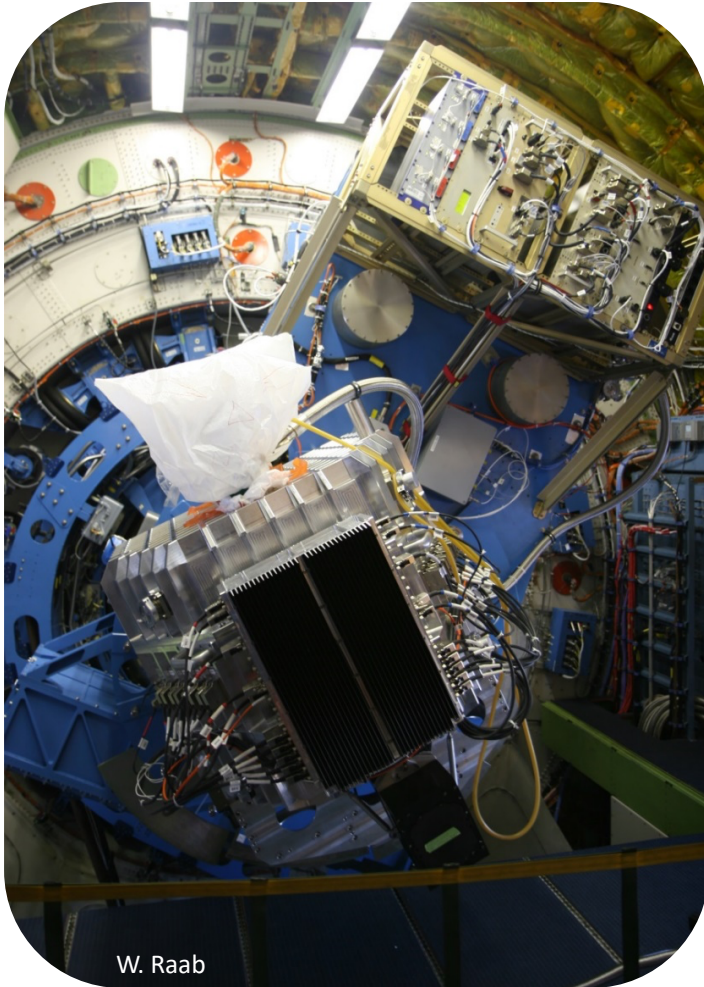




W. Raab

04.05.2018 S. C. Fischer, W. Vacca



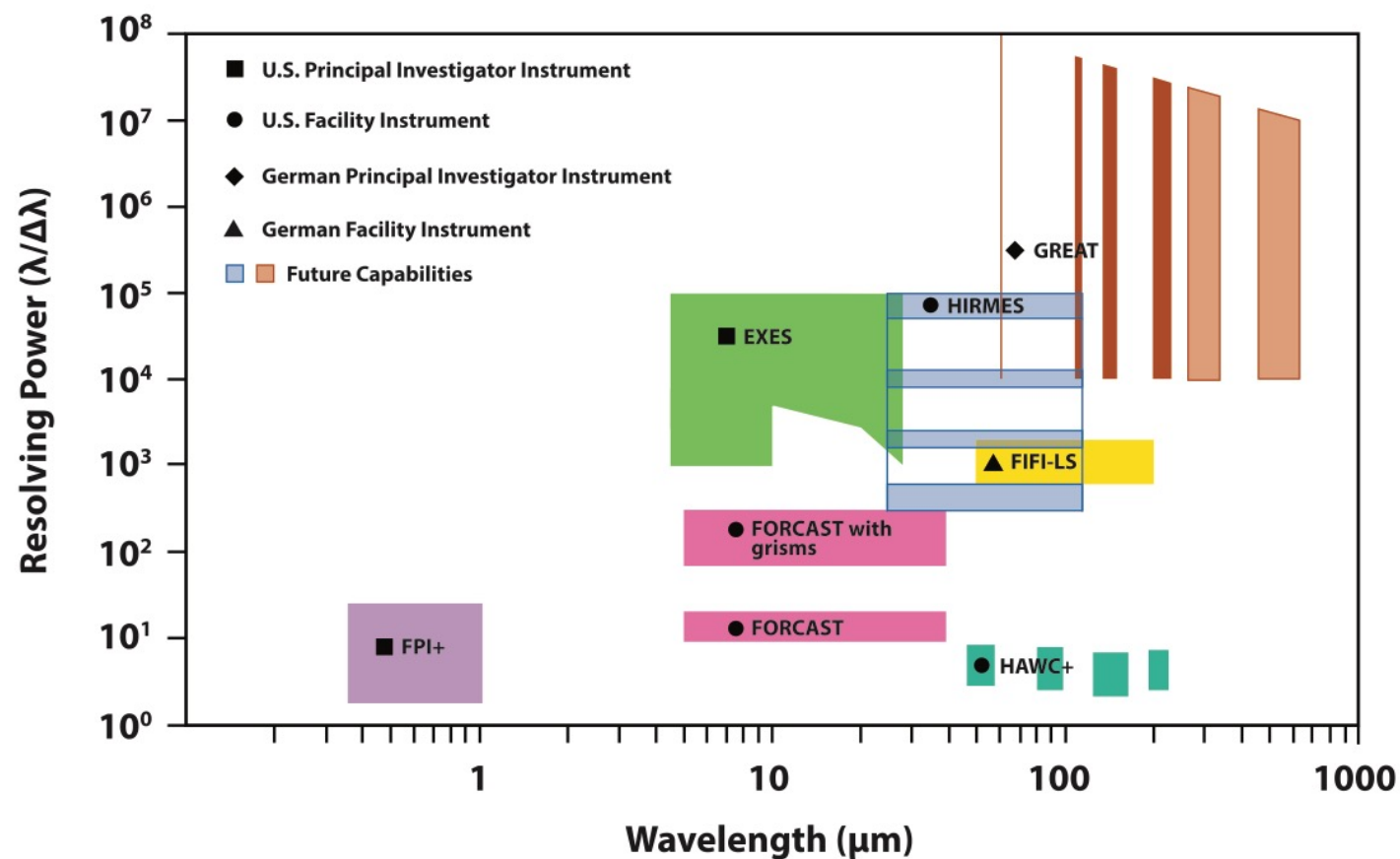
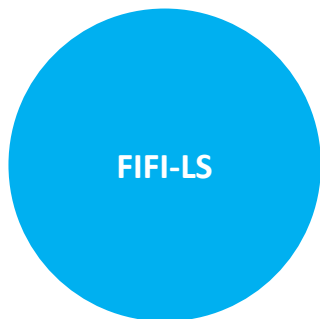
Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

FIFI-LS Tutorial

C. Fischer
W. Vacca
&
FIFI-LS Team





USPOT



Universität Stuttgart
Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

FIFI-LS [AOR ID: N/A]

Unique AOR Label:

Target: None Specified

Observing Condition & Acquisition / Tracking

Observation Order:

* Rest Wavelength Blue (micron):

