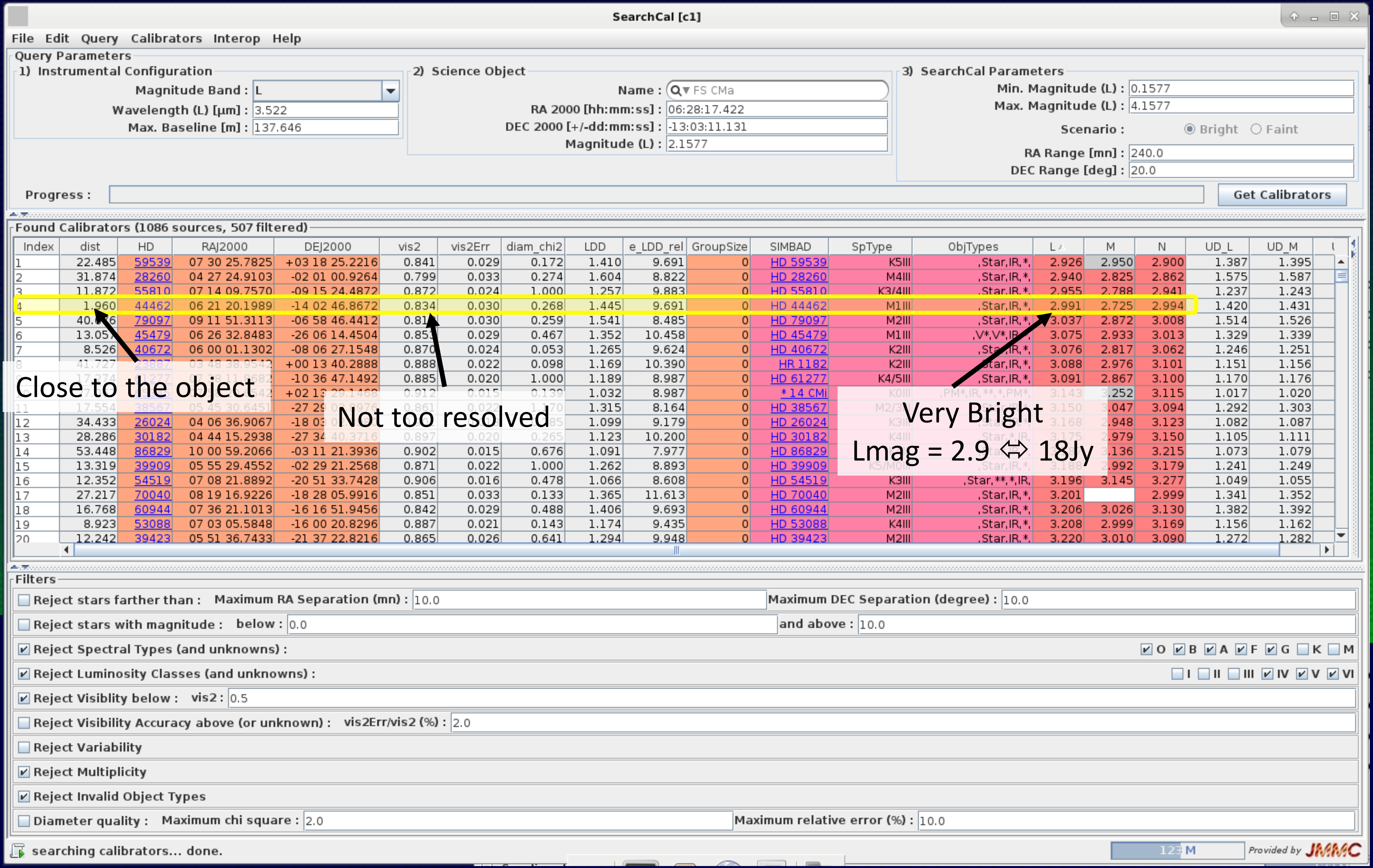
81 M

Provided by JMMC

Corrections



I prefer ordering by Flux on the observed band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File Edit Query Calibrators Interop Help
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Index dist HD RAJ2000 DEJ2000 vis2 vis2Err diam_chi2 LDD e_LDD_rel GroupSize SIMBAD SpType ObjTypes L M N UD_L UD_M
4 1.960 44462 06 21 20.1989 -14 02 46.8672 0.834 0.030 0.268 1.445 9.691 0 HD 44462 M1III ,Star,IR,*, 2.991 2.725 2.994 1.420 1.431
Close to the object
Not too resolved
Very Bright
Lmag = 2.9 ⇔ 18Jy
Filters
Reject stars farther than : Maximum RA Separation (mn) : 10.0 Maximum DEC Separation (degree) : 10.0
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Provided by JMMC

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Question : Is this calibrator a good calibrator for MATISSE N band observation? (Check in the OIFits viewer tab. Why?)

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There are many good calibrators for the L band.

The best might be HD44462 at it is at the same time, one a the brightest (Lmag = 2.99 = 18Jy) and closest (2°), and it is also barely resolved (V > 0.8)

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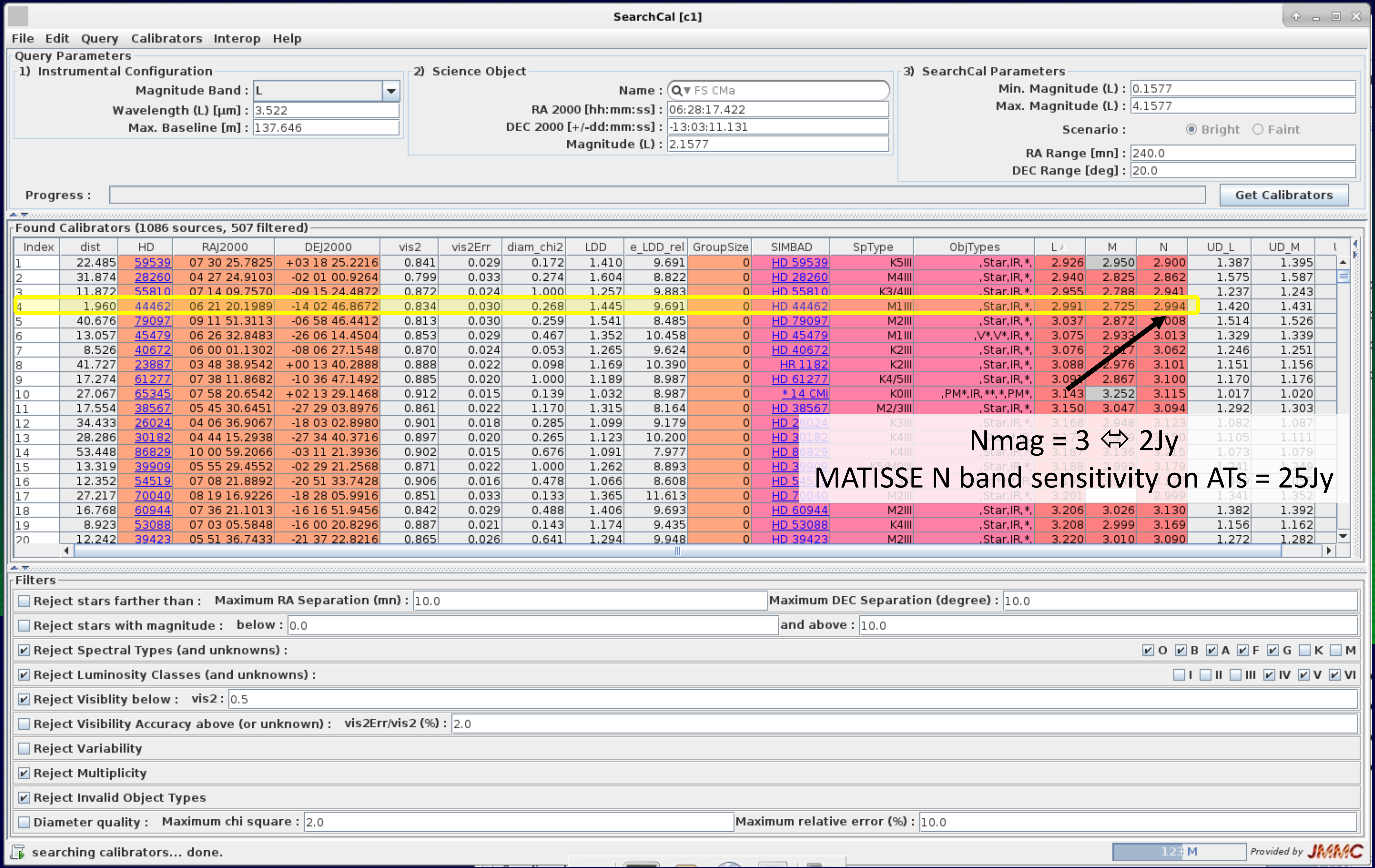

