GTC-EMIR OBSERVATIONS OF MERCER-23

MIRIAM GARCIA & PACO NAJARRO

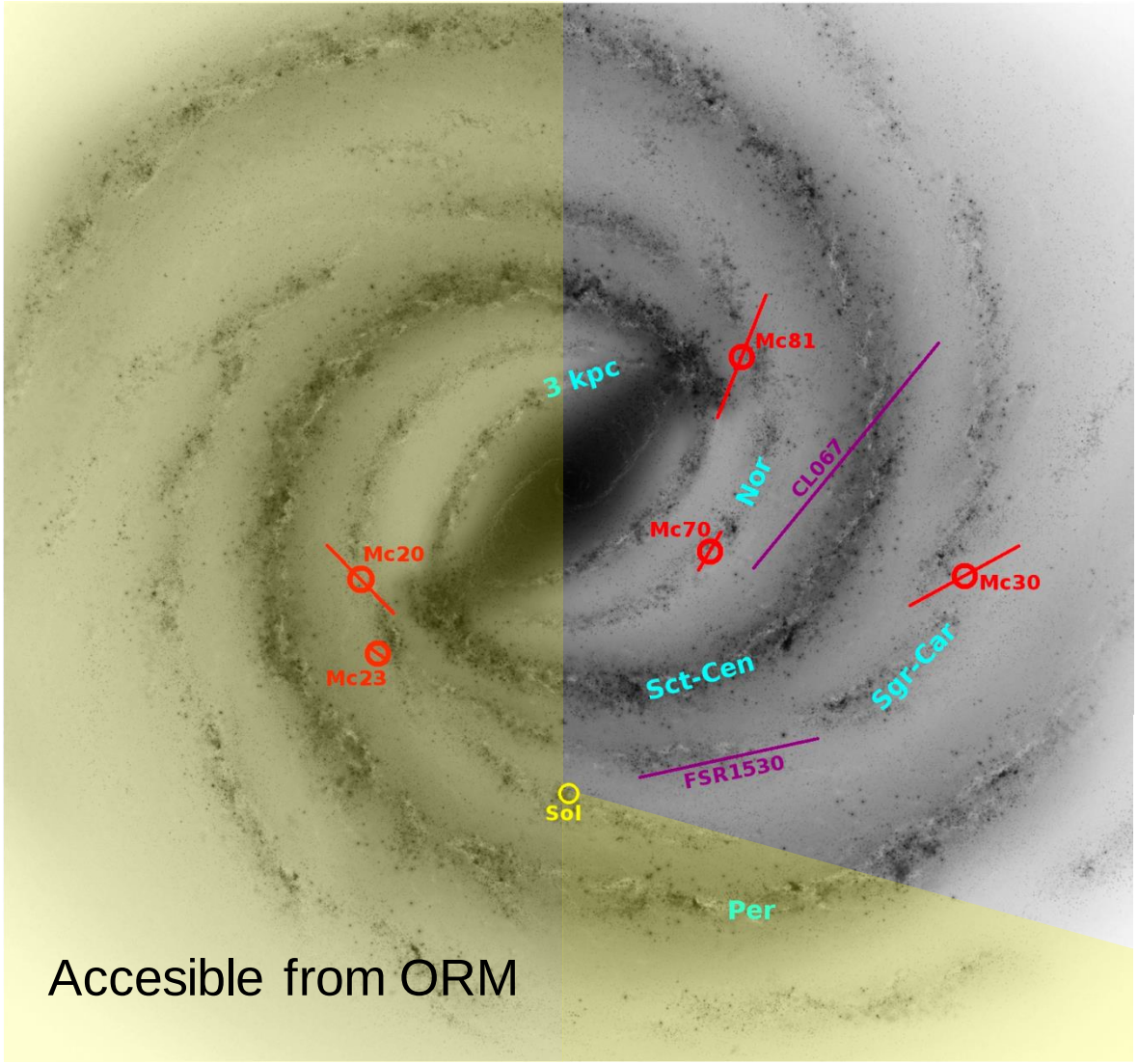
D. De la Fuente Guillén

M. M. Rubio Díez

CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

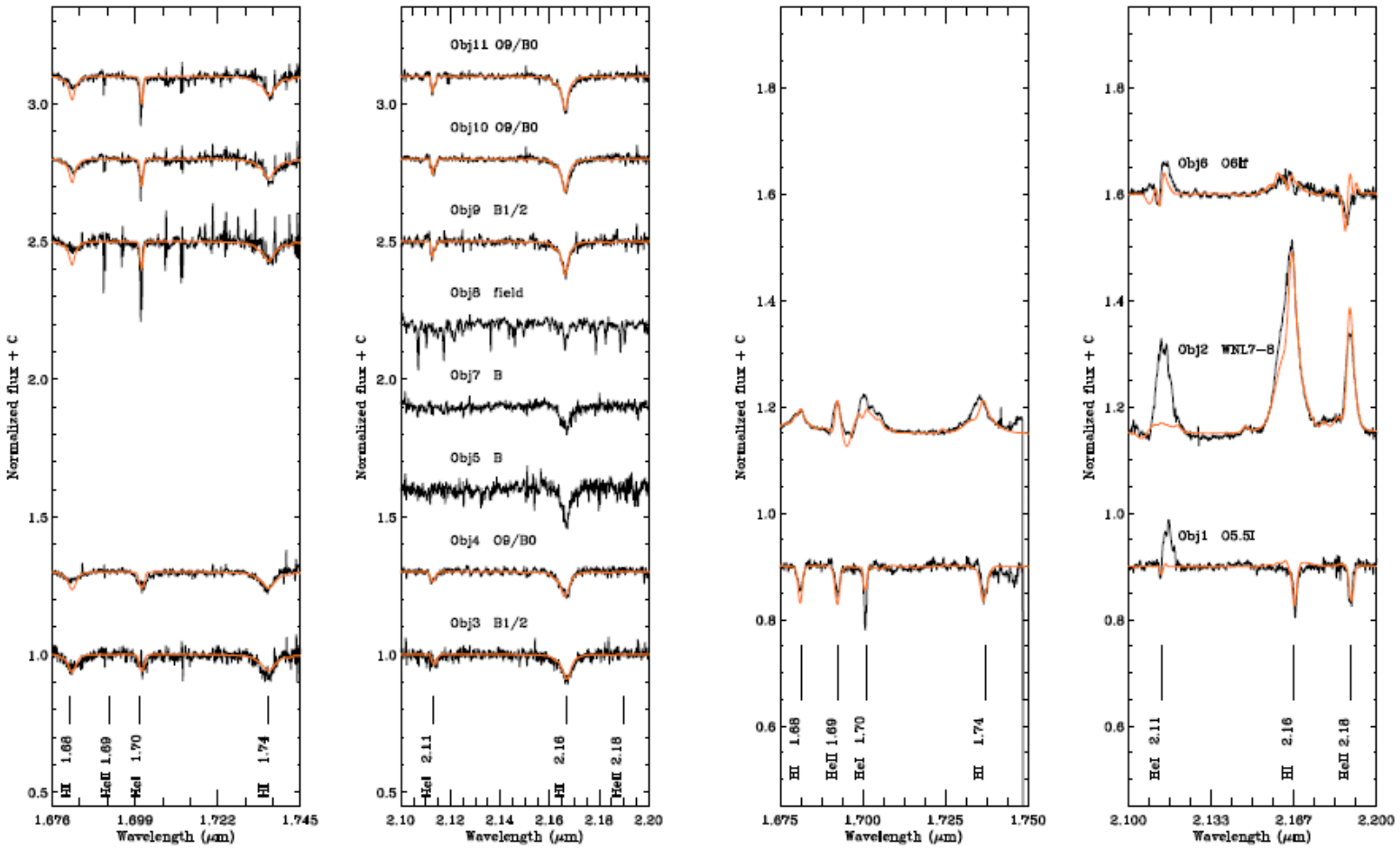
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CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS
INTA
Instituto Nacional de Técnica Aeroespacial

TOWARDS A 2-D METALLICITY MAP OF THE GALAXY



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MC23 HOSTS MASSIVE STARS



VLT-ISAAC observations, Hanson+ 2010

(R~4000, 0.6” slit)

PROJECT GOALS

- **Improved SNR observations to improve radial velocity measurements (and distance determination)**

- **Extended spectral coverage to determine CNO abundances and break-down parameter degeneracy (Teff, logg, stellar wind)**

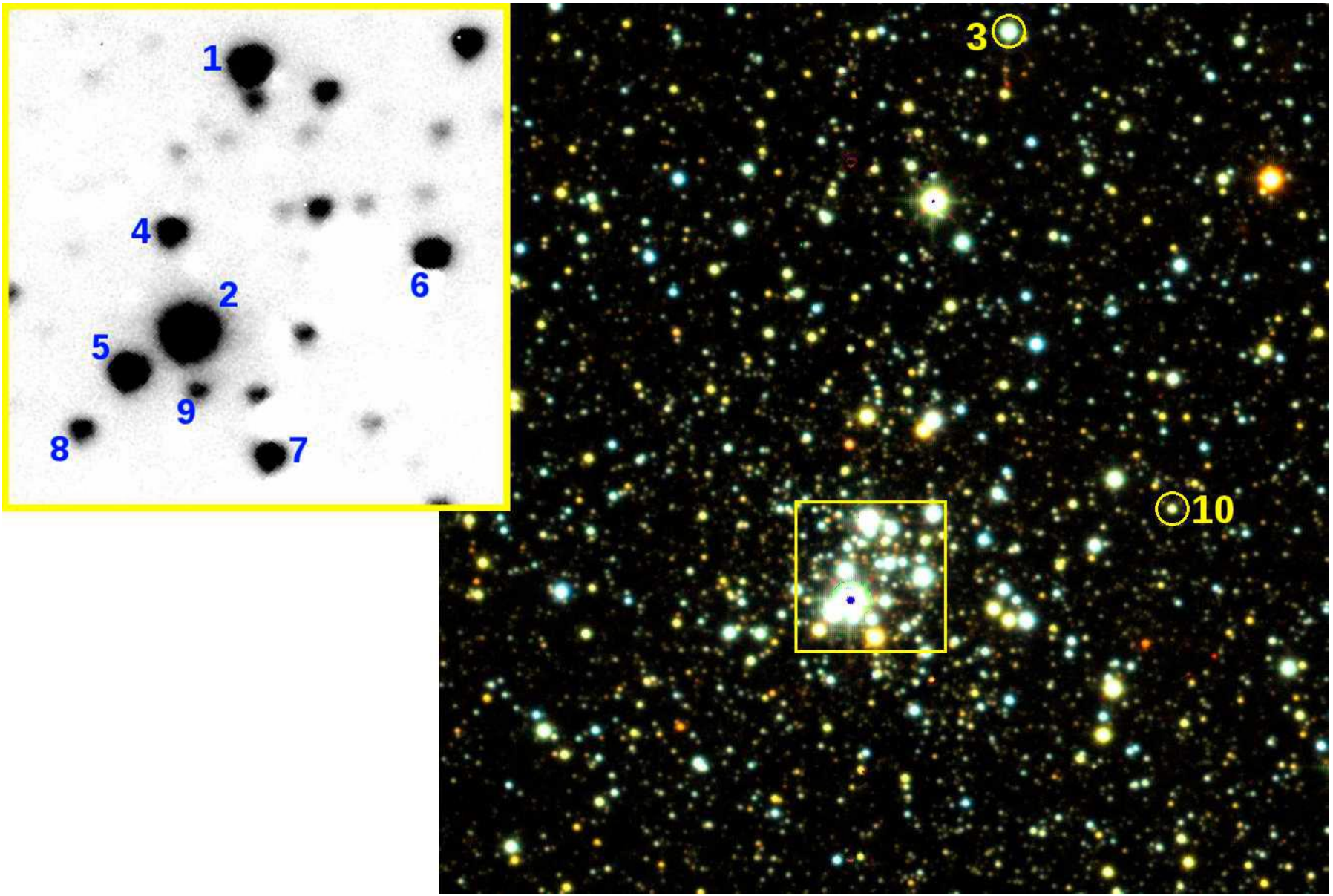
- **Provide technically-easy configuration to test EMIR**

DESIGNING THE OBSERVATIONS

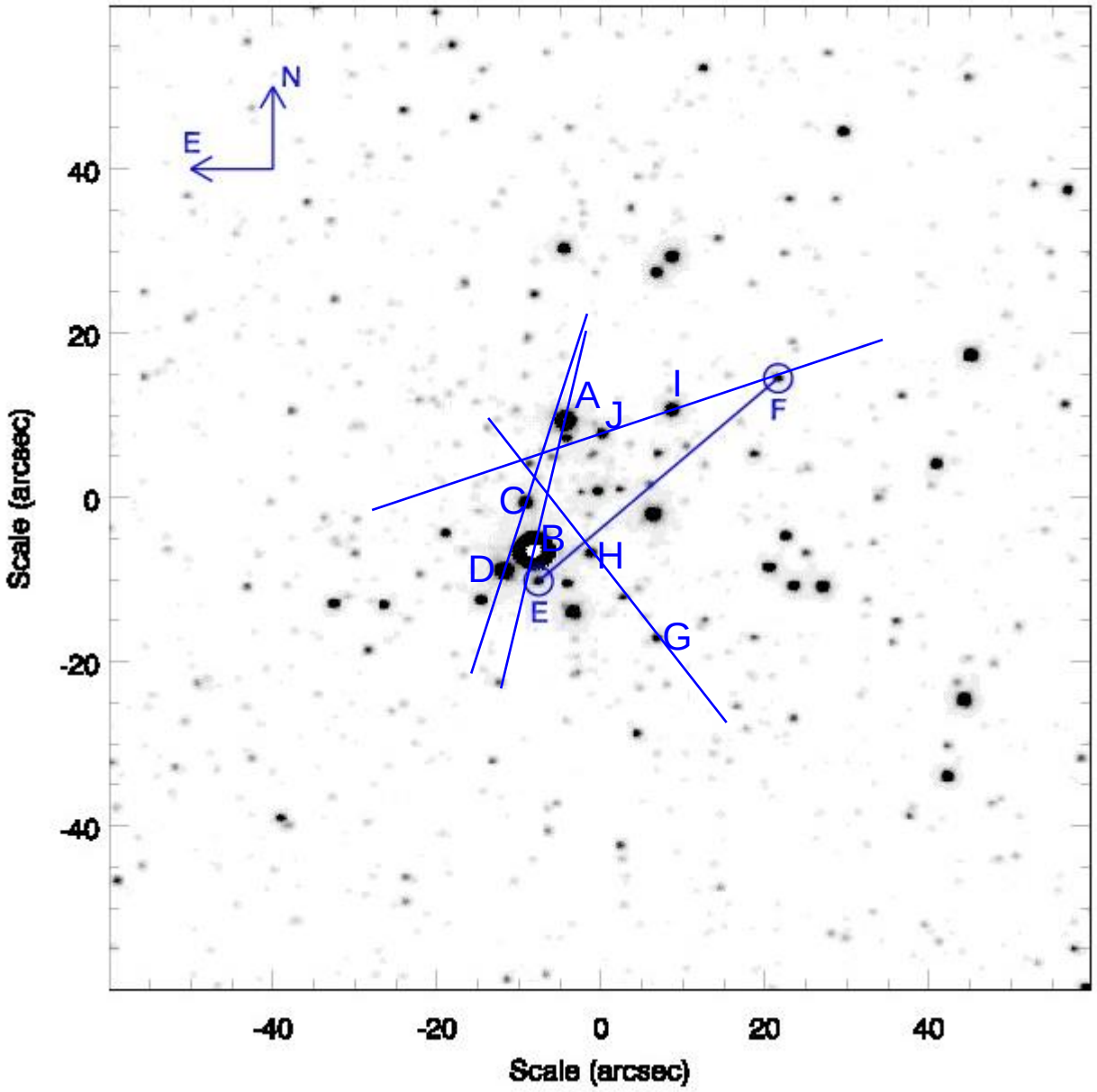
OBSERVATIONS

- **5 Long-slits crossing the cluster**
  - 1 x 1h OB block (JHK) for “bright” stars (K<11)
  - 2 x 1h OB block (JHK) for faint subset
  - All followed by telluric standards
  - 14 OBs total