* Width of Spectrum Blue (km/s OR micron):

Width of Spectral Feature Blue (km/s OR micron):

* Rest Wavelength Red (micron):

* Width of Spectrum Red (km/s OR micron):

Width of Spectral Feature Red (km/s OR micron):

Width Unit:

* Source Velocity (km/s):

Dichroic:

Pointing Array:

Spectral 1:

Spectral 2:

On-source exp. time (sec):

* On **Total exposure time to cover all points in one cycle.**

* Cycles:

Min Contiguous Exp Time (sec):

* MapType:

* Number of Points Along Lat (Grid Only):

* Number of Points Along Lon (Grid Only):

Step Size Along Lat (arcsec):

Step Size Along Lon (arcsec):

Map Offset RA (arcsec):

Map Offset Dec (arcsec):

Map Priority:

FOV Angle (deg):

* Instrument Mode:

Chop Type:

Total Chop Throw (arcsec):

Chop Angle Coordinate:

Chop Pos Angle (deg):

Reference Position

Ref Type: ☒ By Offset ☐ By Position

Map Ref. Pos.:

Reference Name:

RA Offset (arcsec):

Dec Offset (arcsec):

RA (deg):

Dec (deg):

Position: 0h00m00.0000s, +0d00m00.000s

(* = required for Phase I)

Number	Offset East/Row/Perpendicular (")	Offset North/Column/Parrell (")
1	0.0	0.0

04.05.2018 S. C. Fischer, W. Vacco





Checklist

1. **If you have any questions, ask us!**
 2. Does the atmosphere allow my observation?
 3. Flux estimates (on source)
 4. How wide is my line
 5. What observing mode do I need?
 6. Define mapping area
 7. Overall time estimate
- Much later: More details and Strategy

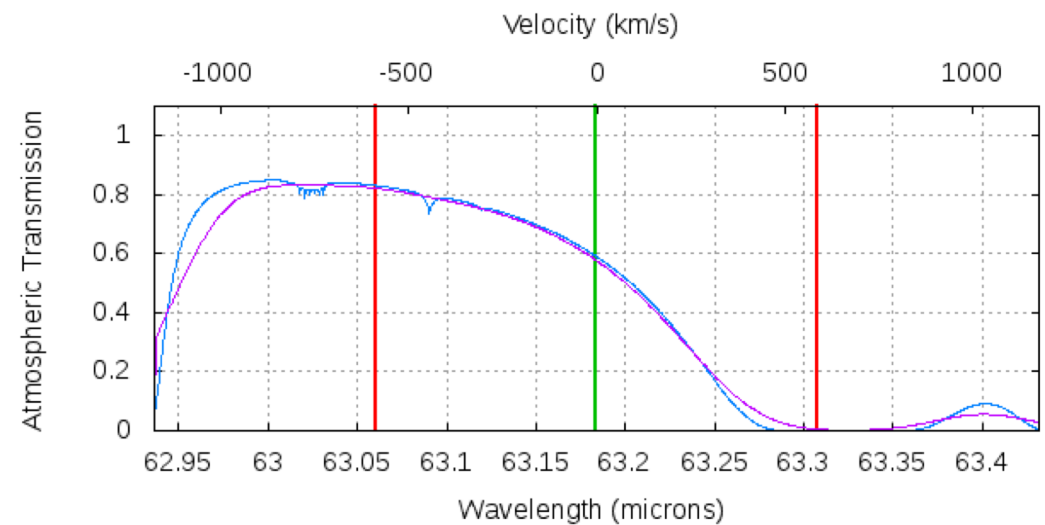
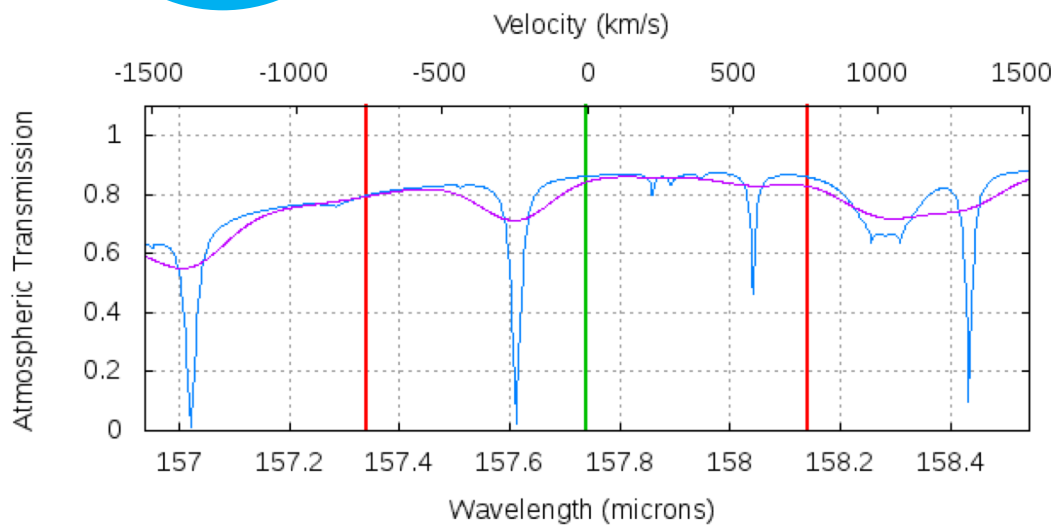


Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)



- Does the atmosphere allow my observation?
- Both plots 41000 ft, 40° elevation, standard water vapor