Index	dist	HD	RAJ2000	DEJ2000	vis2	vis2Err	diam_chi2	LDD	e_LDD_rel	GroupSize	SIMBAD	SpType	ObjTypes	L	M	N	UD_L	UD_M
1	22.485	59539	07 30 25.7825	+03 18 25.2216	0.841	0.029	0.172	1.410	9.691	0	HD 59539	K5III	,Star,IR,*,	2.926	2.950	2.900	1.387	1.395
2	31.874	28260	04 27 24.9103	-02 01 00.9264	0.799	0.033	0.274	1.604	8.822	0	HD 28260	M4III	,Star,IR,*,	2.940	2.825	2.862	1.575	1.587
3	11.872	55810	07 14 09.7570	-09 15 24.4872	0.872	0.024	1.000	1.257	9.883	0	HD 55810	K3/4III	,Star,IR,*,	2.955	2.788	2.941	1.237	1.243
4	1.960	44462	06 21 20.1989	-14 02 46.8672	0.834	0.030	0.268	1.445	9.691	0	HD 44462	M1III	,Star,IR,*,	2.991	2.725	2.994	1.420	1.431
5	40.676	79097	09 11 51.3113	-06 58 46.4412	0.813	0.030	0.259	1.541	8.485	0	HD 79097	M2III	,Star,IR,*,	3.037	2.872	[illegible]	1.514	1.526
6	13.057	45479	06 26 32.8483	-26 06 14.4504	0.853	0.029	0.467	1.352	10.458	0	HD 45479	M1III	,V*,V*,IR,*,	3.075	2.933	3.013	1.329	1.339
7	8.526	40672	06 00 01.1302	-08 06 27.1548	0.870	0.024	0.053	1.265	9.624	0	HD 40672	K2III	,Star,IR,*,	3.076	[illegible]	3.062	1.246	1.251
8	41.727	23887	03 48 38.9542	+00 13 40.2888	0.888	0.022	0.098	1.169	10.390	0	HR 1182	K2III	,Star,IR,*,	3.088	2.976	3.101	1.151	1.156
9	17.274	61277	07 38 11.8682	-10 36 47.1492	0.885	0.020	1.000	1.189	8.987	0	HD 61277	K4/5III	,Star,IR,*,	[illegible]	2.867	3.100	1.170	1.176
10	27.067	65345	07 58 20.6542	+02 13 29.1468	0.912	0.015	0.139	1.032	8.987	0	* 14 CMi	K0III	,PM*,IR,**,*,PM*,	3.143	3.252	3.115	1.017	1.020
11	17.554	38567	05 45 30.6451	-27 29 03.8976	0.861	0.022	1.170	1.315	8.164	0	HD 38567	M2/3III	,Star,IR,*,	3.150	3.047	3.094	1.292	1.303
12	34.433	26024	04 06 36.9067	-18 03 02.8980	0.901	0.018	0.285	1.099	9.179	0	HD 26024	K3III	,Star,IR,*,	3.168	2.948	3.123	1.082	1.087
13	28.286	30182	04 44 15.2938	-27 34 40.3716	0.897	0.020	0.265	1.123	10.200	0	HD 30182	K4III	[illegible]	[illegible]	[illegible]	[illegible]	1.105	1.111
14	53.448	86829	10 00 59.2066	-03 11 21.3936	0.902	0.015	0.676	1.091	7.977	0	HD 86829	K4III	[illegible]	3.187	3.136	[illegible]	1.073	1.079
15	13.319	39909	05 55 29.4552	-02 29 21.2568	0.871	0.022	1.000	1.262	8.893	0	HD 39909	[illegible]	,Star,IR,*,	3.188	[illegible]	3.179	[illegible]	[illegible]
16	12.352	54519	07 08 21.8892	-20 51 33.7428	0.906	0.016	0.478	1.066	8.608	0	HD 54519	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	27.217	70040	08 19 16.9226	-18 28 05.9916	0.851	0.033	0.133	1.365	11.613	0	HD 70040	M2III	,Star,IR,*,	3.201		2.999	1.341	1.352
18	16.768	60944	07 36 21.1013	-16 16 51.9456	0.842	0.029	0.488	1.406	9.693	0	HD 60944	M2III	,Star,IR,*,	3.206	3.026	3.130	1.382	1.392
19	8.923	53088	07 03 05.5848	-16 00 20.8296	0.887	0.021	0.143	1.174	9.435	0	HD 53088	K4III	,Star,IR,*,	3.208	2.999	3.169	1.156	1.162
20	12.242	39423	05 51 36.7433	-21 37 22.8216	0.865	0.026	0.641	1.294	9.948	0	HD 39423	M2III	,Star,IR,*,	3.220	3.010	3.090	1.272	1.282

Nmag = 3 ⇔ 2Jy

MATISSE N band sensitivity on ATs = 25Jy

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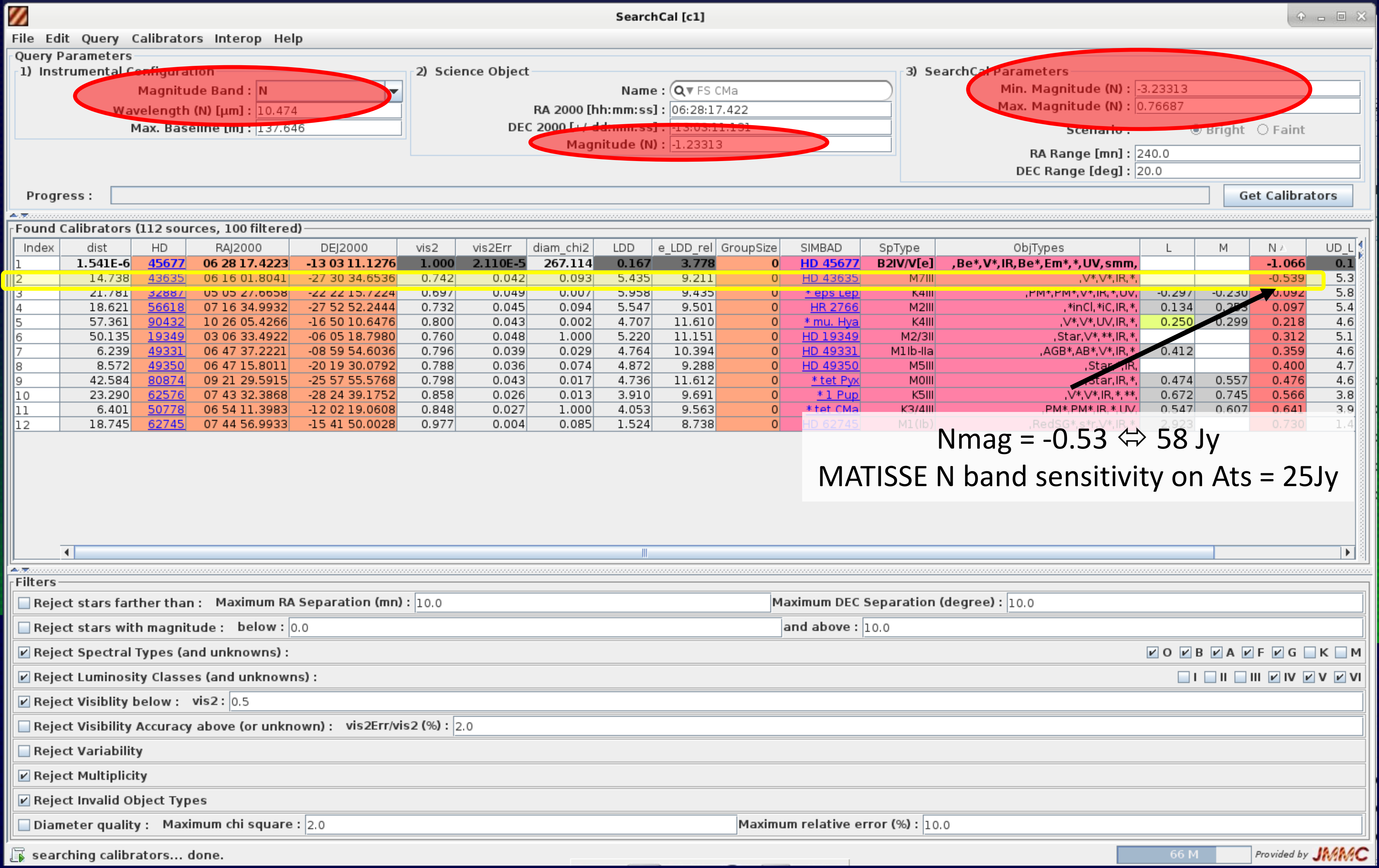

Index	dist	HD	RAJ2000	DEJ2000	vis2	vis2Err	diam_chi2	LDD	e_LDD_rel	GroupSize	SIMBAD	SpType	ObjTypes	L	M	N	UD_L
1	1.541E-6	45677	06 28 17.4223	-13 03 11.1276	1.000	2.110E-5	267.114	0.167	3.778	0	HD 45677	B2IV/V[e]	,Be*,V*,IR,Be*,Em*,*,UV,smm,			-1.066	0.1
2	14.738	43635	06 16 01.8041	-27 30 34.6536	0.742	0.042	0.093	5.435	9.211	0	HD 43635	M7III	,V*,V*,IR,*,			-0.539	5.3
3	21.781	32887	05 05 27.6658	-22 22 15.7224	0.697	0.049	0.007	5.958	9.435	0	* eps Lep	K4III	,PM*,PM*,V*,IR,*,UV,	-0.297	-0.230	0.092	5.8
4	18.621	56618	07 16 34.9932	-27 52 52.2444	0.732	0.045	0.094	5.547	9.501	0	HR 2766	M2III	,*inCl,*iC,IR,*,	0.134	0.253	0.097	5.4
5	57.361	90432	10 26 05.4266	-16 50 10.6476	0.800	0.043	0.002	4.707	11.610	0	* mu. Hya	K4III	,V*,V*,UV,IR,*,	0.250	0.299	0.218	4.6
6	50.135	19349	03 06 33.4922	-06 05 18.7980	0.760	0.048	1.000	5.220	11.151	0	HD 19349	M2/3II	,Star,V*,**,IR,*,			0.312	5.1
7	6.239	49331	06 47 37.2221	-08 59 54.6036	0.796	0.039	0.029	4.764	10.394	0	HD 49331	M1Ib-IIa	,AGB*,AB*,V*,IR,*	0.412		0.359	4.6
8	8.572	49350	06 47 15.8011	-20 19 30.0792	0.788	0.036	0.074	4.872	9.288	0	HD 49350	M5III	,Star,[illegible],IR,			0.400	4.7
9	42.584	80874	09 21 29.5915	-25 57 55.5768	0.798	0.043	0.017	4.736	11.612	0	* tet Pyx	M0III	,Star,IR,*,	0.474	0.557	0.476	4.6
10	23.290	62576	07 43 32.3868	-28 24 39.1752	0.858	0.026	0.013	3.910	9.691	0	* 1 Pup	K5III	,V*,V*,IR,*,**,	0.672	0.745	0.566	3.8
11	6.401	50778	06 54 11.3983	-12 02 19.0608	0.848	0.027	1.000	4.053	9.563	0	* tet CMa	K3/4III	,PM*,PM*,IR,*,UV,	0.547	0.607	0.641	3.9
12	18.745	62745	07 44 56.9933	-15 41 50.0028	0.977	0.004	0.085	1.524	8.738	0	HD 62745	M1(Ib)	,RedSG*,s*r,V*,IR,*,	2.923		0.730	1.4

Nmag = -0.53 ⇔ 58 Jy

MATISSE N band sensitivity on Ats = 25Jy

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There are less calibrators found than for L band!