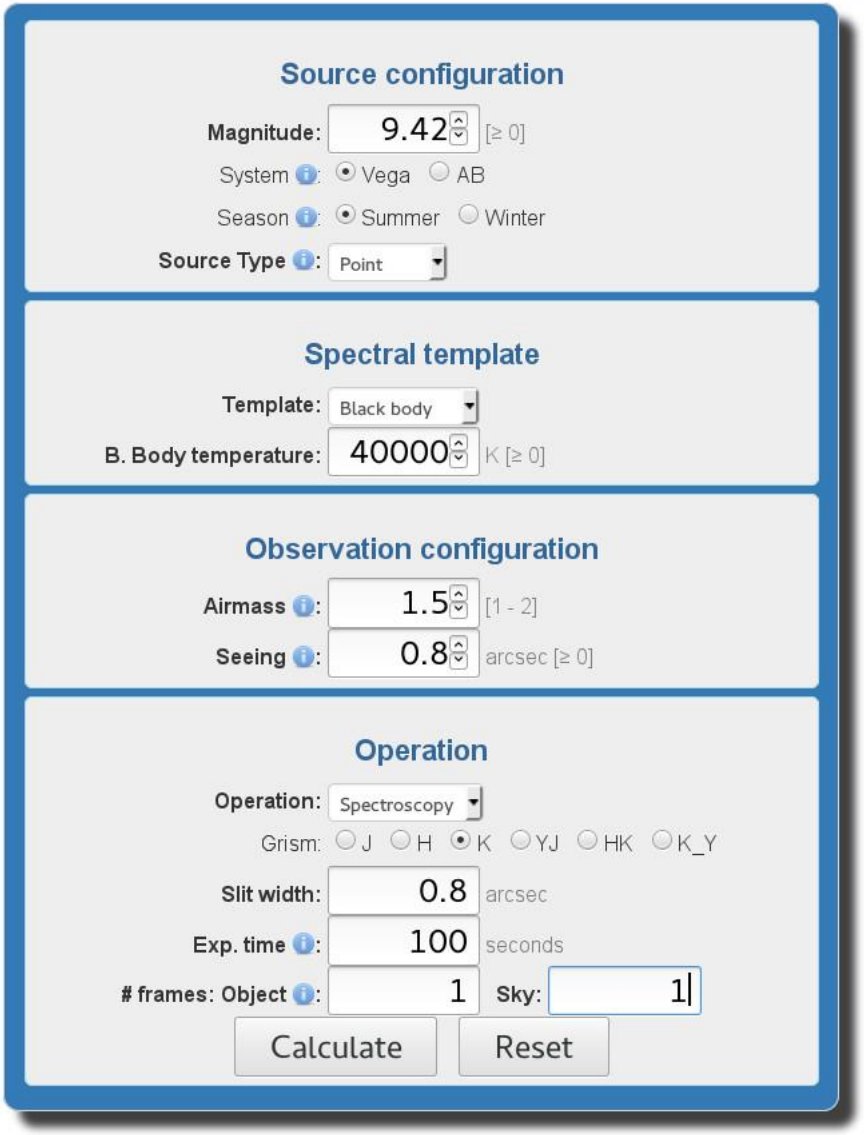
- **J-band, H-band, K-band**
- **0.6” slits (R=5000,4500,4000)**
- **0.9” optical seeing [Requested]**
- **Nod in slit, ABBA pattern**



De la Fuente Guillén 2016, PhD Thesis


N
E
A
J
I
F
C
B
D
H
E
G
40
20
0
-20
-40
Scale (arcsec)
-40
-20
0
20
40
Scale (arcsec)

ESTIMATING EXPOSURE TIMES



EXPTIME AND PHASE-2: LOST IN TRANSLATION

```
slit-AB: 1-OB de  4x(    120./      60./      60./  60.  /  40.)   J/H/K/YJ/HK
slit-CD: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-IJ: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-EF: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K
slit-GH: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K

STD:              4x(     40./      40./      40./  12.  /  12.)   J/H/K/YJ/HK
```

Original

EXPTIME AND PHASE-2: LOST IN TRANSLATION

Original

```
slit-AB: 1-OB de  4x(    120./      60./      60./  60.  /  40.)   J/H/K/YJ/HK
slit-CD: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-IJ: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-EF: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K
slit-GH: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K

STD:              4x(     40./      40./      40./  12.  /  12.)   J/H/K/YJ/HK
```

Intermediate

```
slit-AB: 1-OB de  4 x 120./ 2 x 120./ 2 x 120./ 2 x 120./ 1x 160.   J/H/K/YJ/HK
Texp per node:         30./      15./      15./      15./     10.   J/H/K/YJ/HK

slit-CD: 1-OB de  6 x 180./ 4 x 120./ 2 x 120.   J/H/K
slit-IJ: 1-OB de  6 x 180./ 4 x 120./ 2 x 120.   J/H/K
Texp per node:         30./      15./      15.   J/H/K

slit-EF: 2-OB de  4 x 180./ 4 x 120./ 4 x 120.   J/H/K
slit-GH: 2-OB de  4 x 180./ 4 x 120./ 4 x 120.   J/H/K
Texp per node:         30./      30./      30.   J/H/K


STANDARD:         1 x 160./ 1 x 160./ 1 x 160./ 1 x  48./ 1 x  48.   J/H/K/YJ/HK
Texp per node:         10./      10./      10./       3./       3.   J/H/K/YJ/HK
```

EXPTIME AND PHASE-2: LOST IN TRANSLATION

Original

```
slit-AB: 1-OB de  4x(    120./      60./      60./  60.  /  40.)   J/H/K/YJ/HK
slit-CD: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-IJ: 1-OB de  4x(2 x 120./ 2 x  60./      60.)   J/H/K
slit-EF: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K
slit-GH: 2-OB de  2x(3 x 120./ 2 x 120./ 2 x 120.)   J/H/K

STD:              4x(     40./      40./      40./  12.  /  12.)   J/H/K/YJ/HK
```

Intermediate

```
slit-AB: 1-OB de  4 x 120./ 2 x 120./ 2 x 120./ 2 x 120./ 1x 160.   J/H/K/YJ/HK
Texp per node:         30./      15./      15./      15./     10.   J/H/K/YJ/HK

slit-CD: 1-OB de  6 x 180./ 4 x 120./ 2 x 120.   J/H/K
slit-IJ: 1-OB de  6 x 180./ 4 x 120./ 2 x 120.   J/H/K
Texp per node:         30./      15./      15.   J/H/K

slit-EF: 2-OB de  4 x 180./ 4 x 120./ 4 x 120.   J/H/K
slit-GH: 2-OB de  4 x 180./ 4 x 120./ 4 x 120.   J/H/K
Texp per node:         30./      30./      30.   J/H/K
```

Submitted

```
STANDARD:
Texp per node:
```

```
slit-AB: 1 OB   480. / 240. / 240. / 240. / 160.   J/H/K/YJ/HK
slit-CD: 1 OB   960. / 480. / 360.                 J/H/K
slit-EF: 2 OB   720. / 480. / 480.                 J/H/K
slit-GH: 2 OB   720. / 480. / 480.                 J/H/K
slit-IJ: 1 OB   960. / 480. / 360.                 J/H/K


STANDARD:       160. / 160./ 160./  48./  48.   J/H/K/YJ/HK
```

EXPTIME AND PHASE-2: LOST IN TRANSLATION

Configure as many templates as needed:

-Grism-	-On source exptime- (s)	-Single Int. Time- (s)	-Initial offset- (along the slit)	- ABBA Throw - (arcsec)
grism J	480.	default	0.	90.
grism H	240.	default	0.	90.
grism K	240.	default	0.	90.
grism YJ	240.	default	0.	90.
grism HK	160.	default	0.	90.
none		default		
none		default		

Please outline here briefly the purpose of the observations, and describe the important things you want the night astronomer to know.

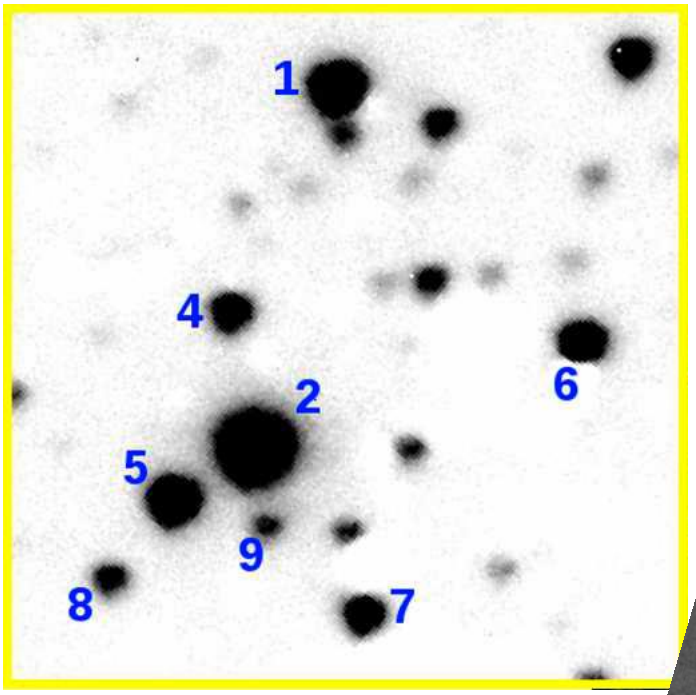
```
EXPOSURE TIMES PER NODE OF THE ABBA PATTERN
-------------------------------------------

slit-AB:  30./ 15./ 15./ 15./ 10.   J/H/K/YJ/HK
slit-CD:  30./ 15./ 15.    J/H/K
slit-EF:  30./ 30./ 30.    J/H/K
slit-GH:  30./ 30./ 30.    J/H/K
slit-IJ:  30./ 15./ 15.    J/H/K

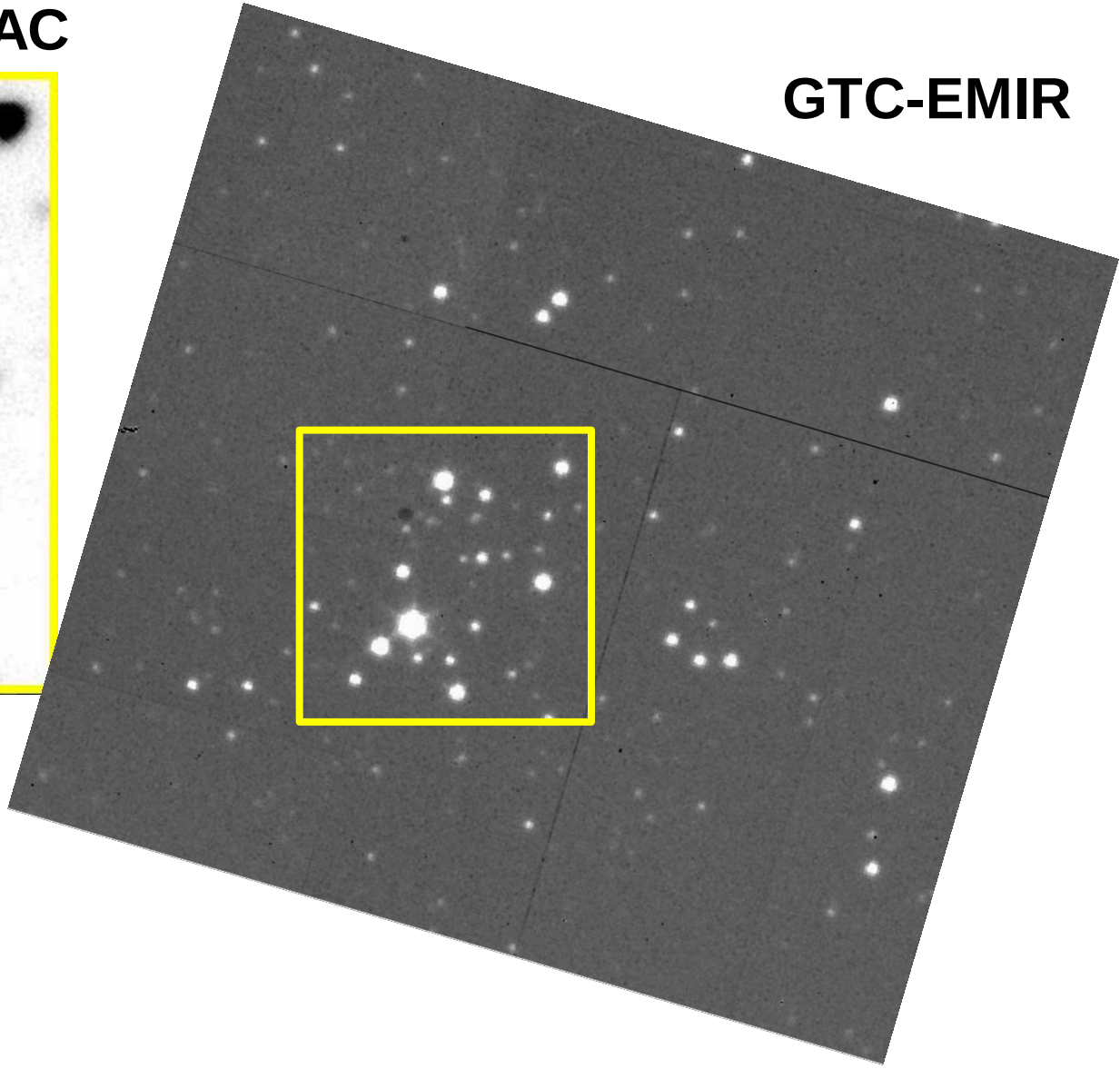
STANDARD: 10./ 10./ 10./  3./  3.   J/H/K/YJ/HK
```

ACQUISITION IMH (K_s, EXPTIME=2s)