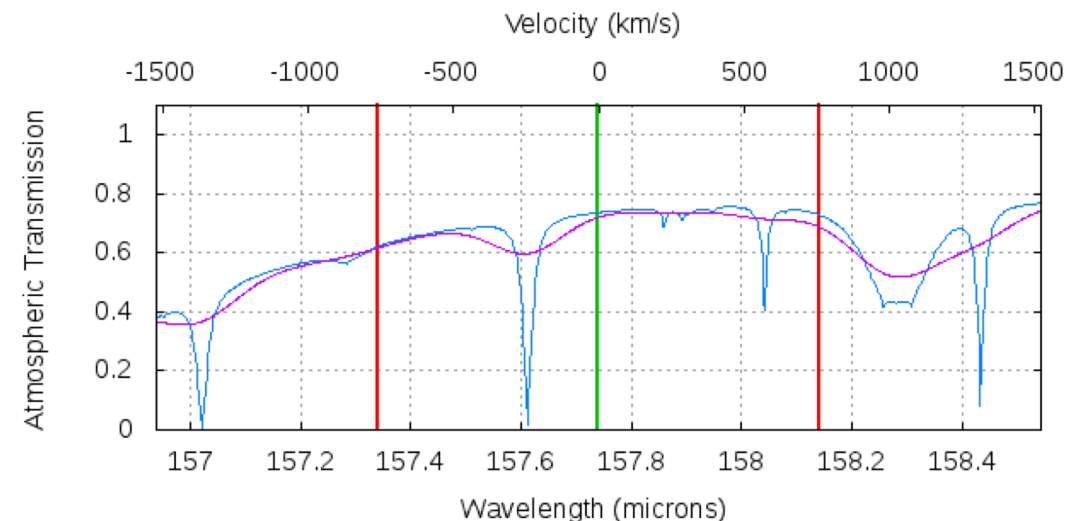
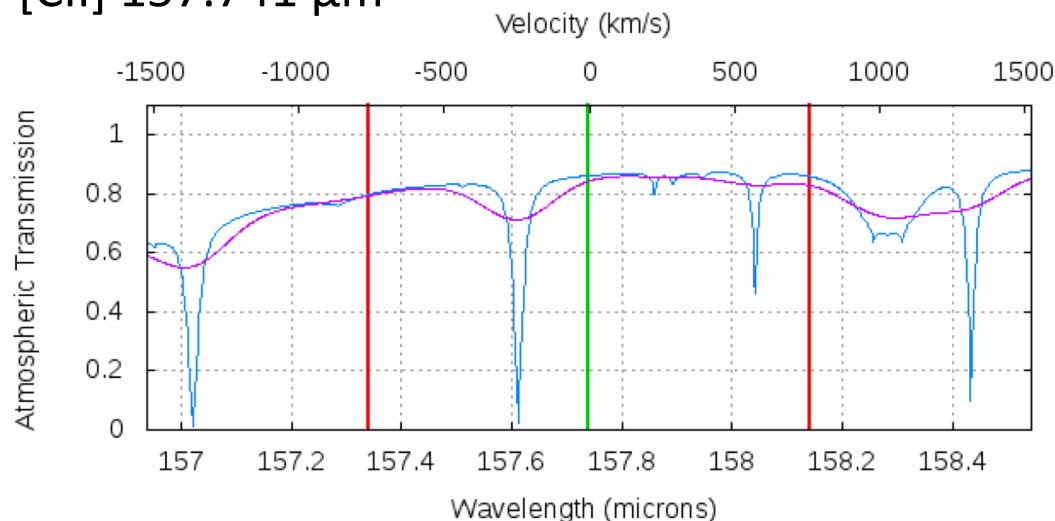
altitude [ft]	water vapor [μm]	altitude [ft]	water vapor [μm]
38000	11	42000	6.3
39000	9.5	43000	5.5
40000	8.4	44000	4.8
41000	7.3	45000	4.2

Water vapor overburden
(zenith) assumed by a
ATRAN



- Does the atmosphere allow my observation?
 - Now 41000 ft, 40° elevation, standard water vapor (7.3 μm) left and 15 μm on the right
 - Transmission robust against water vapor

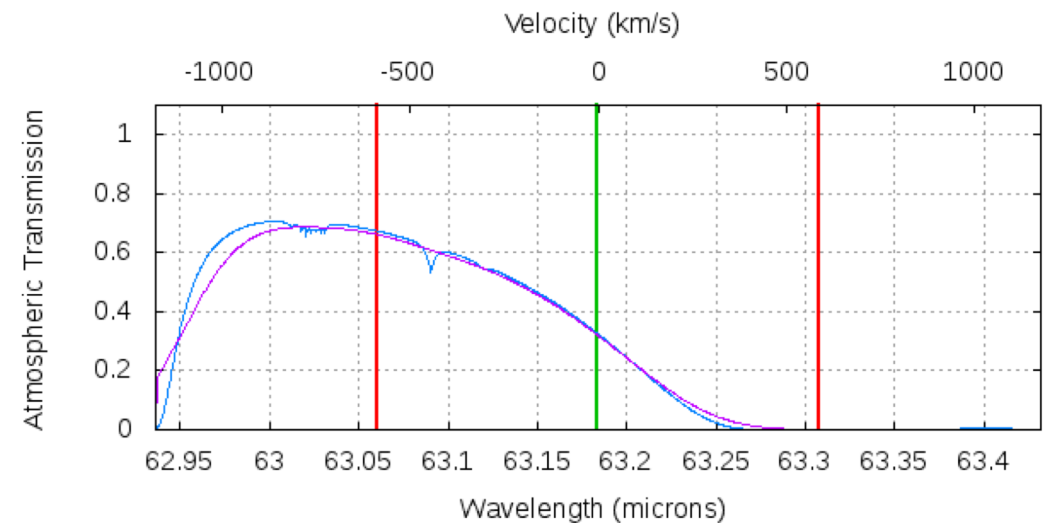
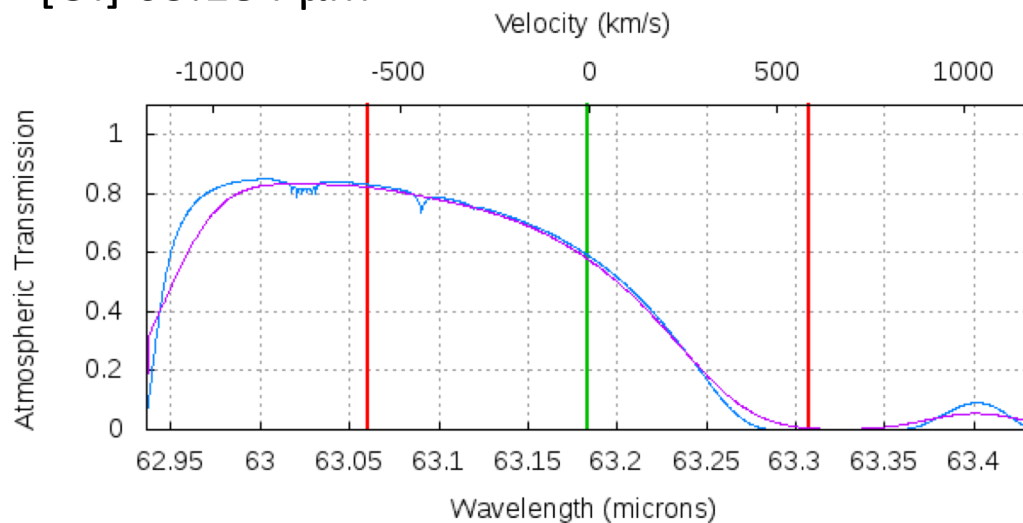
[ClI] 157.741 μm





