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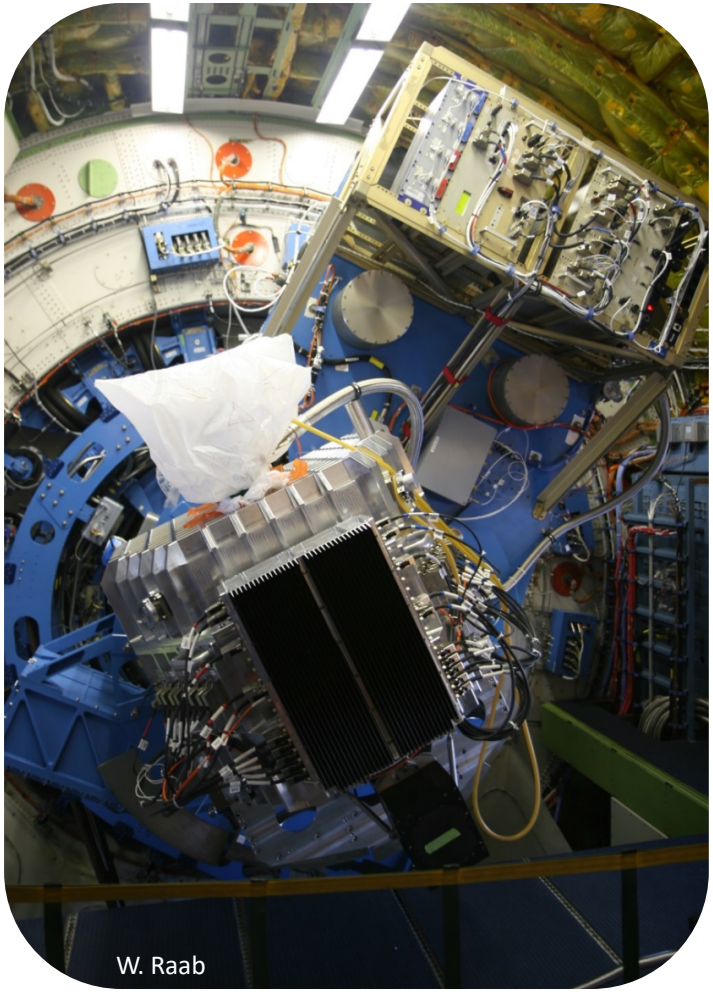
W. Raab

FIFI-LS
Tutorial

C. Fischer
W. Vacca
&
FIFI-LS Team

04.05.2018 S. C. Fischer, W. Vacca

FIFI-LS

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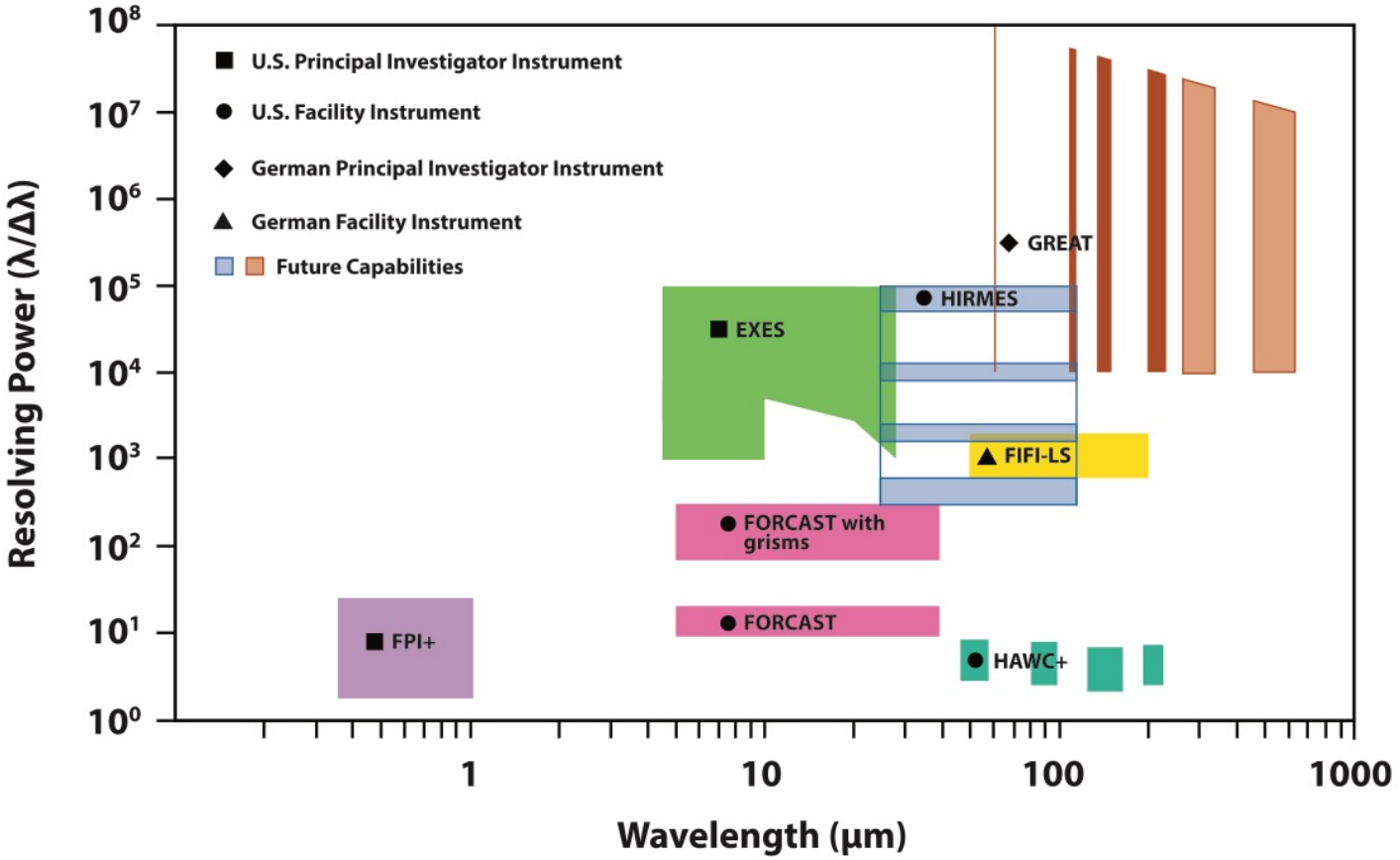
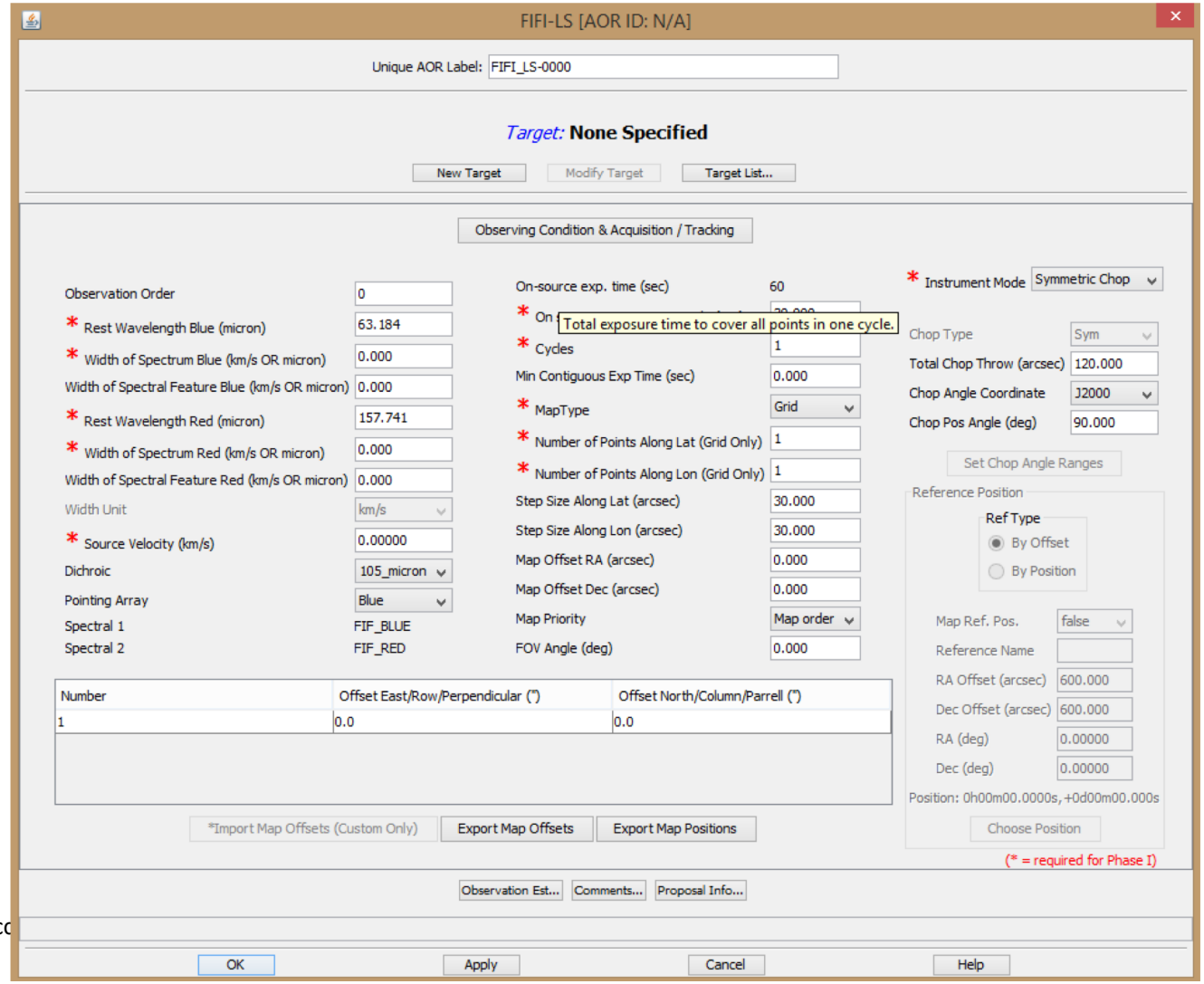


