MIRI-IFU-Spec Hands on

Olivier Berné, Emilie Habart, Pierre Guillard, Hakim Atek

Feb. 24 2020

ERS project 1288

"Radiative feedback from massive stars
as traced by multiband imaging and
spectroscopic mosaics"

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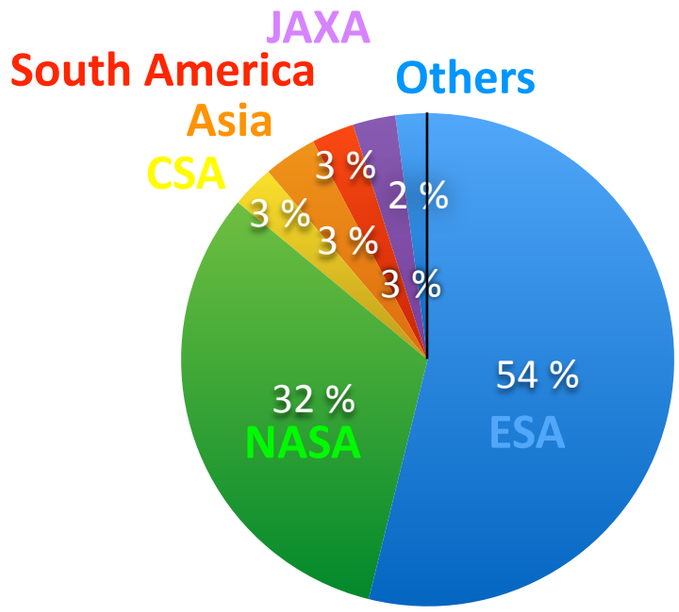
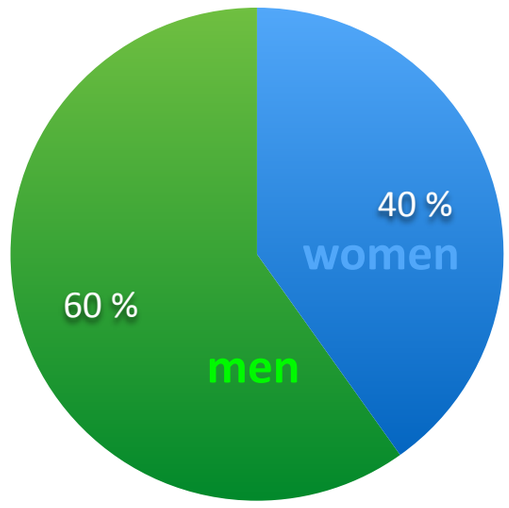
<u>CoIs (17):</u> Abergel A. (FR), Bergin E. (US), Bernard-Salas J. (UK), Bron E. (ES), Cami J. (CA), Cazaux S. (NL), Dartois E. (FR), Fuente A. (ES), Goicoechea J. (ES), Gordon K. (US), Okada Y. (DE), Onaka T. (JP), Robertto M. (US), Röllig M. (DE), Tielens A. (NL), Vicente S. (PT), Wolfire M. (US)

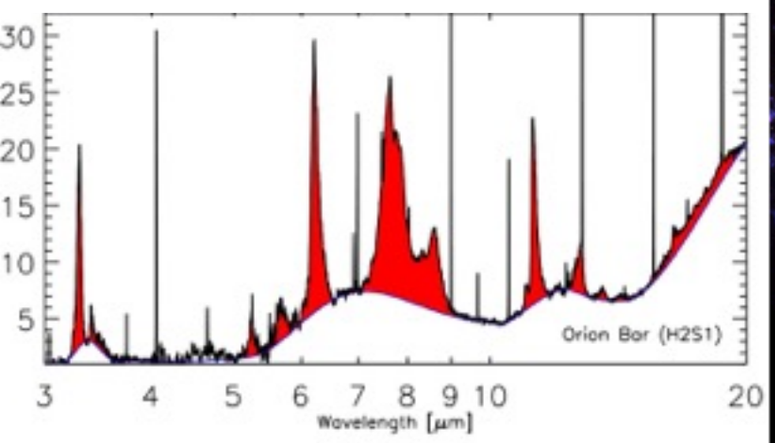
122 Science collaborators from 18 countries.



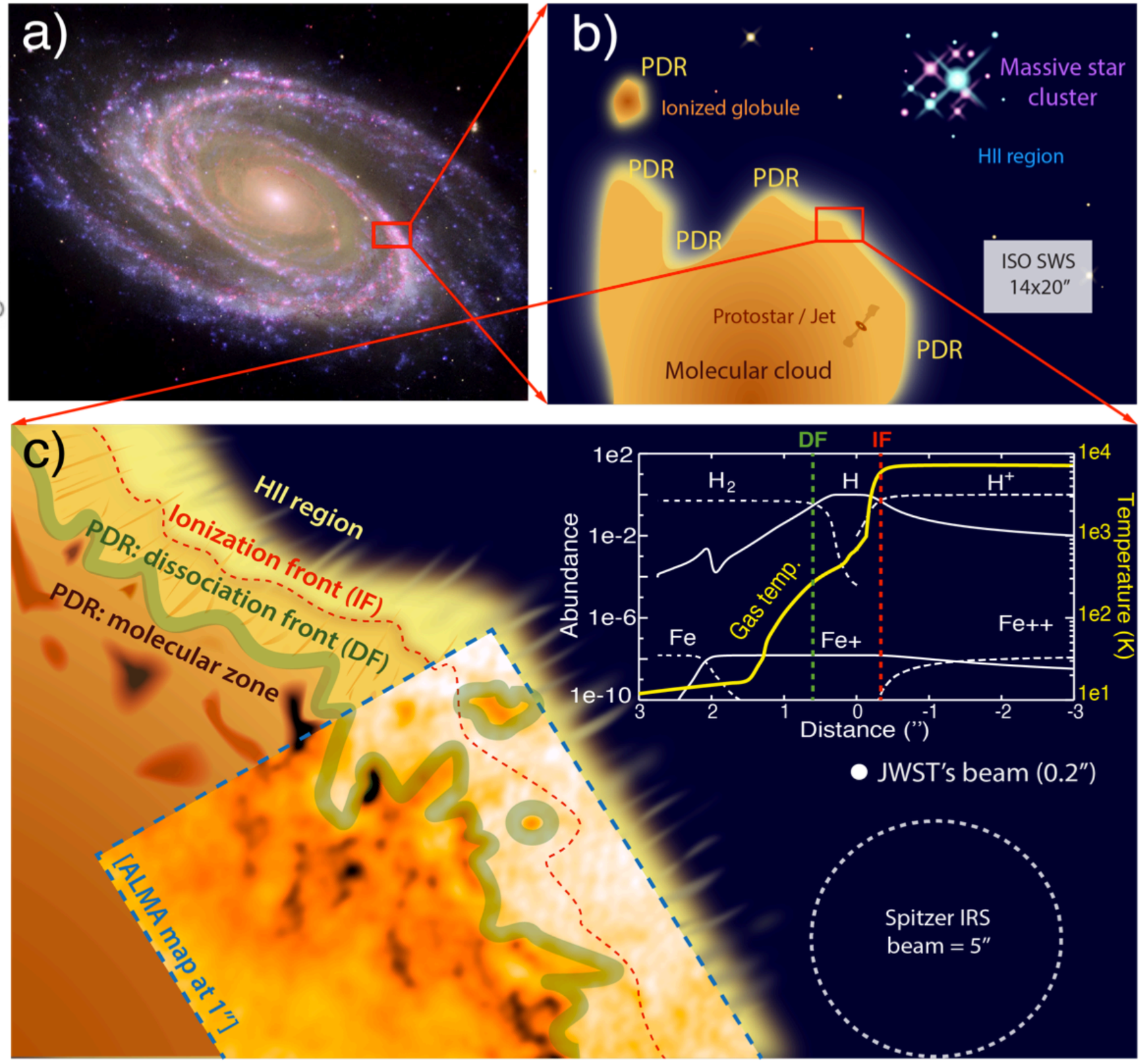


<u>www.jwst-ism.org</u>

Scientific goals



- **The scale length for FUV photon penetration corresponds to a few arcsec.**
- **JWST will resolve the transition from the molecular cloud to the PDR dissociation front and the gas flow into the ionized gas**