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HD43635 is a fairly good one : bright -0.539 and yet not too resolved V>0.74 and not too far 14°.

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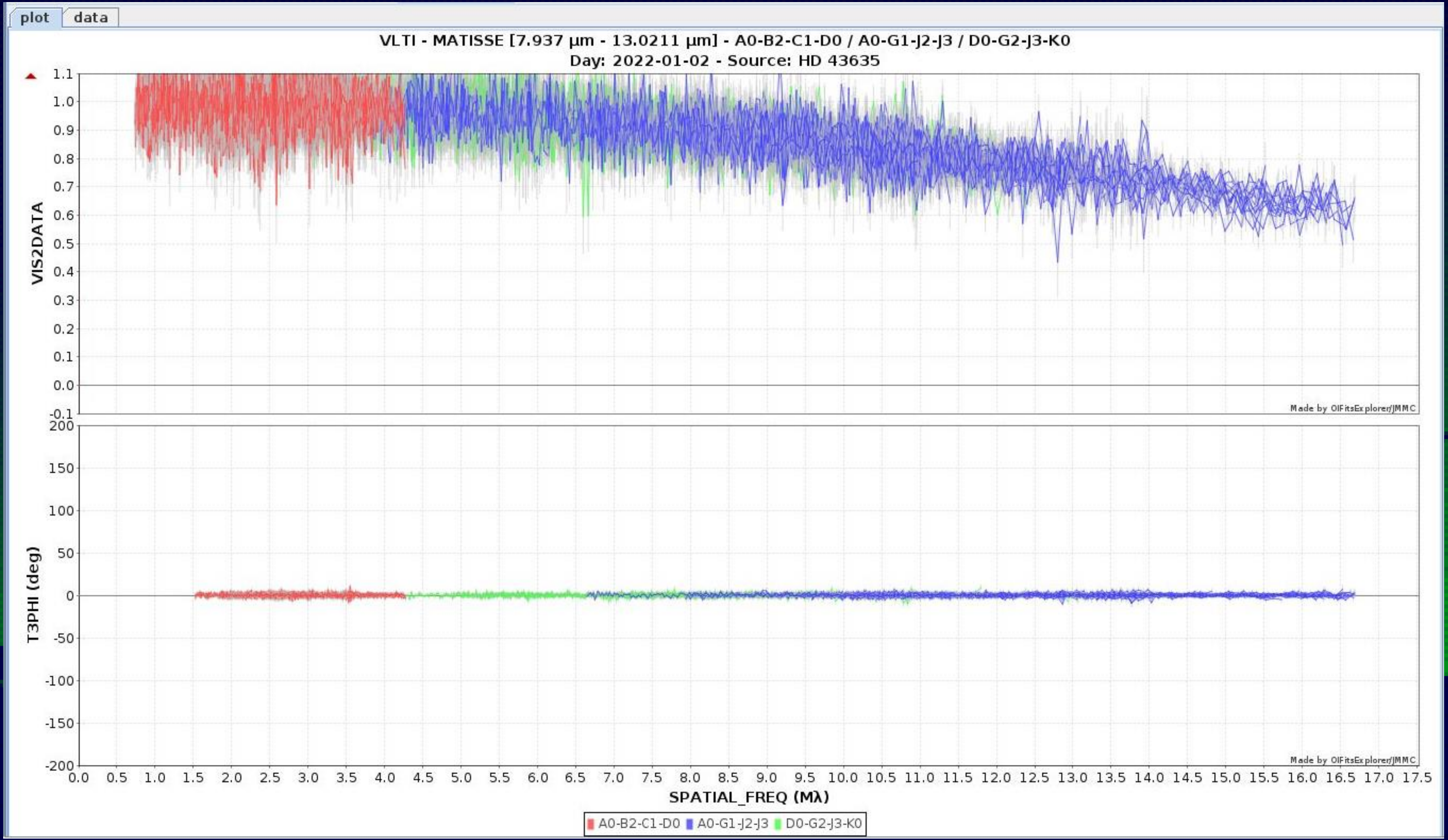

Good calibrator in N band (bright and not too resolved)

Bad calibrator in L band (Almost fully resolved)

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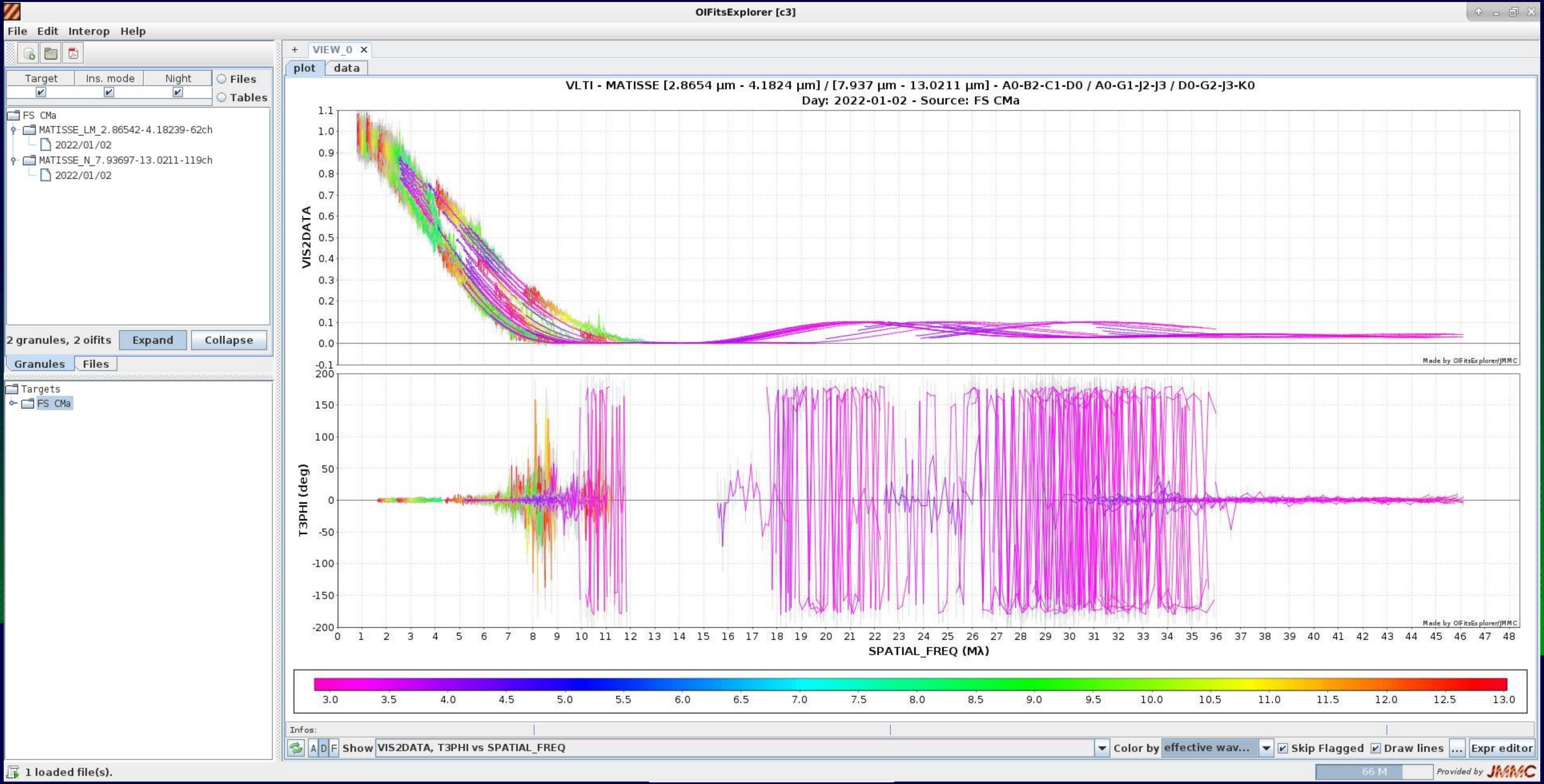
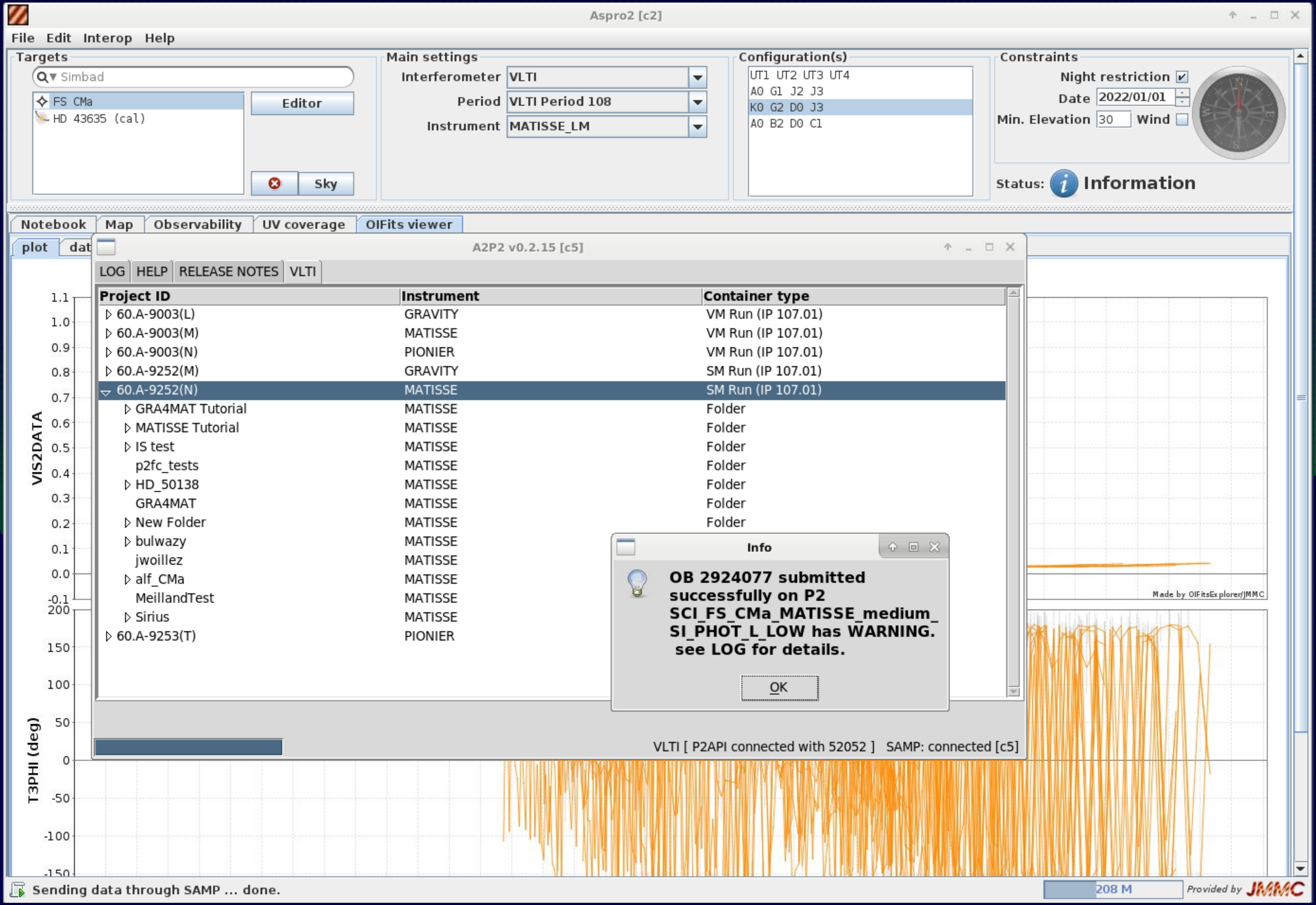
Question : Is the N-band calibrator a good calibrator for MATISSE L band observation? Why?