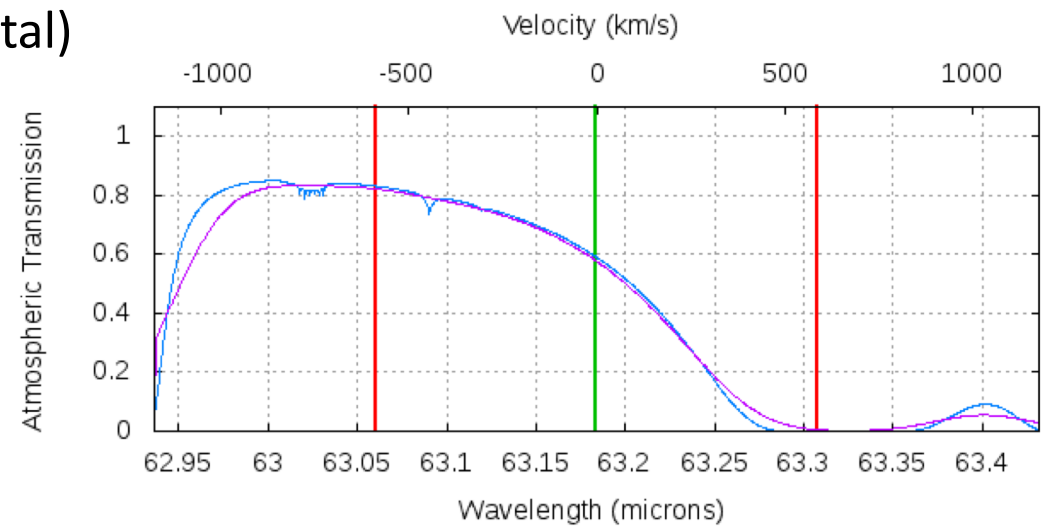
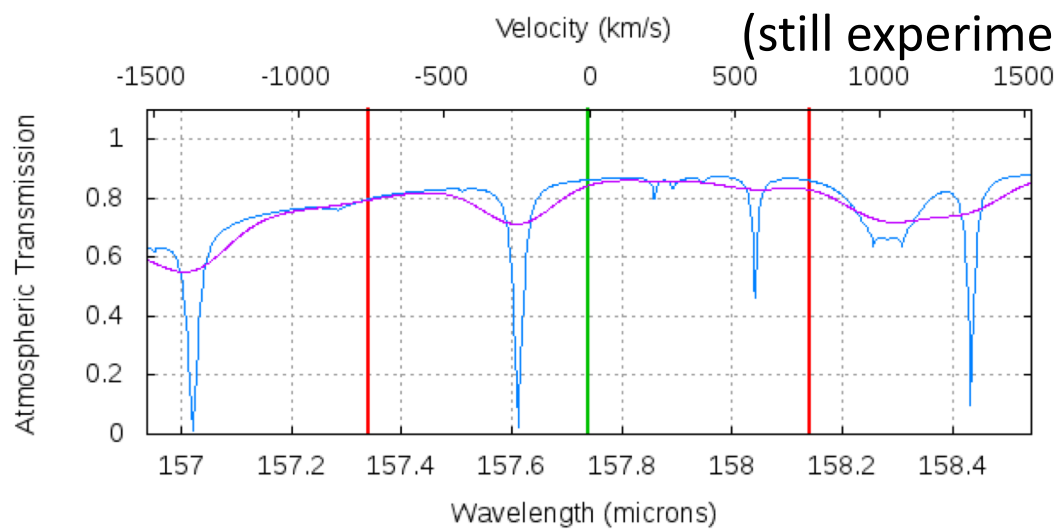
- Does the atmosphere allow my observation?
 - Now 41000 ft, 40° elevation, standard water vapor (7.3 μ m) left and 15 μ m on the right
 - Transmission strongly varies with water vapor

[OI] 63.184 μ m





- Does the atmosphere allow my observation?
- Check for your redshift!
- we can measure the water vapor (with 8% additional overhead)





Checklist

1. If you have any questions, ask us!
2. Does the atmosphere allow my observation?
3. Flux estimates (on source)
4. How wide is my line
5. What observing mode do I need?
6. Define mapping area
7. Overall time estimate
- Much later: More details and Strategy



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

Checklist



- Flux estimates (on source)
 - We really can't help you with that, but some things to keep in mind:

Observatory Altitude (in feet; < 60000 ft):	38000	☒ ft ☐ m
Water Vapor Overburden (in microns; 0 if unknown):	0	
Telescope elevation (between 20 and 60 deg):	40	
Signal to Noise Ratio / Integration Time (minutes):	5	☒ SNR ☐ On-Source Int. Time
Wavelength (in microns, between 51 and 203):	157.741	
Source :	2.087e-17	☒ line (in W/m ²) ☐ continuum (in Jy)
Velocity correction (source VLSR, in km/s):	0	
Band width :	0	☒ km/s ☐ microns
Comment :		

- per spatial pixel ("spaxel")
 - 6"x6" blue channel
 - 12"x12" red channel

<https://fifi-ls.sofia.usra.edu/cgi-bin/fifi-ls/fifi.cgi>



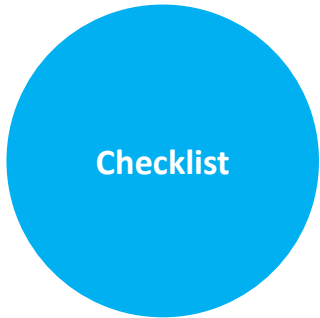
Checklist

1. If you have any questions, ask us!
2. Does the atmosphere allow my observation?
3. Flux estimates (on source)
4. How wide is my line
5. What observing mode do I need?
6. Define mapping area
7. Overall time estimate
- Much later: More details and Strategy

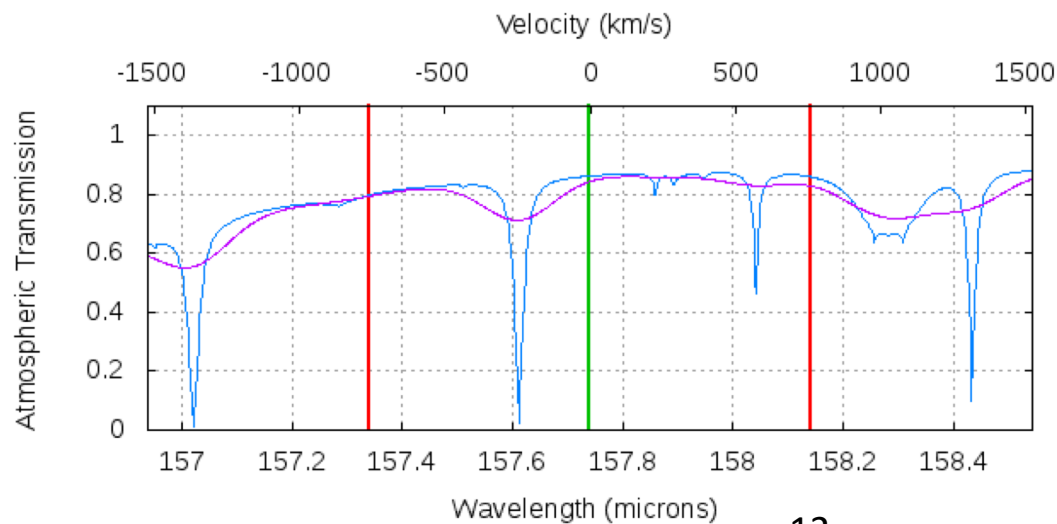
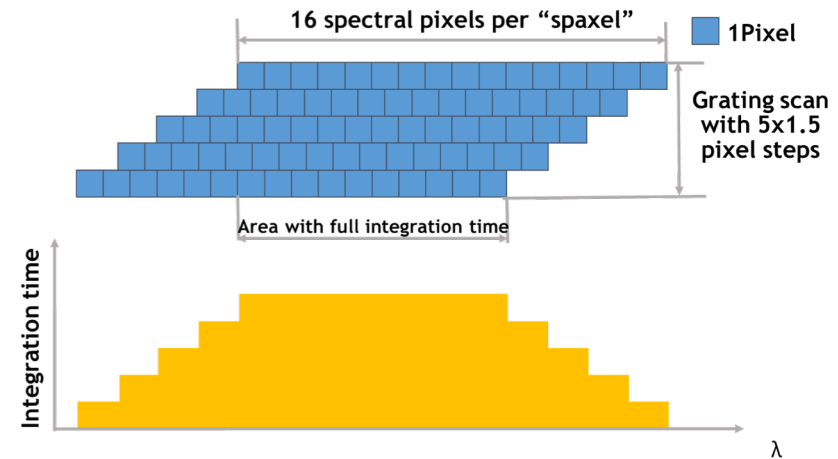


