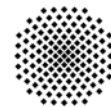
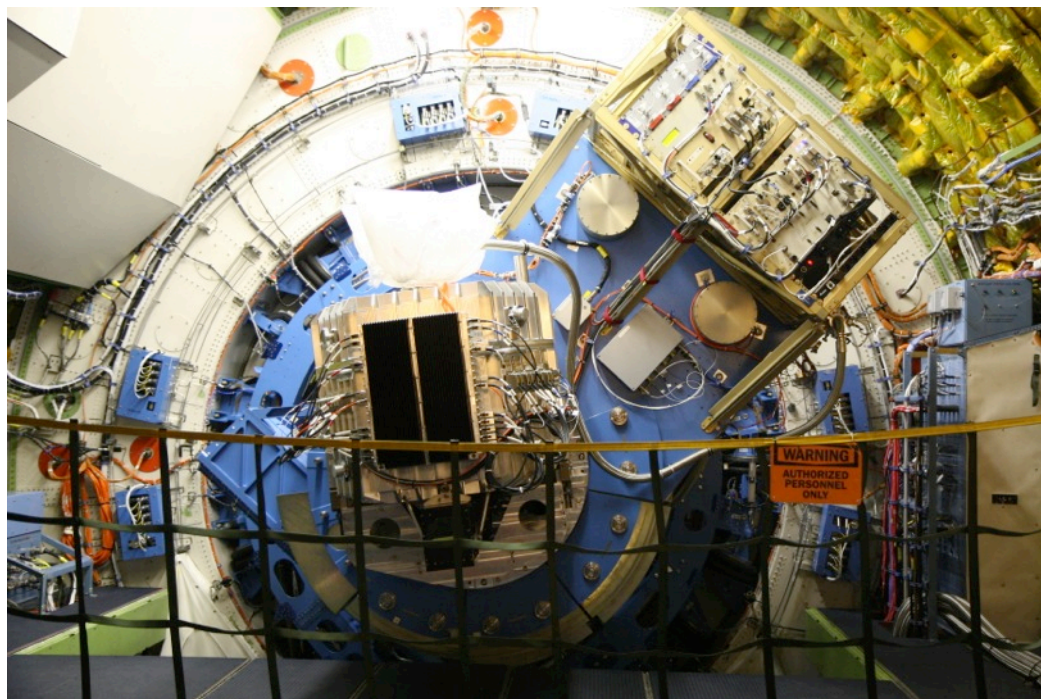




# FIFI-LS First Results



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aufgrund eines Beschlusses  
des Deutschen Bundestages

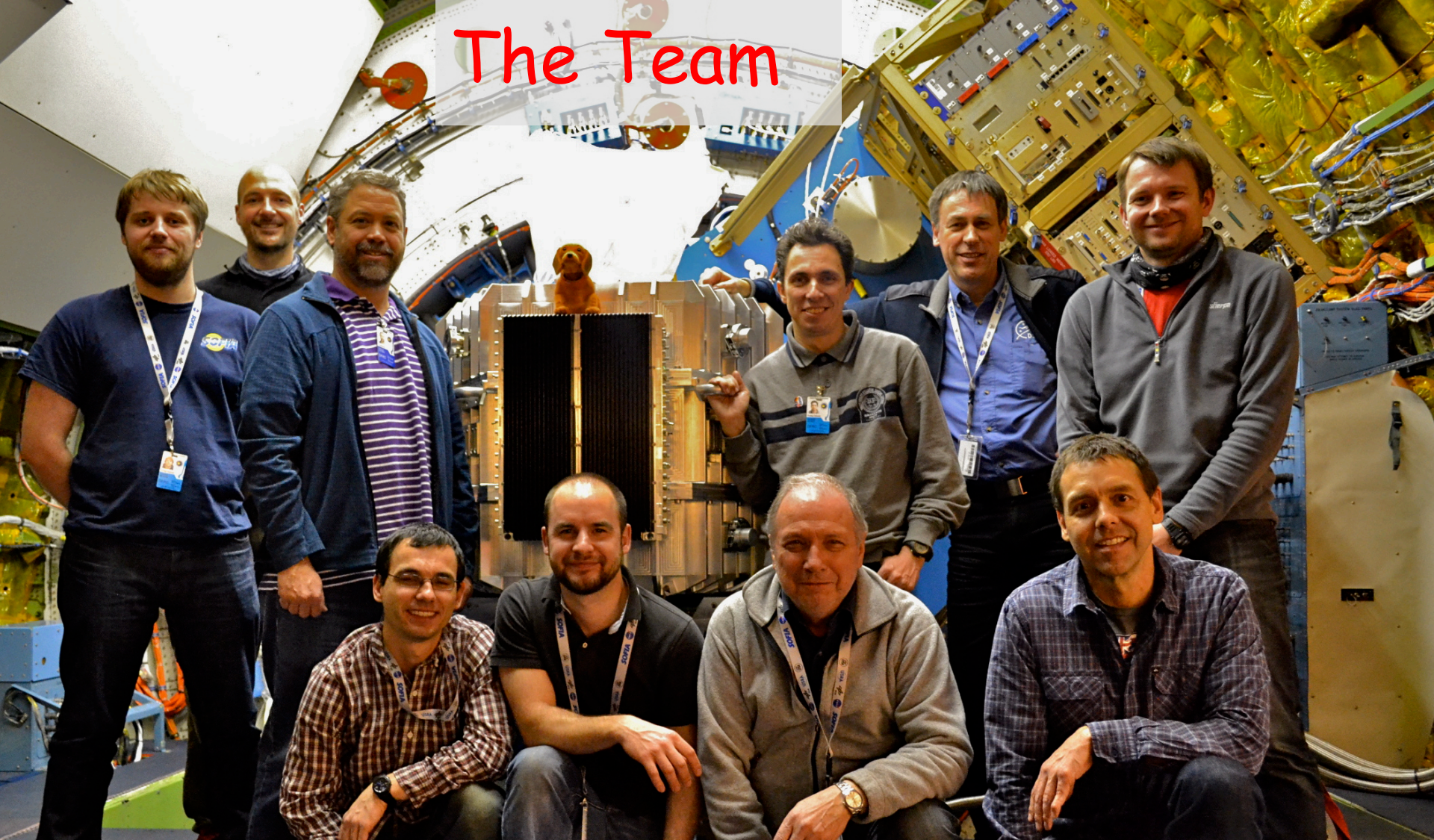


First Flights  
March - April 2014



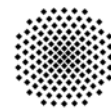
Randolf Klein  
FIFI-LS Instrument Scientist  
USRA - NASA Ames

