Stratospheric Observatory for Infrared Astronomy

Observing with FIFI-LS

Typical observing modes and how to use them

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- Integration time estimates
  - Spectral setup
  - Atmosphere

- Mapping
  - Dithering
  - Spatial sampling

- Chopper setup

The online time estimator:

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 :		

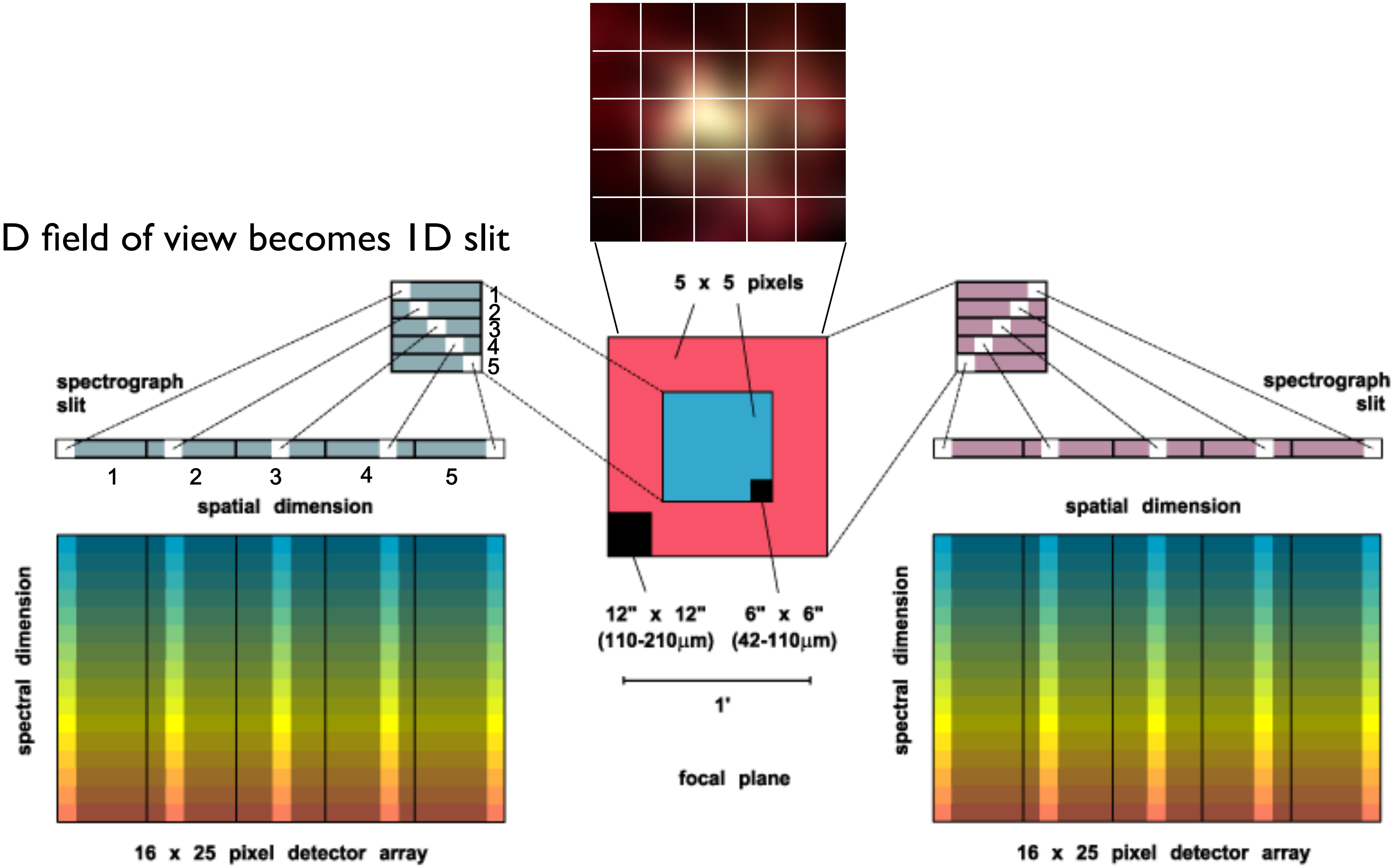
- per spatial pixel (“spaxel”)
  - 6’’x6’’ blue channel
  - 12’’x12’’ red channel