VLT-ISAAC

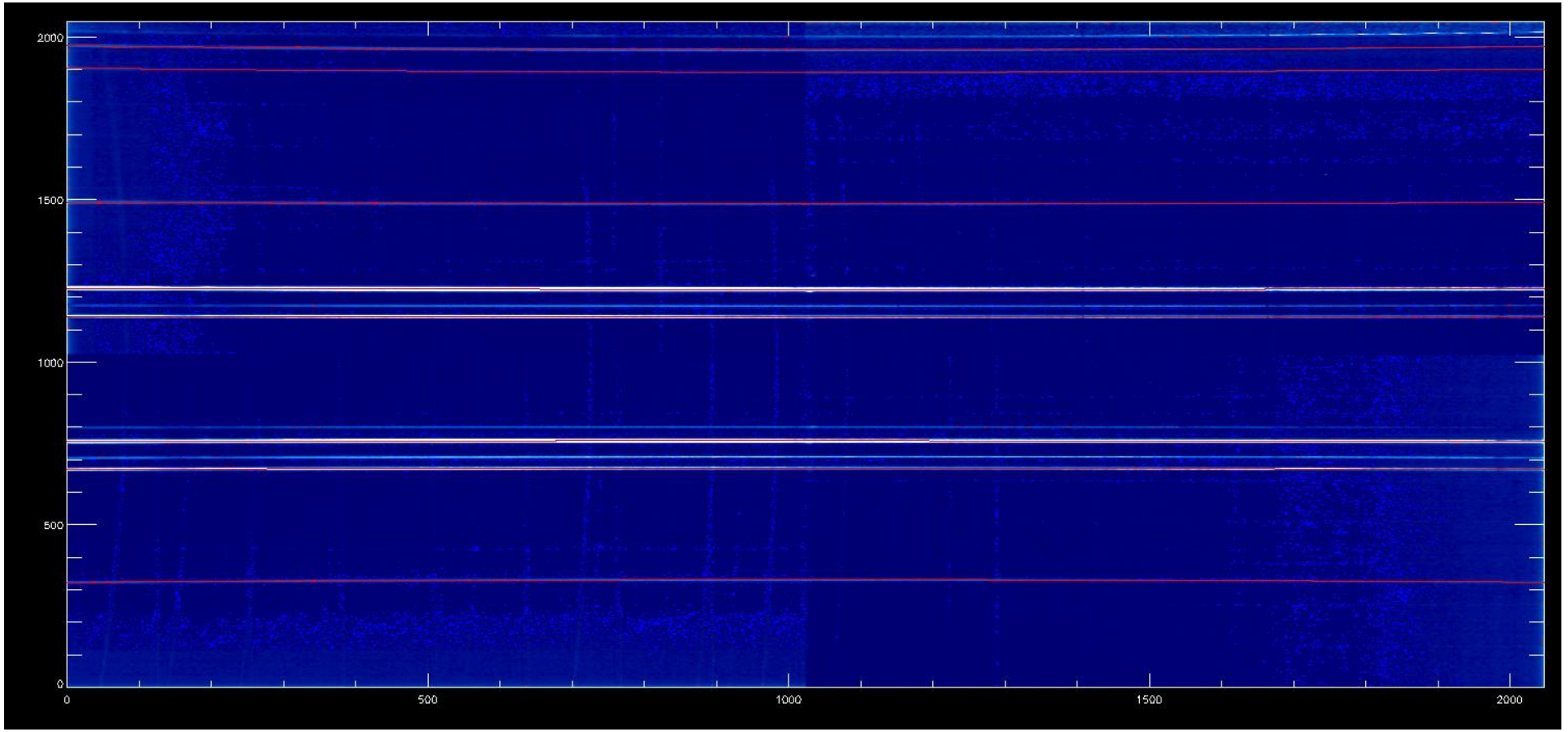


GTC-EMIR

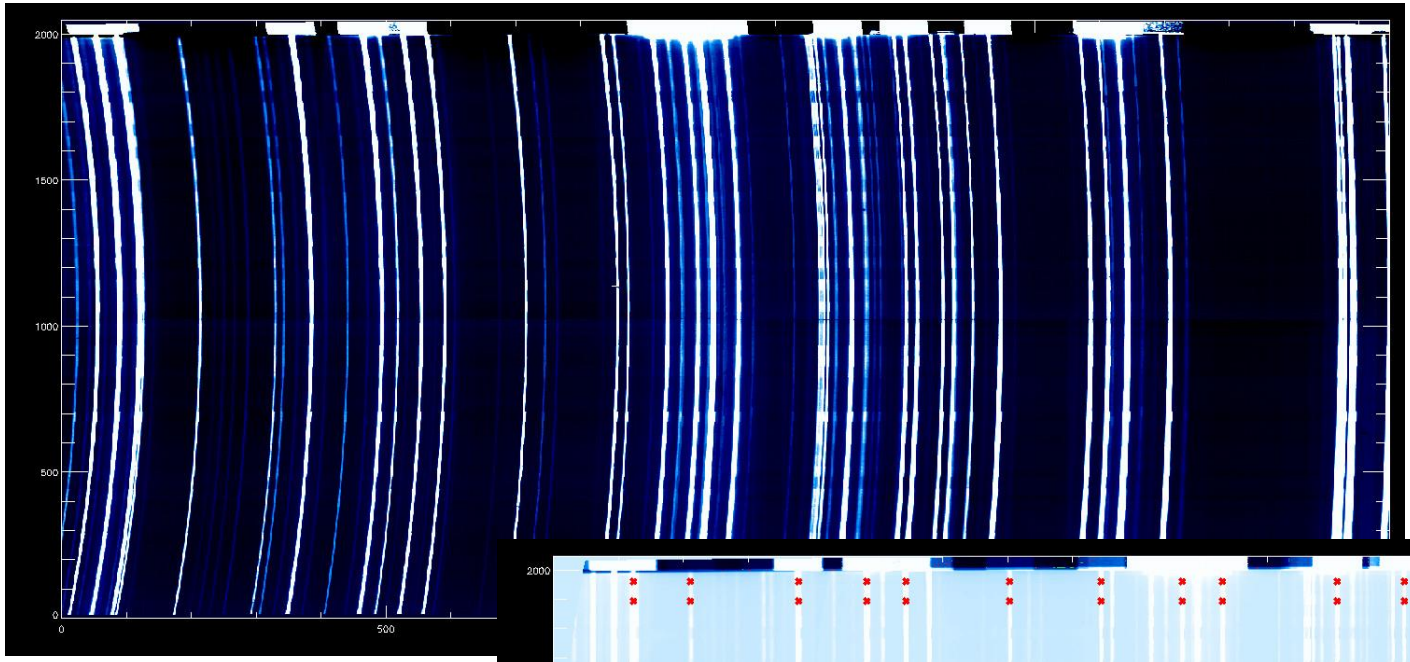


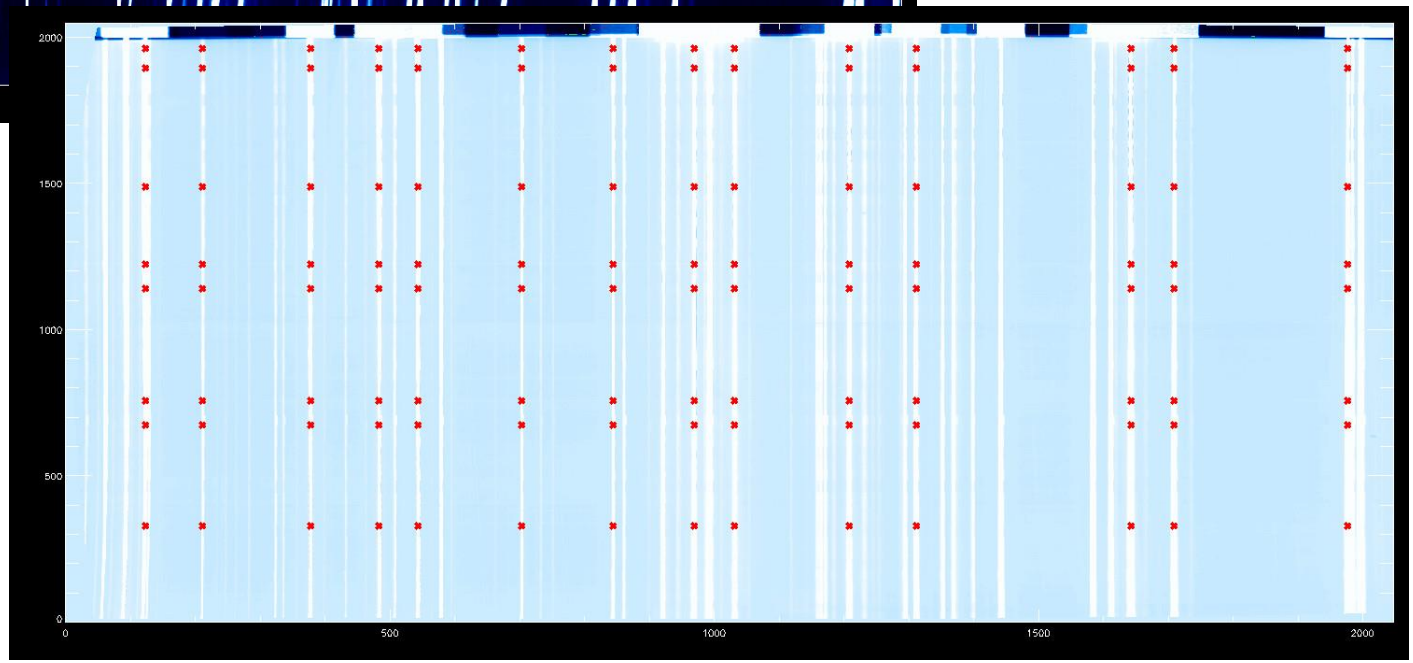
DATA REDUCTION

SPATIAL DISTORTION CORRECTION

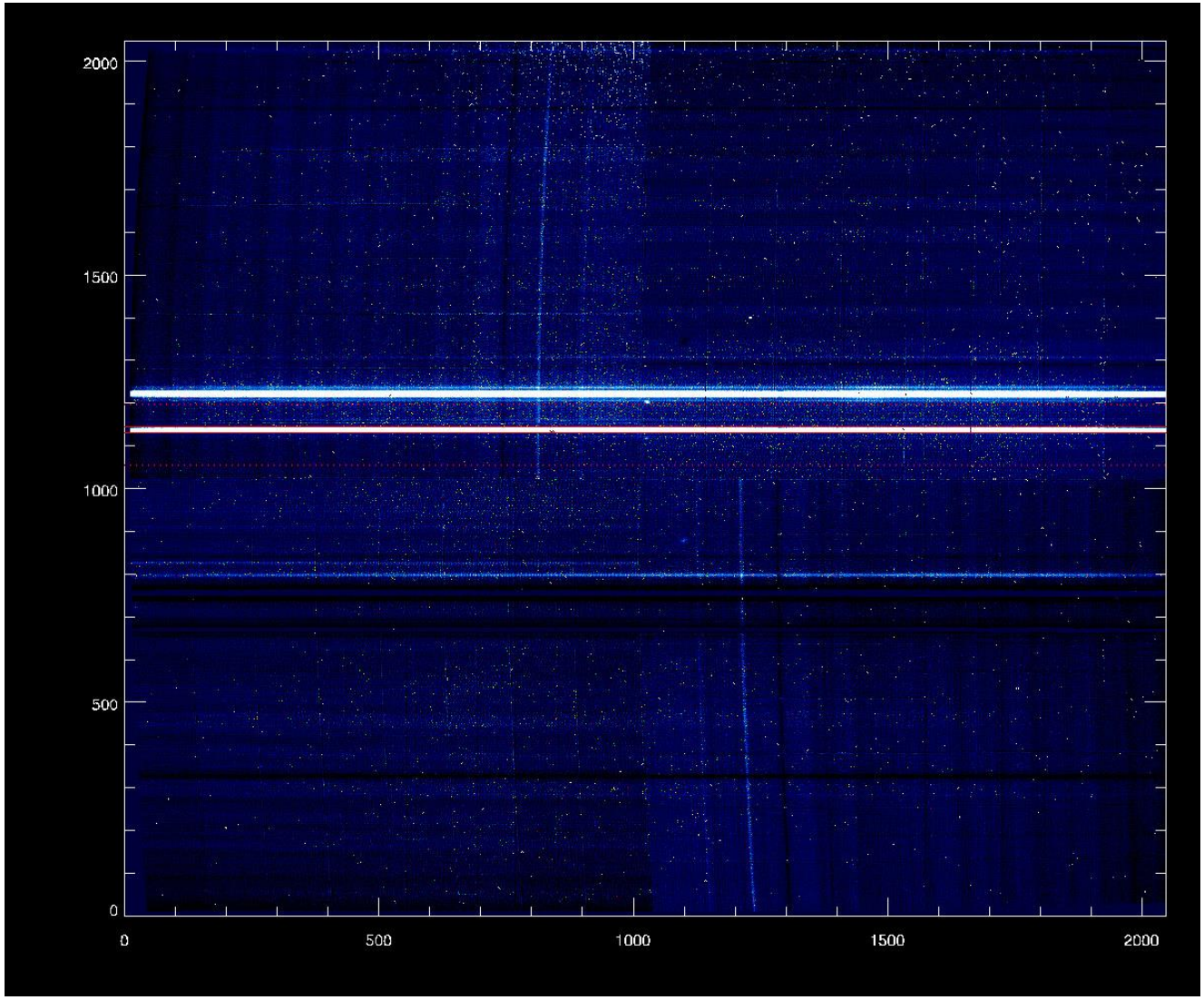


WAVELENGTH CALIBRATION

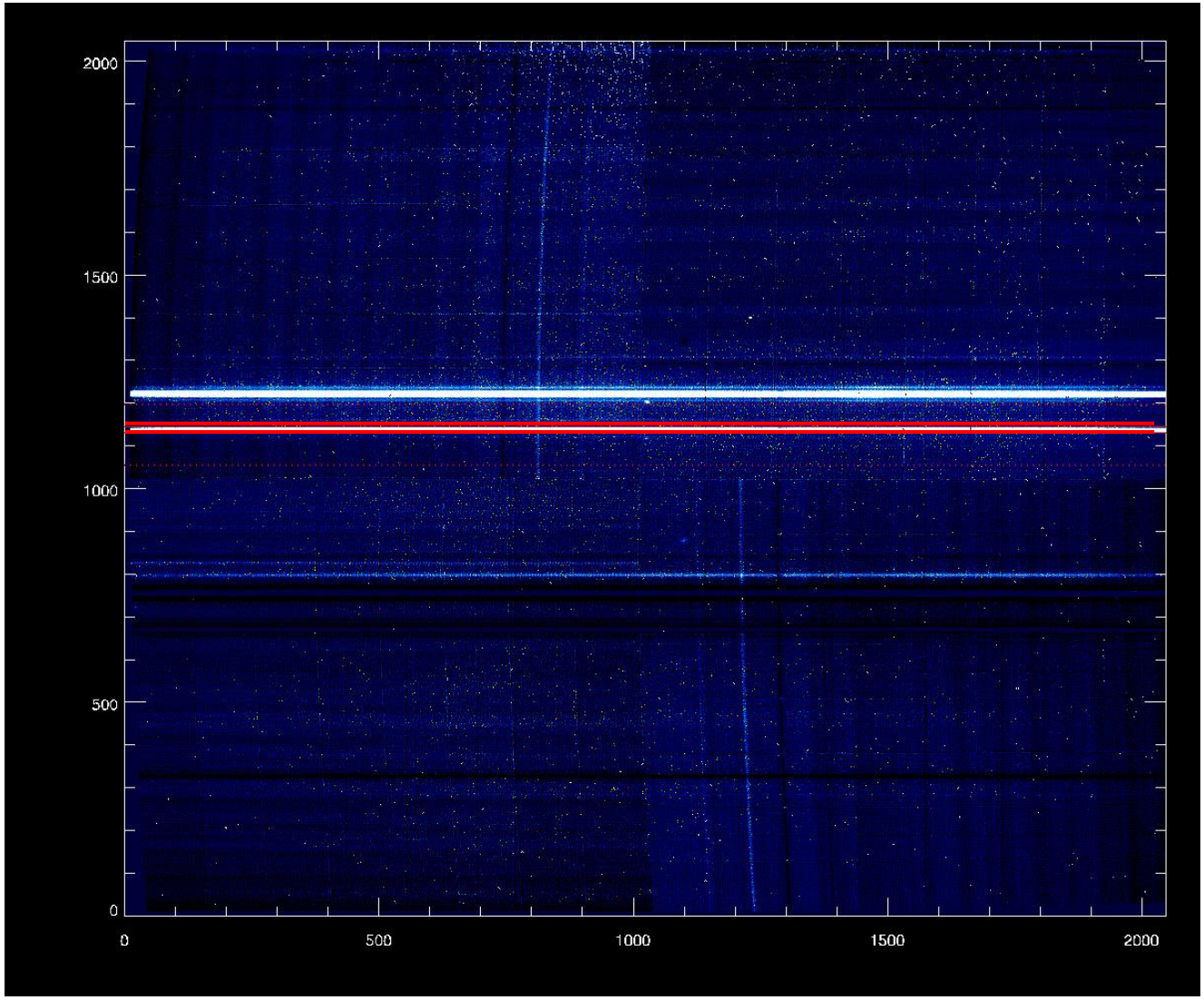