# The Team



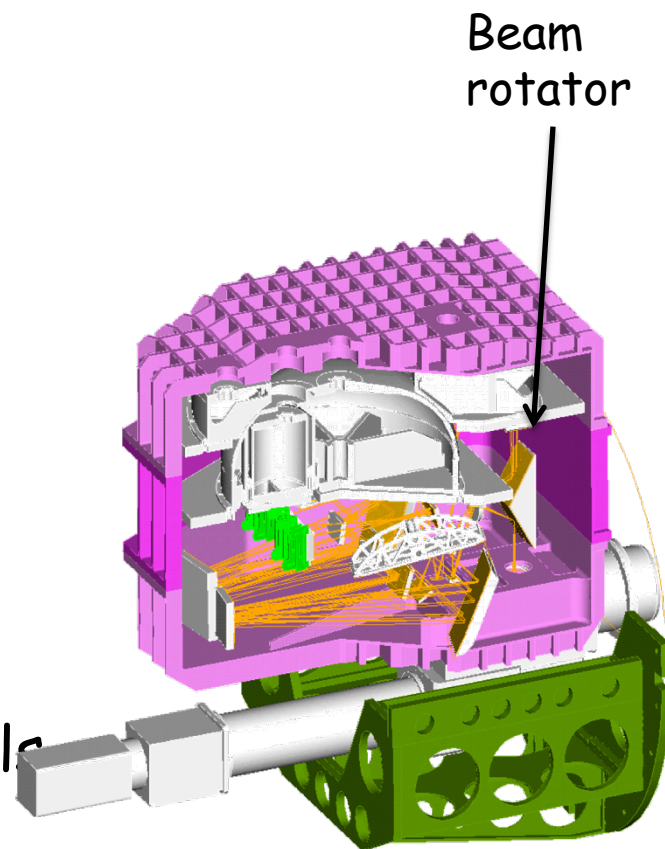
S. Beckmann A. Bryant S. Colditz  
C. Fischer F. Fumi N. Geis R. Hönle  
R. Klein A. Krabbe L. Looney A. Poglitsch  
W. Raab S. Ragan F. Rebell M. Savage

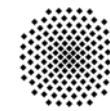
Special Guests:  
Bill Wohler (NASA)  
Erick Starman (USRA)  
Christof Iserlohe (Köln)



# FIFI LS: the Field-Imaging Far-Infrared Line Spectrometer

- Far-infrared spectrometer employing two parallel channels:
  - Blue 50-110  $\mu\text{m}$   
5x5 pixel field of view: 6" per spatial pixel
  - Red 110-200  $\mu\text{m}$   
5x5 pixel field of view: 12" per spatial pixel
- Imaging spectrometer concept
  - Each channel: 5x5 spatial pixels
  - 16 spectral pixels per spatial pixels
- Spectral resolution:  $R=1000-3000$

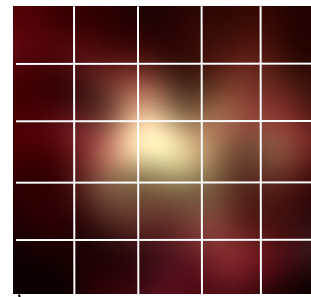




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# Integral Field Concept

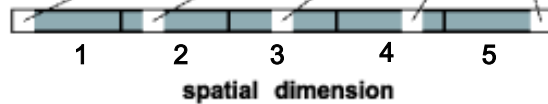
2D field of view  
becomes 1D slit



Footprint of Red and  
Blue channels are  
concentric

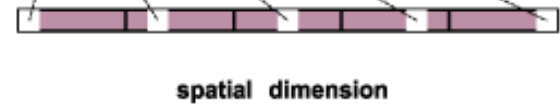
5 x 5 pixels

spectrograph  
slit



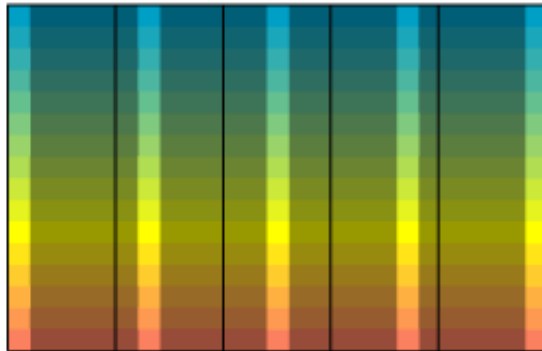
spatial dimension

spectrograph  
slit



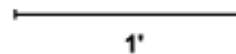
spatial dimension

spectral dimension



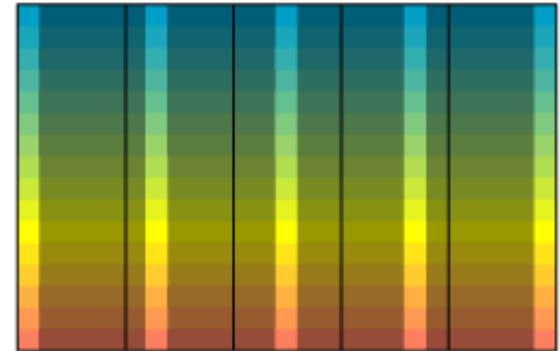
16 x 25 pixel detector array

12" x 12" (110-210 $\mu$ m)  
6" x 6" (42-110 $\mu$ m)



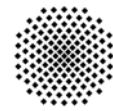
focal plane

spectral dimension



16 x 25 pixel detector array

2D detector contains 3D data cube



## FIFI-LS and PACS

FIFI-LS and the PACS spectrometer (was on Herschel) are sister instruments sharing many design features.

- Same detector, same IFU
- Similar optical layout

Herschel's cold telescope in space allowed more sensitive observations (by a factor of 5-10)

BUT

### FIFI-LS

- Two independent gratings
- 6" and 12" pixels
- Fast mapping of two lines

### PACS-S

- One grating
- 9.7" pixels
- Single line, slower telescope



## Science Case

Mapping of **FIR fine structure lines** in galactic and extra galactic sources.