USPOT



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Checklist

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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?
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7. Overall time estimate

- Much later: More details and Strategy

atmosphere

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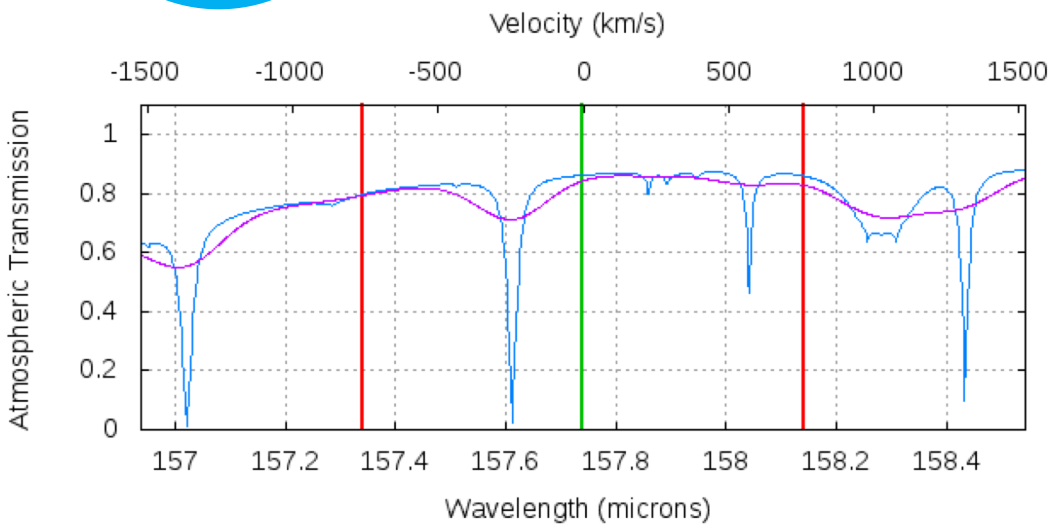
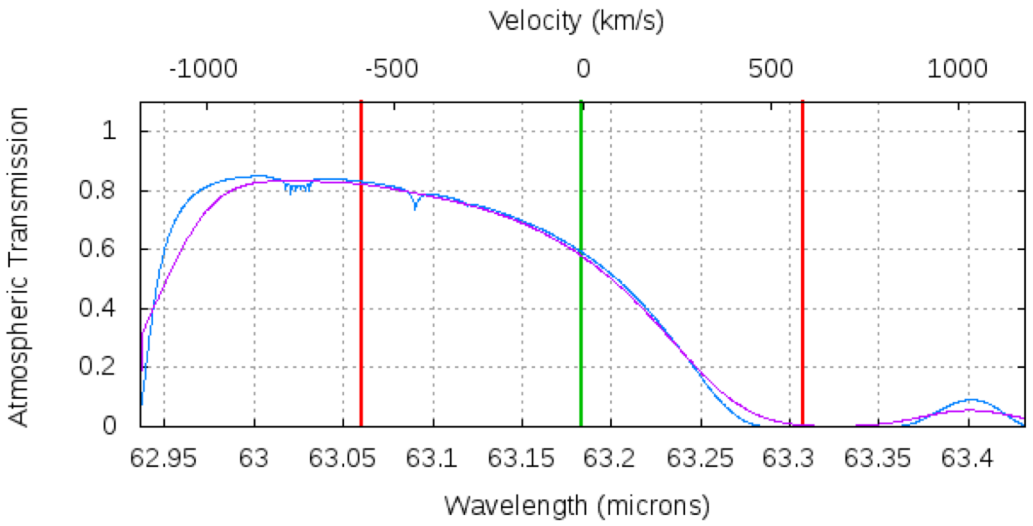
- Does the atmosphere allow my observation?
  - Both plots 41000 ft, 40° elevation, standard water vapor