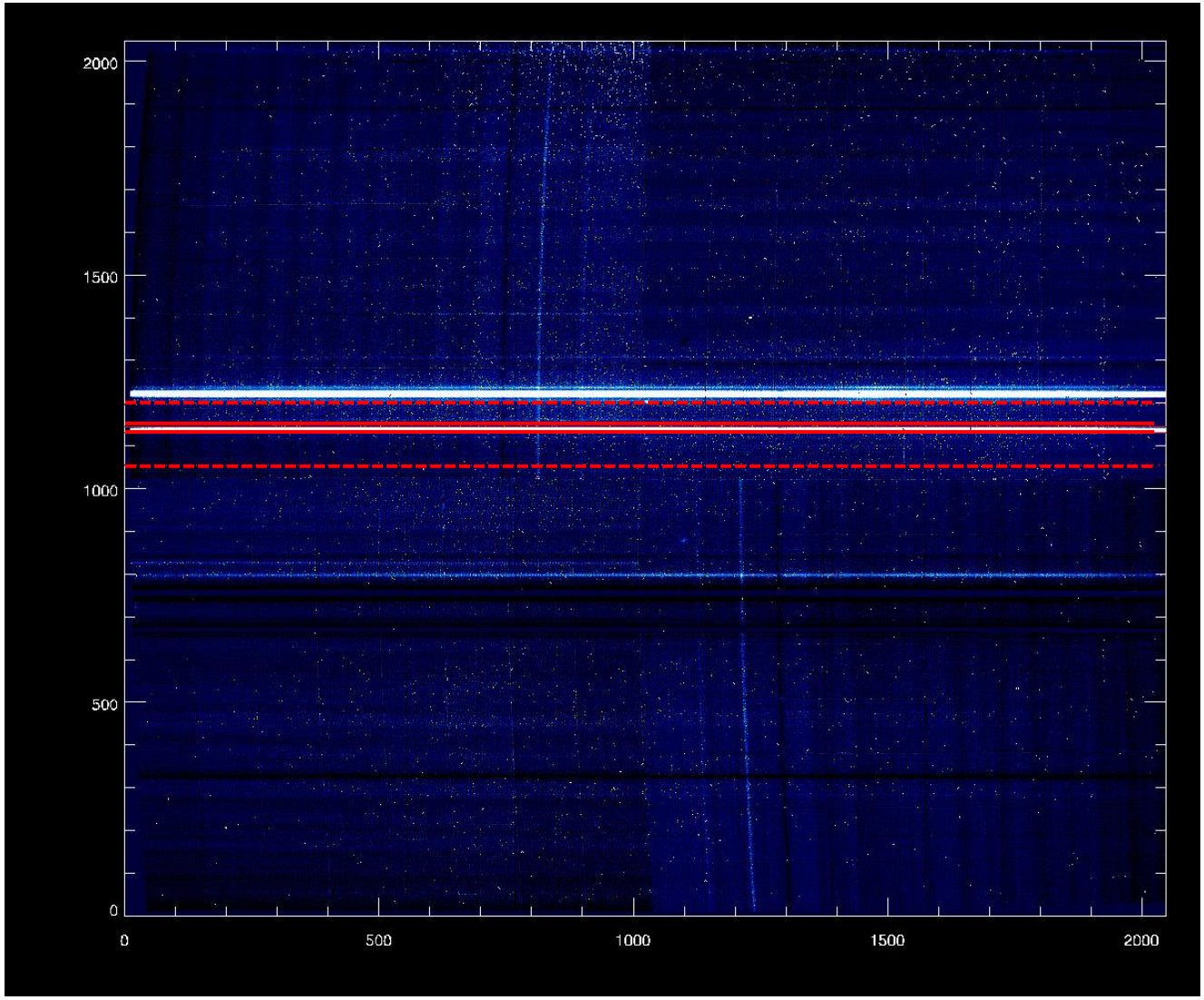
SPECTRAL EXTRACTION



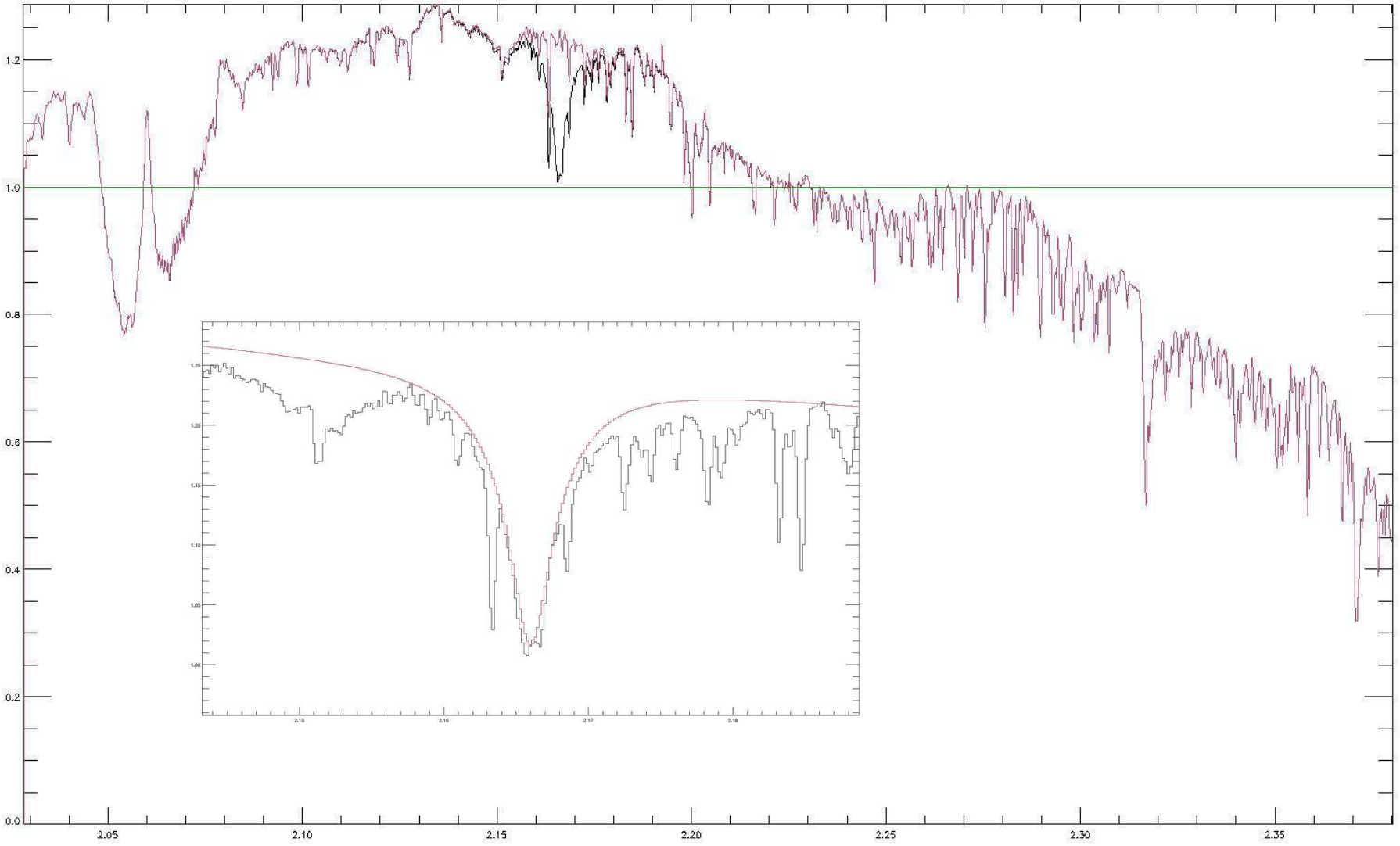
SPECTRAL EXTRACTION



SPECTRAL EXTRACTION

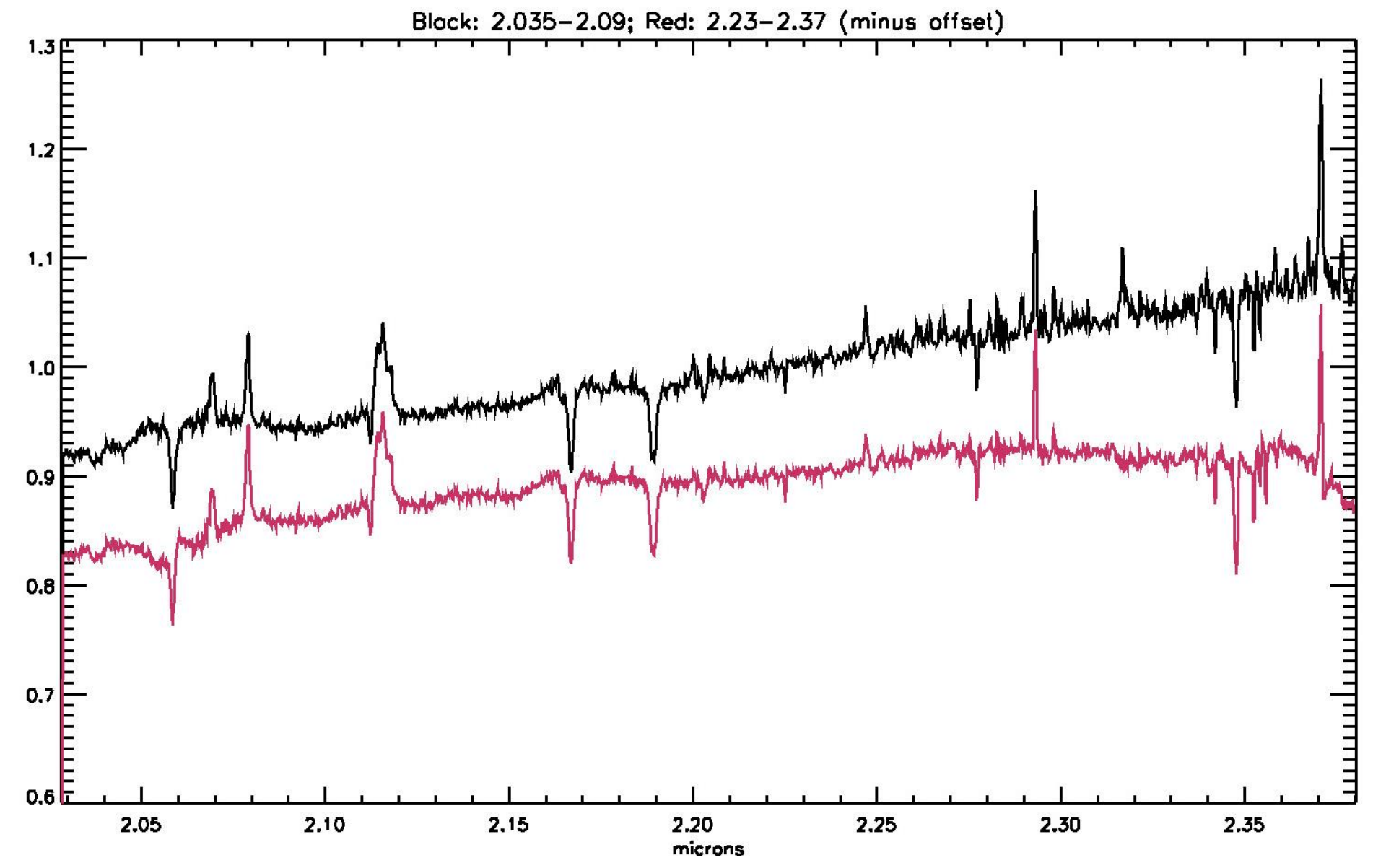


TELLURIC CORRECTION

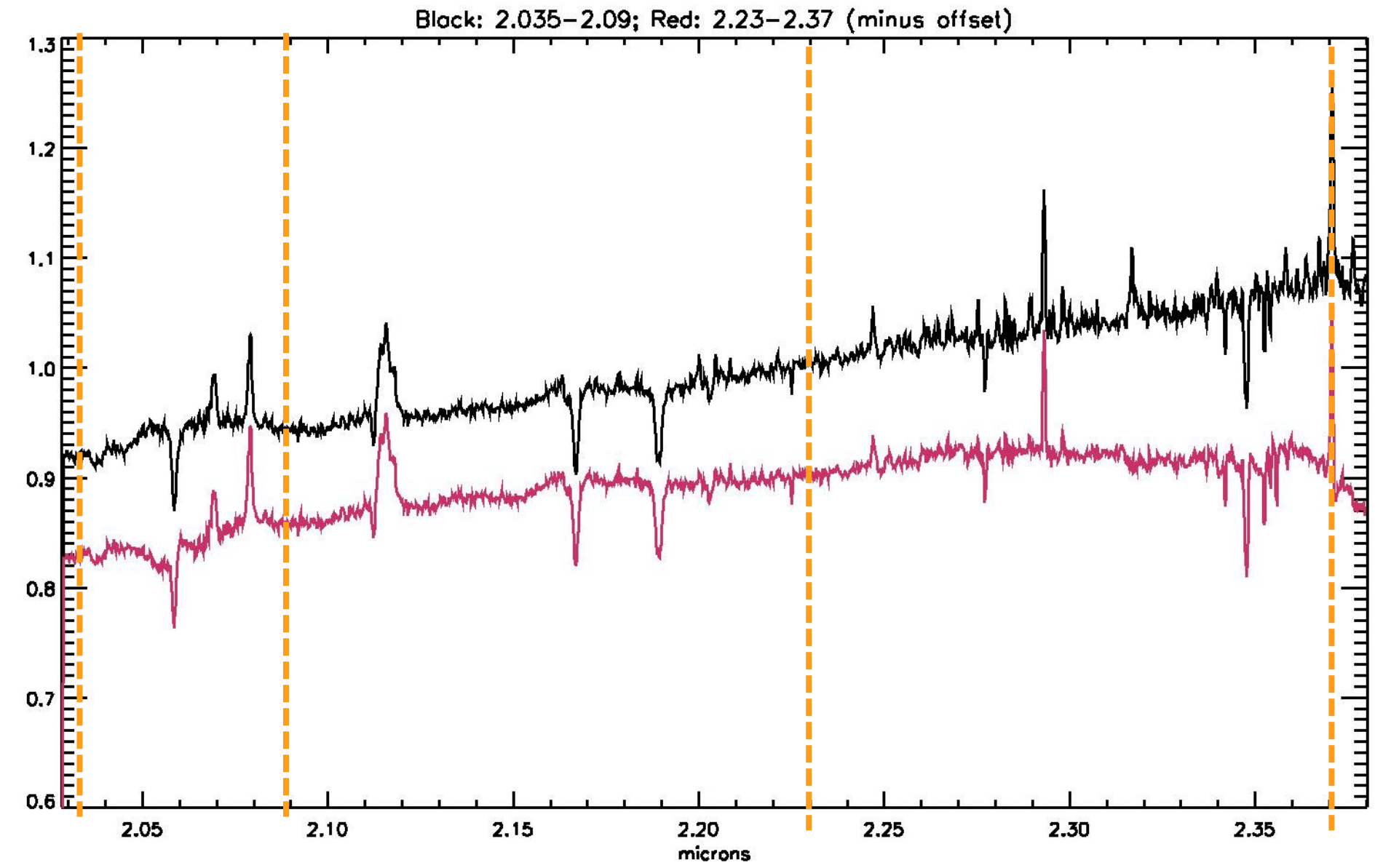


Martell: Rubio-Díez, PhD Thesis