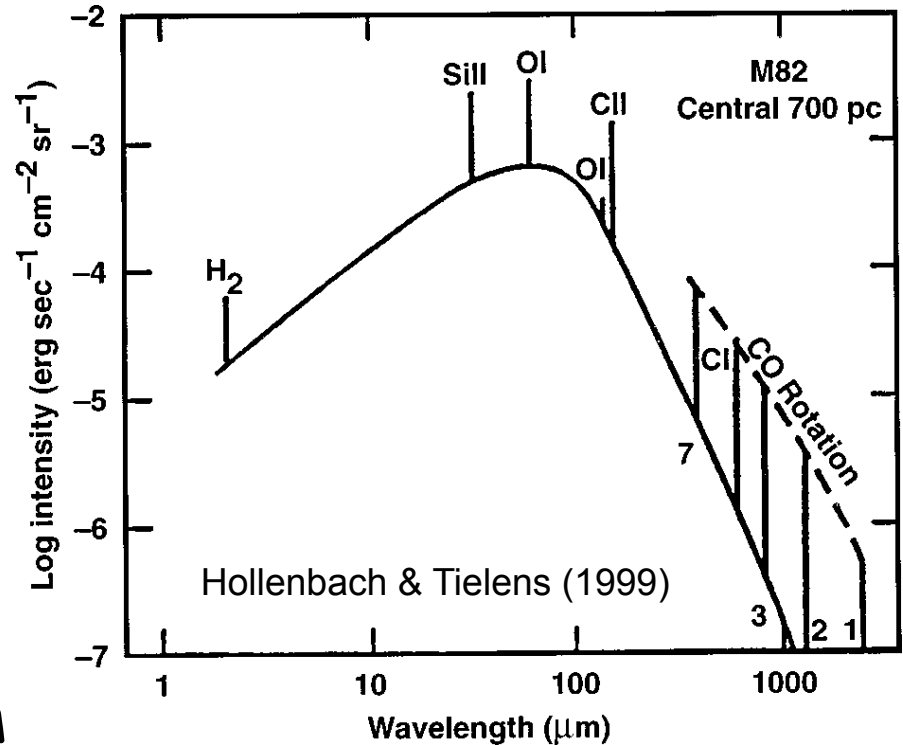
Main cooling lines of the interstellar gas in the FIFI-LS range:

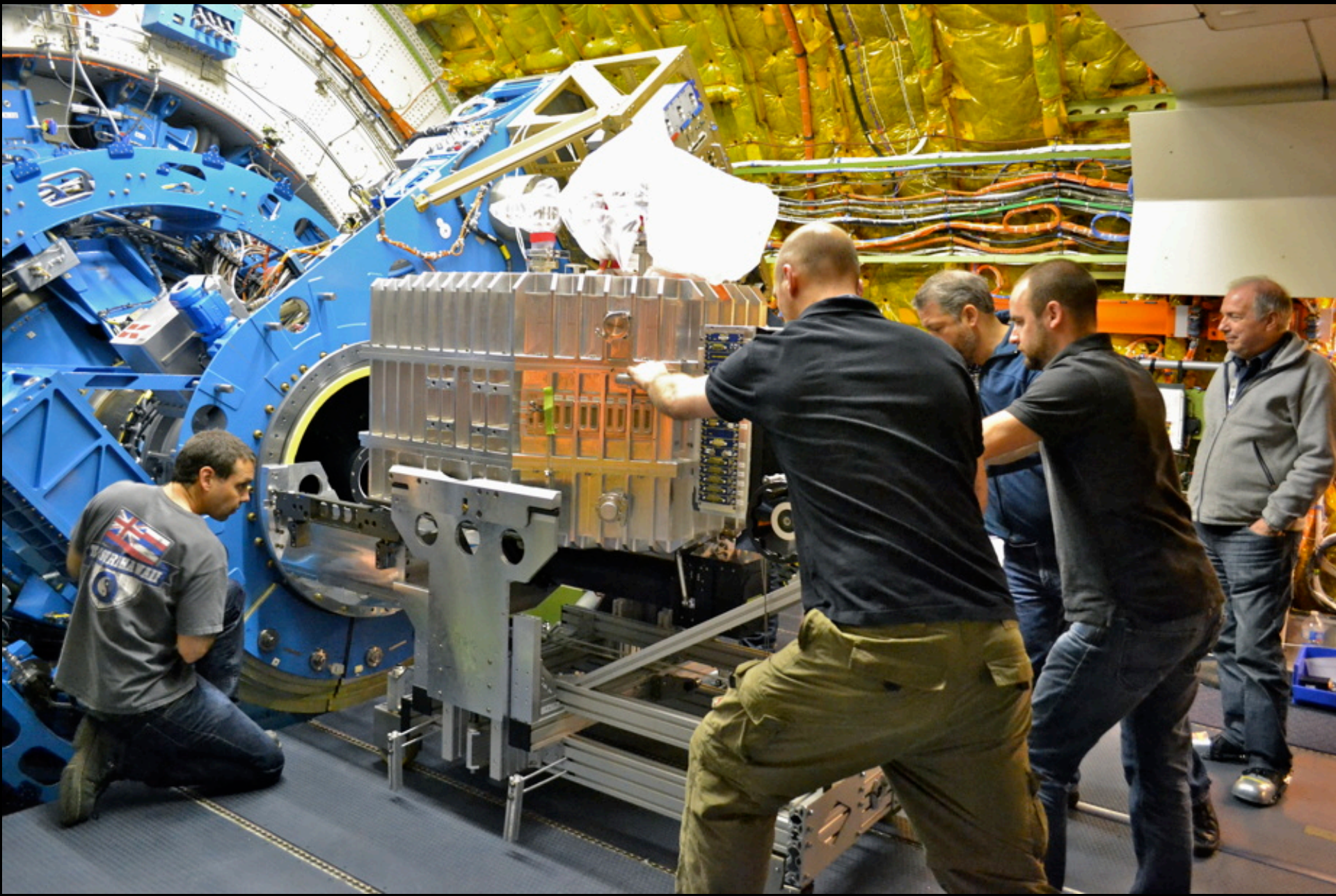
- [CII] 158 $\mu\text{m}$
- [OI] 63.18 $\mu\text{m}$ , 145.4 $\mu\text{m}$

In ionized regions:

- [OIII] 51.81 $\mu\text{m}$ , 88.36 $\mu\text{m}$

But also high-J CO lines, OH-lines etc.





# M42 Orion Nebula

A sampler  
of the first  
FIFI-LS  
data ever  
taken.