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

atmosphere

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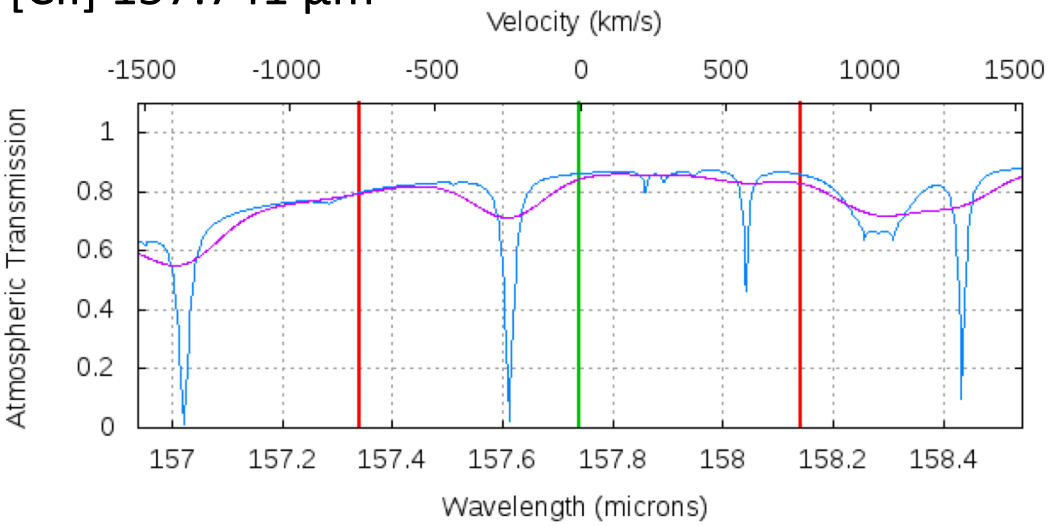
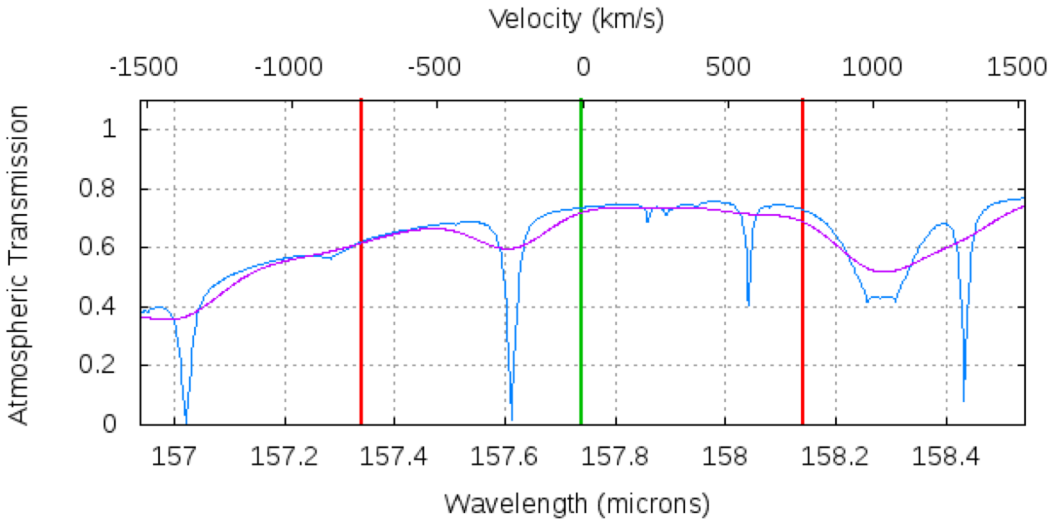
- Does the atmosphere allow my observation?
  - Now 41000 ft, 40° elevation, standard water vapor (7.3µm) left and 15 µm on the right
  - Transmission robust against water vapor

[CII] 157.741 µm





atmosphere

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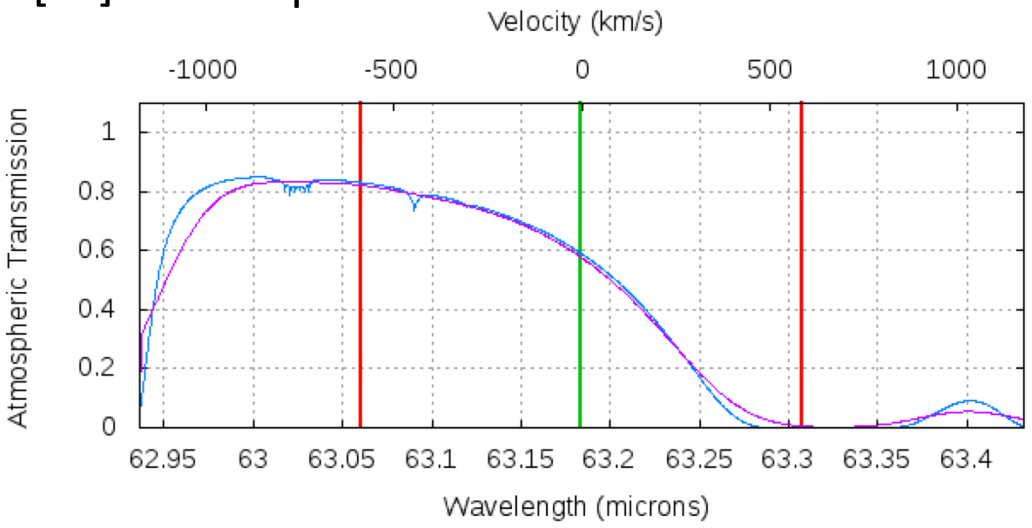
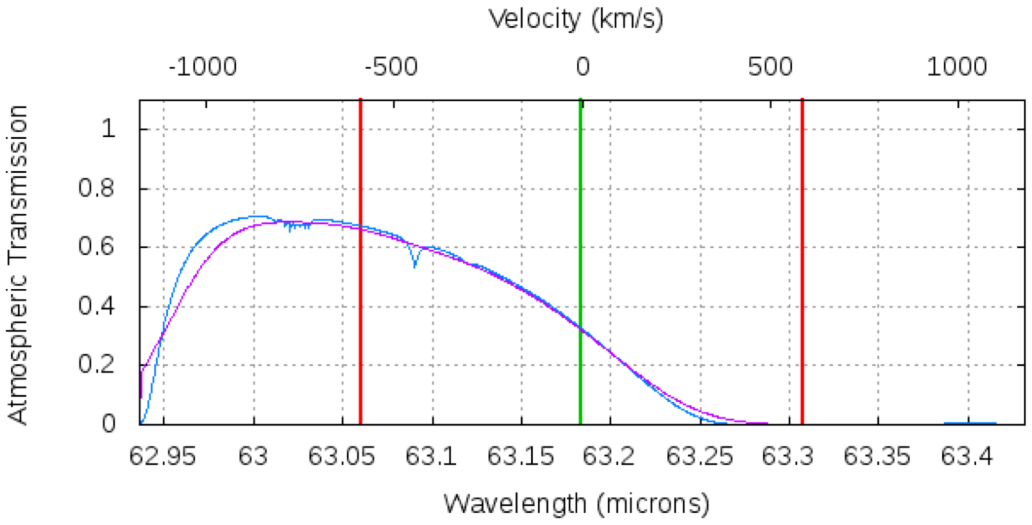
- Does the atmosphere allow my observation?
  - Now 41000 ft, 40° elevation, standard water vapor (7.3µm) left and 15 µm on the right
  - Transmission strongly varies with water vapor