Universität Stuttgart

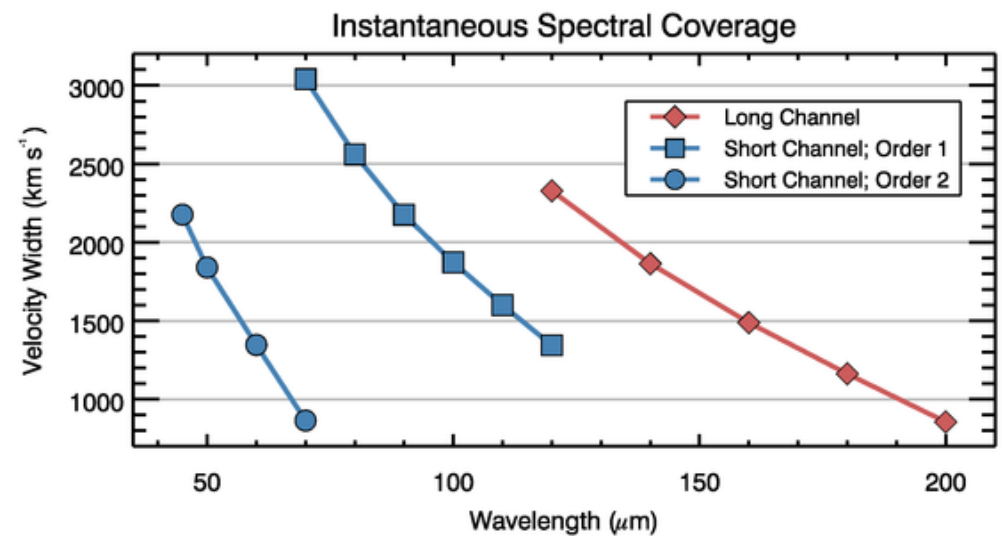
Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)



- How wide is my line



12





Checklist

1. If you have any questions, ask us!
2. Does the atmosphere allow my observation?
3. Flux estimates (on source)
4. How wide is my line
5. What observing mode do I need?
6. Define mapping area
7. Overall time estimate
- Much later: More details and Strategy



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

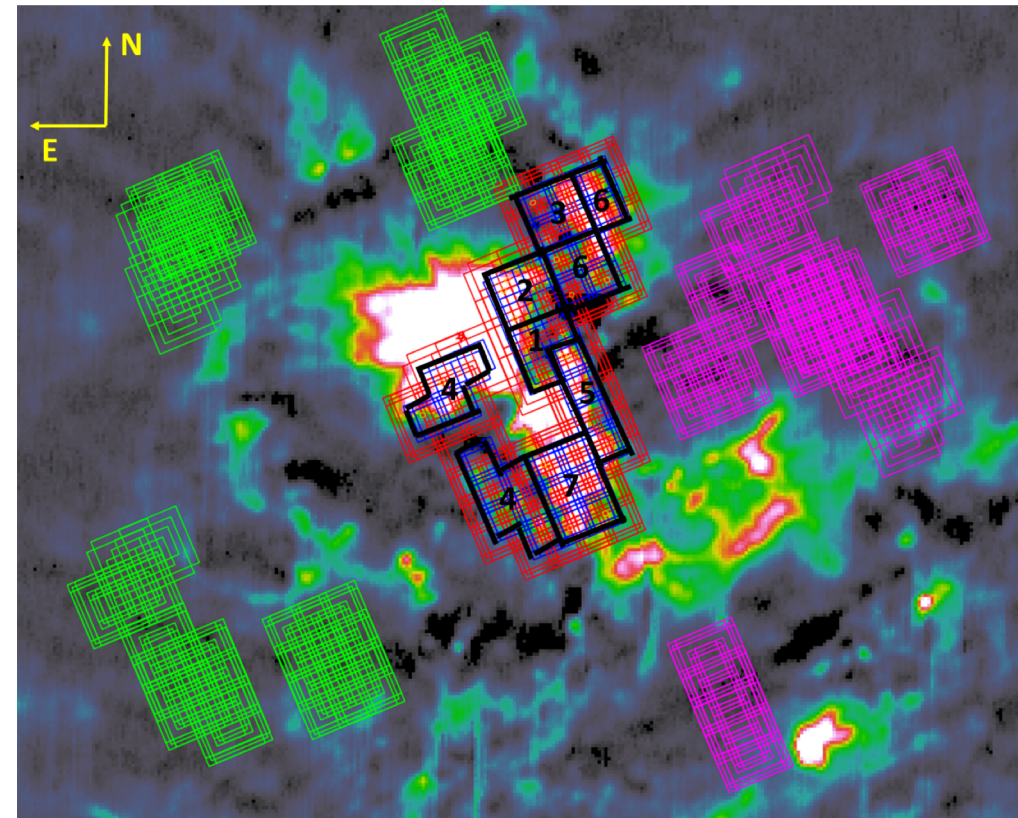
Checklist



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

- What observing mode do I need?
- Symmetric Chopping is the most efficient mode
 - Max throw depends on wavelength
 - Recommended:
 - <5' below $63\mu\text{m}$
 - <6' below $88\mu\text{m}$
 - Max. 8' available in the red channel
 - Emission free on “both sides”