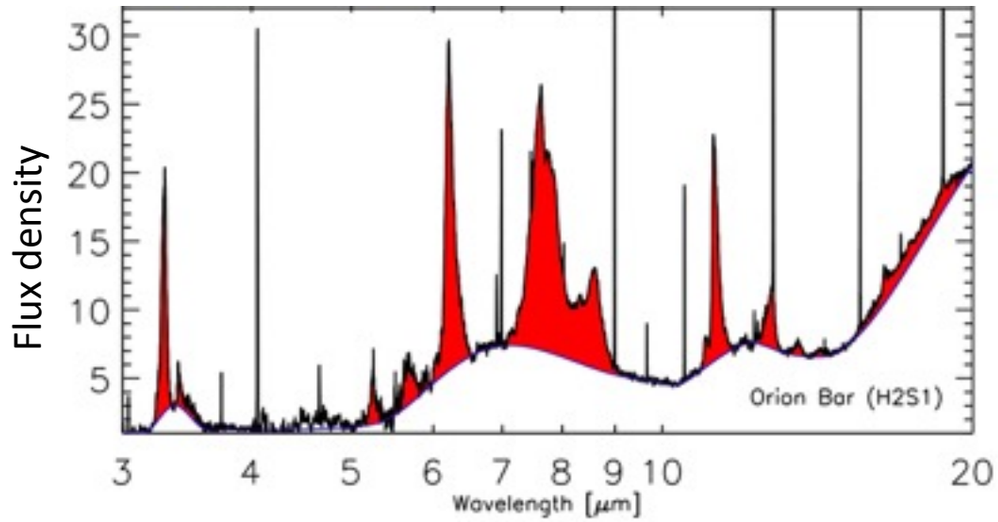


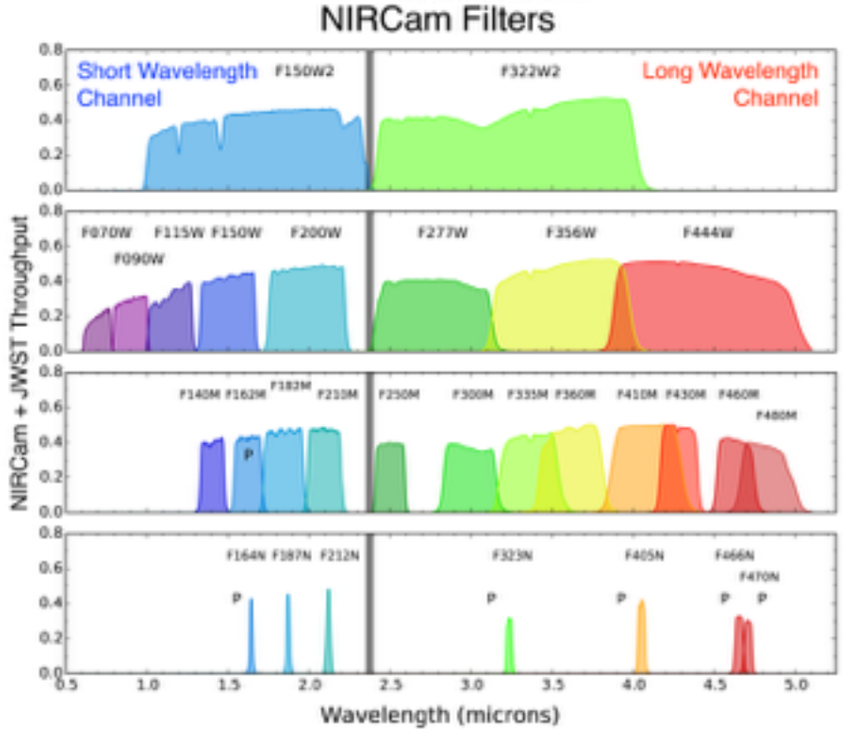
P1 : Enhanced data products

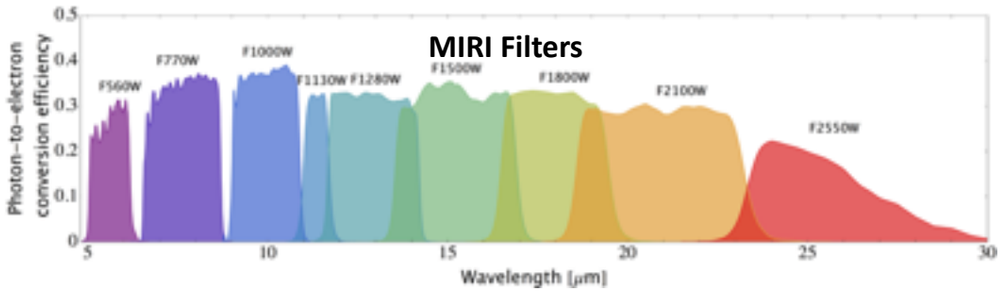
- **Maps of integrated lines/bands** from IFU spectroscopy cubes
- **Template spectra (HII region, IF, DF, molecular zone)** directly extracted from the observations or blind signal separation methods

P2 : Products facilitating data reduction and manipulation

- **Spectral order stitching and stitched cubes**
- **Cross-correlate spectra & images**
- **pyPAHFIT** decompose the spectra into gas lines, dust features (aromatic/PAHs, aliphatics, fullerenes, silicates, ices), and dust continuum components (of all pixels in IFU maps)
- **List of all the lines/bands** present in the data

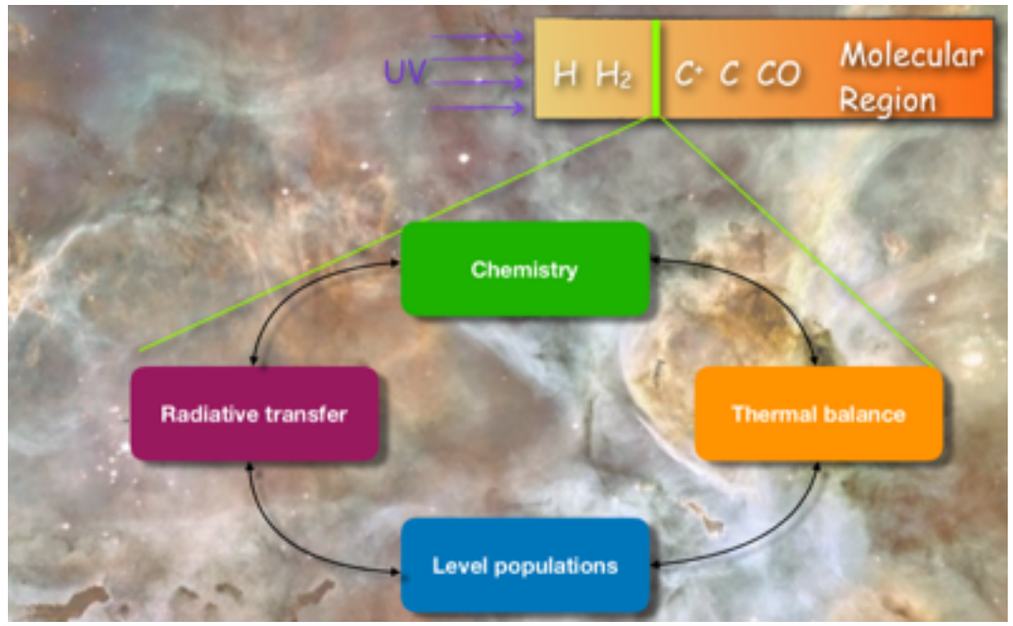


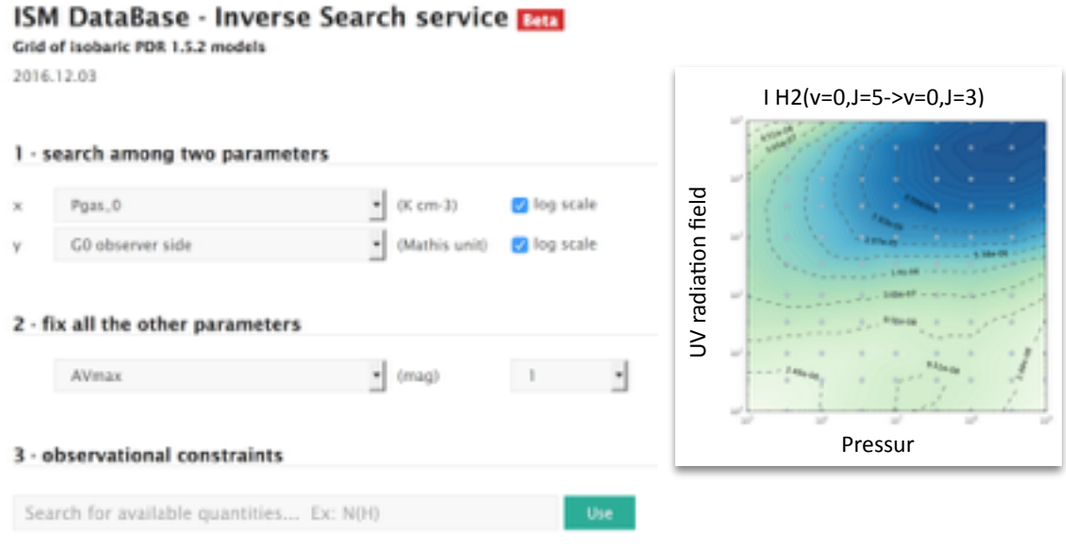




P3 : Data-interpretation tools

- **H_2 fitting tool** maps of T_{ex}, N_{H_2} and R_{otp}
- **PDR model toolbox** web-based fitting tool for maps to search in massive grids of complete models and derive physical parameters from observations of any number of lines
- **PAHdb Spectral Analysis Tool** decomposition of PAH emission into contributing sub-populations (charge, size, composition, structure). Fit of the observations with theoretical/laboratory IR cross section spectra from the NASA Ames PAH IR Spectroscopic Database
- **Ionized gas lines toolbox** diagnostic diagrams of key species for conversion of the lines intensities into physical conditions and extinction. Based on multi-level models or Cloudy.