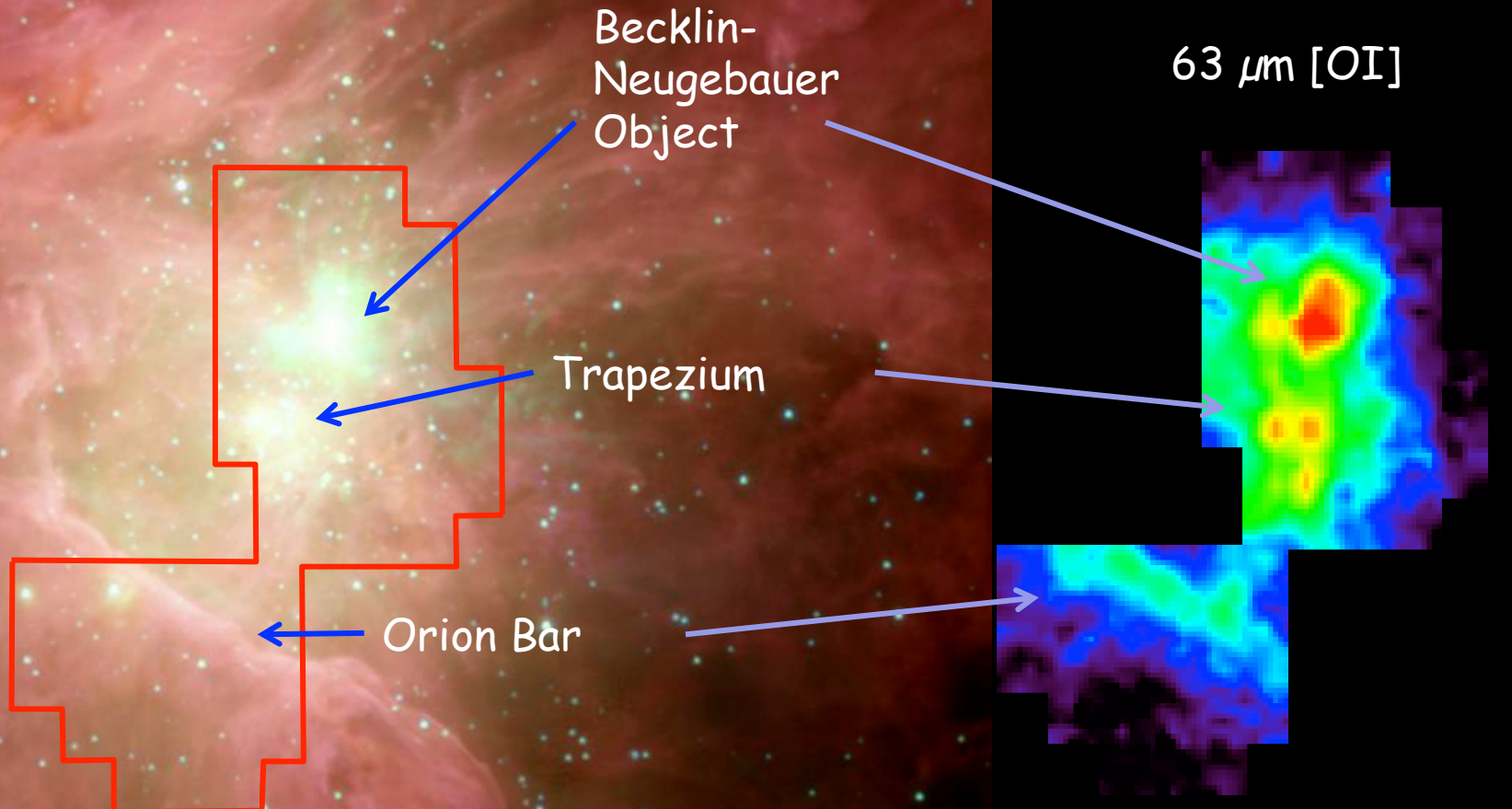
Becklin-  
Neugebauer  
Object

Trapezium

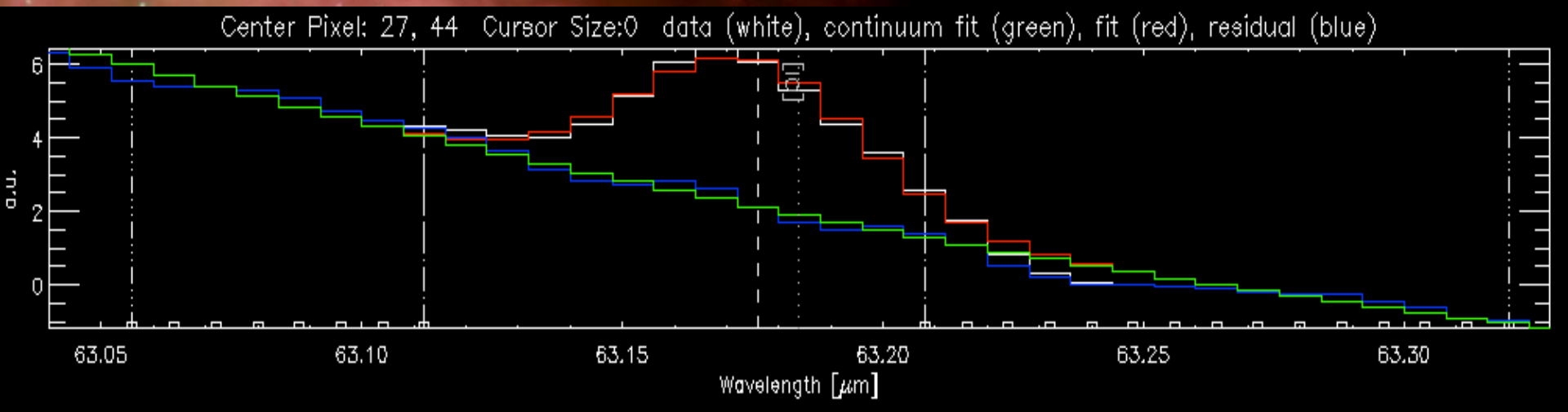
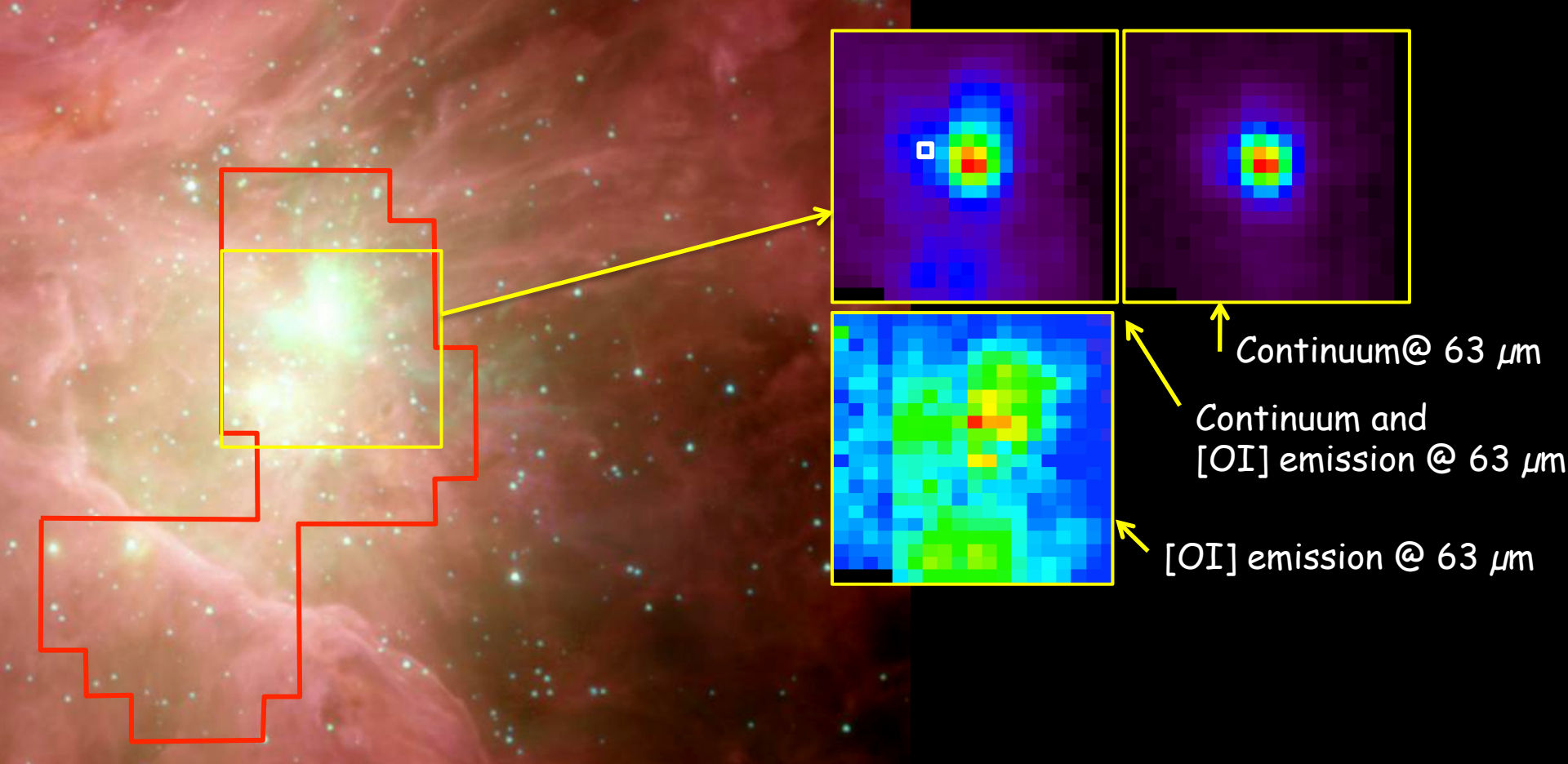
Orion Bar