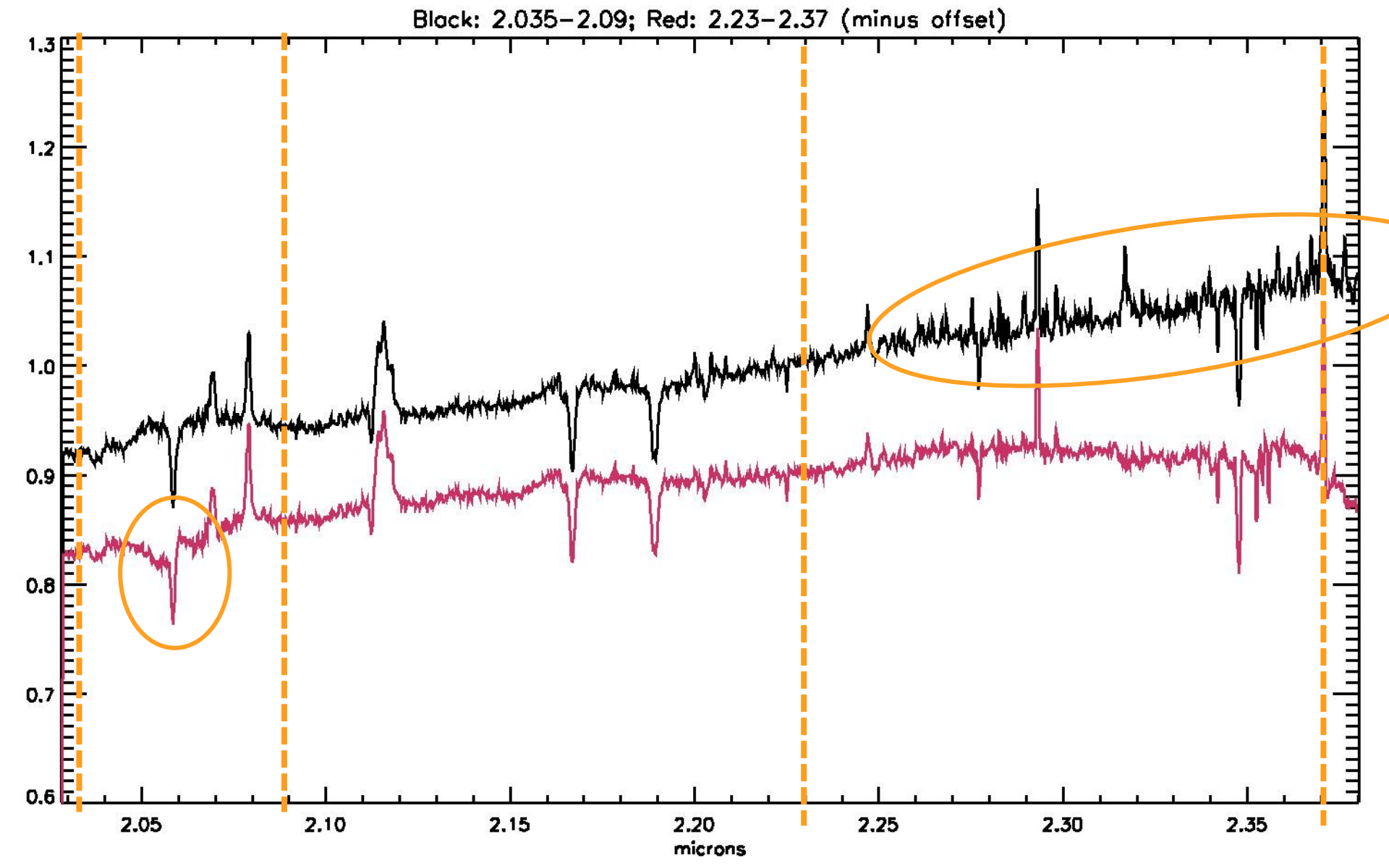
TELLURIC CORRECTION



TELLURIC CORRECTION

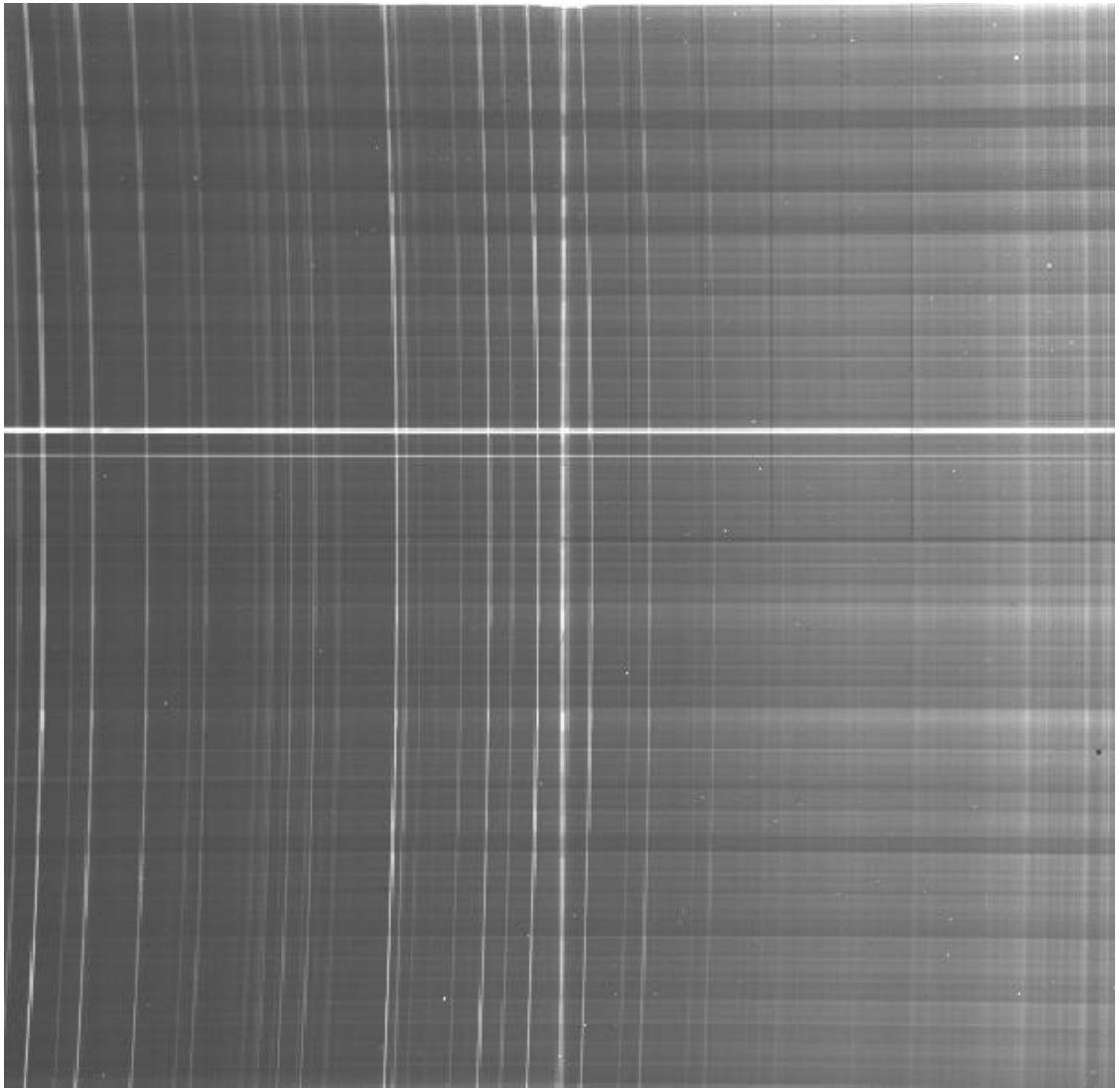


TELLURIC CORRECTION

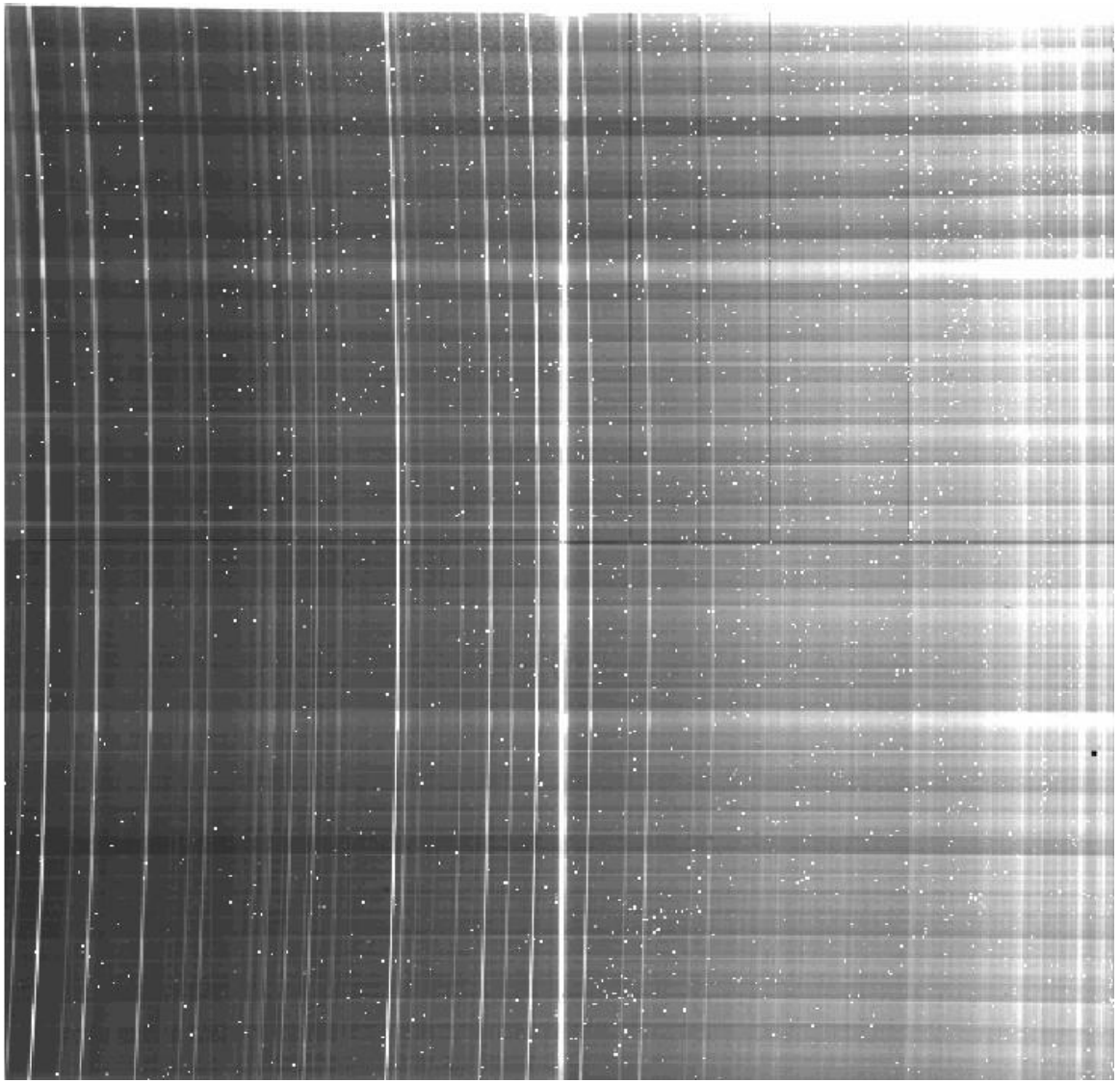


SOME PROBLEMS

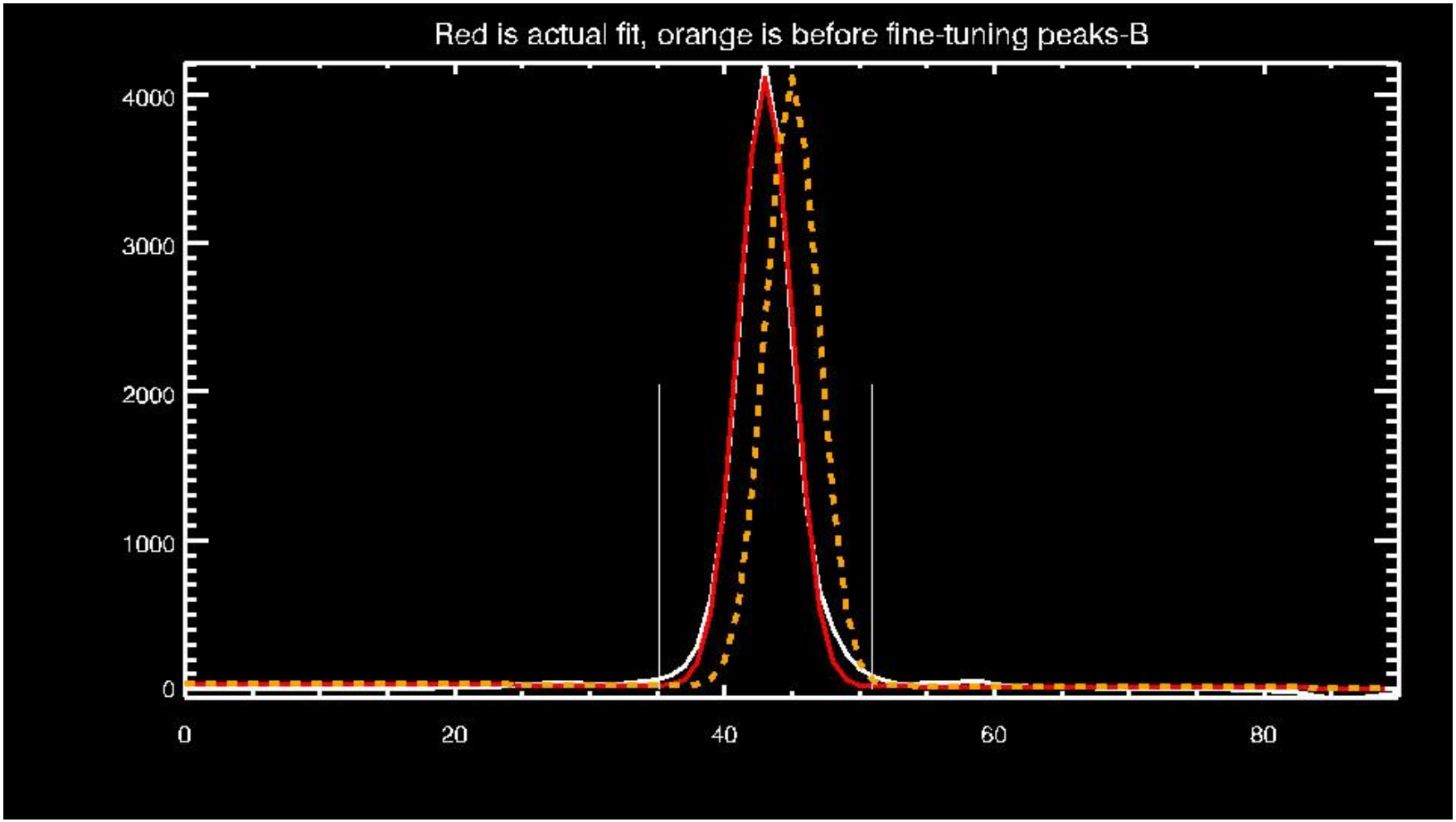
RAW IMH BRIGHT OBJECTS (OB0003)