Checklist

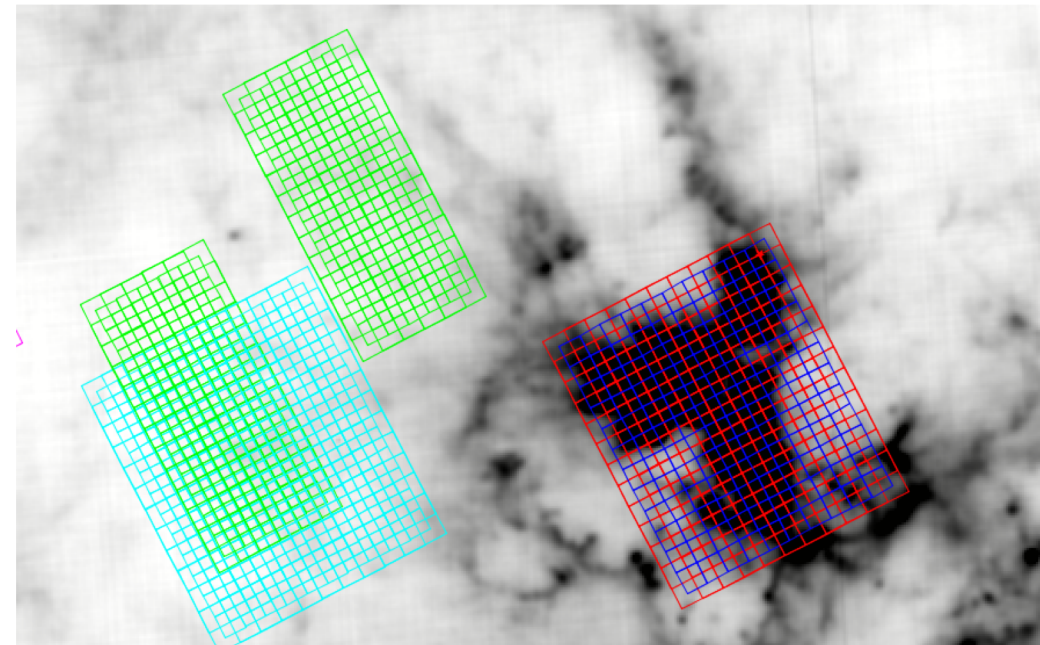
- What observing mode do I need?

- “[CII] is everywhere”
 - Sometimes asymmetric is the safer way to go
 - For “narrow” lines Bright Object helps to ease the pain
 - Don’t worry about telescope chop angle limitations while proposing (we can do partial asymmetric chopping)
 - Contact us for unchopped observations



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)





Checklist

1. If you have any questions, ask us!
2. Does the atmosphere allow my observation?
3. Flux estimates (on source)
4. How wide is my line
5. What observing mode do I need?
6. Define mapping area
7. Overall time estimate
 - Much later: More details and Strategy



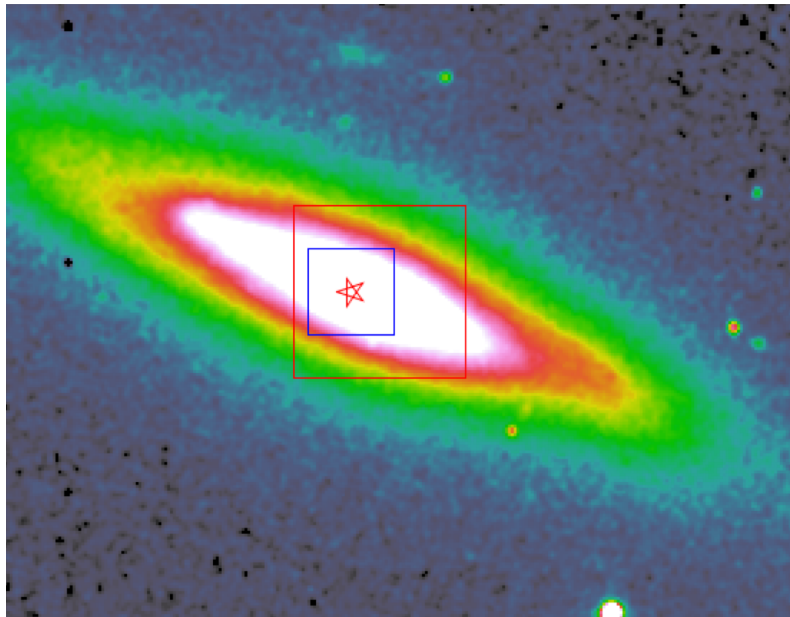
Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

Checklist



- Define mapping area
 - Different array sizes
 - ~10arcsec offset between red and blue channel
 - Can be rotated as needed with detector angle
- You probably want to dither
 - Keep in mind you will get edges
 - We will take care of the dither in Phase II
- For larger Maps 15 or 30 arcsec rasters are popular



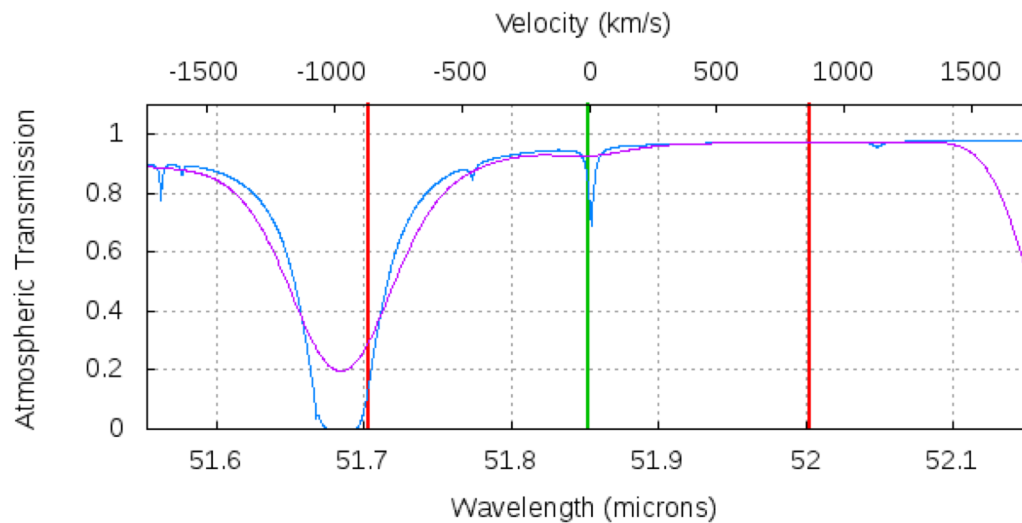
Example M82

- Does the atmosphere allow my observation?
- $Z = 0.00073$ ($\sim 220 \text{ km/s}$)