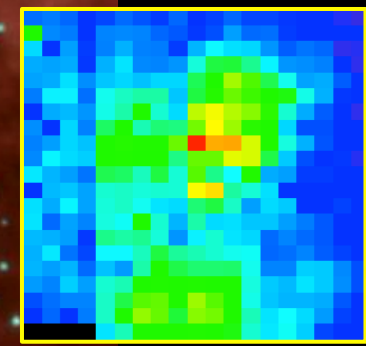
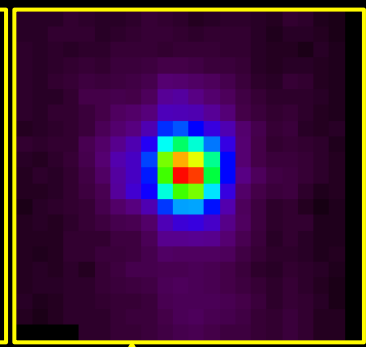
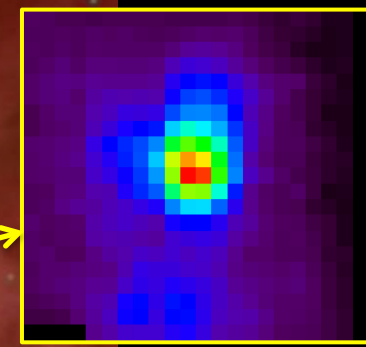
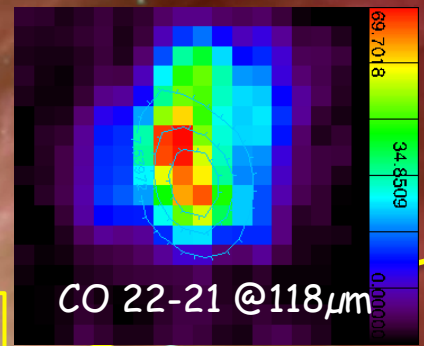
# M42 - Orion Nebula