No it is much too resolved in the L band.
Resolution in L with 130m : 250 λ/B ≈ 5.7 mas
This is very closed to HD43635 diameter 5.4 mas

7 Exporting Data from ASPRO



OIFits files (for L & N bands) exported from ASPRO and loaded in OIFitsExplorer



Oberving block directy submitted from ASPRO to ESO p2 interface using a2p2 tool

8 Bonus

8 Bonus : Beyond our MATISSE Observation

8.1 Resolving the stellar surface

Question : Is it possible to constrain the stellar diameter using the VLTI? What are the two advantages of using CHARA for that purpose?

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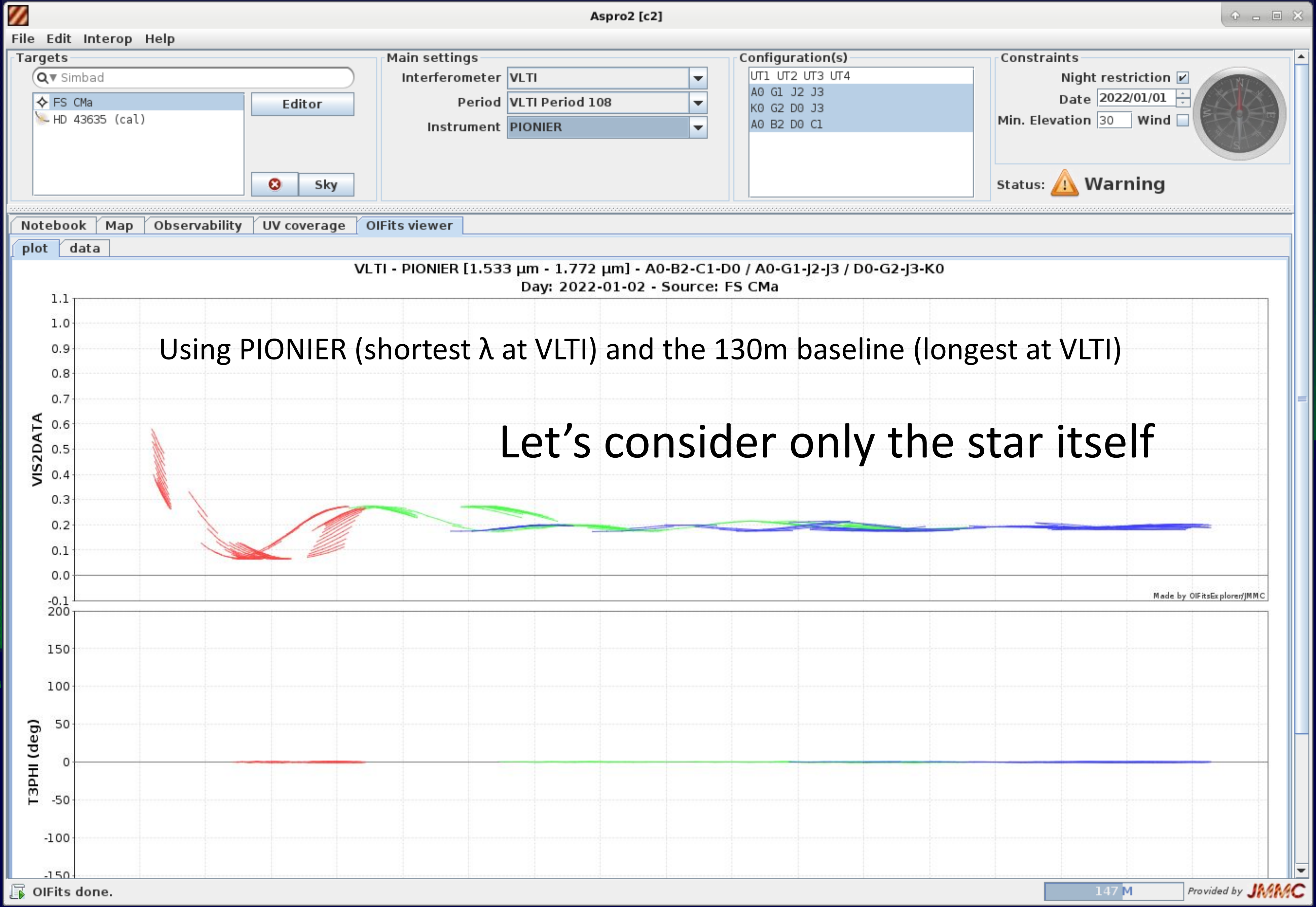
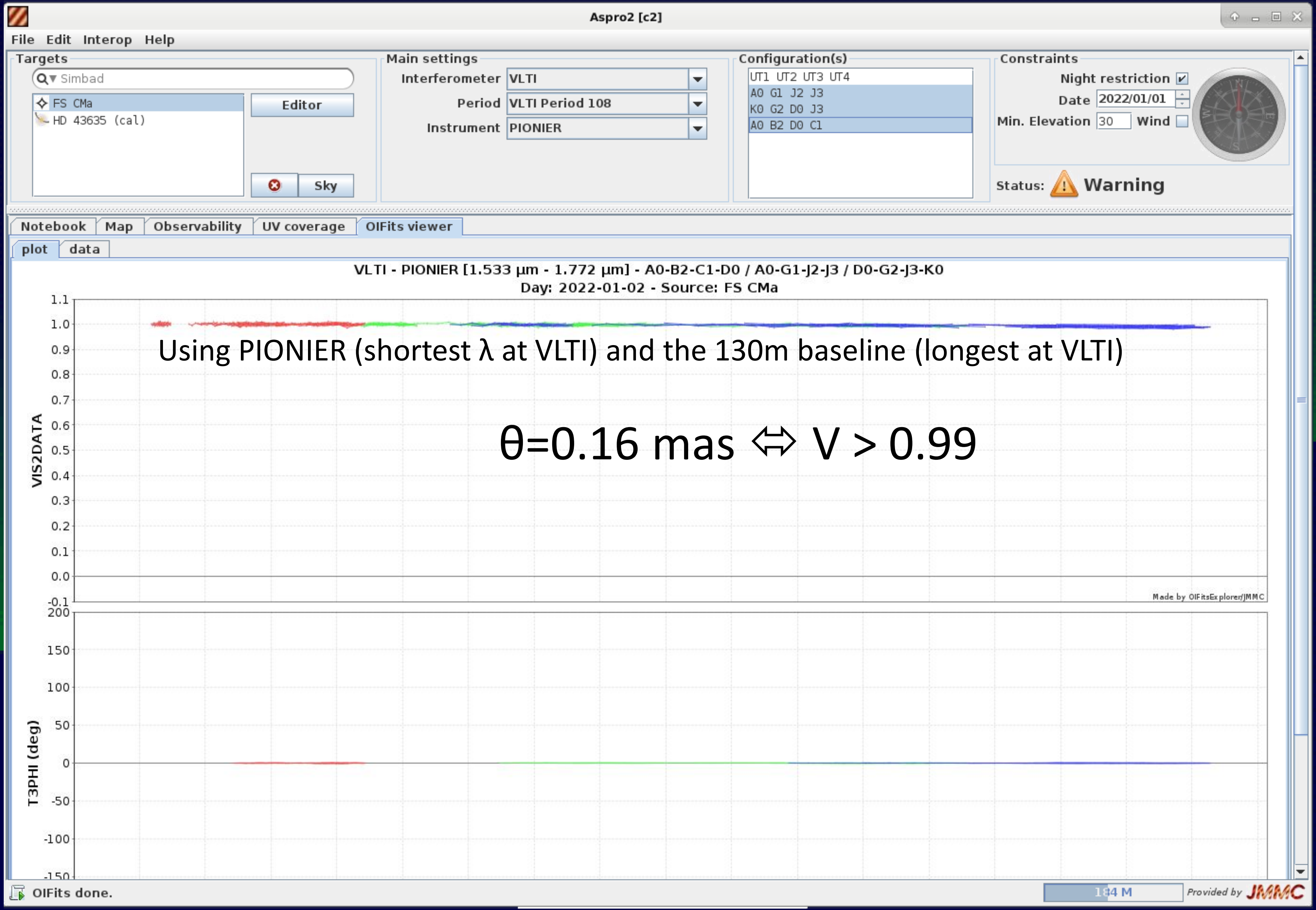