http://ismdb.obspm.fr

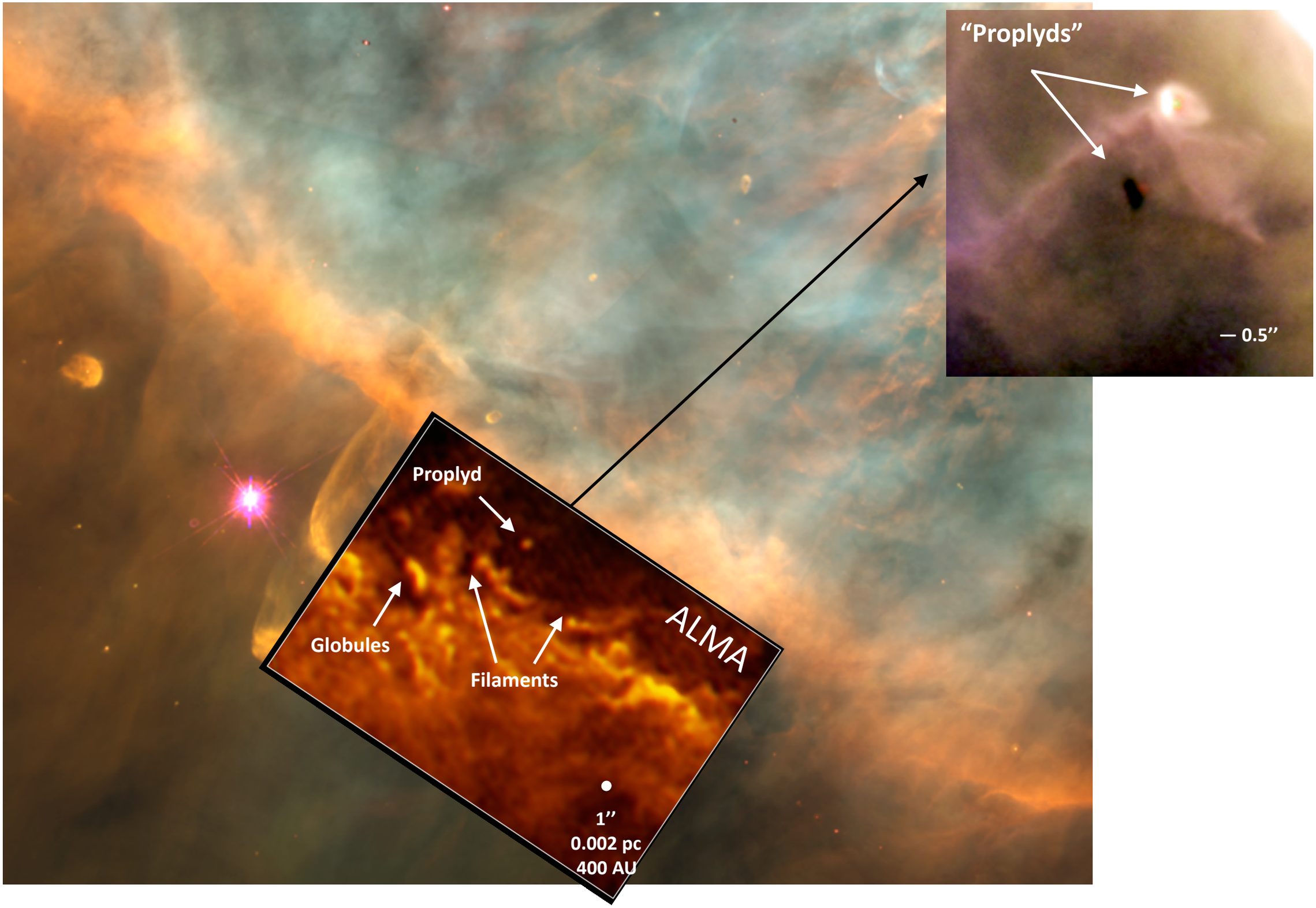
The scene

The Orion Bar

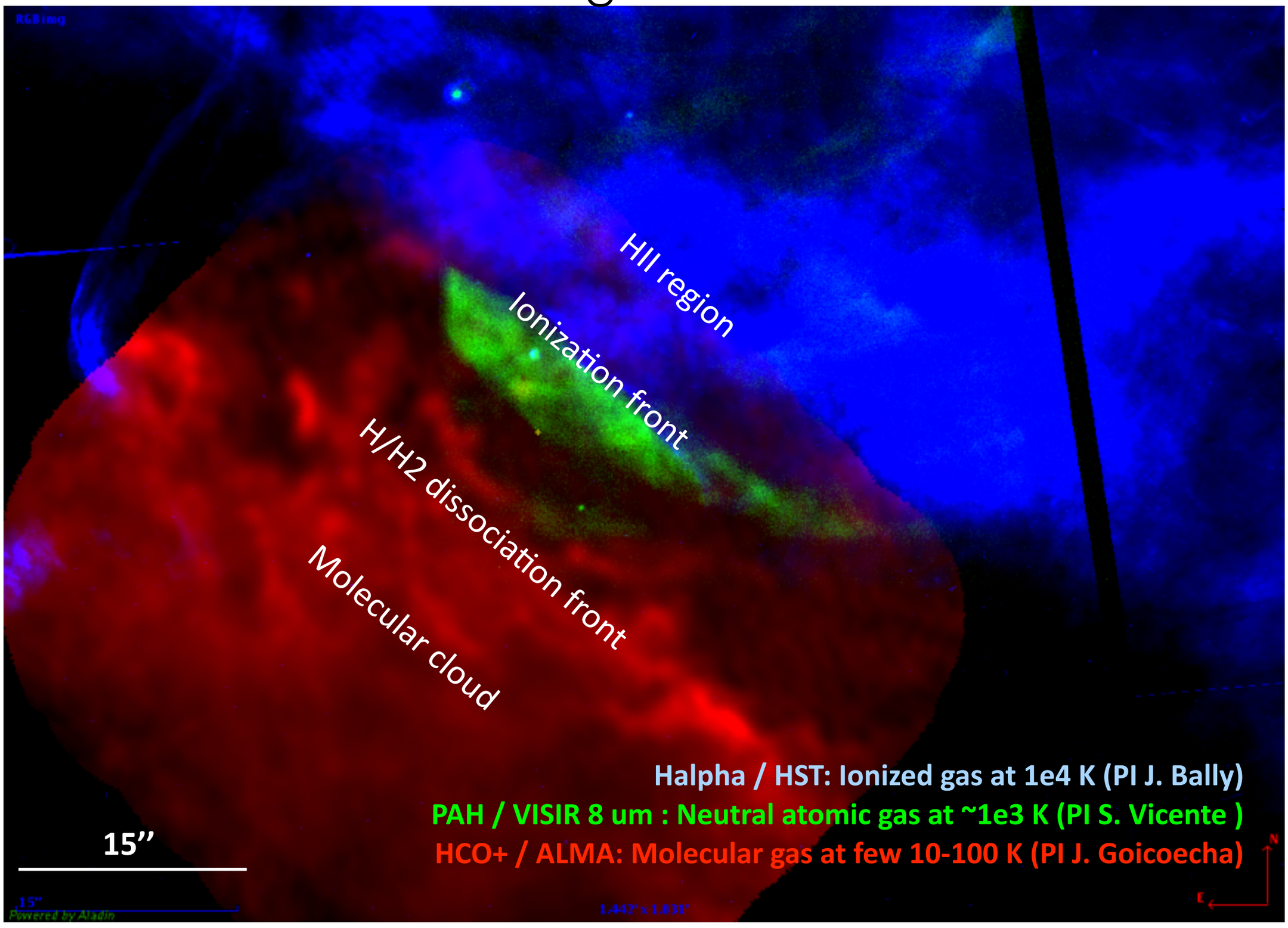
- Archetypical PDR
- Nearby (414 pc)
- Well studied
- Completes GTO (Horsehead and NGC 7023)
- Total time ~30 hrs

(Subject to change depending on date of launch: Trifid is the alternative target)

The Orion Bar

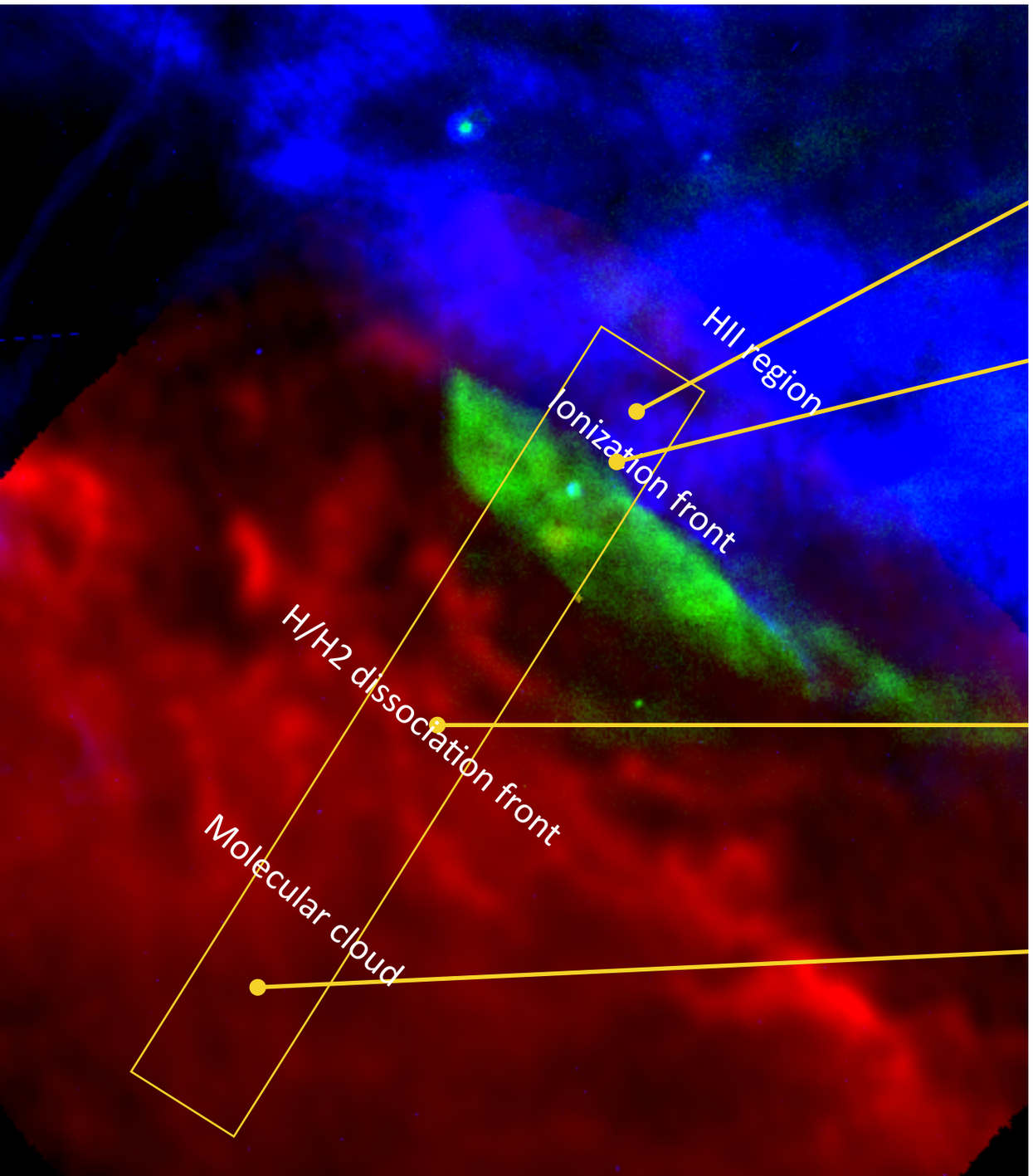


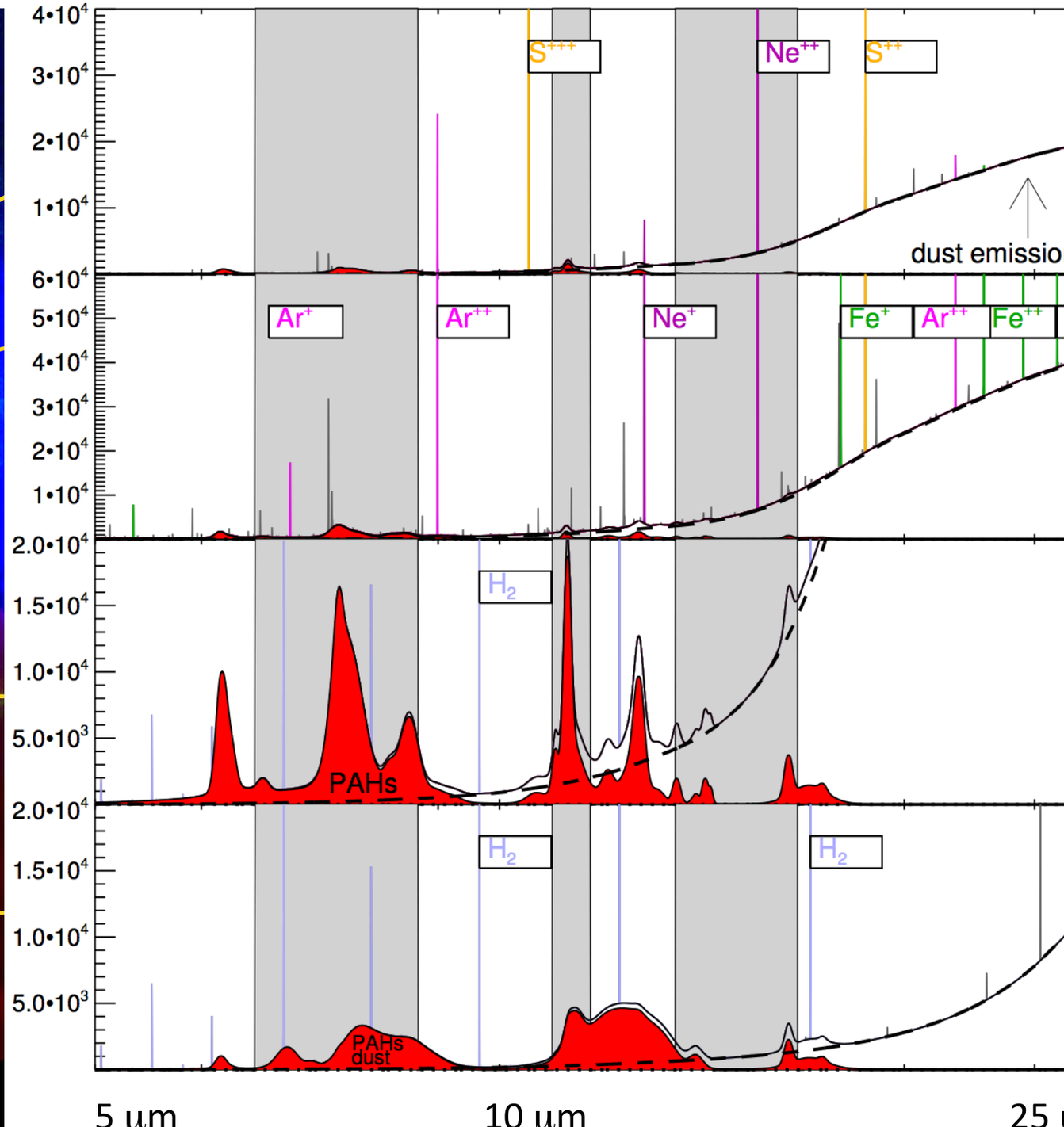
Current multiwavelength view of the Orion Bar