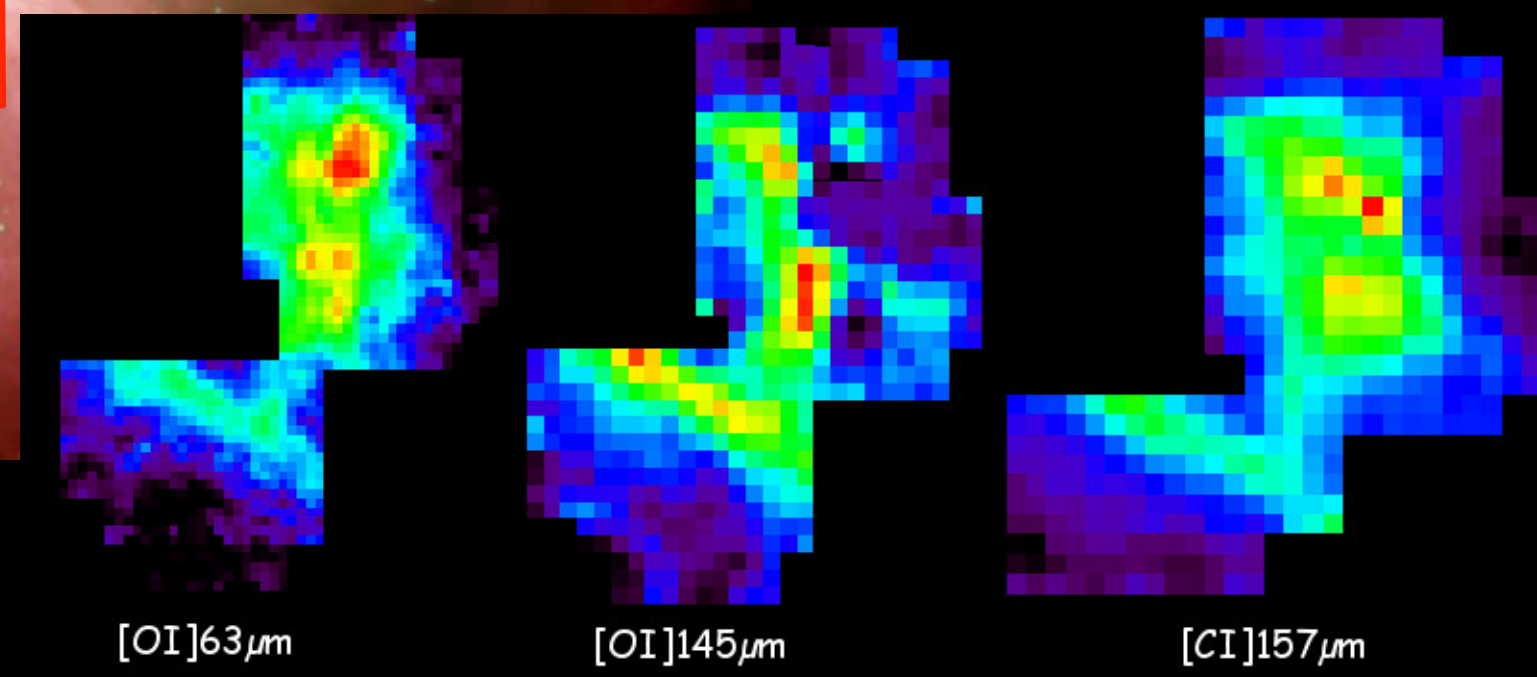
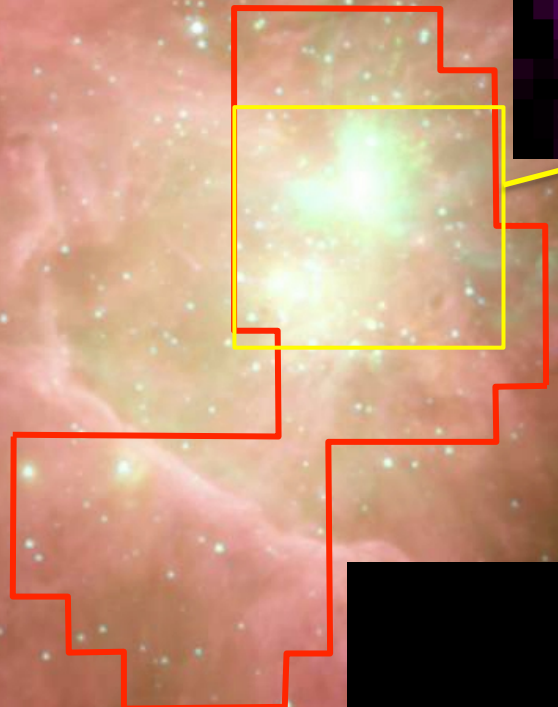
SOFIA & FIFI-LS



Total observing time incl. all overheads: 80min



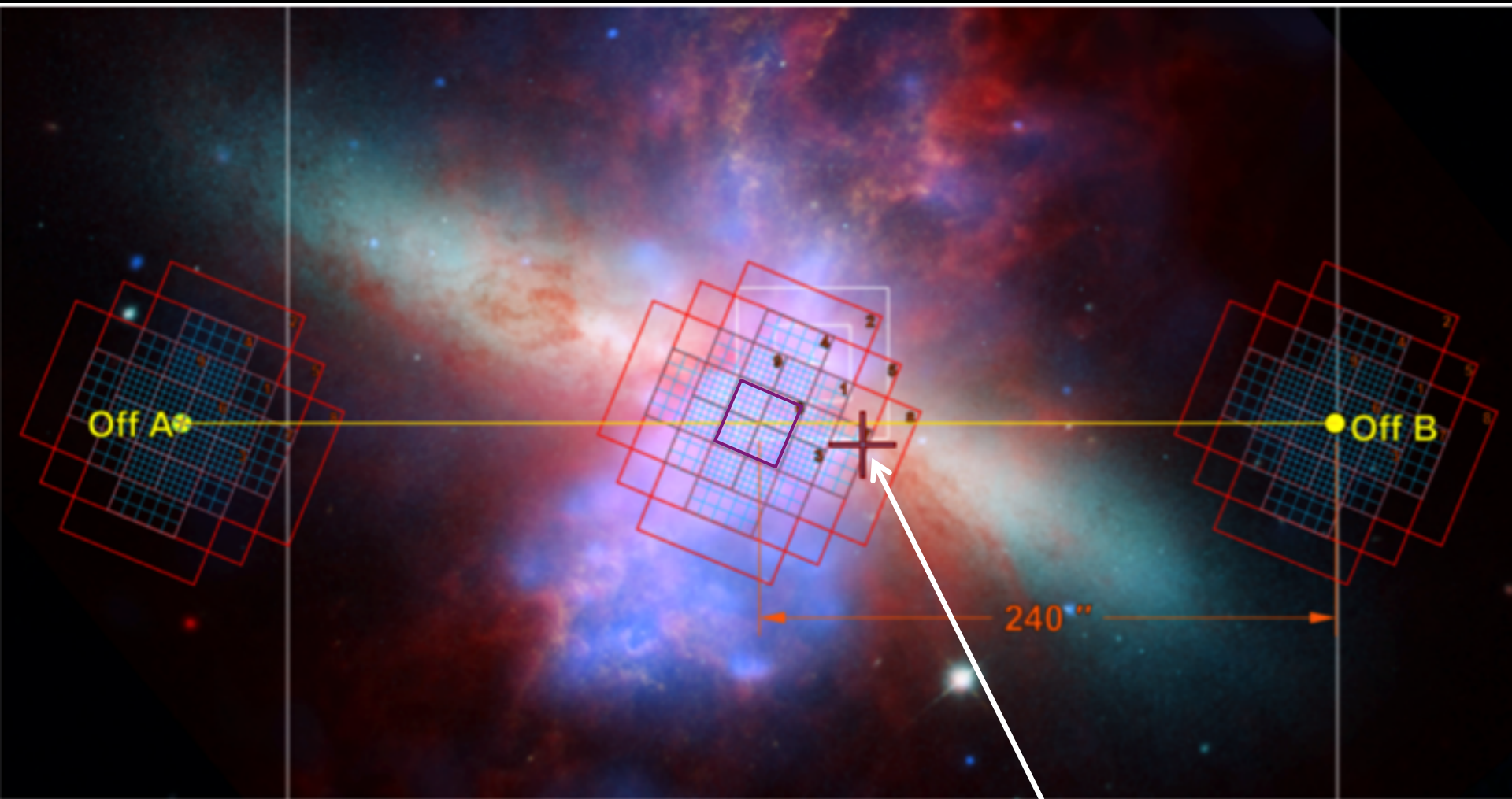
Continuum @ 63  $\mu\text{m}$   
Continuum and [OI] emission @ 63  $\mu\text{m}$   
[OI] emission @ 63  $\mu\text{m}$