Using PIONIER (shortest λ at VLTI) and the 130m baseline (longest at VLTI)

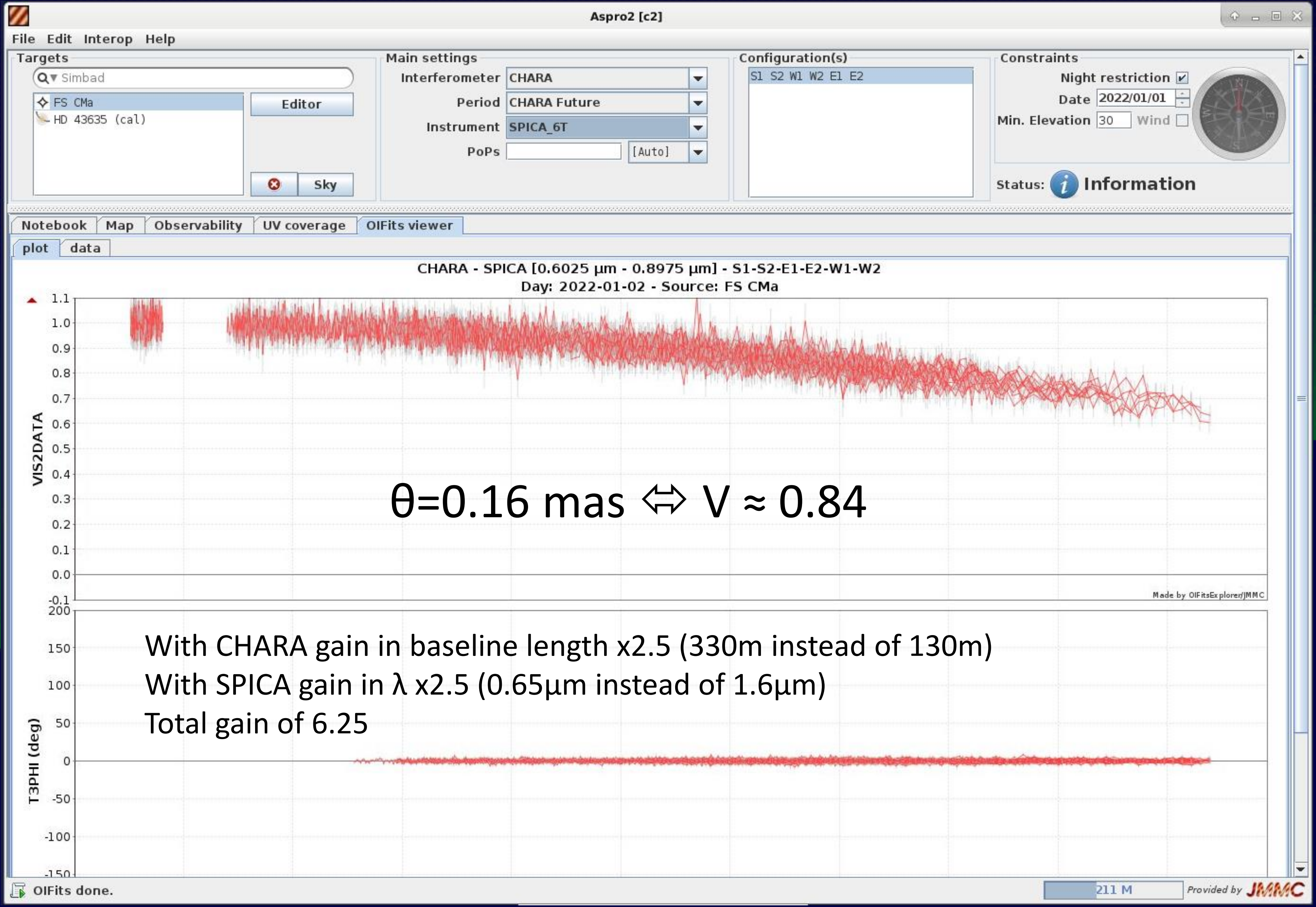
Let’s consider only the star itself



Using PIONIER (shortest λ at VLTI) and the 130m baseline (longest at VLTI)

θ=0.16 mas ⇔ V > 0.99

Corrections



θ=0.16 mas ⇔ V ≈ 0.84

With CHARA gain in baseline length x2.5 (330m instead of 130m)

With SPICA gain in λ x2.5 (0.65µm instead of 1.6µm)

Total gain of 6.25

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Question : Can we constrain the stellar diameter with CHARA/SPICA? What about the limb darkening or a putative stellar surface flattening?