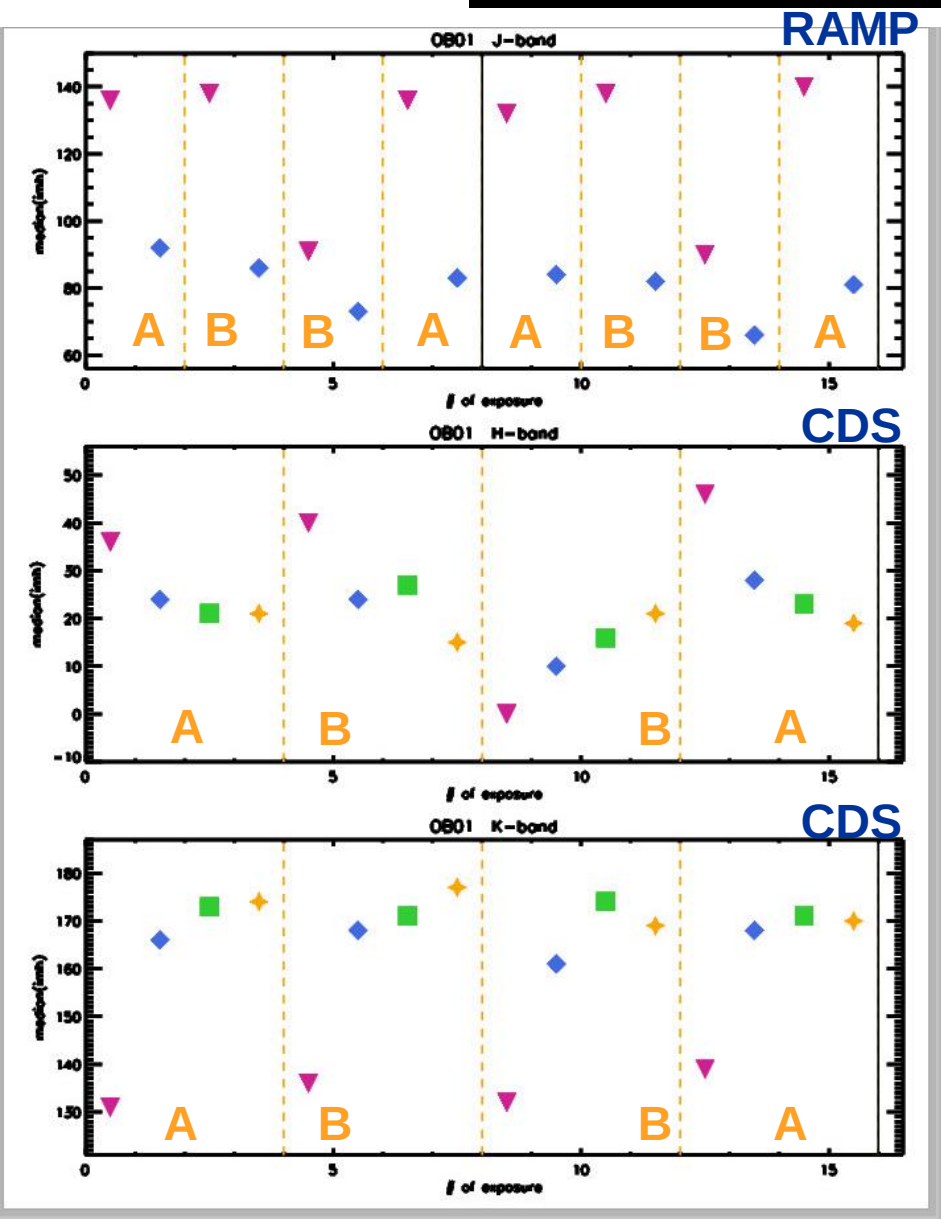
RAW IMH FAINT OBJECTS (OB0005)

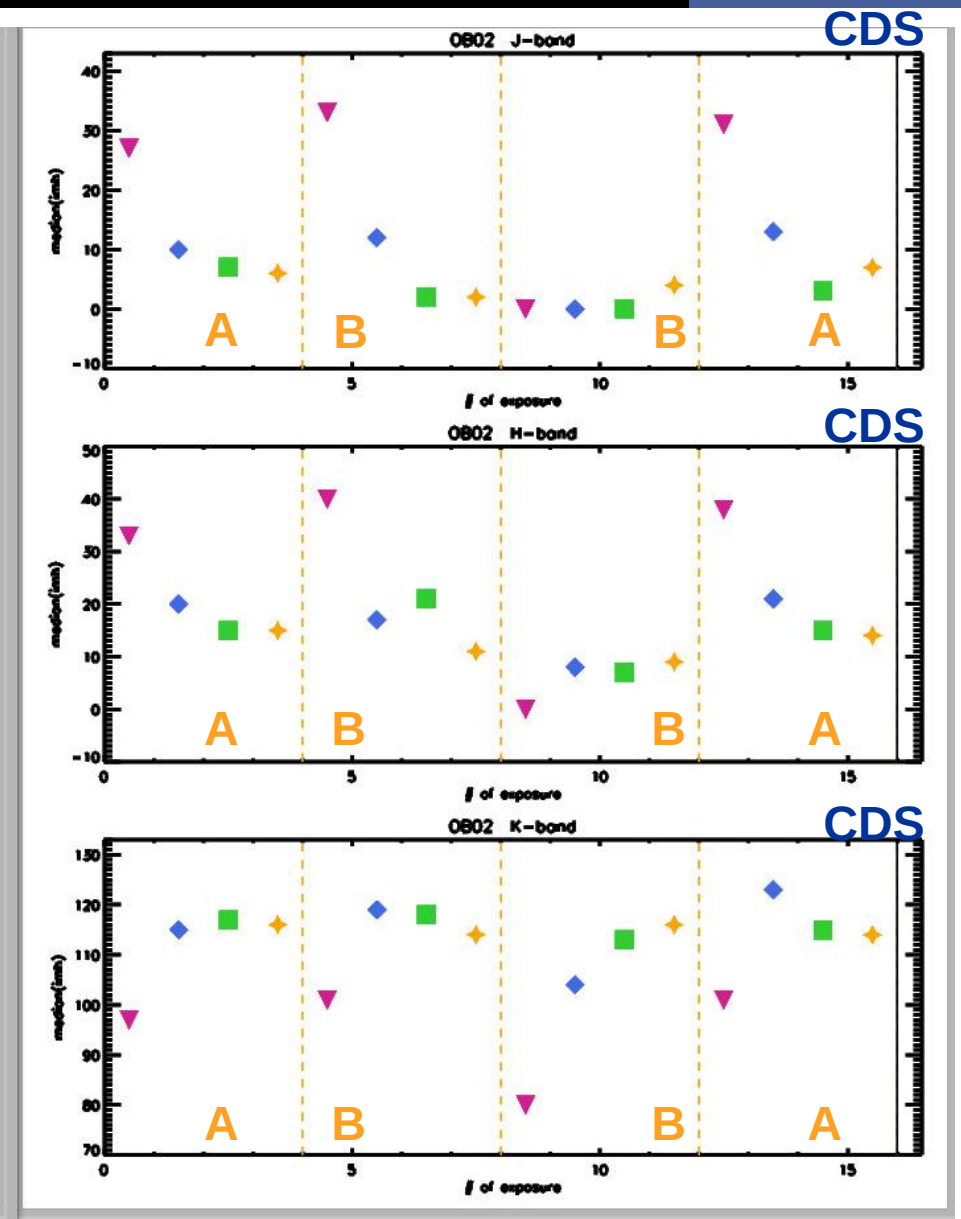


DTU TILT (?)

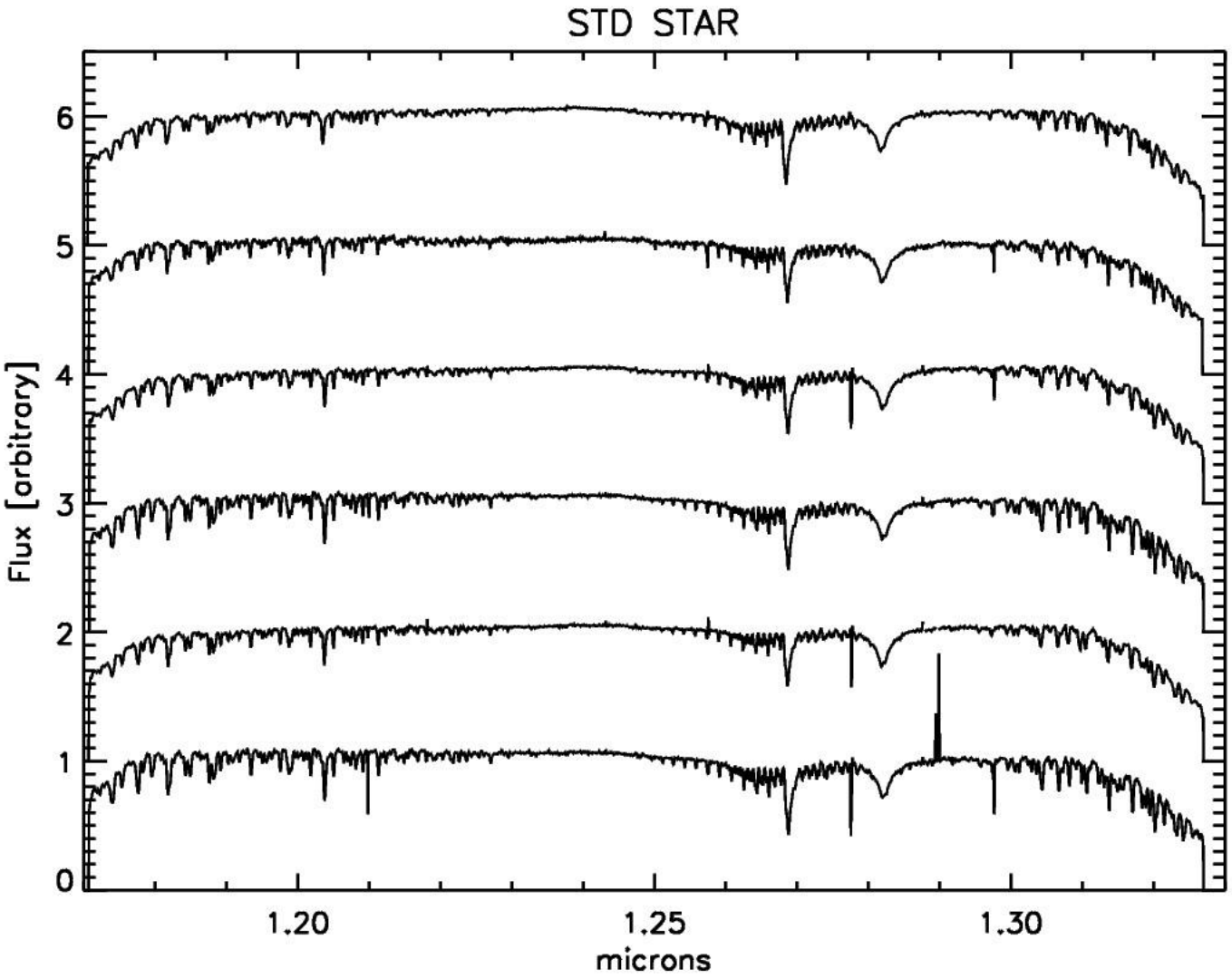

Red is actual fit, orange is before fine-tuning peaks-B
4000
3000
2000
1000
0
0
20
40
60
80

DETECTOR DRIFT (?)