SOFIA &  
FIFI-LS

M82 Galaxy

Ionized Oxygen

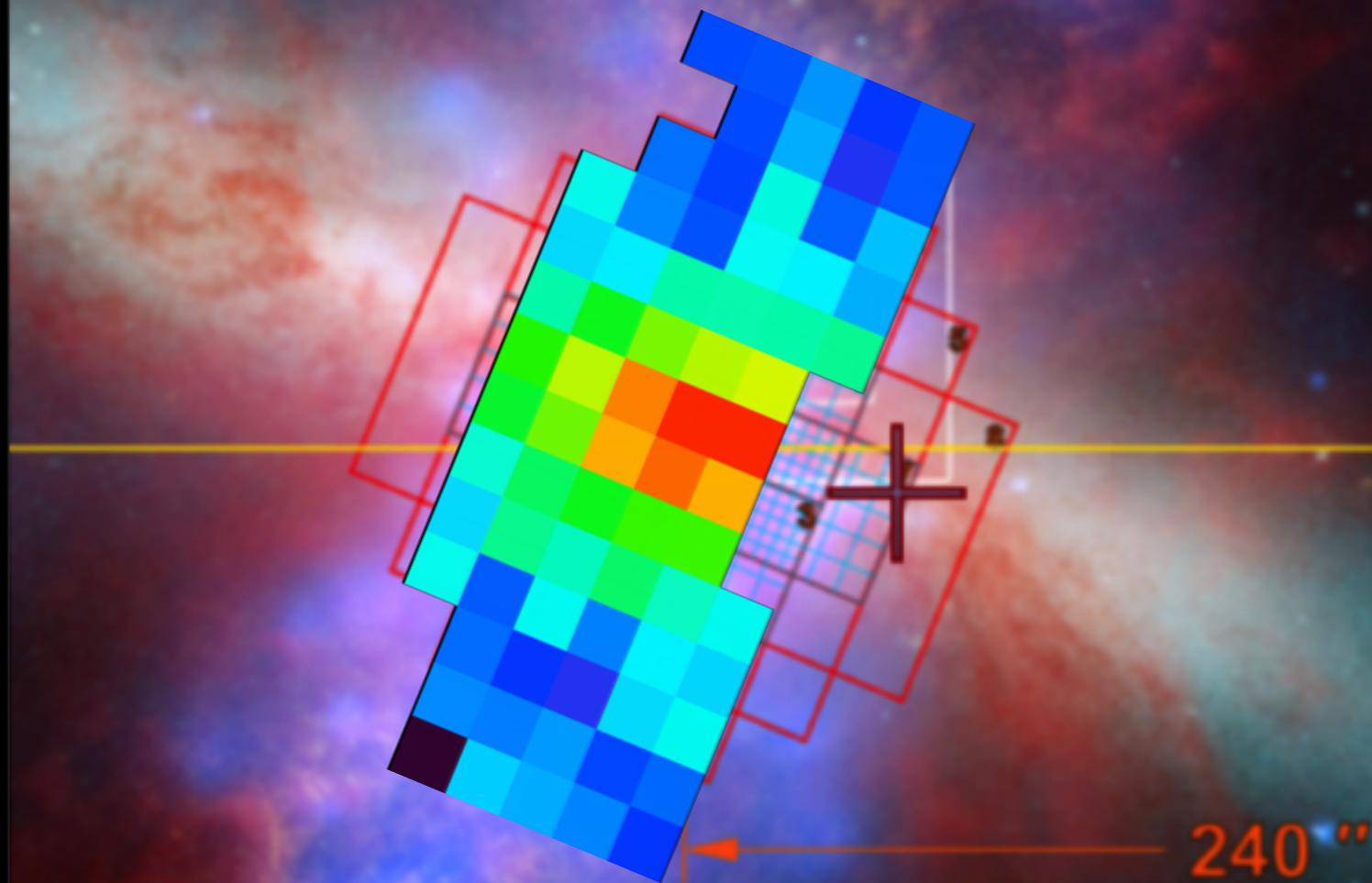


Location of SN, but a detection  
was not to be expected.