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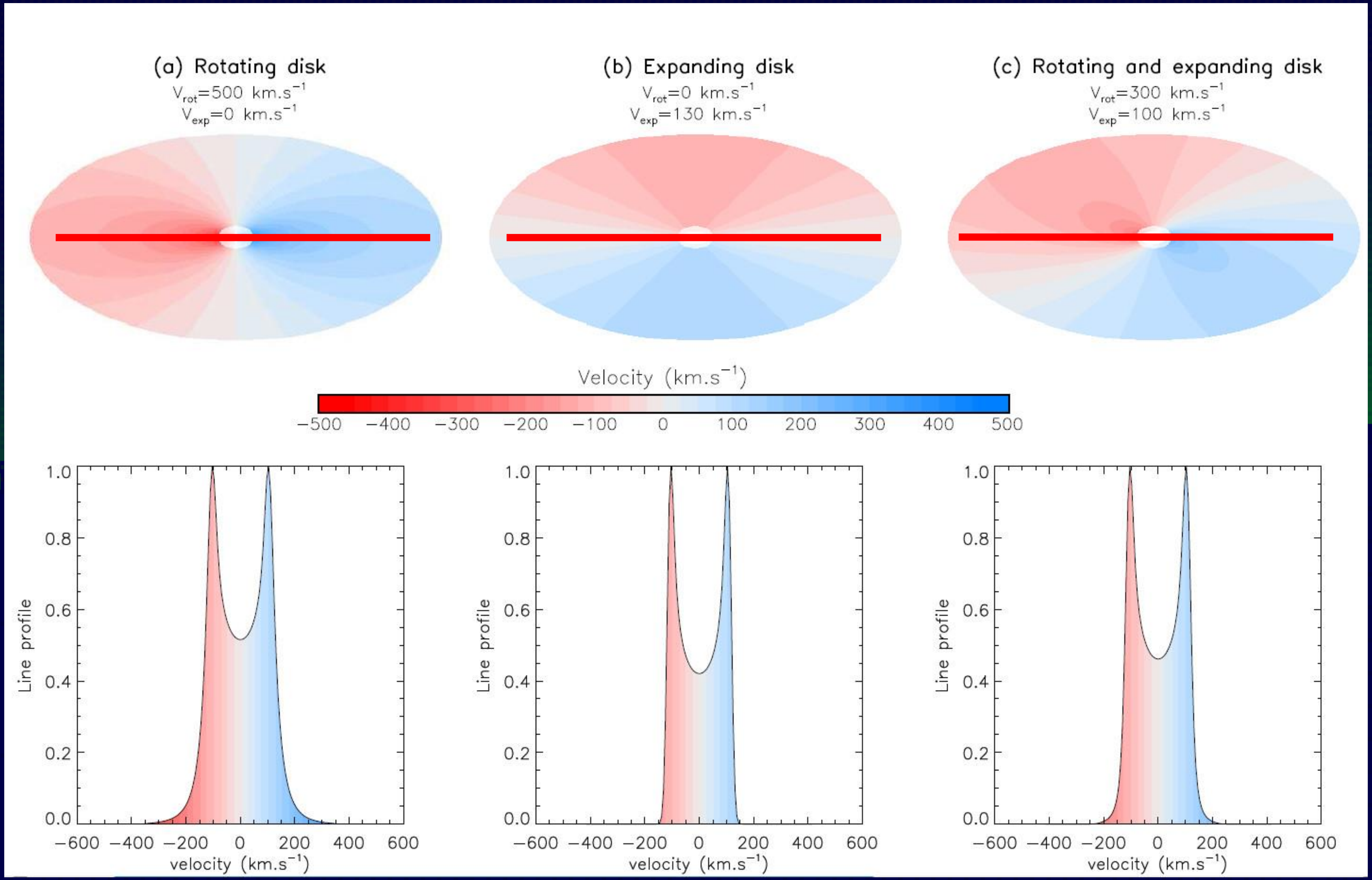
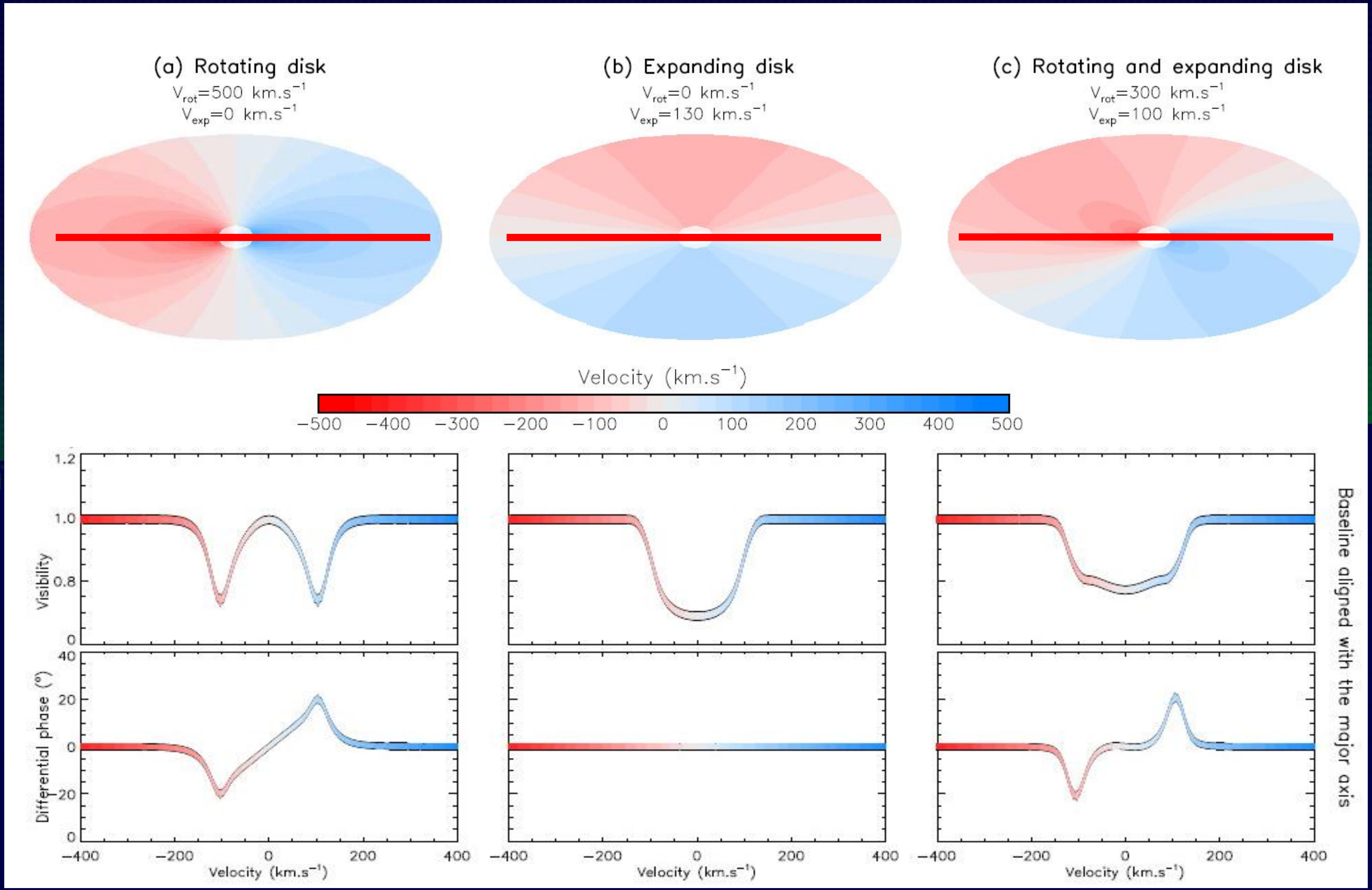
Corrections




(a) Rotating disk
V_{rot}=500 km.s^{-1}
V_{exp}=0 km.s^{-1}
(b) Expanding disk
V_{rot}=0 km.s^{-1}
V_{exp}=130 km.s^{-1}
(c) Rotating and expanding disk
V_{rot}=300 km.s^{-1}
V_{exp}=100 km.s^{-1}
Velocity (km.s^{-1})
−500 −400 −300 −200 −100 0 100 200 300 400 500
Visibility
Differential phase (°)
Velocity (km.s^{-1})
Baseline aligned with the major axis

8 Bonus : Beyond our MATISSE Observation

8.1 Resolving the stellar surface

Question : Is it possible to constrain the stellar diameter using the VLTI? What are the two advantages of using CHARA for that purpose?

No the object is fully unresolved : V>0.99
CHARA => 330m (2.5 gain in resolution, VLTI => 130m)
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Total gain in angular resolution = 6.25

Switch to the CHARA array in the **Interferometer** scrolling menu. In the **Period**, choose **CHARA Future** and finally, in **Instrument** choose **SPICA_6T**.

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No we cannot constrain the limb darkening or flattening as the the is not resolve enough

8.2 Studying the circumstellar gas geometry and kinematics

Interferometric observations with a high-enough spectral resolution (R>500) allows to separate circumstellar gas and dust by looking at narrow spectral features such as emission lines of hydrogen. It also enables the study of the gas kinematics.

Question : Which VLTI and CHARA instrument(s) offer(s) a high-enough spectral resolution to resolve emission lines?

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$$\frac{\Delta\lambda}{\lambda} = \frac{\Delta v}{c}$$

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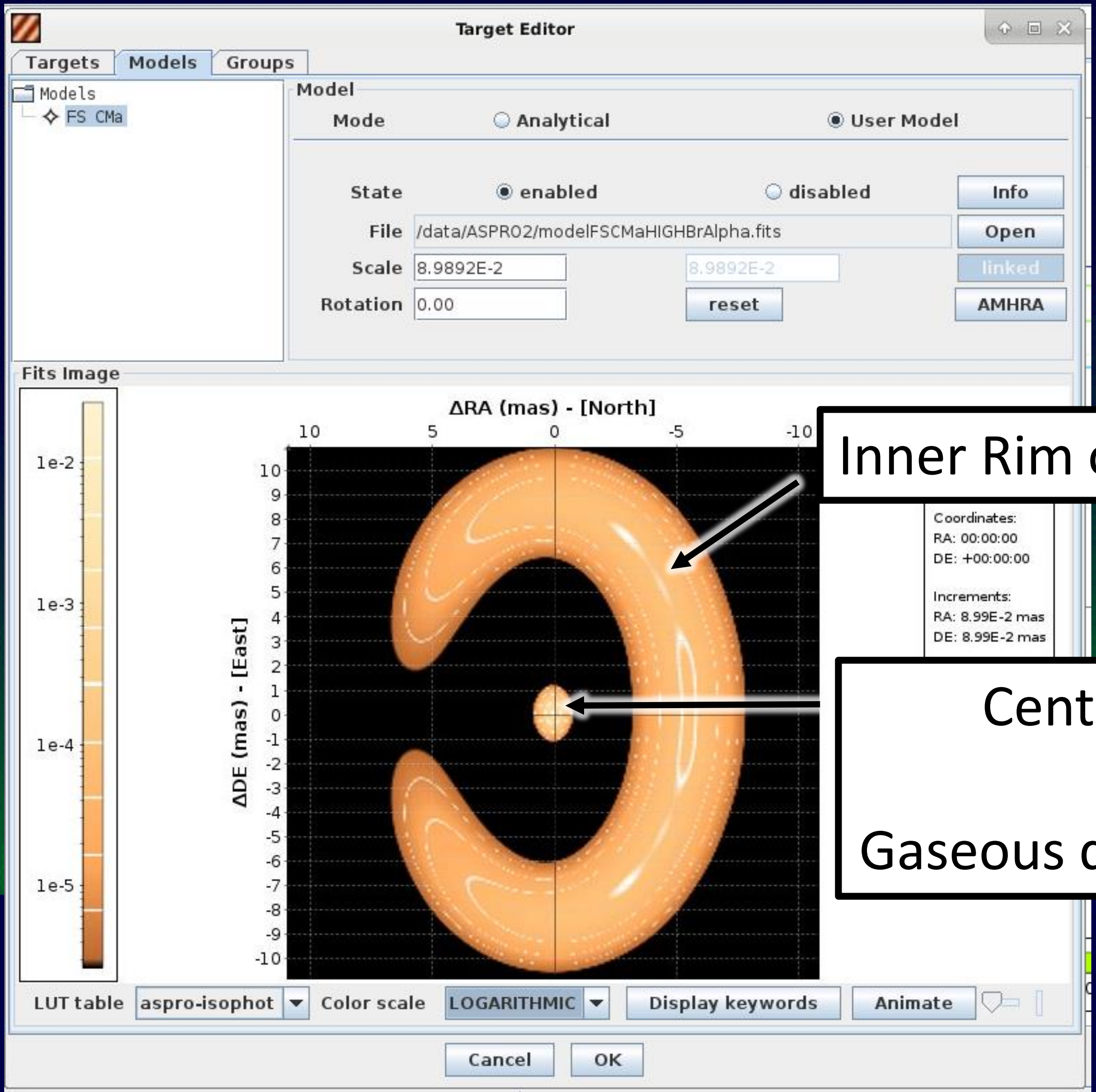