QUALITY OF TELLURIC STD SPECTRUM



OB14: airm 1.87-2.16

OB12: airm 1.20-1.28

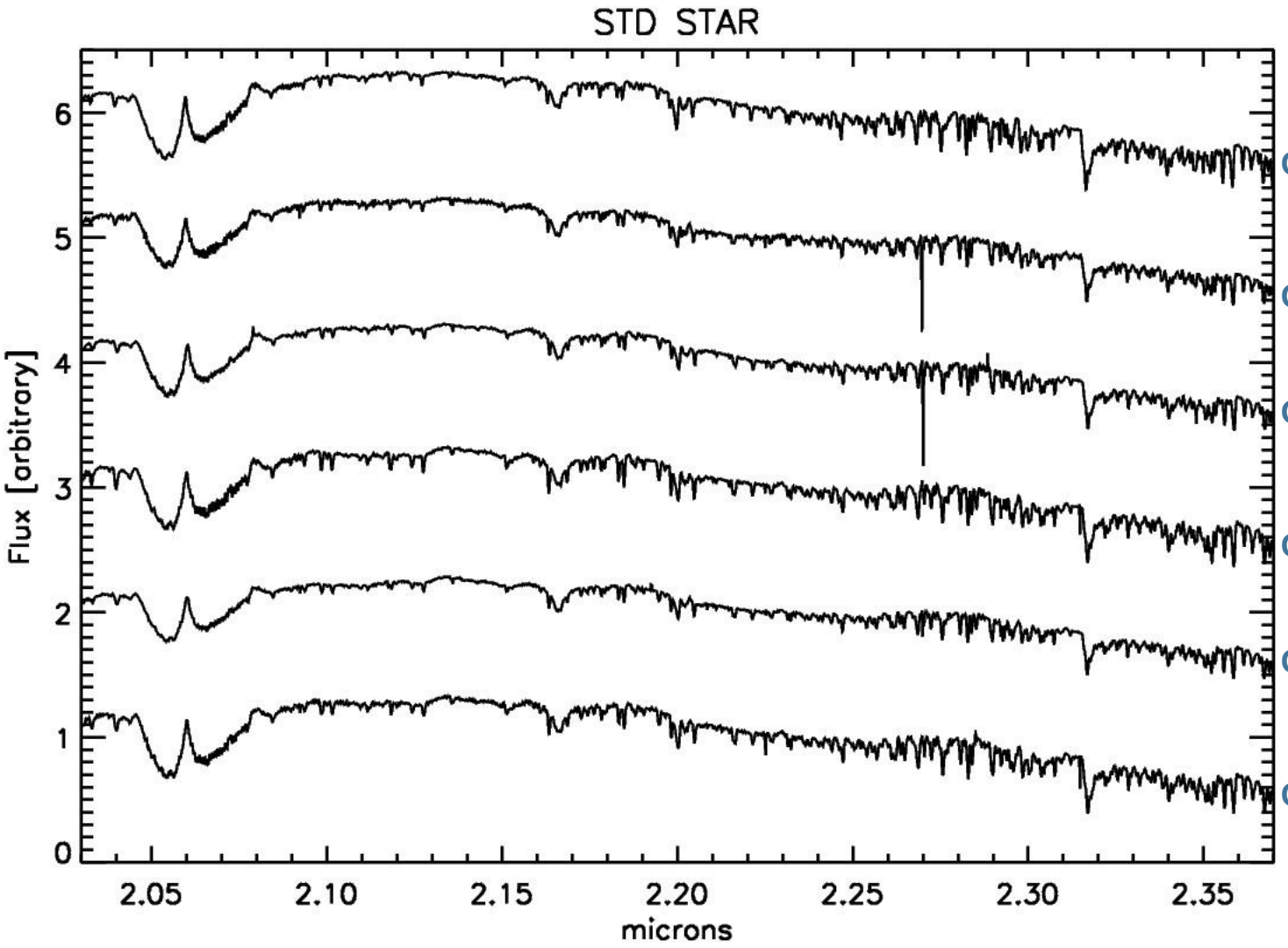
OB08: airm 1.41-1.58

OB06: airm 1.69-1.92

OB04: airm 1.16-1.22

OB02: airm 1.91-2.29

QUALITY OF TELLURIC STD SPECTRUM



OB14: airm 1.87-2.16

OB12: airm 1.20-1.28

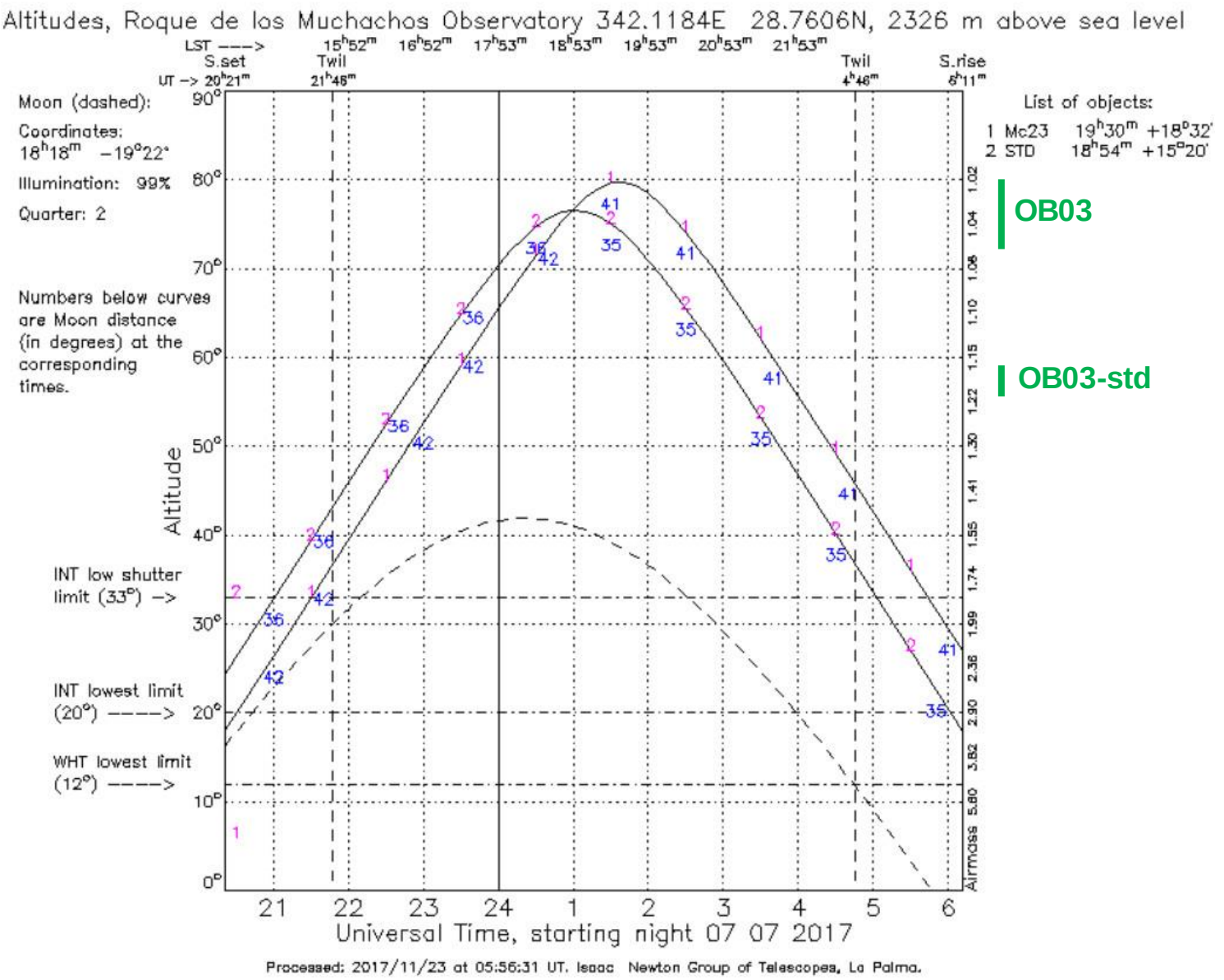
OB08: airm 1.41-1.58

OB06: airm 1.69-1.92

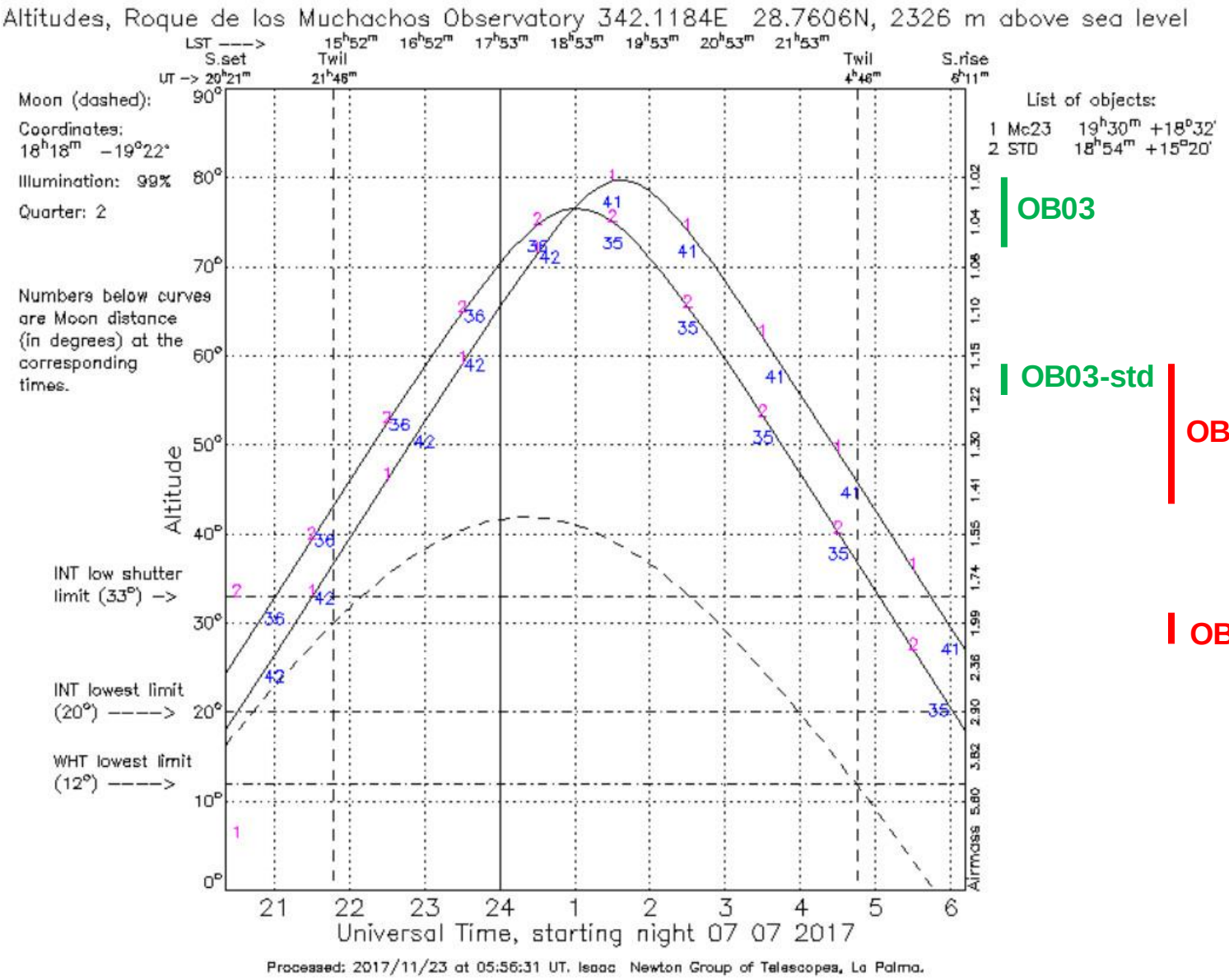
OB04: airm 1.16-1.22

OB02: airm 1.91-2.29

AIRMASS (+TWILIGHT +FLEXURES?)

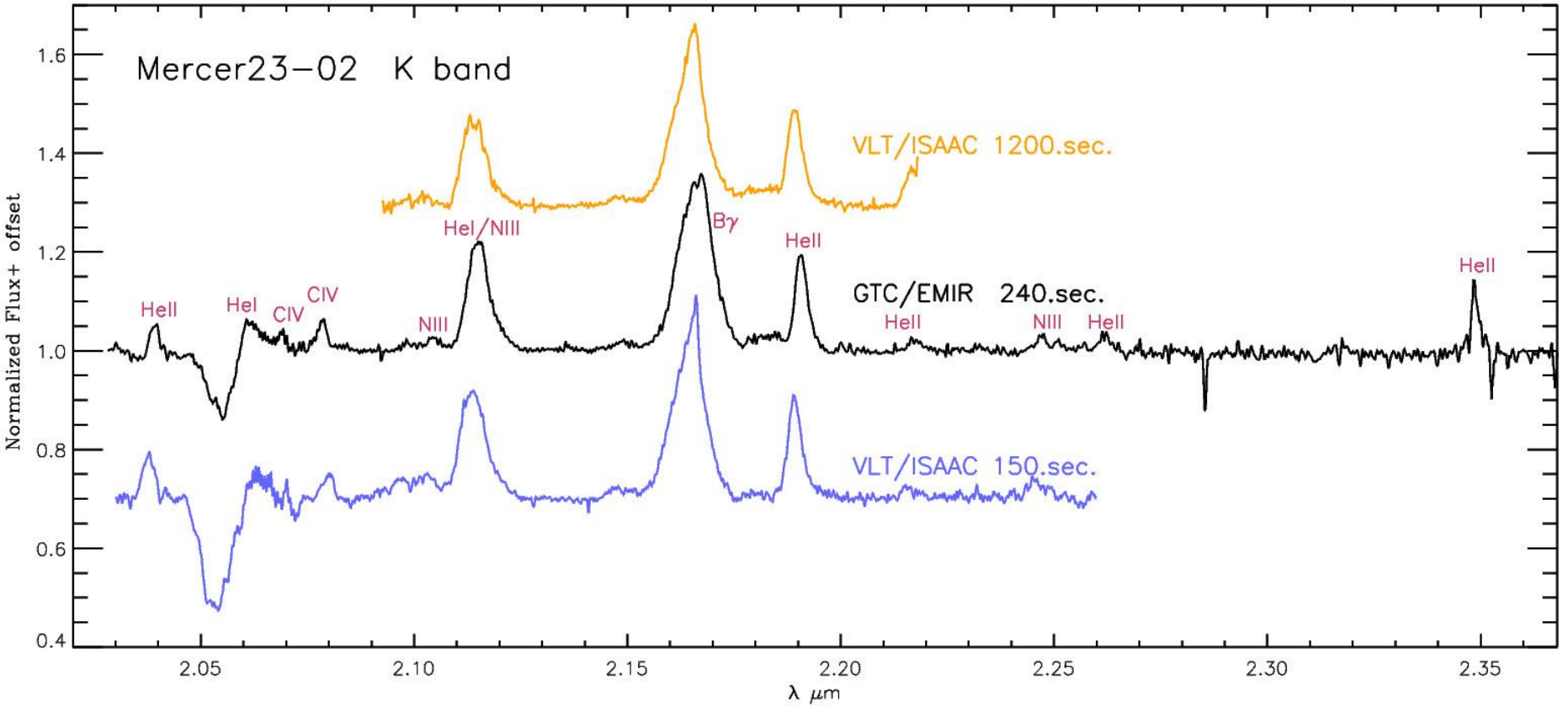


AIRMASS (+TWILIGHT +FLEXURES?)