[OI] 63.184 µm





atmosphere

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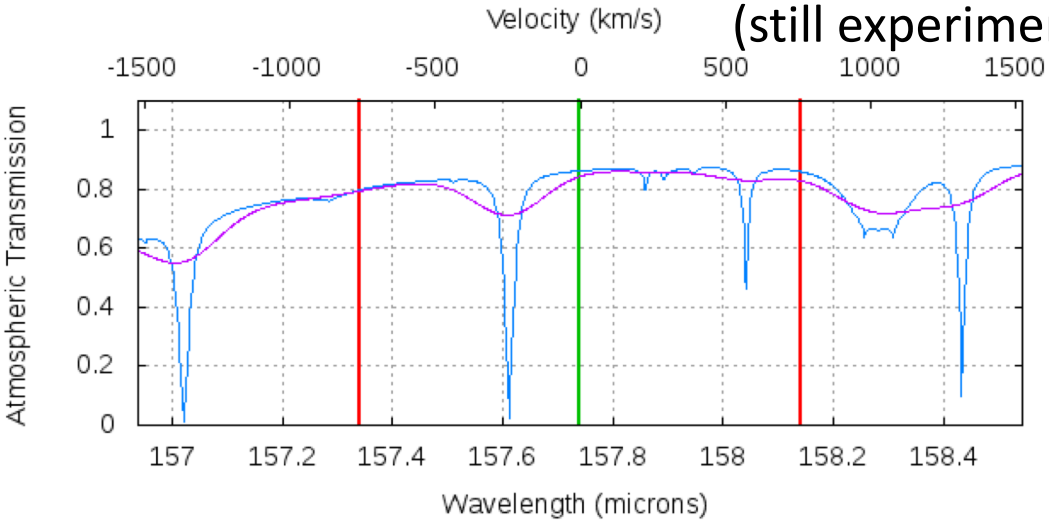
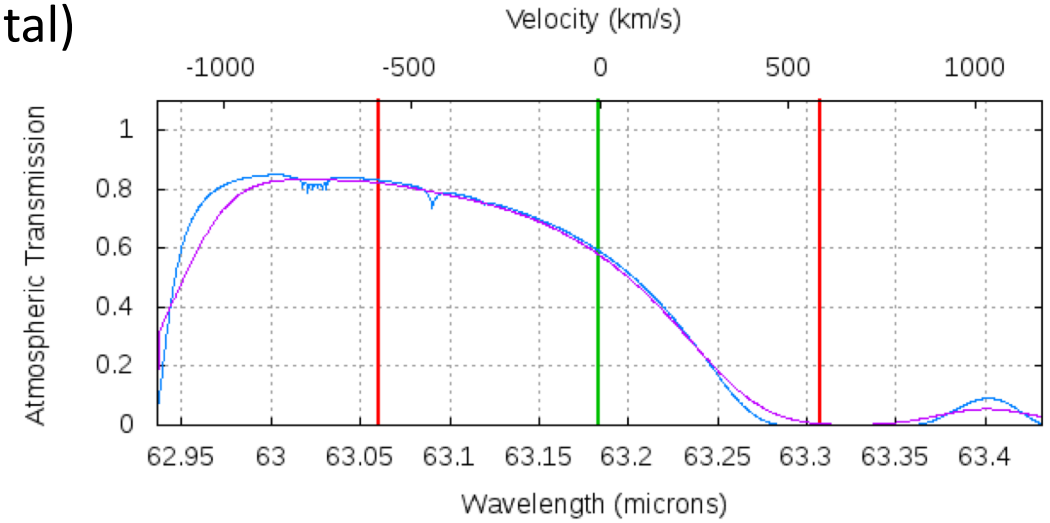
- Does the atmosphere allow my observation?
  - Check for your redshift!
  - we can measure the water vapor (with 8% additional overhead)

(still experimental)





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- 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

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Checklist

- How wide is my line

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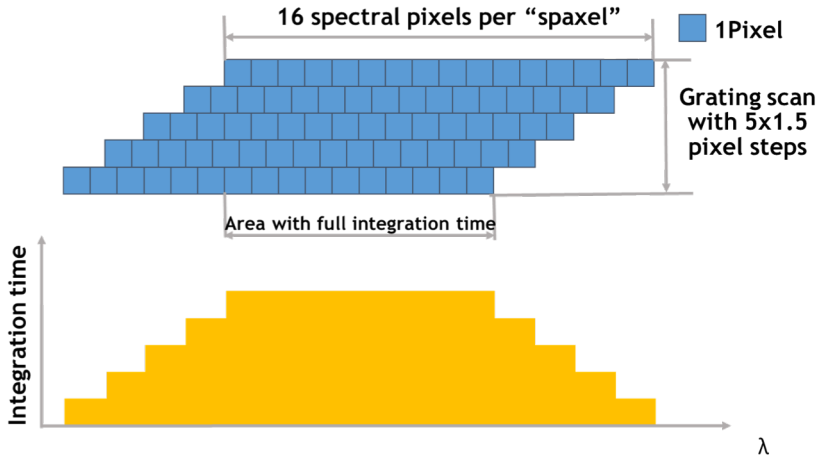