Image in the continuum

Inner Rim of dusty disk

Central Star
+
Gaseous disk emission

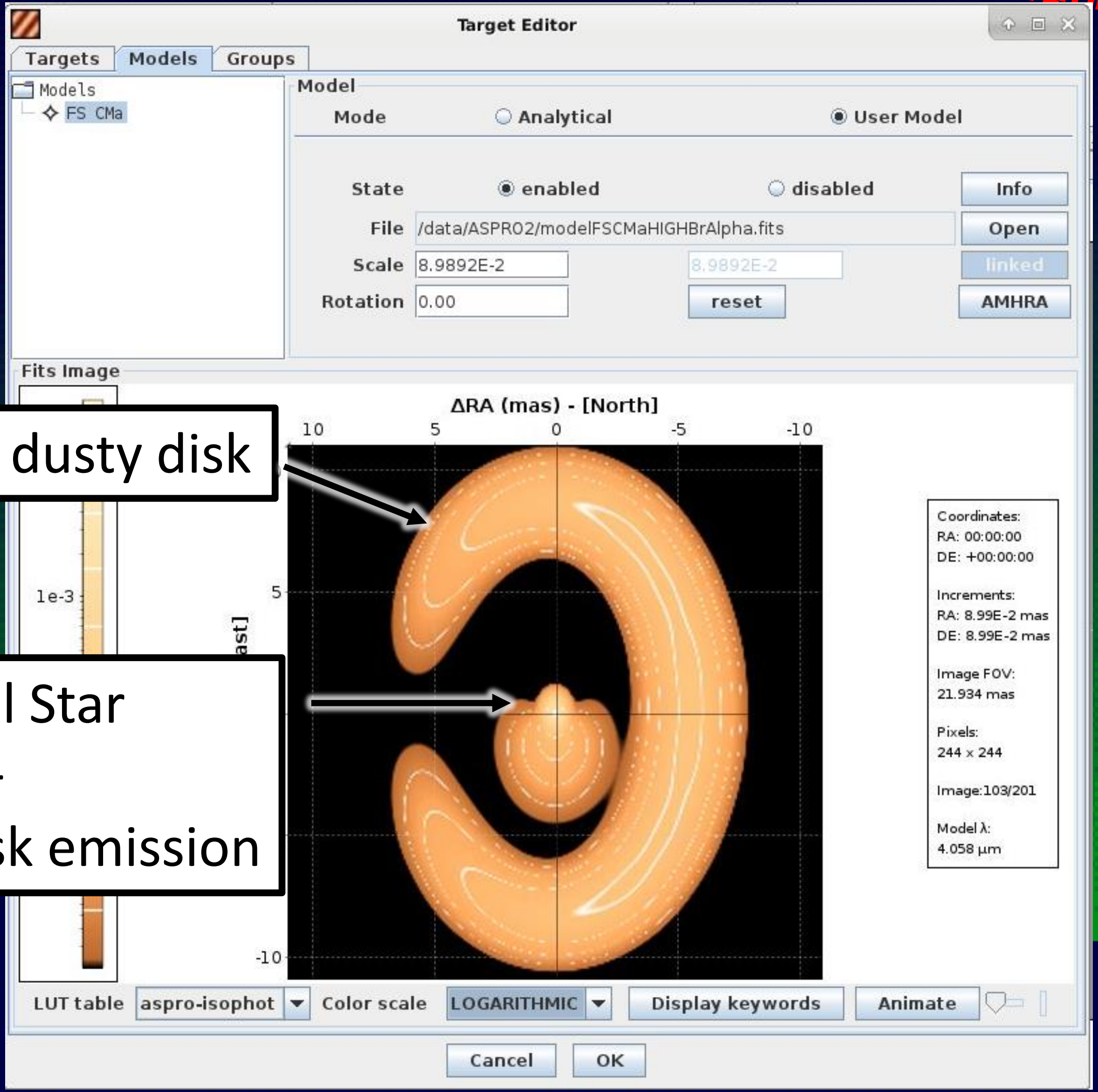
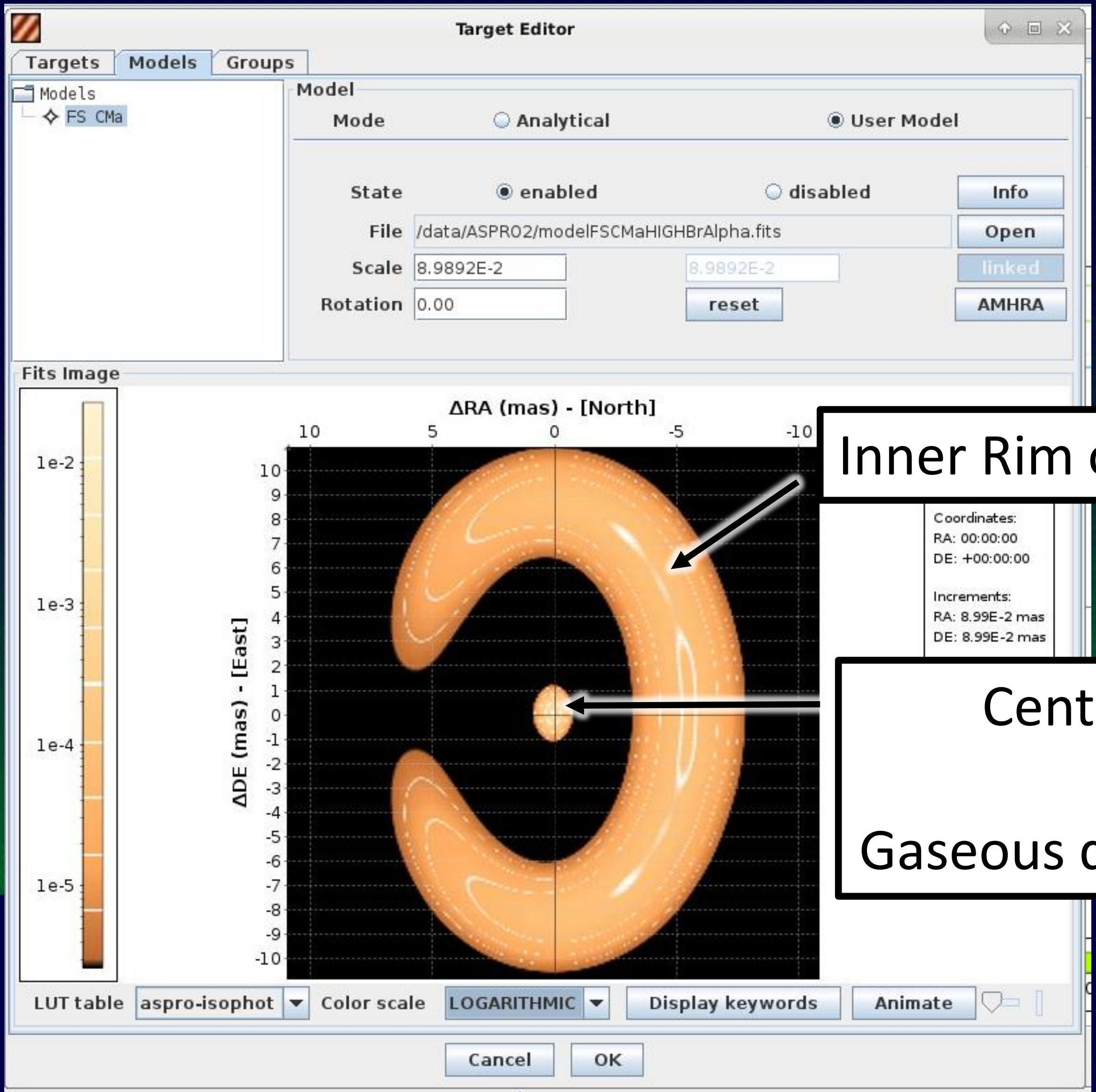