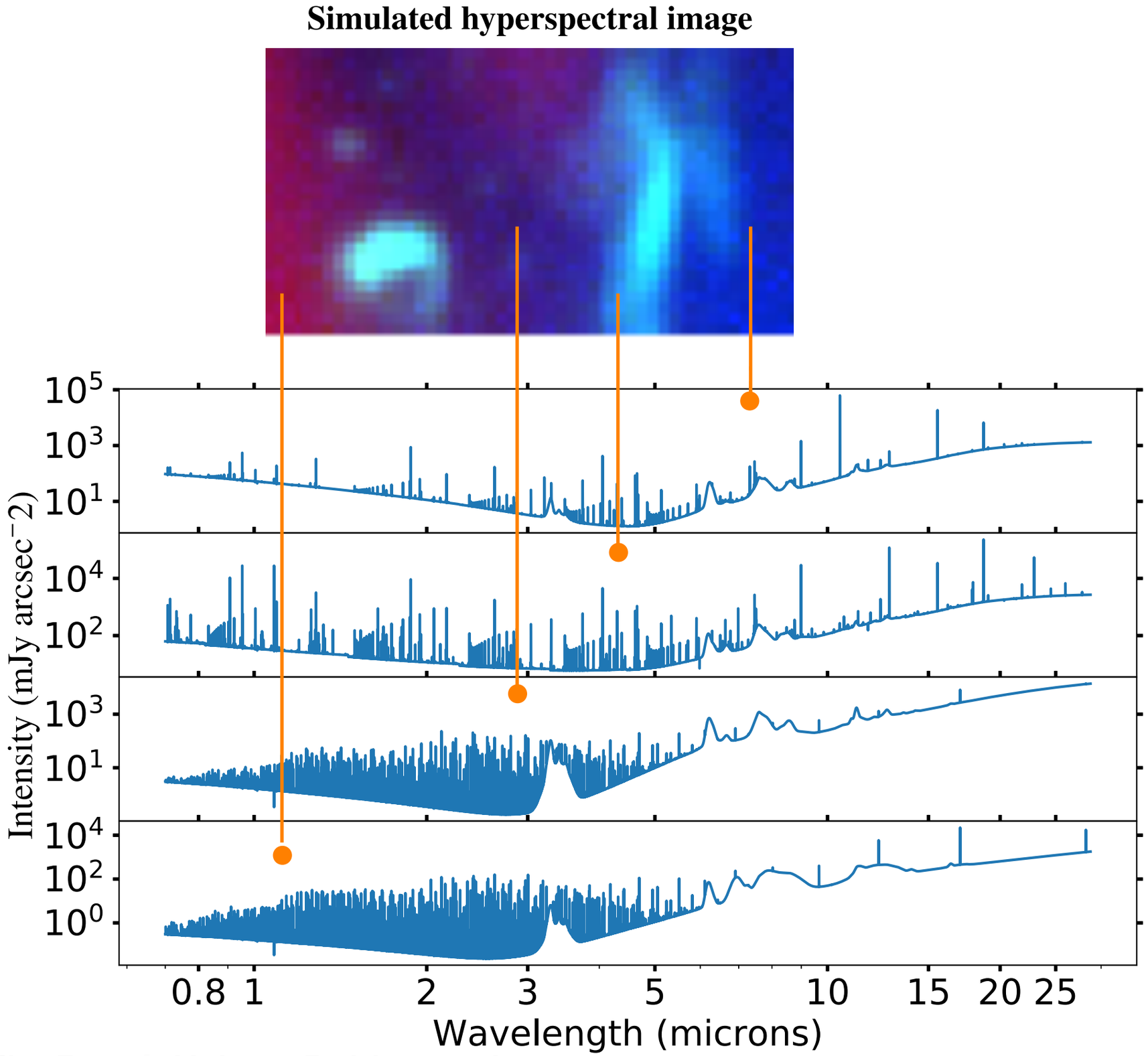
Synthetic spectra

Ionized gas : Cloudy models (Ferland et al. 1998)
Molecular lines : Meudon PDR code (Le Petit et al. 2006)
PAH : spectra from ML (Foschino et al. 2019)
Dust : DUSTEM Model (Compiègne et al. 2011)





Towards realistic synthetic observations

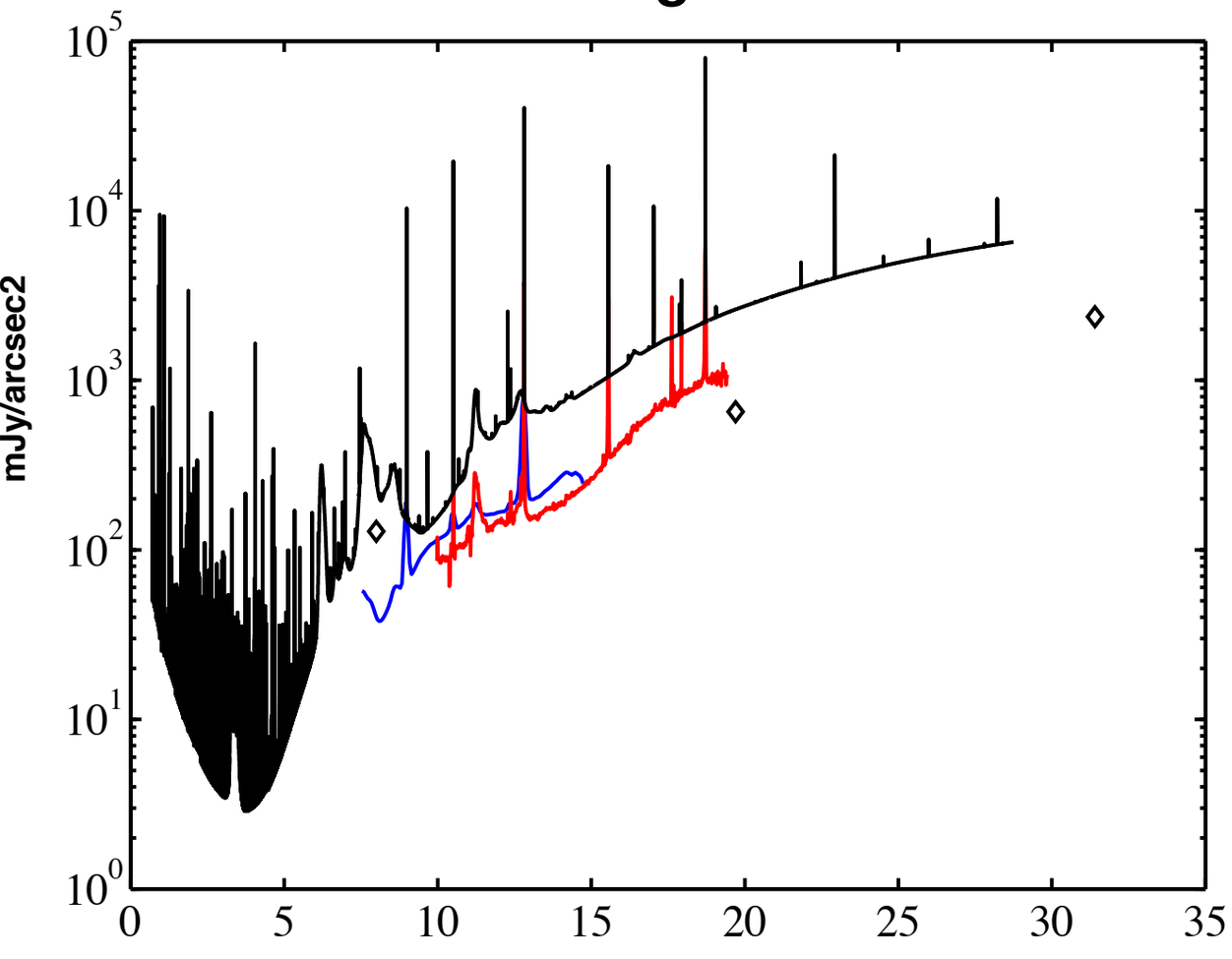


Guilloteau, Oberlin, Berné, Habart, Dobigeon, in prep.