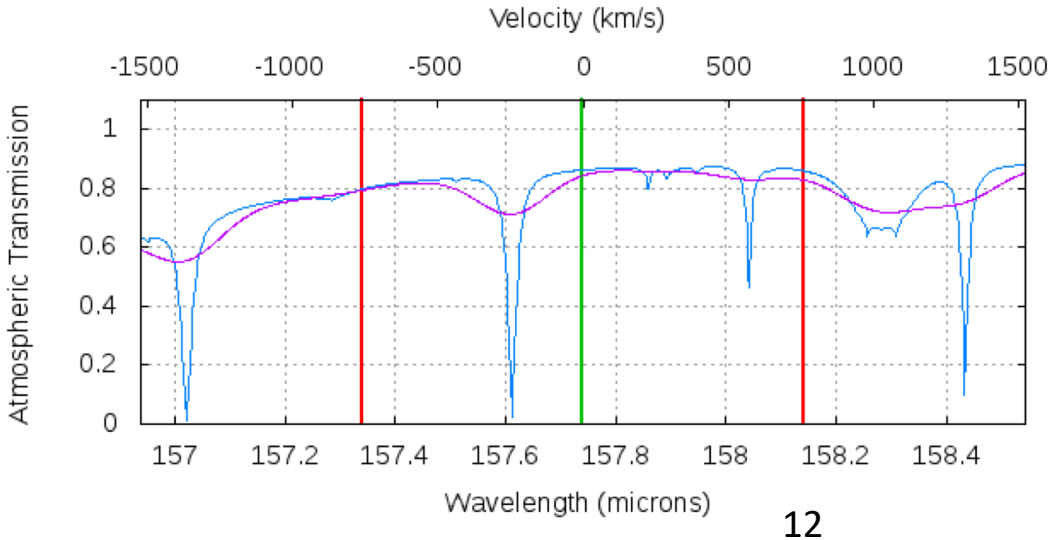

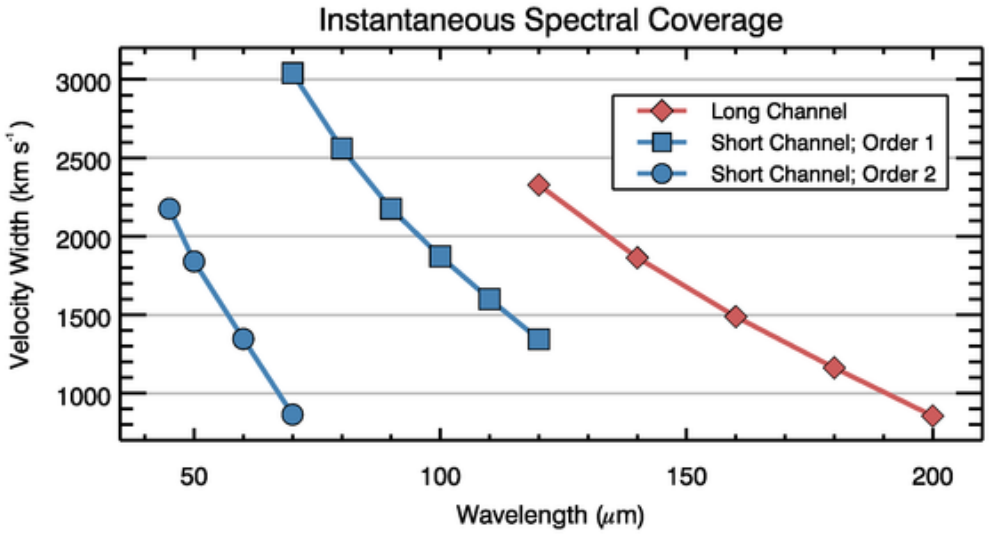

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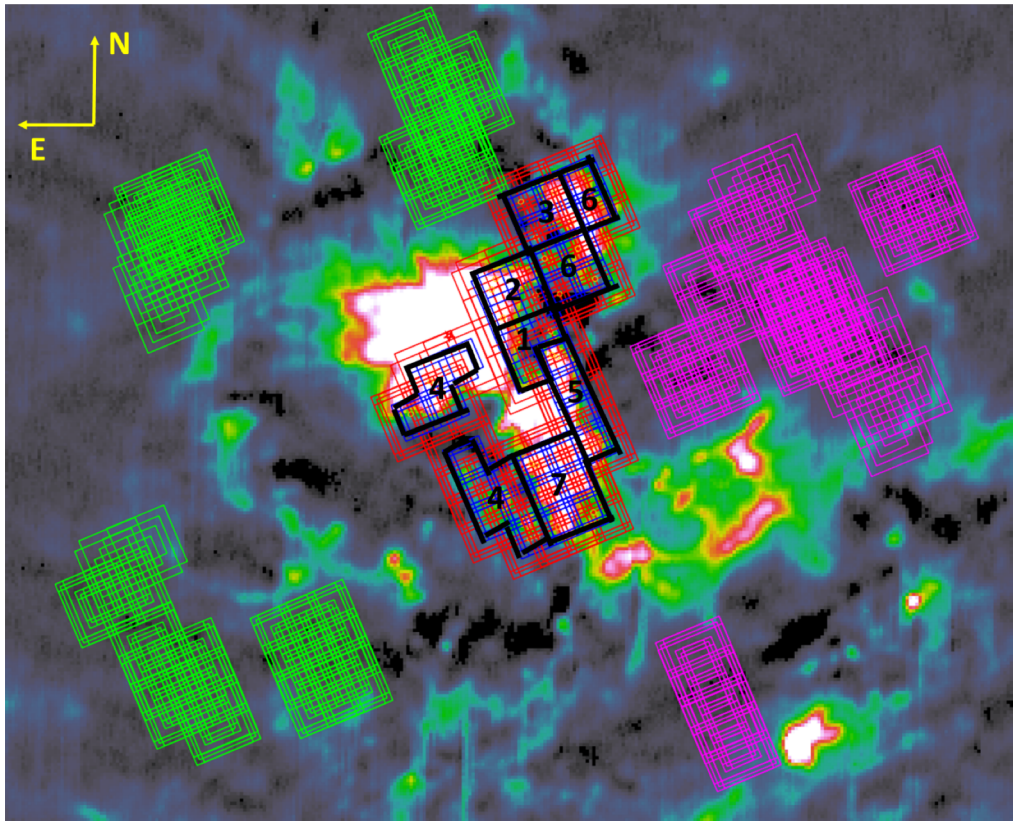
- What observing mode do I need?