Image in one channel of the Brα line

Corrections



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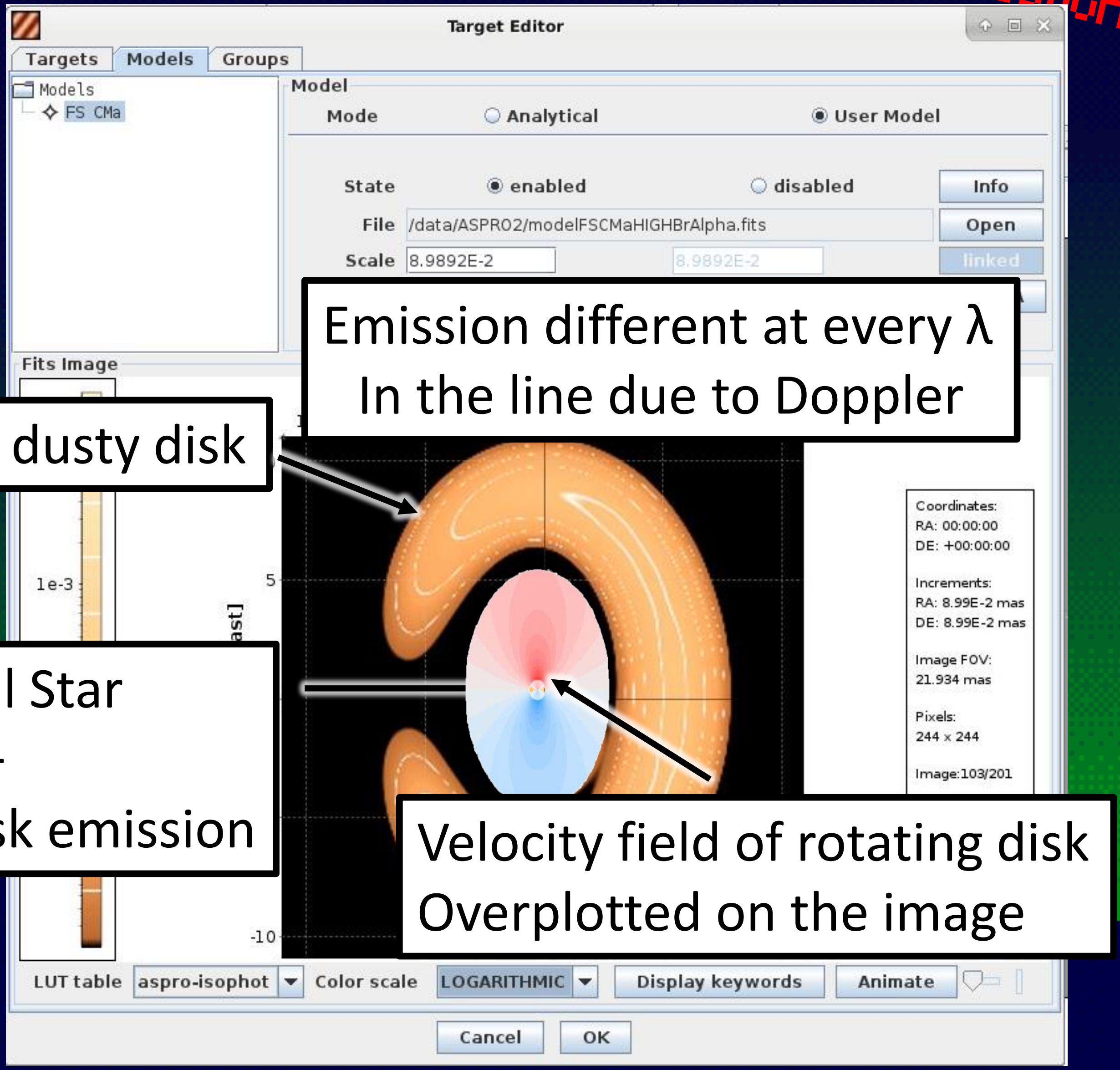

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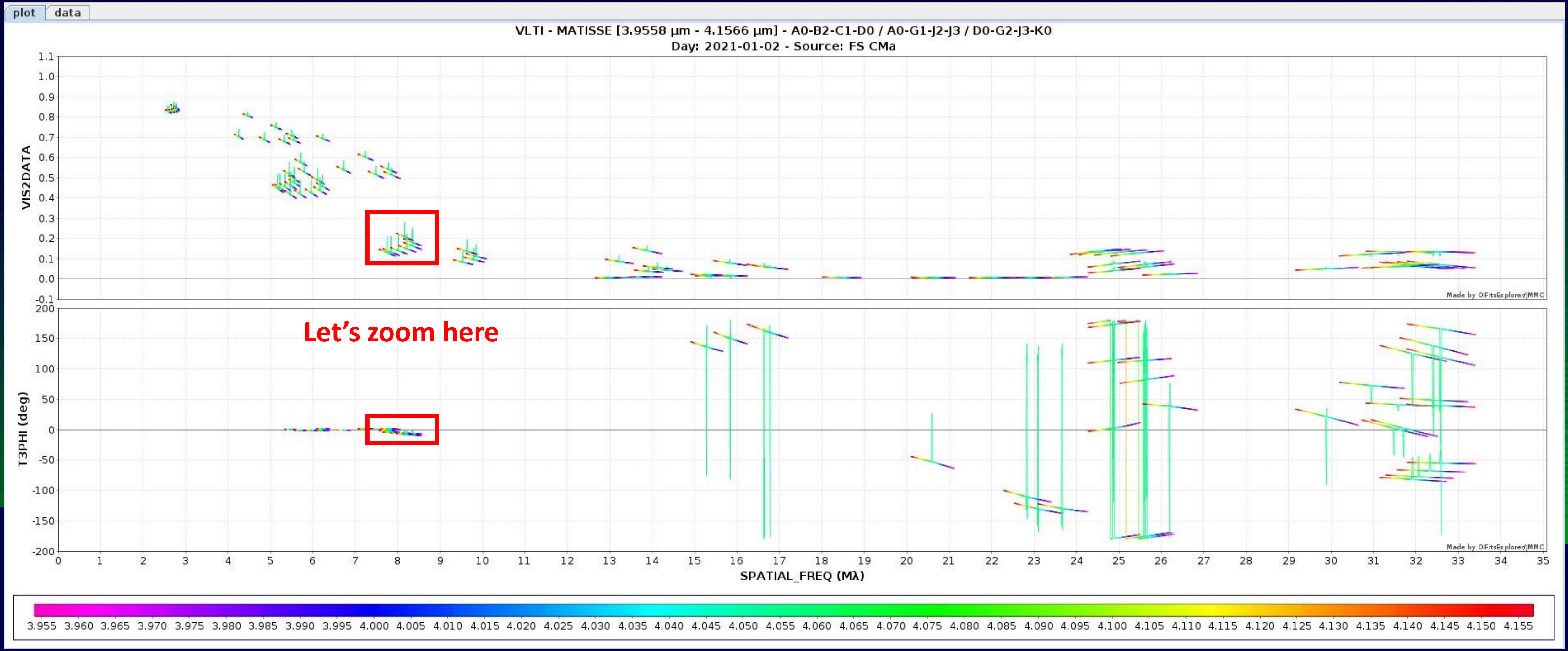
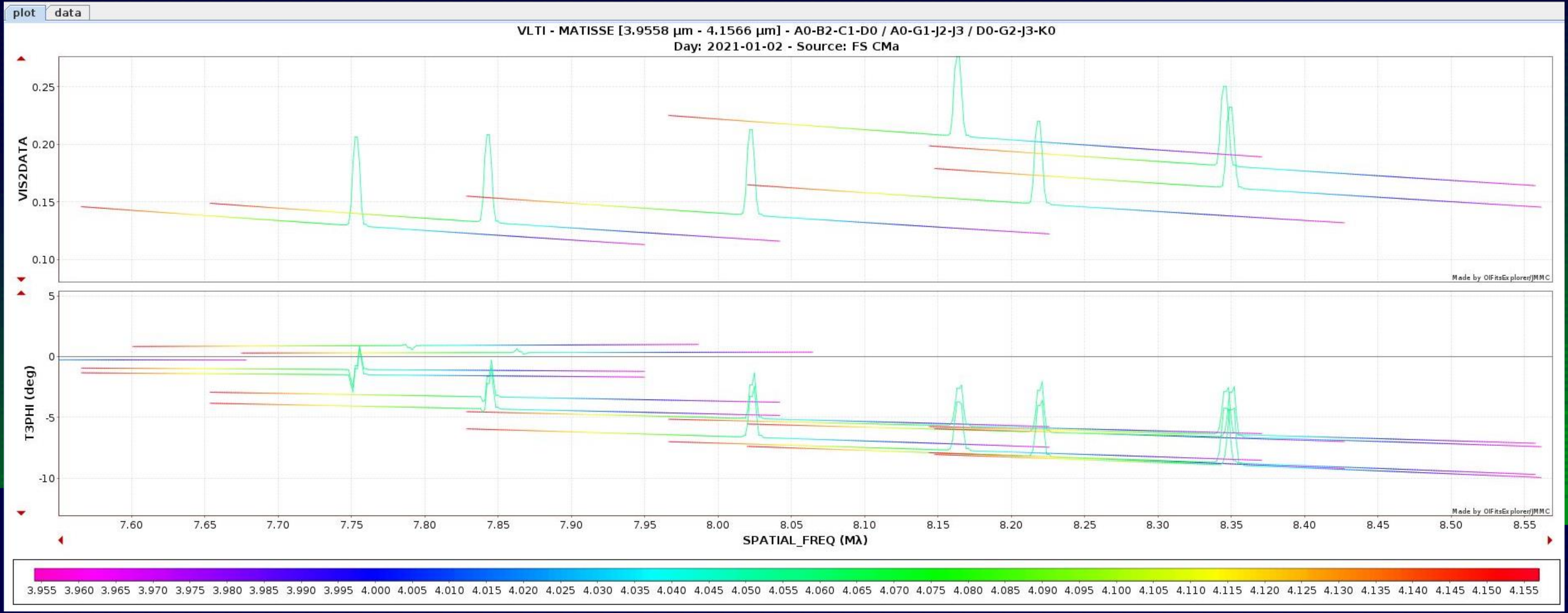


Small but detectable effect in the Brα emission line



Rise in the visibility ⇔ object smaller in the emission line

Signal in the Closure Phase ⇔ non-centro-symmetric object in each spectral channel

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The visibility is rising in the emission line because the environment appears smaller.
As the object is not centro-symmetric through the line because of the there is the phase signal in the line
This can help constrain the object kinematics