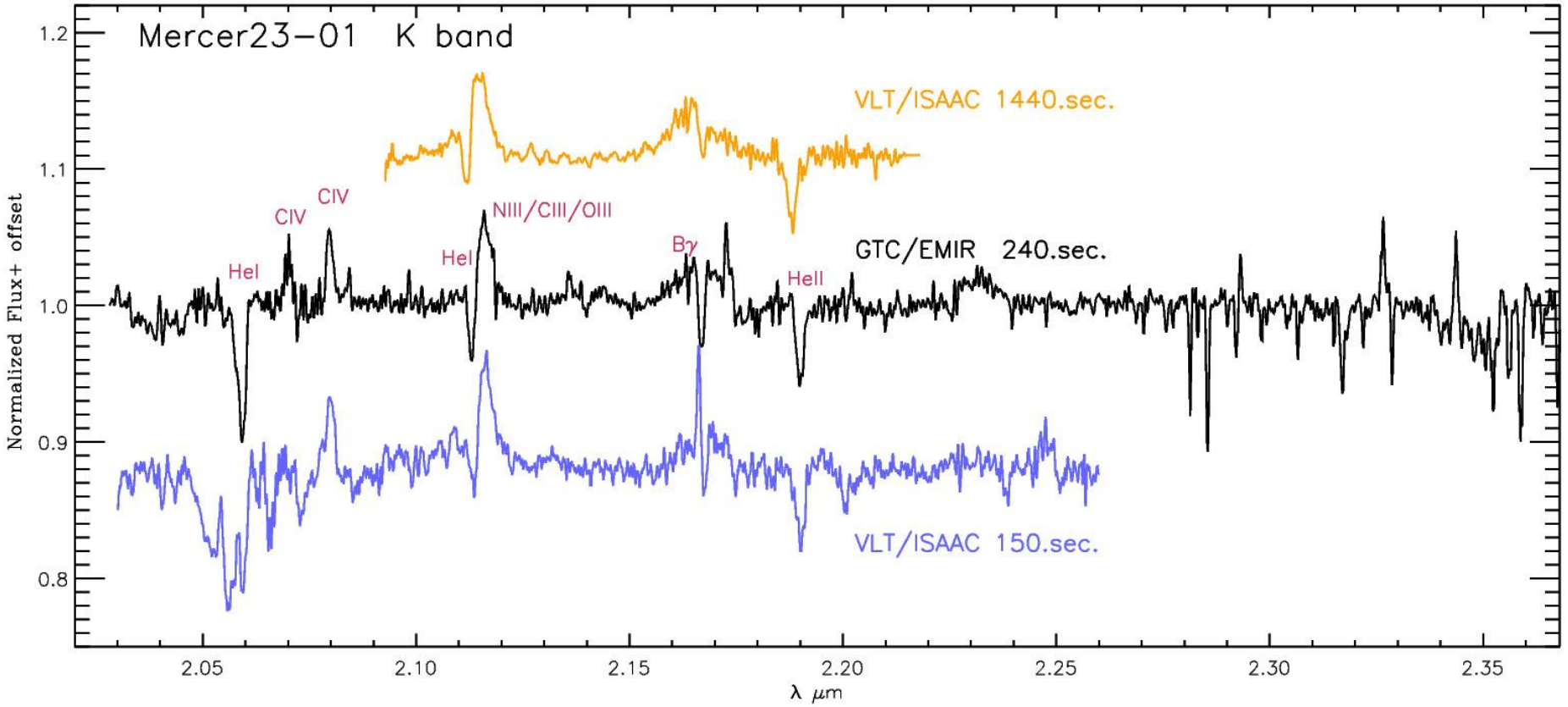


RESULTS

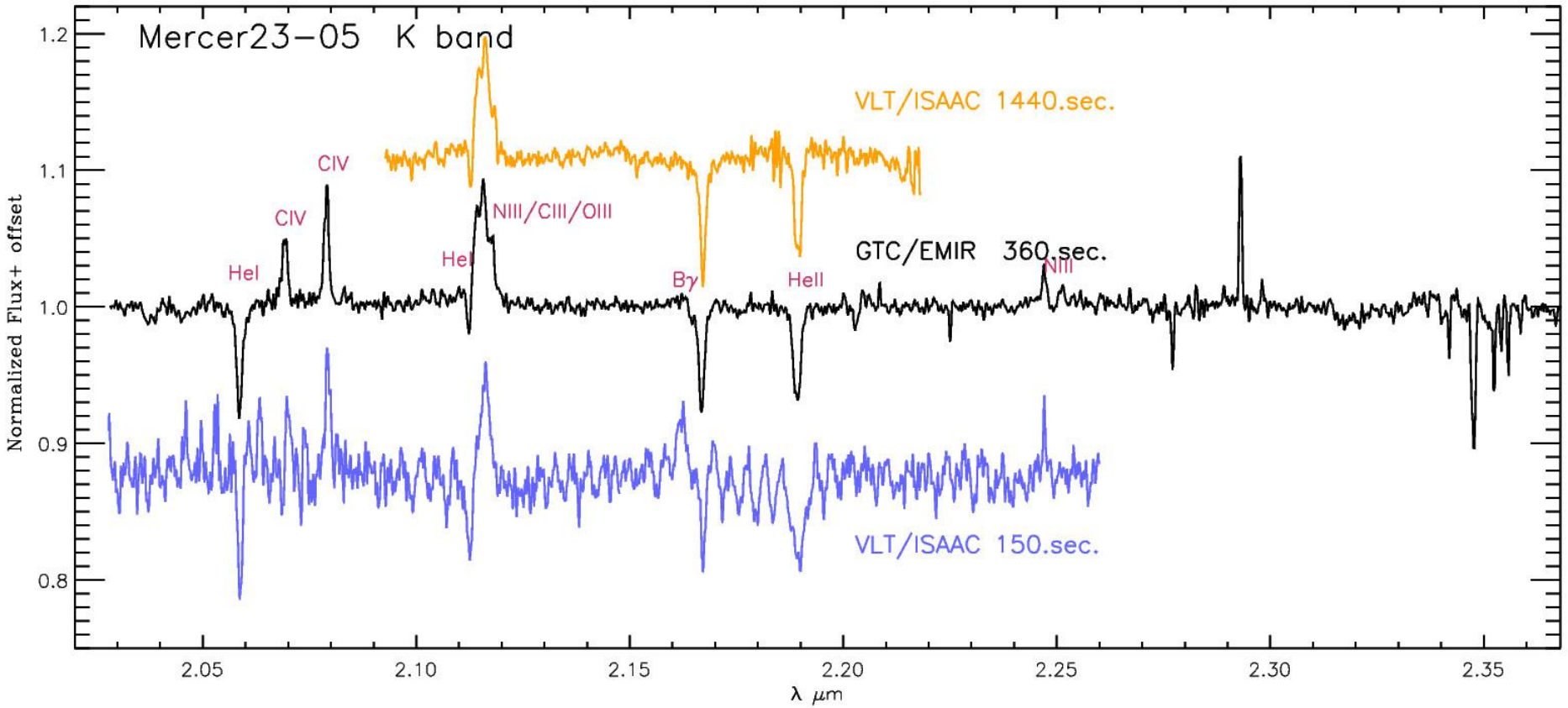
REDUCED SPECTRA



REDUCED SPECTRA



REDUCED SPECTRA



CONCLUSIONS

- **EMIR can provide beautiful data of obscured massive stars**

- **We had indeed detected some problems that have been reported in this workshop:**
  - EMIR's efficiency calculation tool: how to implement exposures in phase-2
  - Detector signal drifts at low count level
  - nod-B spectra have poorer quality:

    DTU tilt w.r.t. nominal position or pointing accuracy?

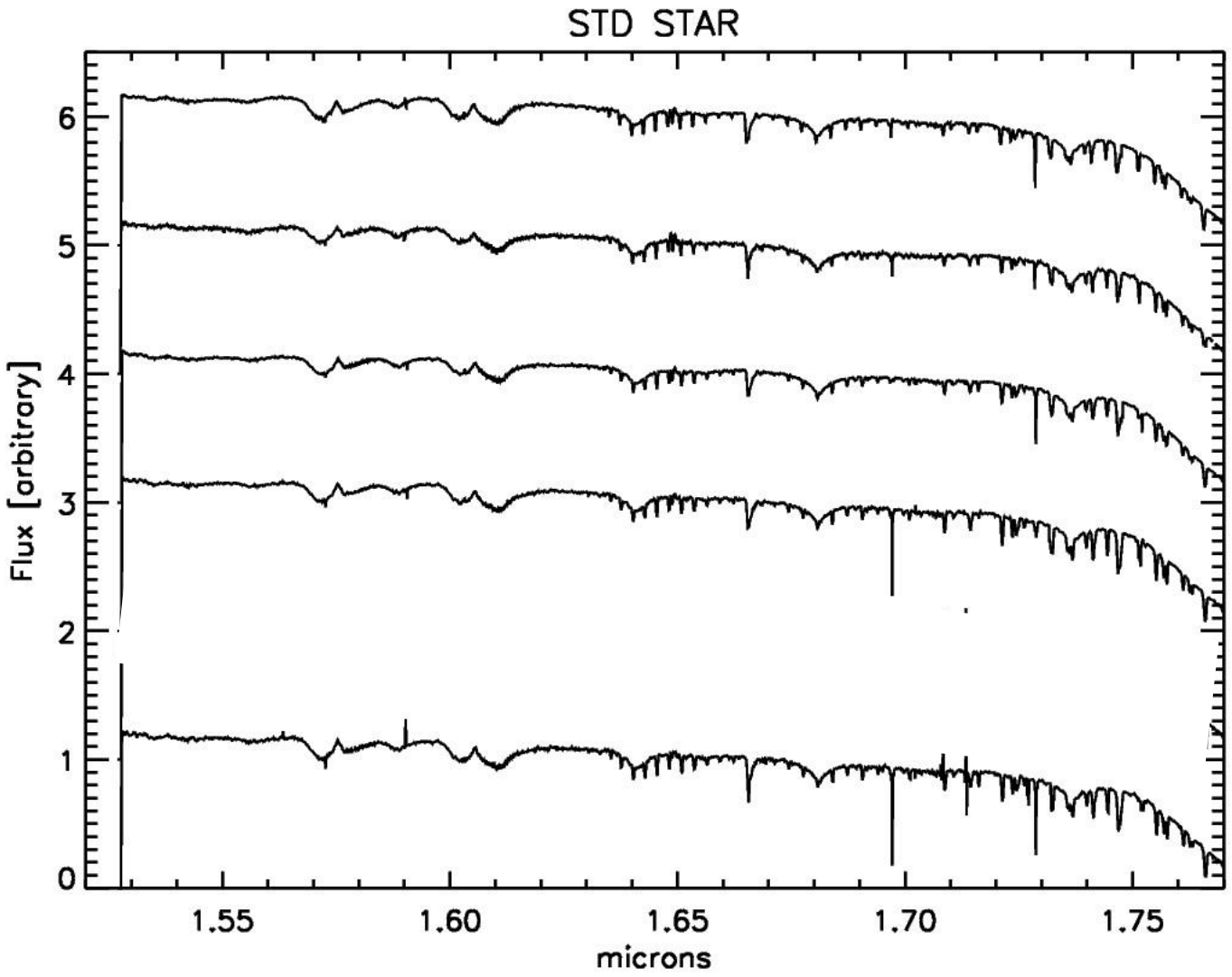
WISH LIST FOR EMIR-TEAM AND GTC

- Neither the ETC nor the breakdown of EXPTIME by EMIR is trivial
- Adapt GTC's phase-2 to how the EMIR works
- Which imh-header should we use? 0 or 1 ?

- Add a keyword with the offset applied for the nodding pattern AB
- Standardize headers (the object-name is missing in one OB)
- Standardize delivered files (on OB is missing the observatory standard).

- Please, do not execute good-visibility objects with high airmass

QUALITY OF TELLURIC STD SPECTRUM



HANSON+ 2010 VS DE LA FUENTE 2016

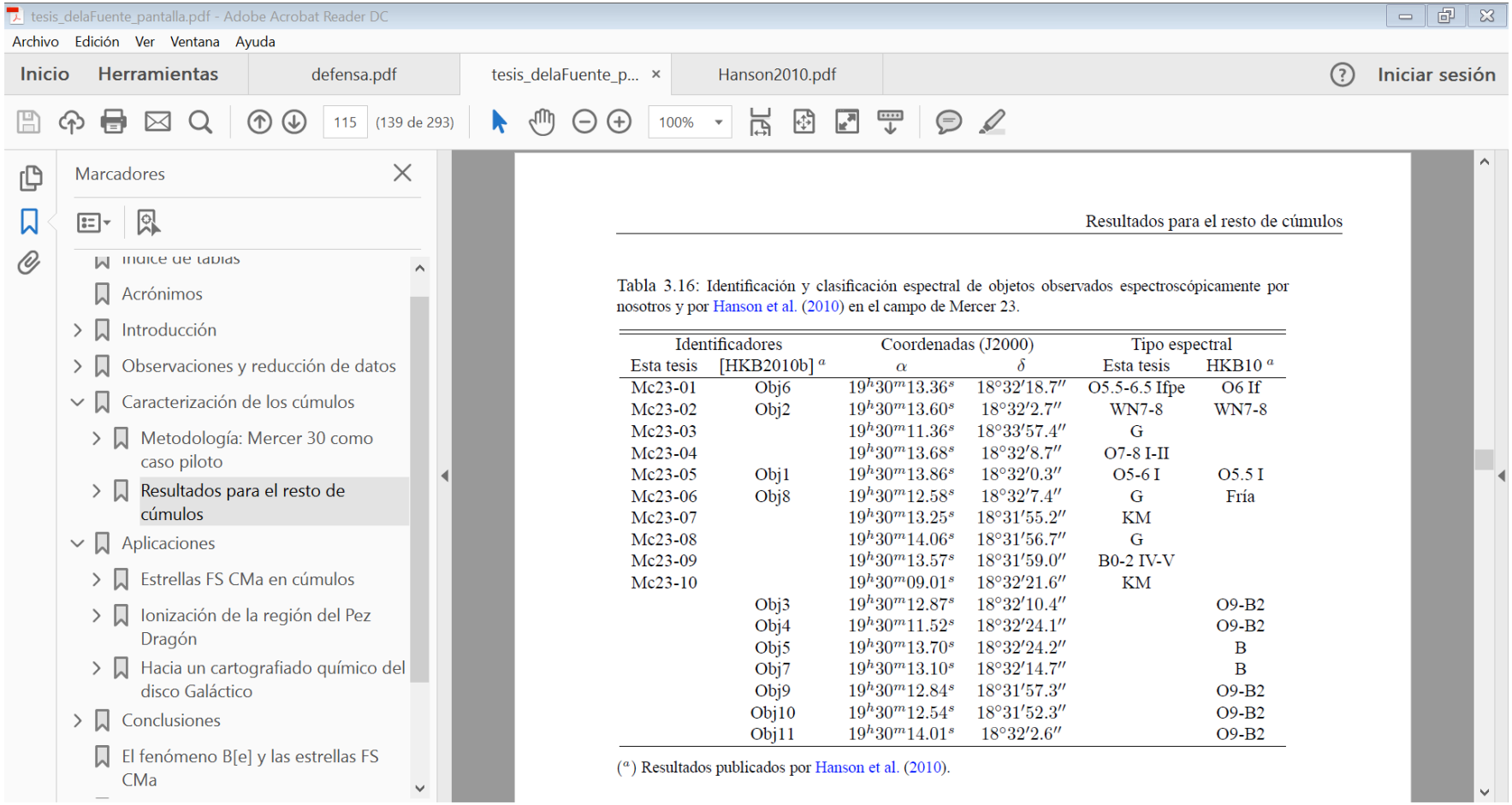


Tabla 3.16: Identificación y clasificación espectral de objetos observados espectroscópicamente por nosotros y por Hanson et al. (2010) en el campo de Mercer 23.

Identificadores		Coordenadas (J2000)		Tipo espectral	
Esta tesis	[HKB2010b] [a]	α	δ	Esta tesis	HKB10 [a]
Mc23-01	Obj6	$19^h30^m13.36^s$	$18°32'18.7''$	O5.5-6.5 Ifpe	O6 If
Mc23-02	Obj2	$19^h30^m13.60^s$	$18°32'2.7''$	WN7-8	WN7-8
Mc23-03		$19^h30^m11.36^s$	$18°33'57.4''$	G	
Mc23-04		$19^h30^m13.68^s$	$18°32'8.7''$	O7-8 I-II	
Mc23-05	Obj1	$19^h30^m13.86^s$	$18°32'0.3''$	O5-6 I	O5.5 I
Mc23-06	Obj8	$19^h30^m12.58^s$	$18°32'7.4''$	G	Fría
Mc23-07		$19^h30^m13.25^s$	$18°31'55.2''$	KM	
Mc23-08		$19^h30^m14.06^s$	$18°31'56.7''$	G	
Mc23-09		$19^h30^m13.57^s$	$18°31'59.0''$	B0-2 IV-V	
Mc23-10		$19^h30^m09.01^s$	$18°32'21.6''$	KM	
	Obj3	$19^h30^m12.87^s$	$18°32'10.4''$		O9-B2
	Obj4	$19^h30^m11.52^s$	$18°32'24.1''$		O9-B2
	Obj5	$19^h30^m13.70^s$	$18°32'24.2''$		B
	Obj7	$19^h30^m13.10^s$	$18°32'14.7''$		B
	Obj9	$19^h30^m12.84^s$	$18°31'57.3''$		O9-B2
	Obj10	$19^h30^m12.54^s$	$18°31'52.3''$		O9-B2
	Obj11	$19^h30^m14.01^s$	$18°32'2.6''$		O9-B2

([a]) Resultados publicados por Hanson et al. (2010).