- Symmetric Chopping is the most efficient mode
  - Max throw depends on wavelength
  - Recommended:
    - <5’ below 63µm
    - <6’ below 88µm
    - Max. 8’ available in the red channel
  - Emission free on “both sides”



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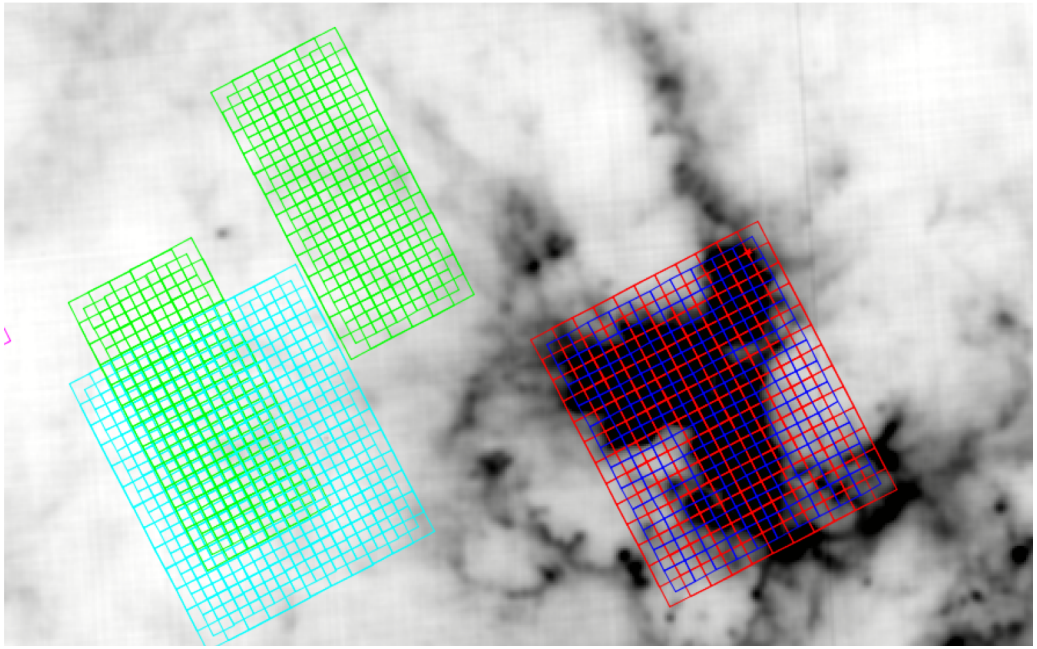
- What observing mode do I need?

- "[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



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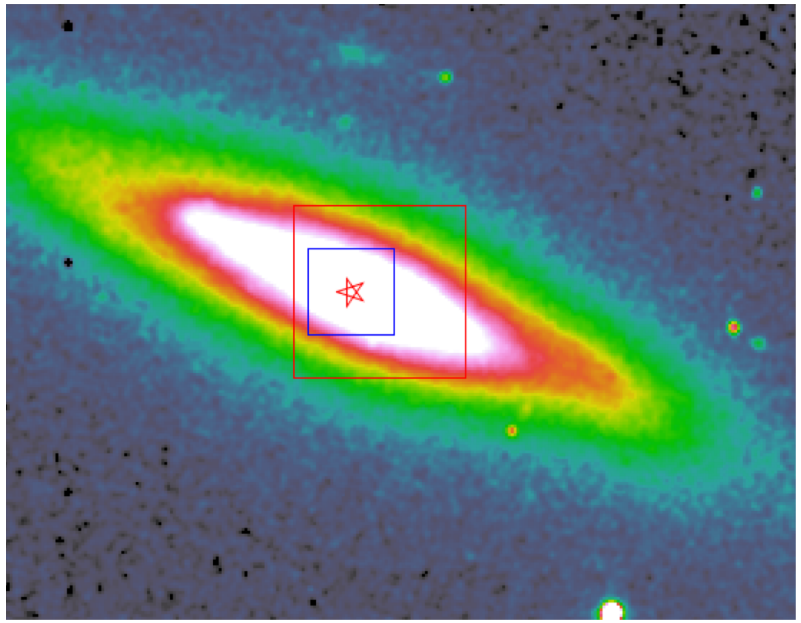
- Define mapping area
  - Different array sizes
  - ~10arcsec offset between red and blue channel
    - Can be rotated as needed with detector angle
  - You probably want to dither
    - Keep in mind you will get edges
    - We will take care of the dither in Phase II
  - For larger Maps 15 or 30 arcsec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



Example M82

- Does the atmosphere allow my observation?
  - Z = 0.00073 (~220km/s)

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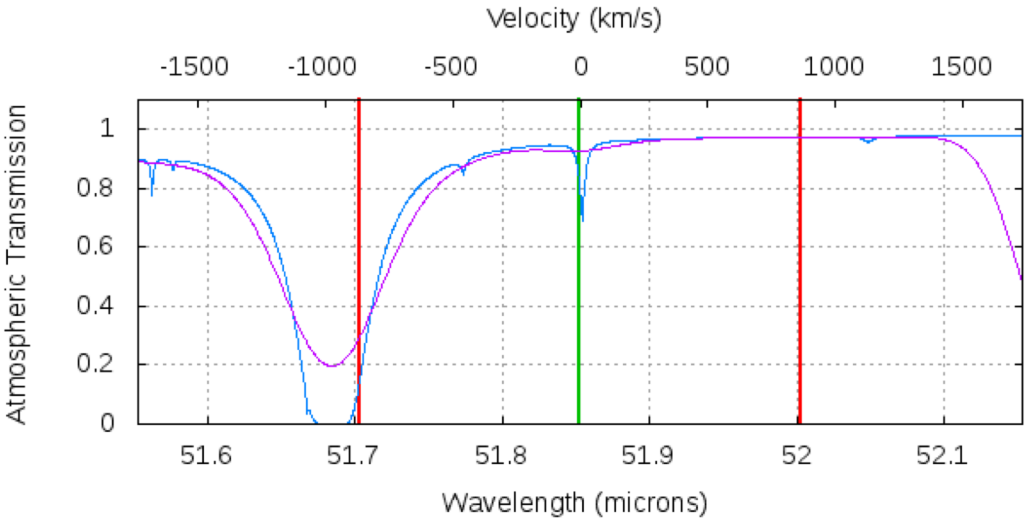
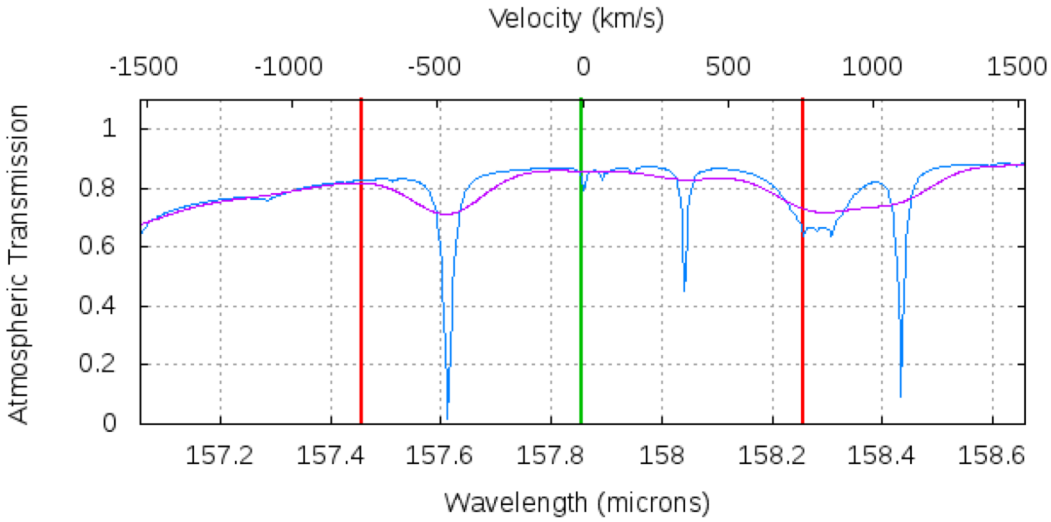
[OIII] 51.815 µm