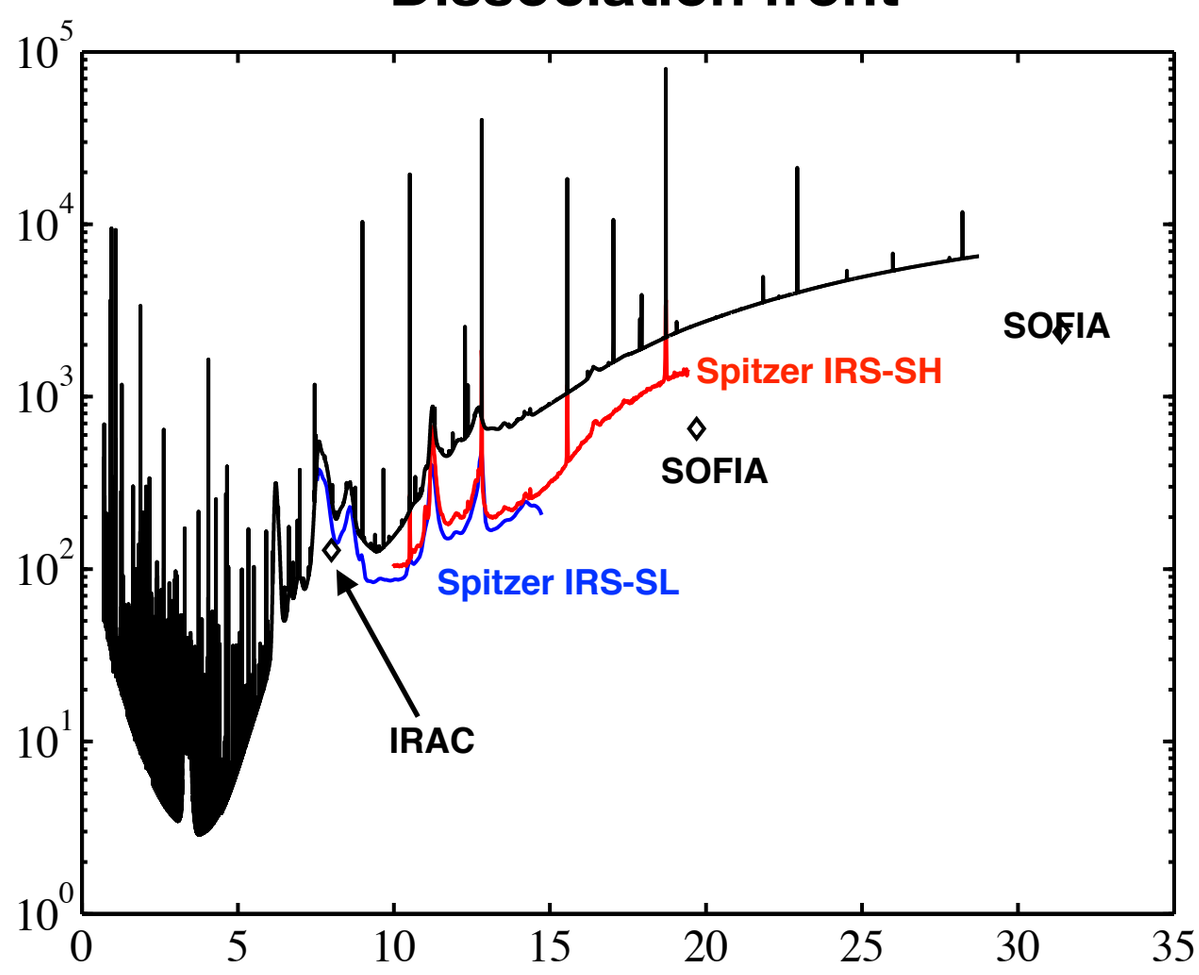
ETC computations

Take reference spectrum and multiply by 3 :
- **to take beam dilution into consideration**
- **to take spectral dilution in consideration**

HII region



Dissociation front



ETC => No saturation, with possible exception of NeII line beyond the IF

- IFU settings : 5 groups, 1 integrations, 1 exposure (with 4 dithers => insert “4 exposures in ETC)). Fast readout.
- **Spectrum** shown above is used as input.
- **Source** is extended and fills the whole field of view.

Results of ETC are shown below (partially obsolete) :

ID		Mode	λ	Scn	(s)	SNR	
10	☐	miri mrs	20.00	1	55.50	458.96	⚠

- Partial saturation: There are 1040 saturated pixels at the end of a ramp. Partial ramps may still be used in some cases.