SOFIA &  
FIFI-LS

M82 Galaxy

Ionized Carbon



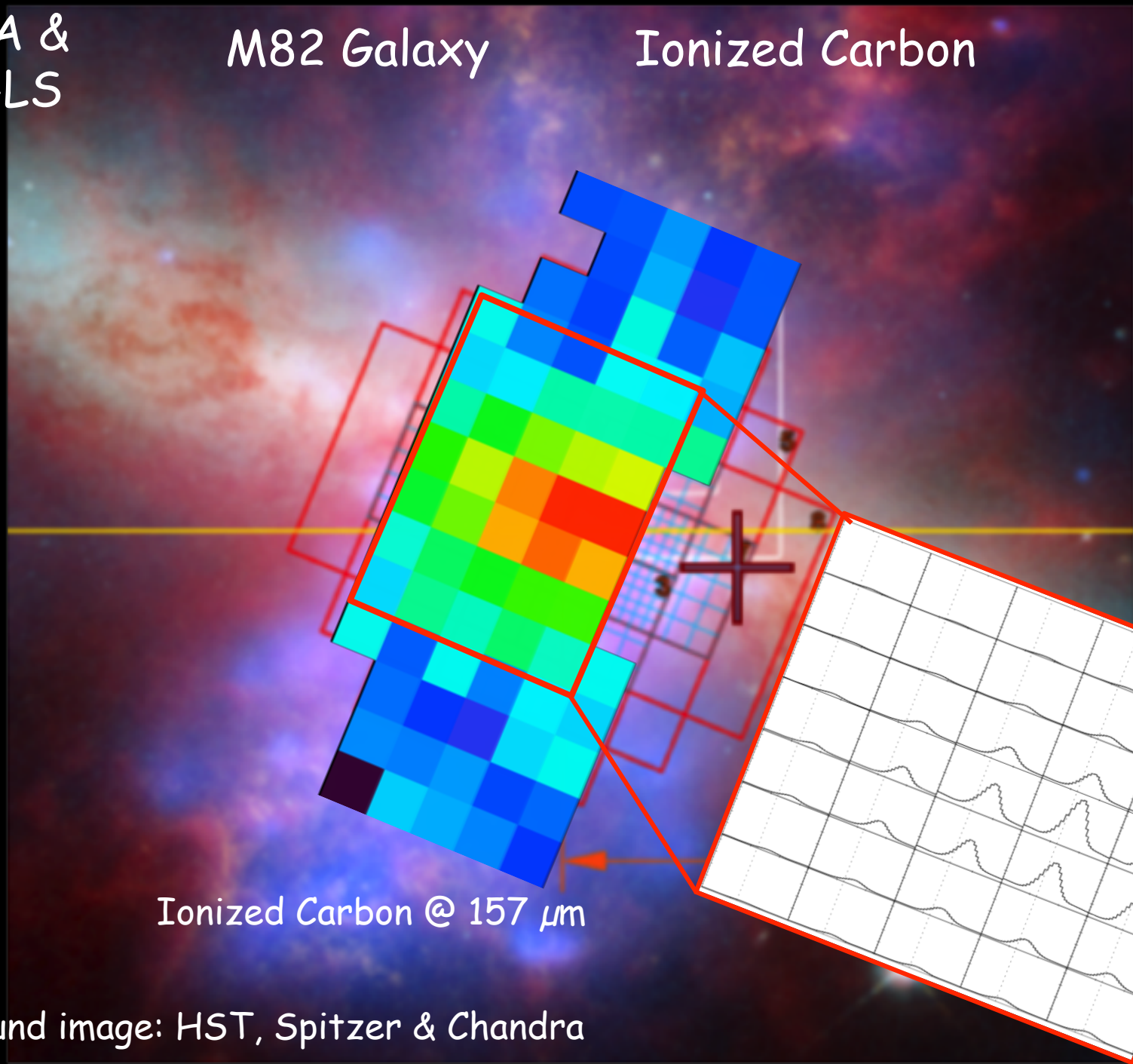
Ionized Carbon @ 157  $\mu\text{m}$

Background image: HST, Spitzer & Chandra

SOFIA &  
FIFI-LS

M82 Galaxy

Ionized Carbon



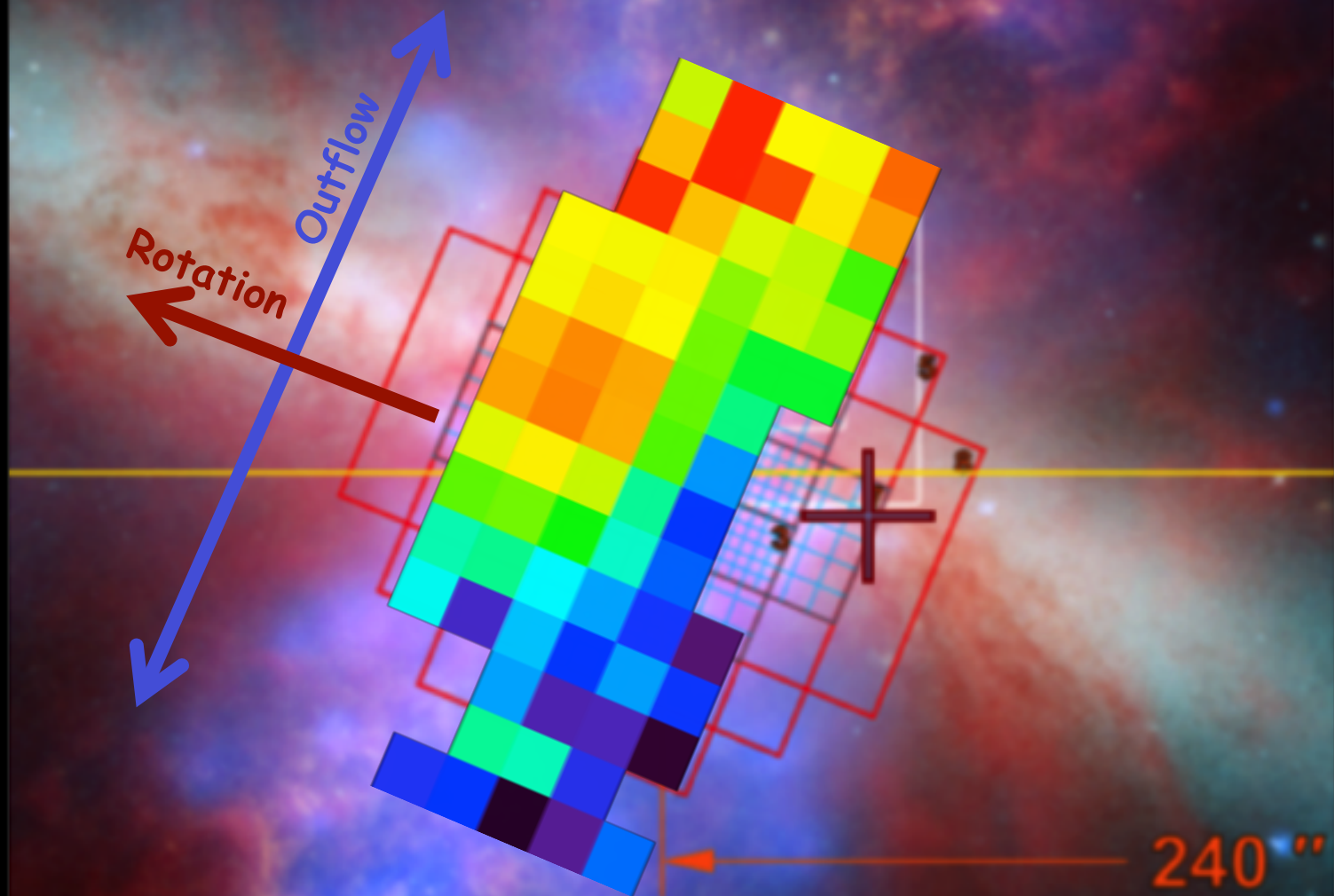
Ionized Carbon @ 157  $\mu\text{m}$

Background image: HST, Spitzer & Chandra

SOFIA &  
FIFI-LS

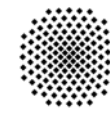
M82 Galaxy

Ionized Carbon



Velocity of ionized Carbon @ 157  $\mu\text{m}$   
from -130 km/s to +130 km/s

Background image: HST, Spitzer & Chandra



## Plans for Cycle 3

- About 70h of open time has been approved with FIFI-LS.
- Improvement of the data reduction.
- Development of a Data Reduction Pipeline.
- FIFI-LS will transition from PI-instrument to Facility instrument
- Preparing Cycle 4 Call

Thank you!