[CII] 157.741 µm



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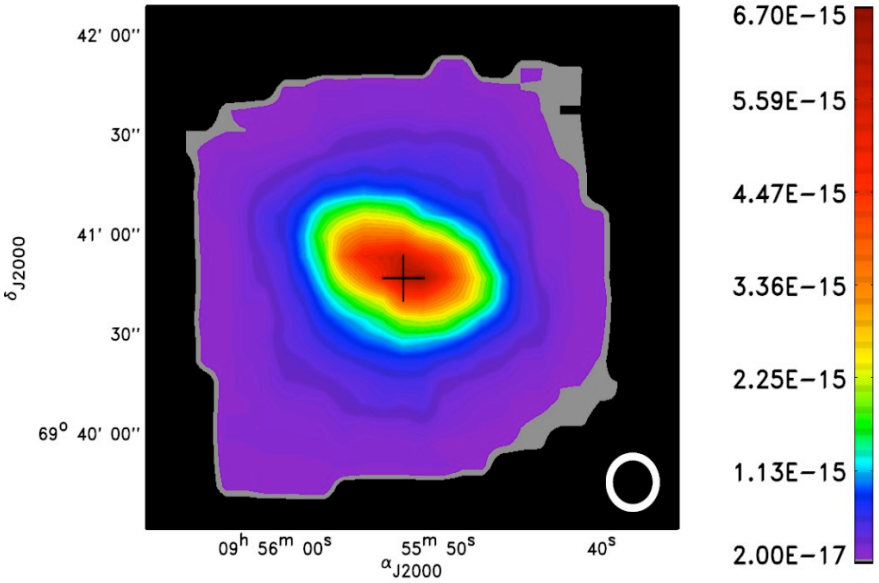
Example M82

- Flux estimates



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

[OIII] 52µm from ISO LWS:

- 10.4 W/m^2 e-14 per beam (80 arcsec)
- 7.4 W/m^2 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] 158µm 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

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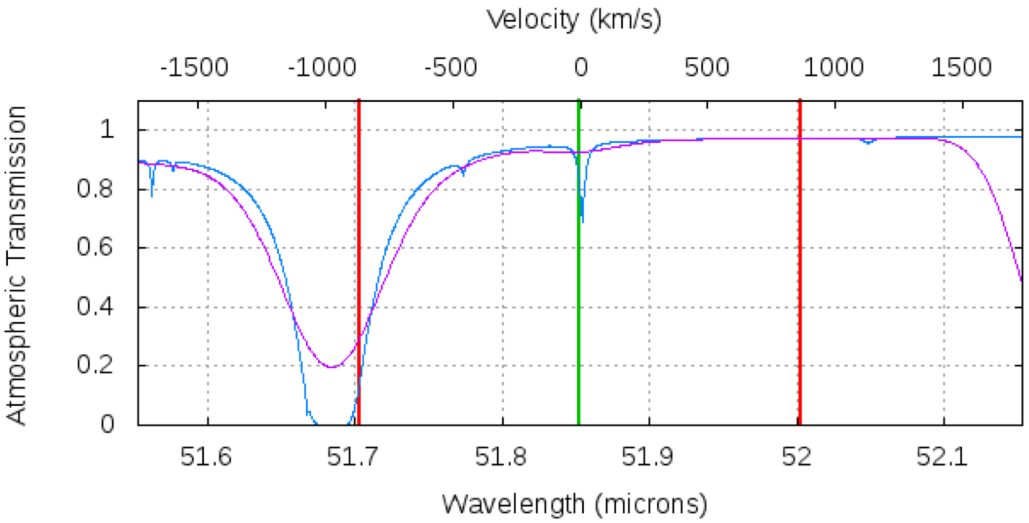
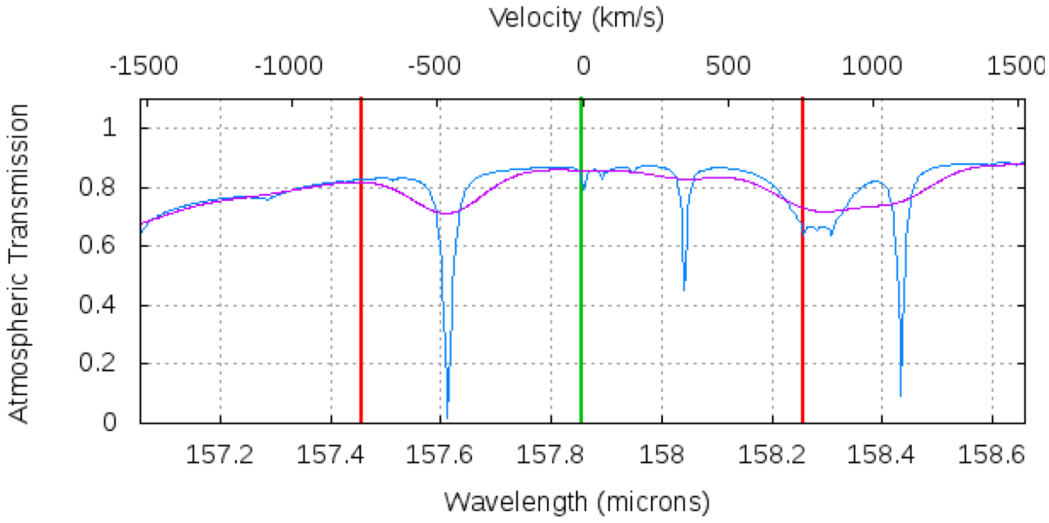
- How wide is my line
  - We have about +/- 750 km/s on the detector
  - FWHW of the Instrument is about 300 km/s
  - From PACS: Rotation ~ +/-150km/s ; Dispersion < 400km/s