Scene ★ | Backgrounds | Instrument Setup | Detector Setup | Strategy

Subarray: FULL

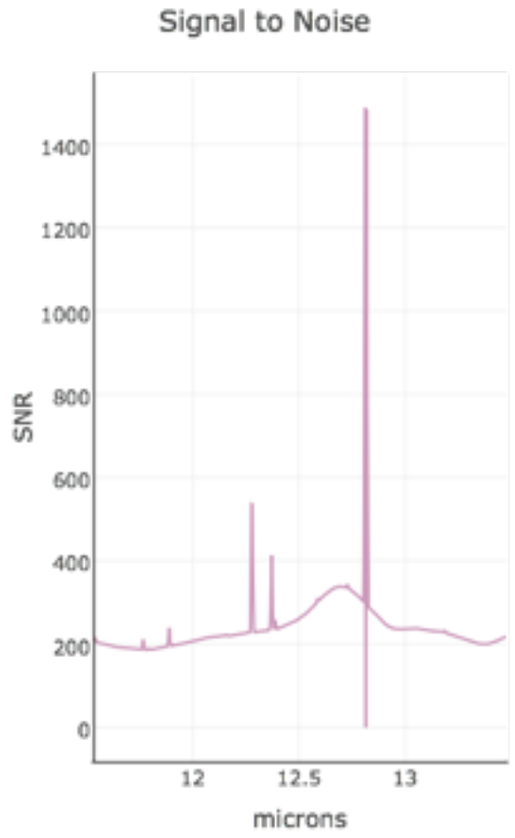
Readout pattern: FAST

Groups per integration: 5

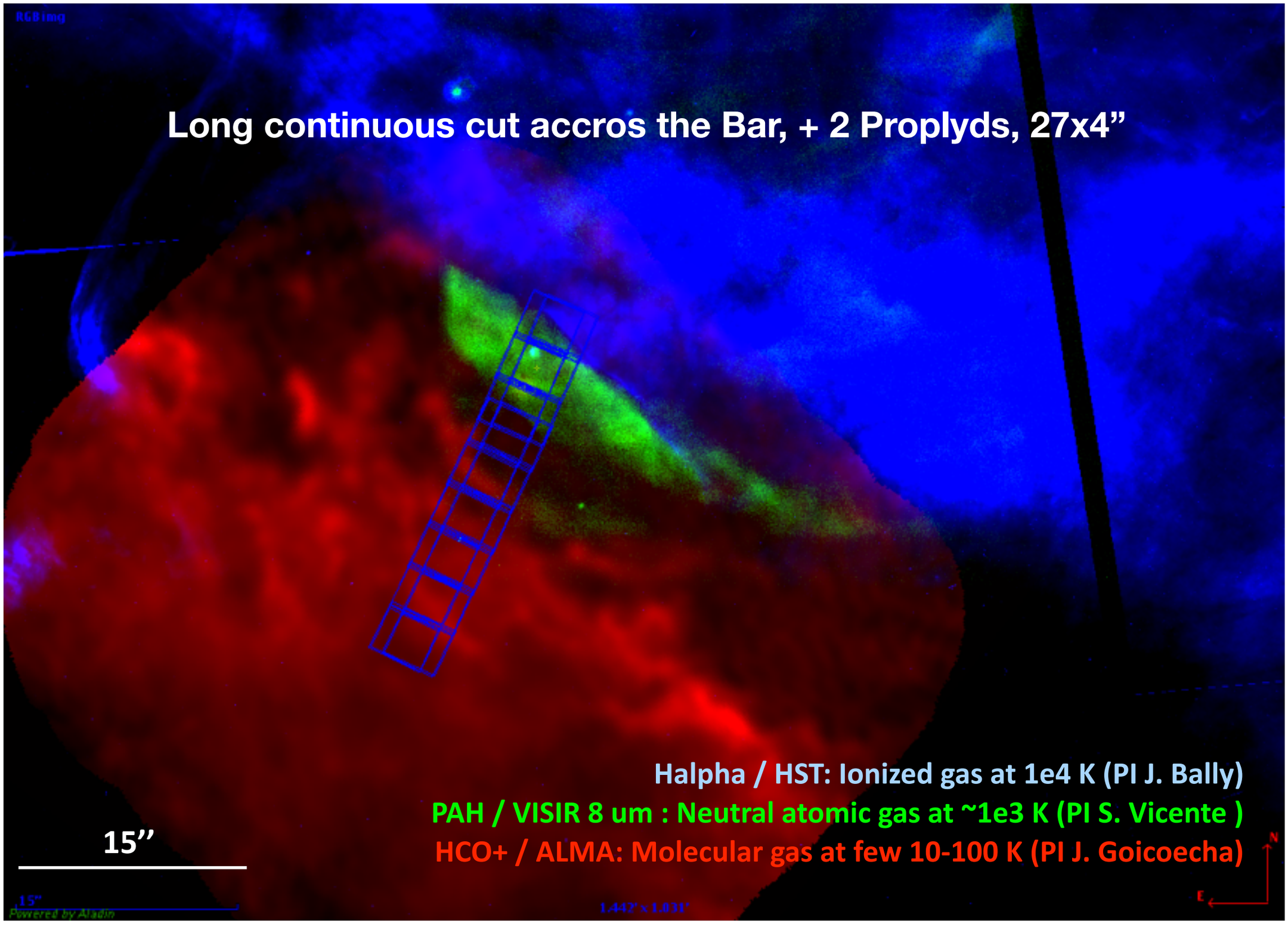
Integrations per exposure: 1

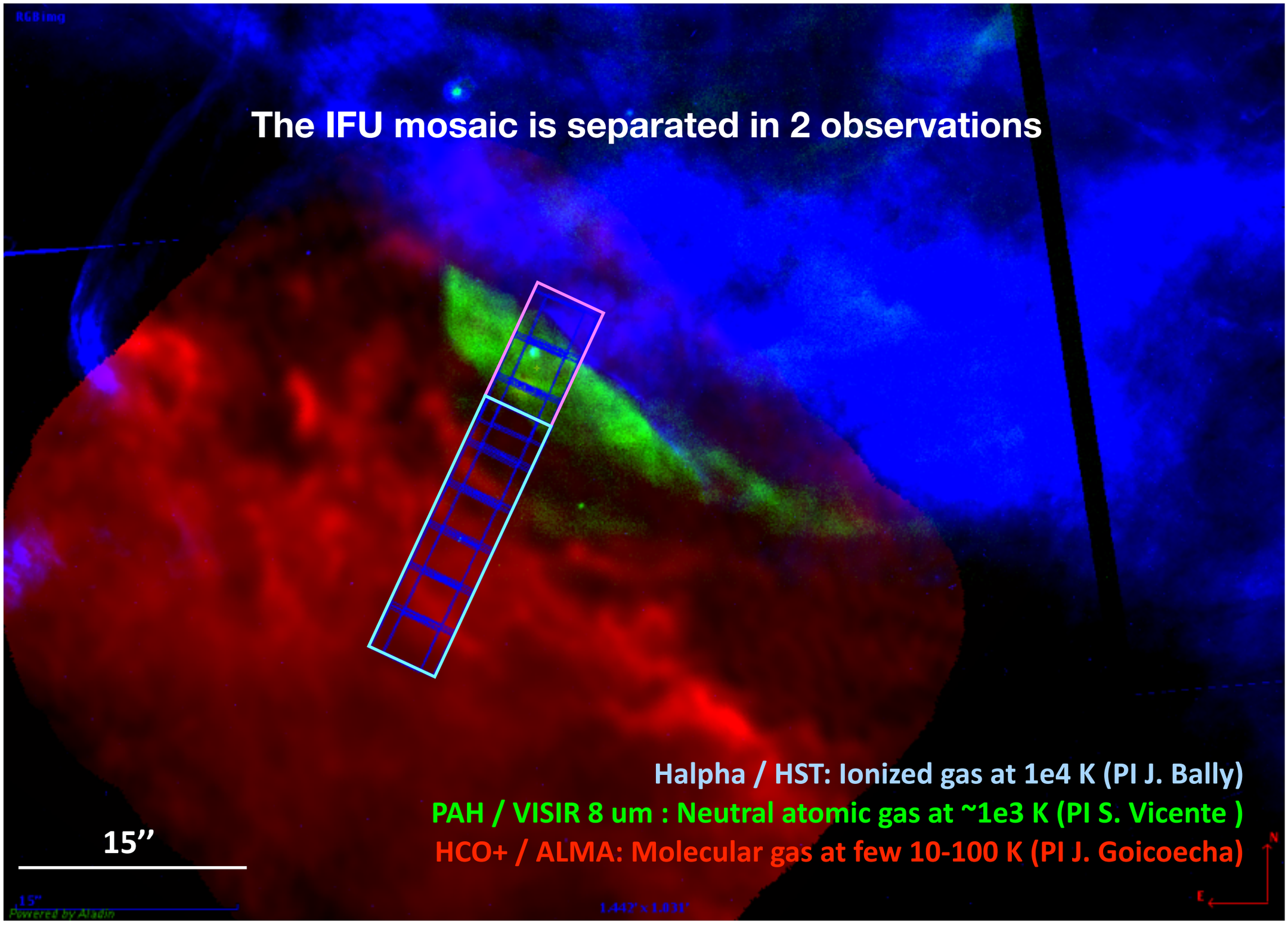
Exposures per specification: 4

Total exposure time: 00:00:56 (55.50 s)



APT Settings for the observations


RGBimg
Long continuous cut accros the Bar, + 2 Proplyds, 27x4”
Halpha / HST: Ionized gas at 1e4 K (PI J. Bally)
PAH / VISIR 8 um : Neutral atomic gas at ~1e3 K (PI S. Vicente)
HCO+ / ALMA: Molecular gas at few 10-100 K (PI J. Goicoecha)
15”
15"
Powered by Aladin
1.442' x 1.031'
N
E


RGBimg
The IFU mosaic is separated in 2 observations
Halpha / HST: Ionized gas at 1e4 K (PI J. Bally)
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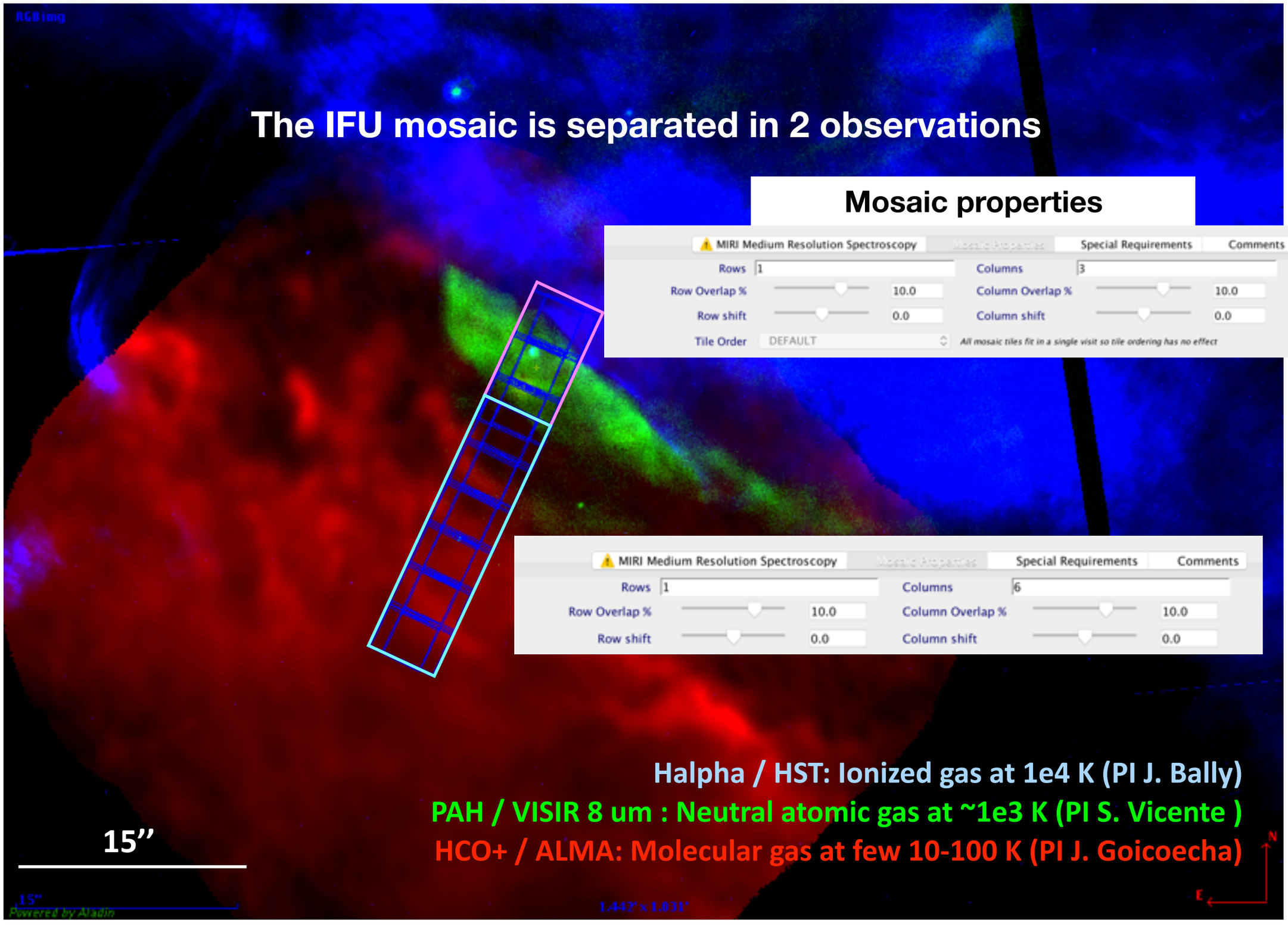
RGBimg
The IFU mosaic is separated in 2 observations
Mosaic properties
MIRI Medium Resolution Spectroscopy
Special Requirements
Comments
Rows 1
Columns 3
Row Overlap % 10.0
Column Overlap % 10.0
Row shift 0.0
Column shift 0.0
Tile Order DEFAULT
All mosaic tiles fit in a single visit so tile ordering has no effect
MIRI Medium Resolution Spectroscopy
Special Requirements
Comments
Rows 1
Columns 6
Row Overlap % 10.0
Column Overlap % 10.0
Row shift 0.0
Column shift 0.0
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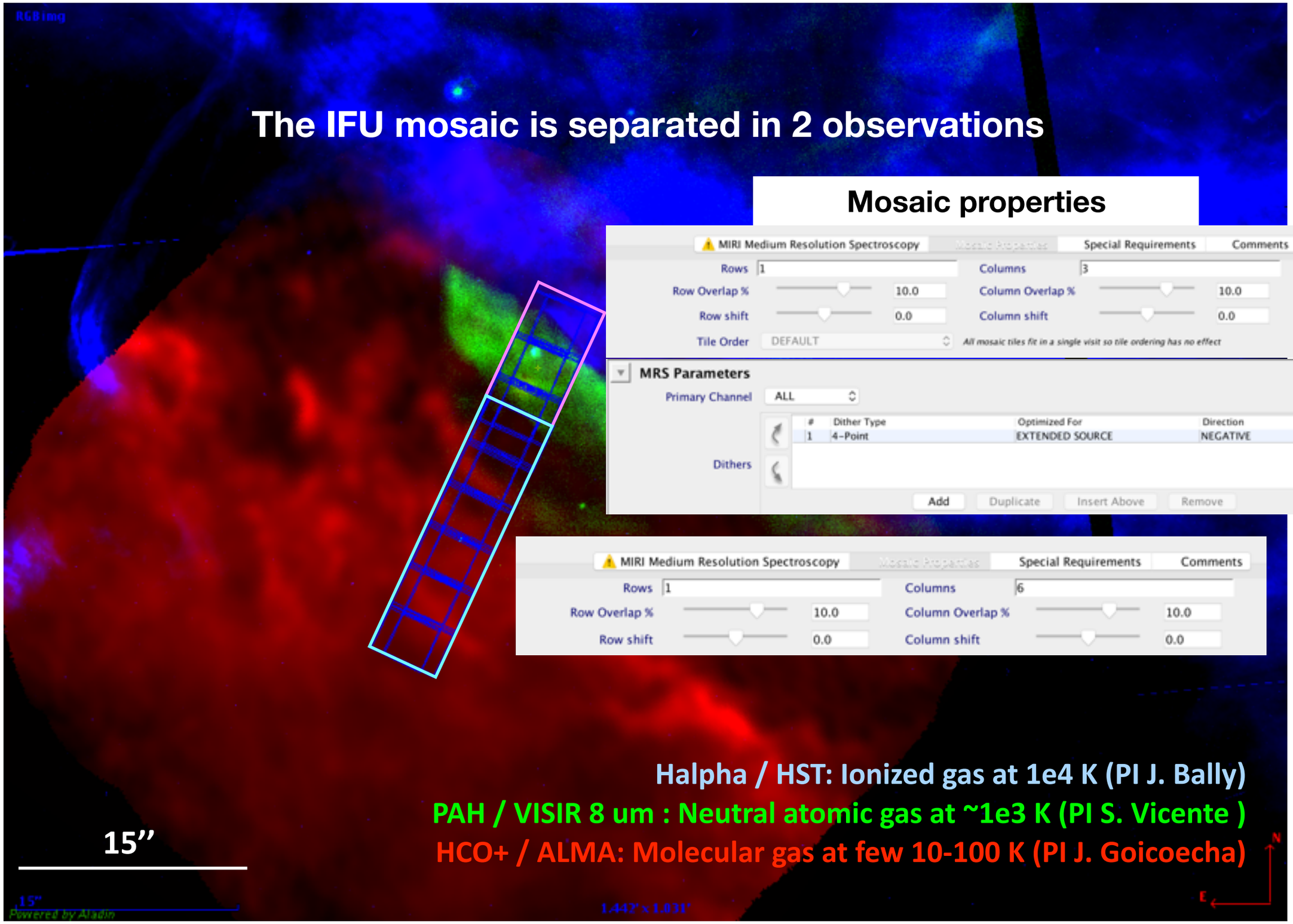
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Tile Order DEFAULT
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MRS Parameters
Primary Channel ALL
Dither Type Optimized For Direction
1 4-Point EXTENDED SOURCE NEGATIVE
Dithers
Add Duplicate Insert Above Remove
MIRI Medium Resolution Spectroscopy
Special Requirements
Comments
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Columns 6
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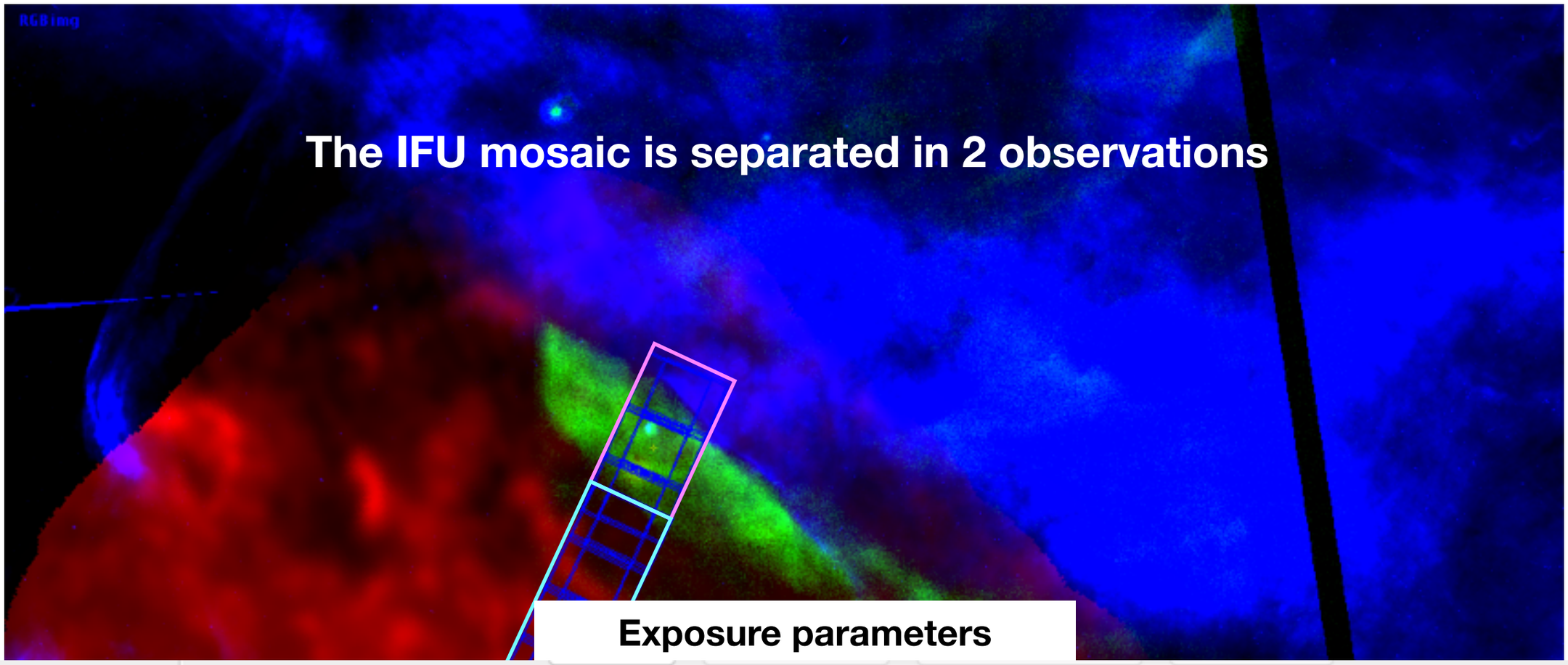
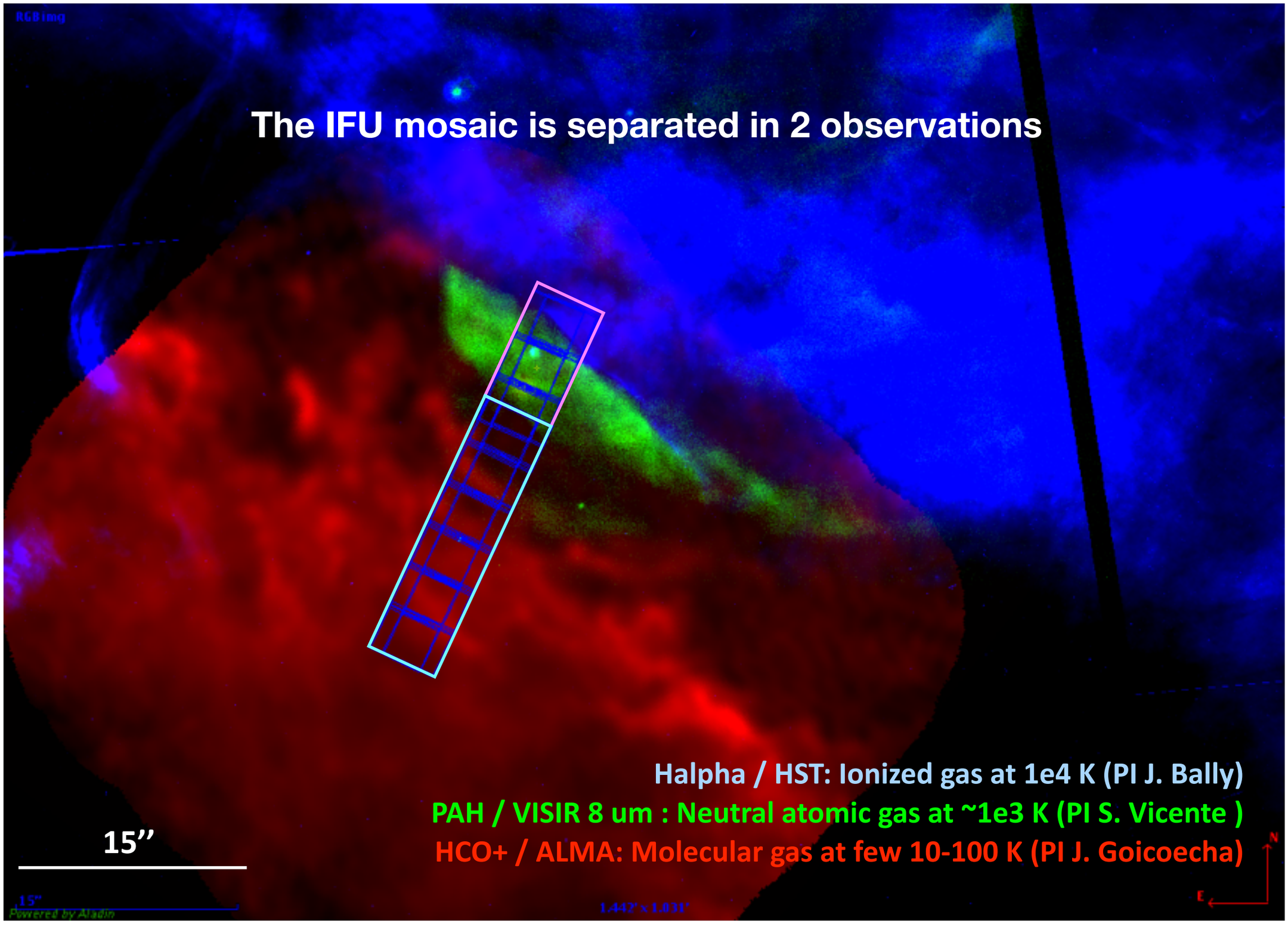