Be aware how FIFI-LS works spectrally

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

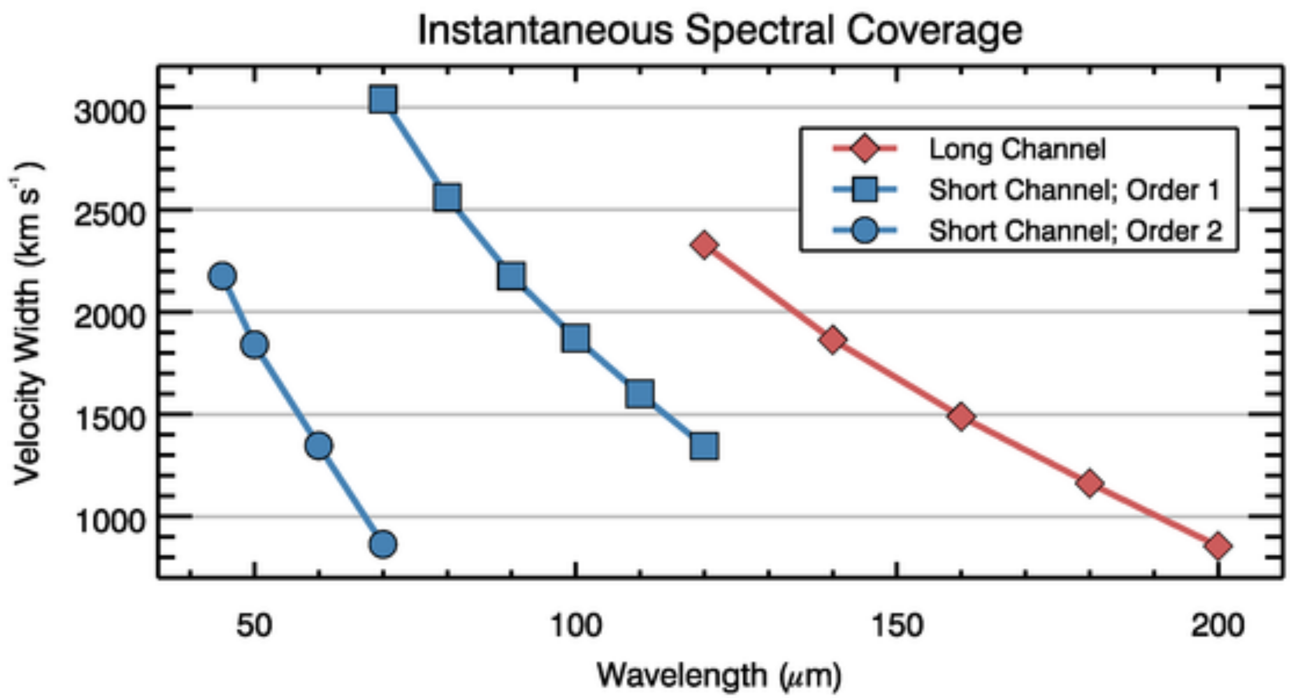
Be aware how FIFI-LS works spectrally

2D field of view becomes 1D slit



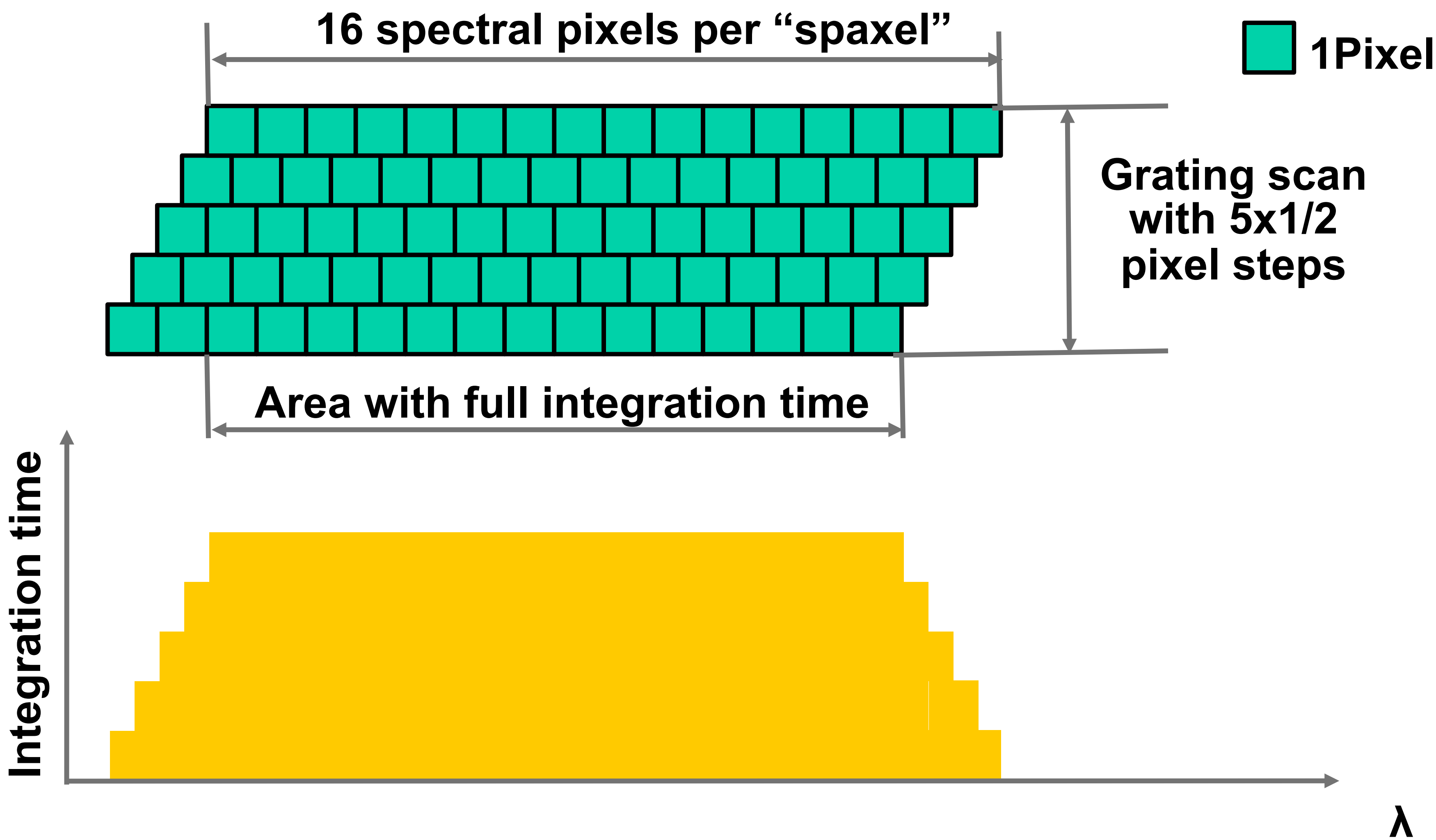
2D detector contains 3D data cube

Be aware how FIFI-LS works spectrally