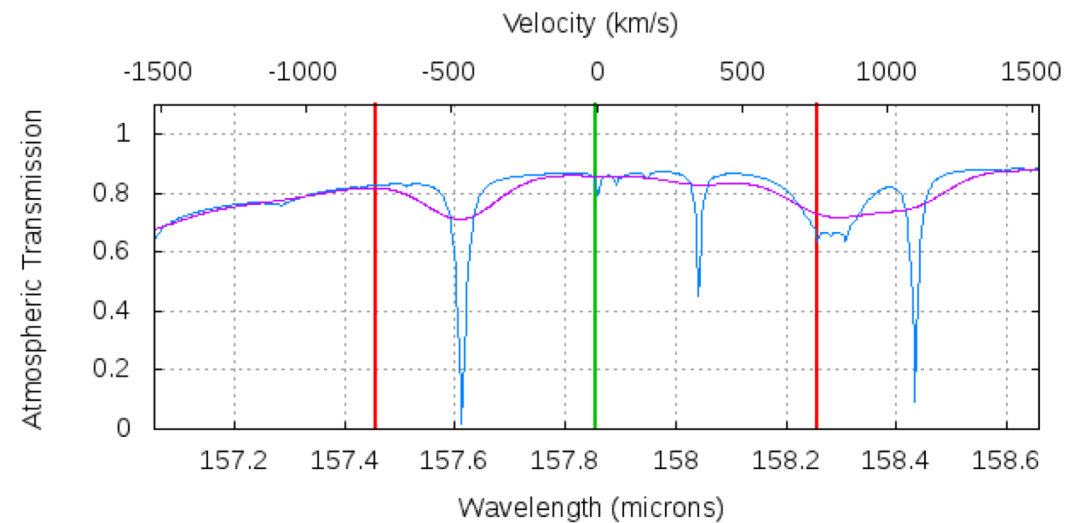


Universität Stuttgart
Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

[OIII] 51.815 μm



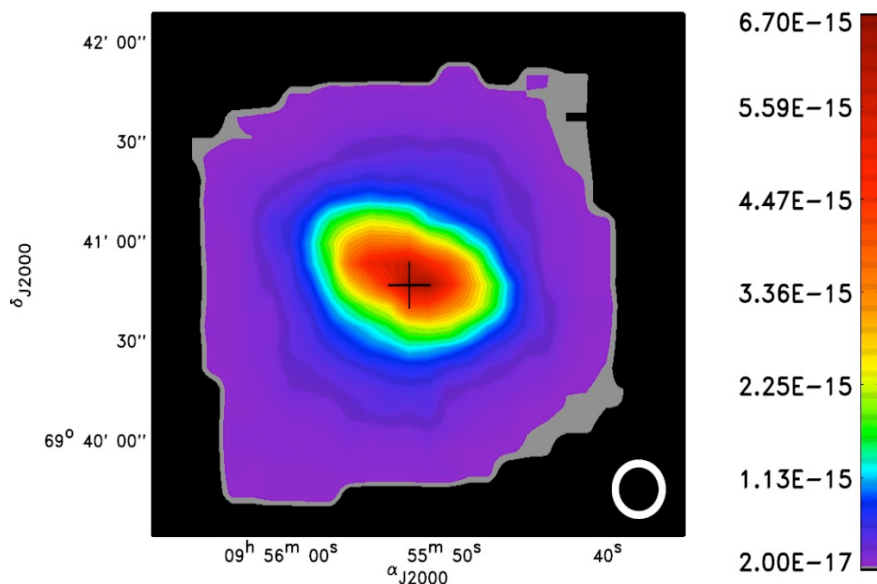
[CII] 157.741 μm





Example M82

Flux estimates



- Fluxes per 9.4'' x 9.4'' PACS spaxel
- From Contursi et al. 2013

[OIII] 52 μ m from ISO LWS:

- 10.4 W/m² e-14 per beam (80 arcsec)
- 7.4 W/m² e-16 per FIFI-LS blue channel "spaxel"
- Ask the time estimator
- SNR 10 in 30 sec on source
- **peak should be easy**
- **getting a map possible**

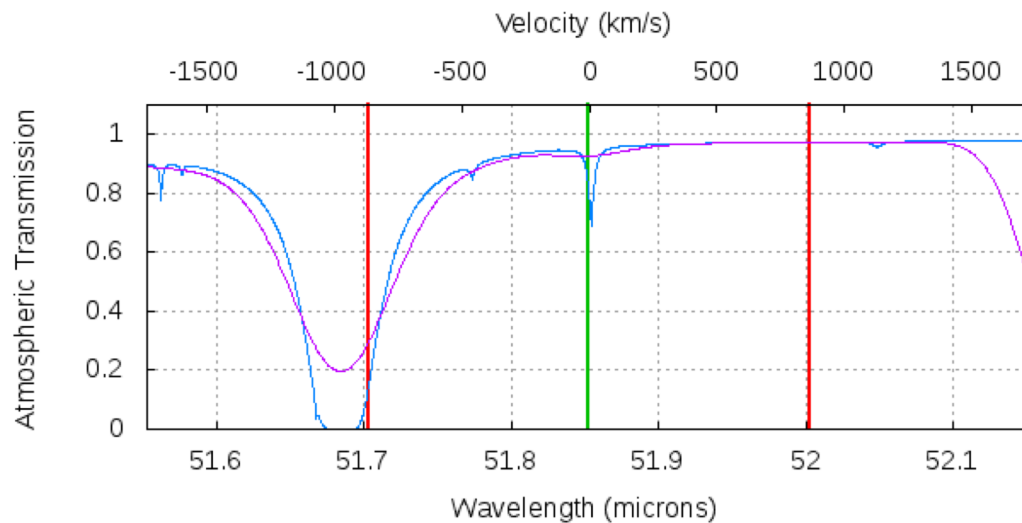
[CII] 158 μ m from PACS:

- Lets ignore different Spaxel sizes (FIFI-LS / PACS) here
- On the edges ~2 W/m² e-17 per "spaxel"
- Ask the time estimator
- SNR 4 in 15 min on source for the edges (~40min total)
- **Excellent SNR in central region**
- **Extending map in the outflows should be possible**

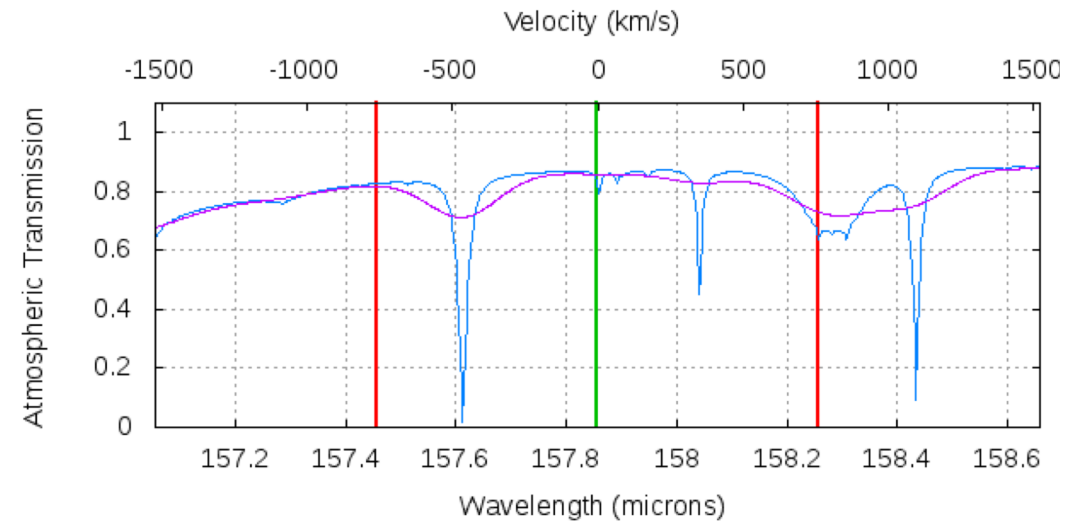


Example M82

- How wide is my line
 - We have about ± 750 km/s on the detector
 - FWHW of the Instrument is about 300 km/s
 - From PACS: Rotation $\sim \pm 150$ km/s ; Dispersion < 400 km/s