Exposure parameters

Simultaneous Imaging: YES Imager Subarray: SUB128

Exposure Parameters

#	Detector	Wavele...	Filter	Readо...	Group...	Integr...	Expos...	Dither	Total D...	Total I...	Total E...	ETC W...	ETC
1	IMAGER		F770W	FAST	5	1	1	Dither 1	4	4	2.381		
1	MRSL...	SHOR...		FAST	5	1	1	Dither 1	4	4	55.501		
1	MRSS...	SHOR...		FAST	5	1	1	Dither 1	4	4	55.501		
2	IMAGER		F1130W	FAST	5	1	1	Dither 1	4	4	2.381		
2	MRSL...	MEDIU...		FAST	5	1	1	Dither 1	4	4	55.501		
2	MRSS...	MEDIU...		FAST	5	1	1	Dither 1	4	4	55.501		
3	IMAGER		F1500W	FAST	5	1	1	Dither 1	4	4	2.381		
3	MRSL...	LONG(C)		FAST	5	1	1	Dither 1	4	4	55.501		
3	MRSS...	LONG(C)		FAST	5	1	1	Dither 1	4	4	55.501		


RGBimg
The IFU mosaic is separated in 2 observations
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15”
15"
Powered by Aladin
1.442' x 1.031'
N
E

⚠ MIRI Medium Resolution Spectroscopy | Mosaic Properties | Special Requirements | Comments

Special Requirements

Sequence Observations 2, 6, 12, Non-interruptible
Aperture PA Range 50 to 60 Degrees (V3 50.0 to 60.0)