[OIII] 51.815 µm



[CII] 157.741 µm

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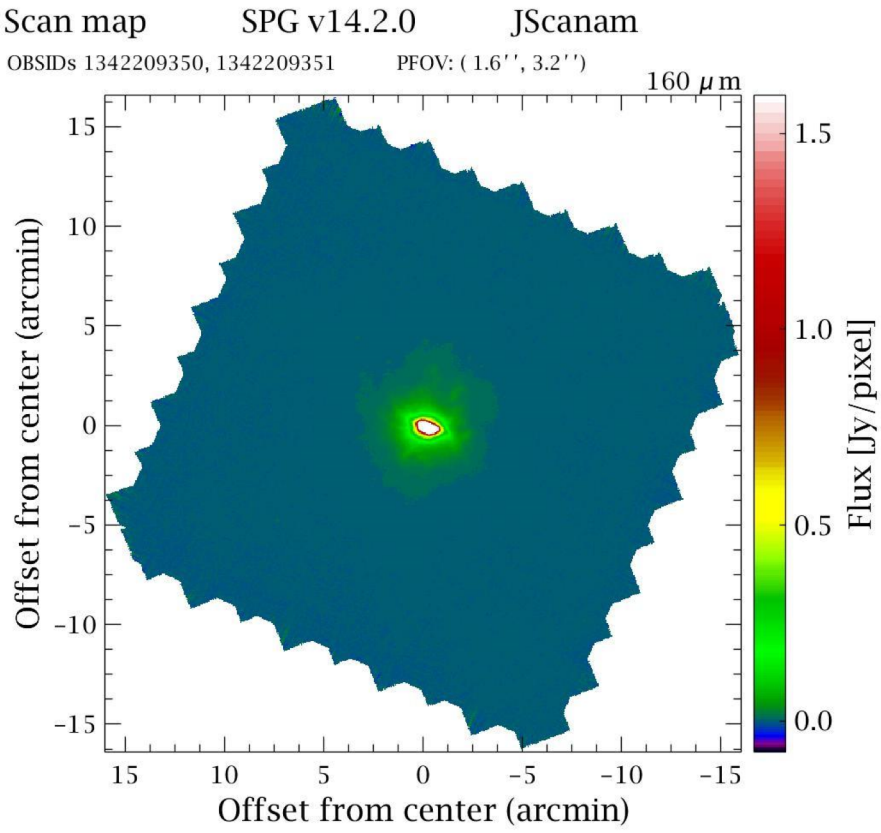
Example M82

- 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 lets look at the mapping area

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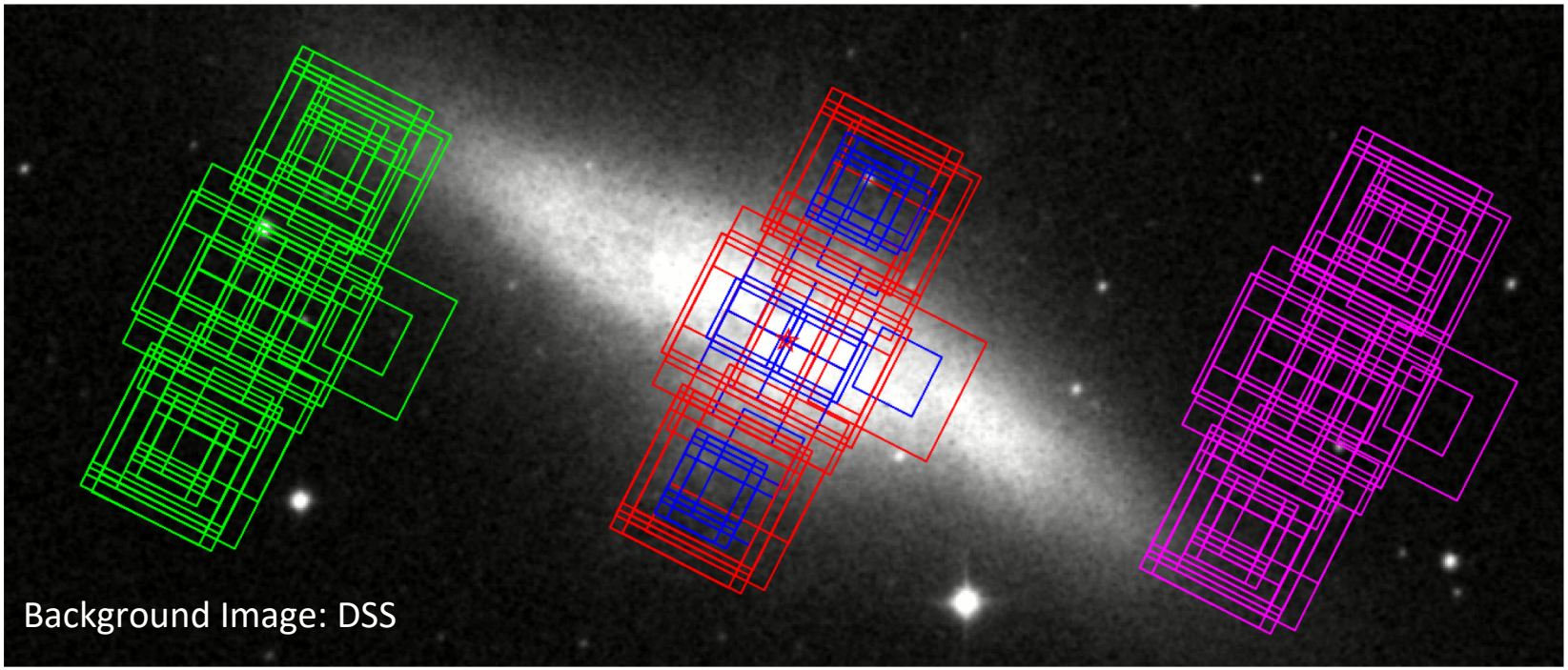

- Basically 2 maps
- Center for [OIII] will need about 2 fields and give us cross calibration with PACS [CII] for free
- Outflows for [CII]; ~ 2 fields; plus “intermediate” fields

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- 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