[OIII] 51.815 μm

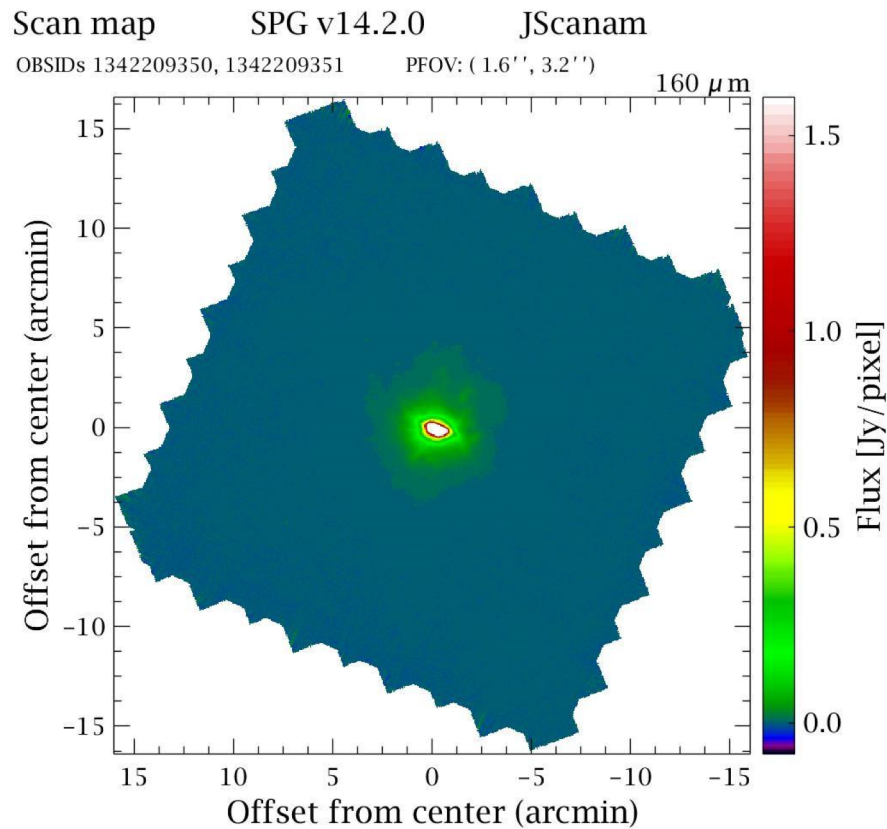


[CII] 157.741 μm



Example M82

- What observing mode do I need?
- Can we chop symmetrically?



- No big issue here
- E-W chop to get out of the outflow

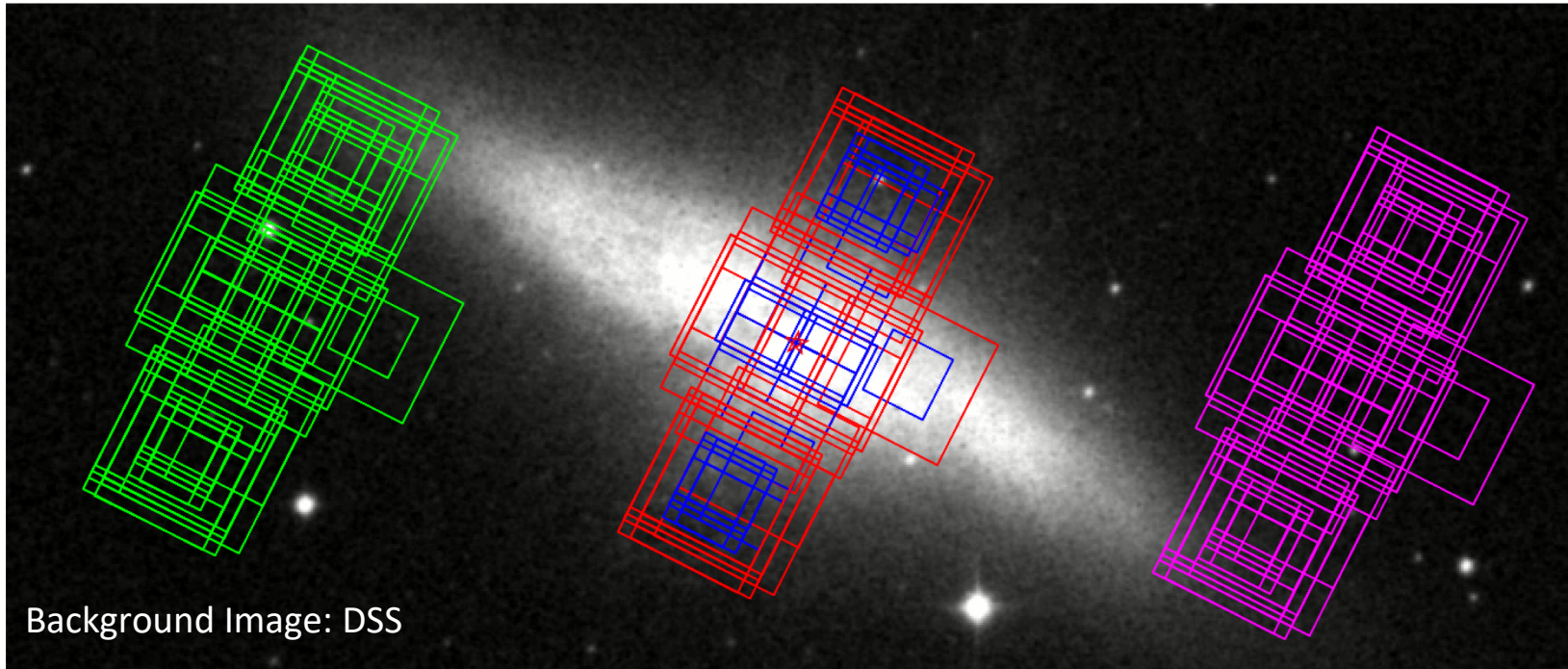
Example M82

- What observing mode do I need?
- Can we chop symmetrically? -> Yes
- And let's look at the mapping area



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)



Background Image: DSS

- Basically 2 maps
- Center for [OIII] will need about 2 fields and give us cross calibration with PACS [CII] for free
- Outflows for [CII]; ~ 2 fields; plus “intermediate” fields



Checklist



Universität Stuttgart

Institut für Raumfahrtssysteme (IRS)
Deutsches SOFIA Institut (DSI)

- Overall time estimate
 - Center with [OIII] is rather easy
 - Around 30min total for 2 fields
 - 15min per field; ~6min on source
 - Outflows in [CII] will dominate the integration time
 - Around 6h total for 2 fields + some overlap
 - 2.5h per fields; would result in SNR ~10 based on PACS edge fluxes (now considering the bigger FIFI-LS pixels)
- Total time about 6.5h