Add... Remove Edit

Simultaneous Imaging: YES Imager Subarray: SUB128

⚠ Exposure Parameters

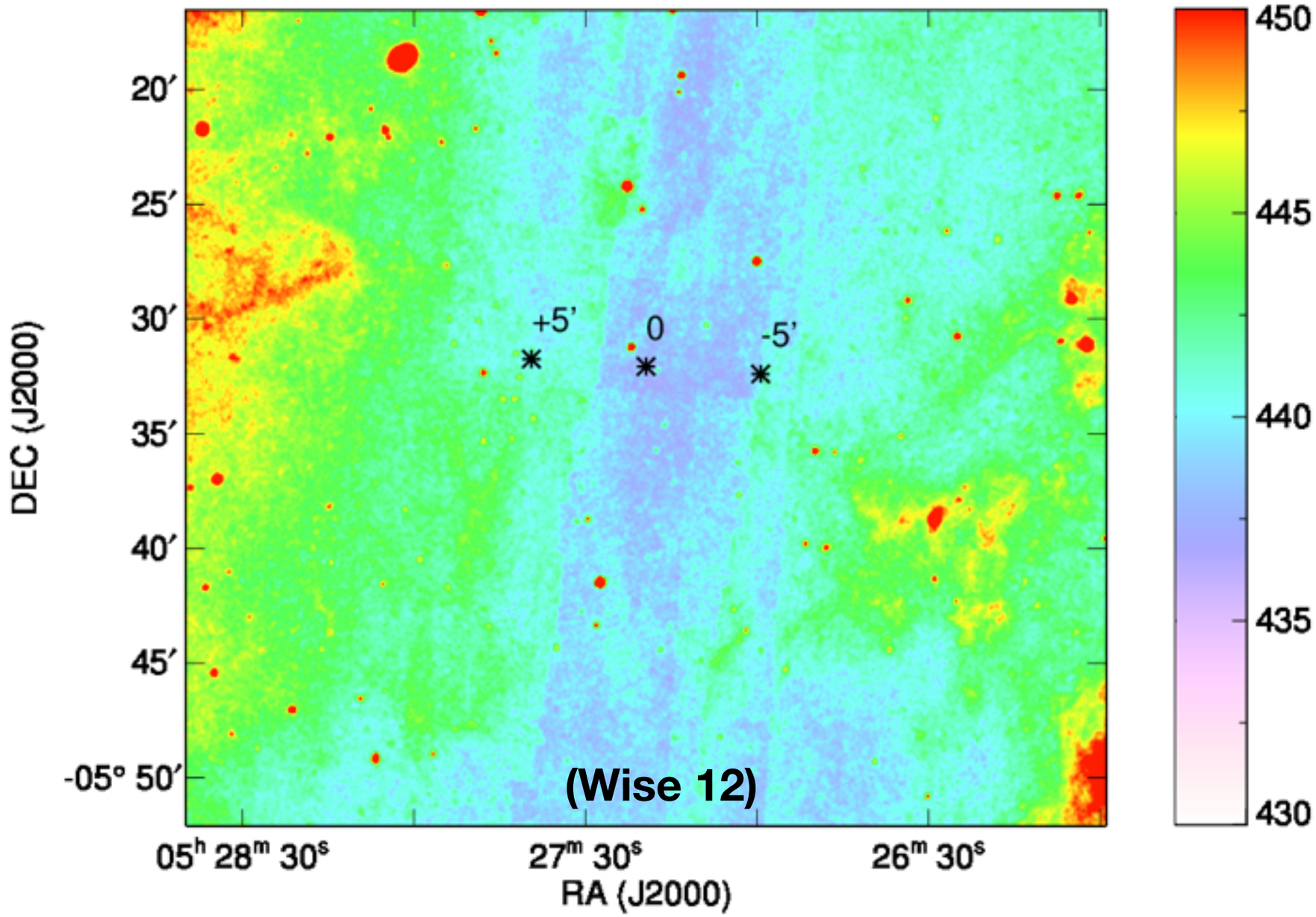
	#	Detector	Wavele...	Filter	Readо...	Group...	Integr...	Expos...	Dither	Total D...	Total I...	Total E...	ETC W...	ETC
	1	IMAGER		F770W	FAST	5	1	1	Dither 1	4	4	2.381		
	1	MRSL...	SHOR...		FAST	5	1	1	Dither 1	4	4	55.501		
	1	MRSS...	SHOR...		FAST	5	1	1	Dither 1	4	4	55.501		
	2	IMAGER		F1130W	FAST	5	1	1	Dither 1	4	4	2.381		
	2	MRSL...	MEDIU...		FAST	5	1	1	Dither 1	4	4	55.501		
	2	MRSS...	MEDIU...		FAST	5	1	1	Dither 1	4	4	55.501		
⚠	3	IMAGER		F1500W	FAST	5	1	1	Dither 1	4	4	2.381		
	3	MRSL...	LONG(C)		FAST	5	1	1	Dither 1	4	4	55.501		
	3	MRSS...	LONG(C)		FAST	5	1	1	Dither 1	4	4	55.501		

APT settings

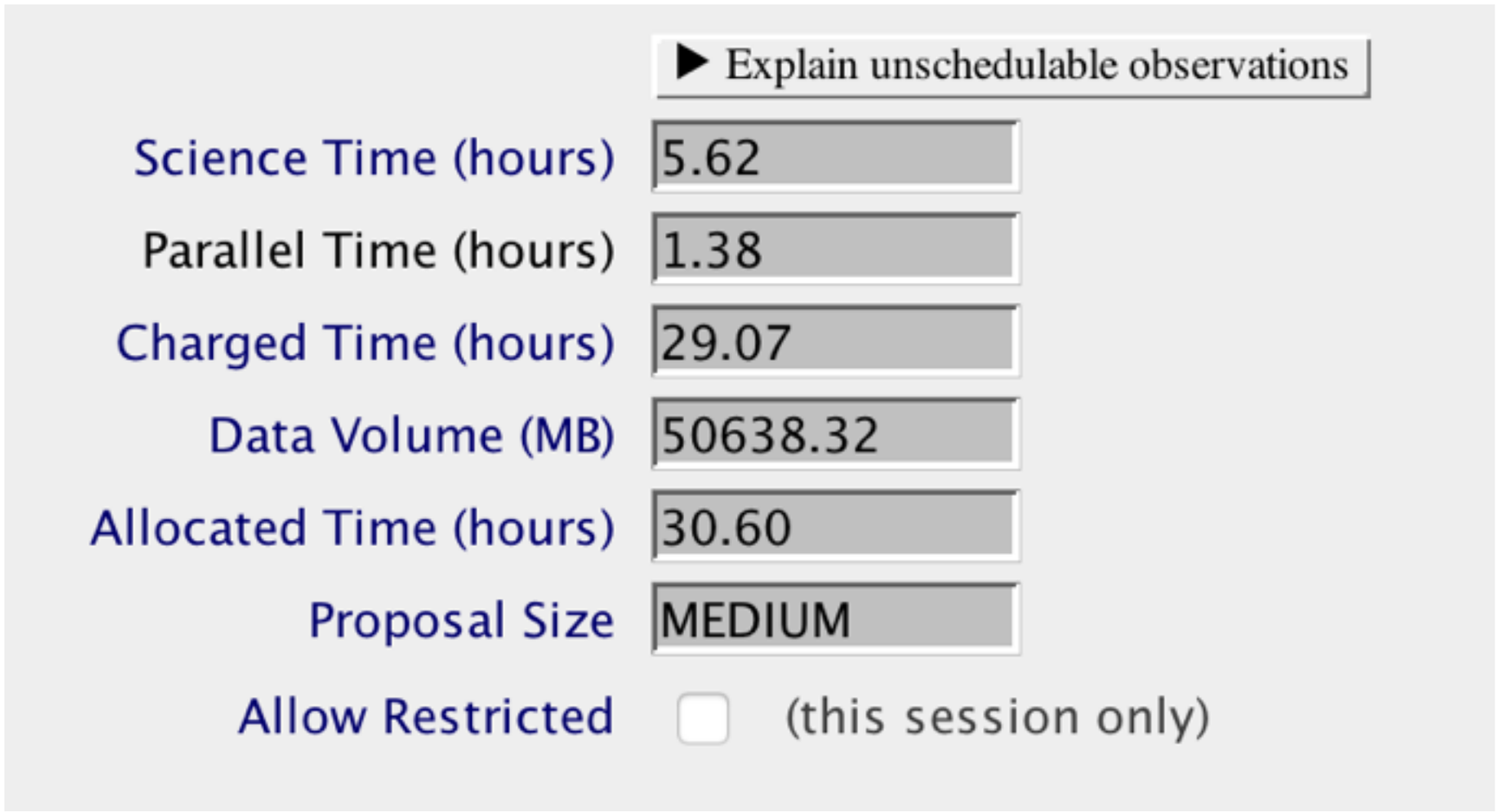
IFU settings

Off positions

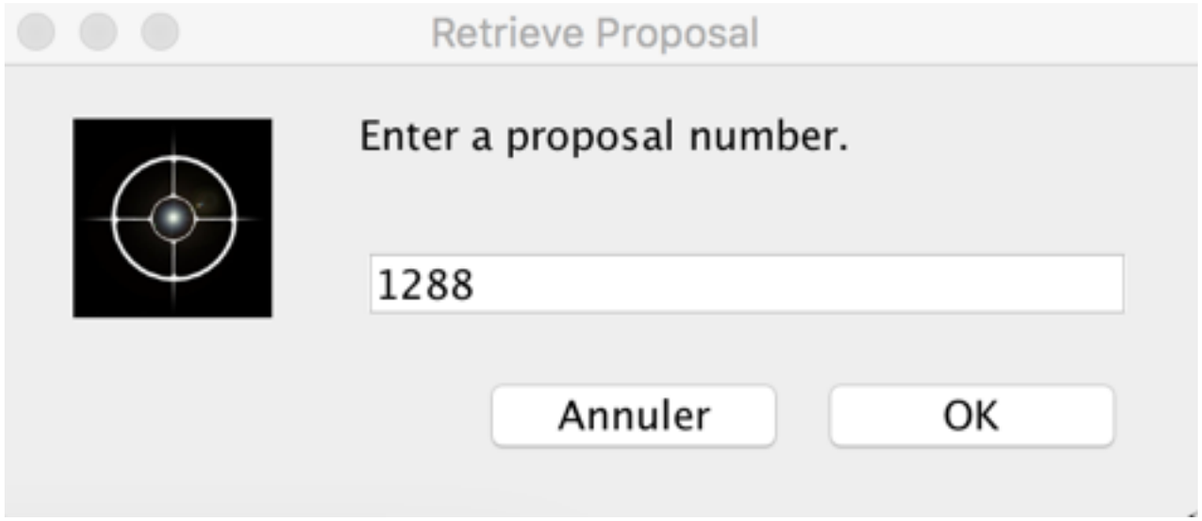
Off positions ~ 2 deg away, single IFU pointing with same parameters. Dominated by CIB and Zodiacal light



Total time


▶ Explain unschedulable observations
Science Time (hours)
5.62
Parallel Time (hours)
1.38
Charged Time (hours)
29.07
Data Volume (MB)
50638.32
Allocated Time (hours)
30.60
Proposal Size
MEDIUM
Allow Restricted
(this session only)

Retrieve APT file from



Community oriented program

- Telecons open to the community will be organized on a regular basis
- Community workshop (2021)
- **People interested are welcome to register on our website to keep posted and participate**

www.jwst-ism.org

End


Current
19.274:00:00:00
04-Nov-19
00:00:00
27-Jan-20
00:00:00
20-Apr-20
00:00:00
NIRCam Orion Bar Imaging (Obs 1)
MIRI IFU Orion Bar H2 (Obs 2)
NIRSpec IFU Orion Bar H2 (Obs 3)
MIRI Orion Bar Imaging (Obs 4)
NIRSpec IFU Orion Bar HII (Obs 5)
MIRI IFU Orion Bar HII (Obs 6)
MIRI Orion Bar OFF (Obs 12)
NIRSpec Orion Bar OFF (Obs 13)