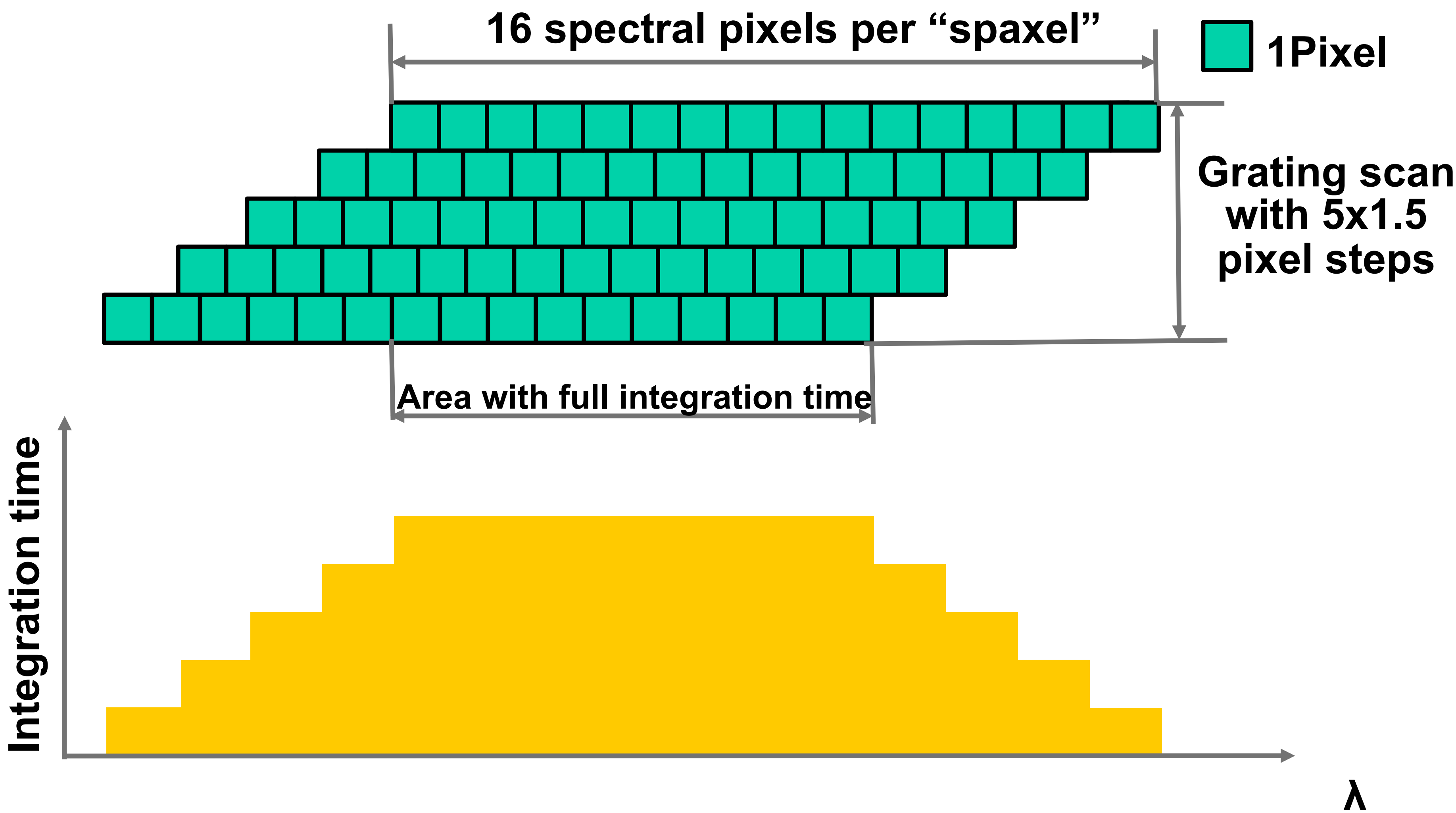


- **Instantaneous spectral coverage is fixed**

Be aware how FIFI-LS works spectrally



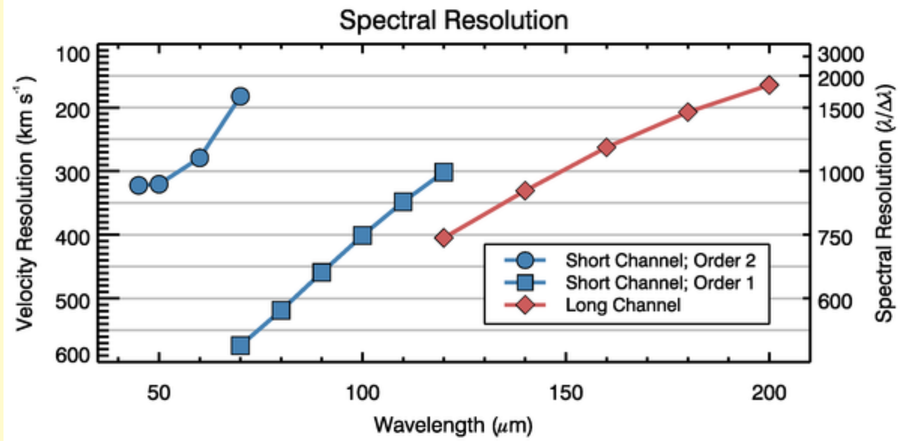
Be aware how FIFI-LS works spectrally



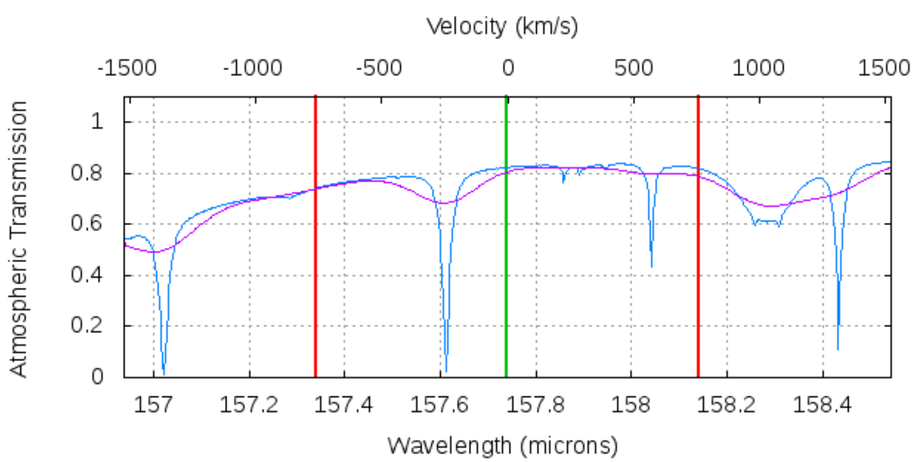
Observatory Altitude (in feet; < 60000 ft):	39000 ft		
Water Vapor Overburden (in microns; 0 if unknown):	0		
Telescope elevation (between 20 and 60 deg):	45		
Signal to Noise Ratio / Integration Time (s):	5 SNR		
Wavelength (in microns, between 40 and 200):	157.741		
Source :	2.087e-17 line (in W/m^2)		
Velocity correction (source VLSR, in km/s):	0		
Band width :	0 km/s		

List of derived values:

Velocity corrected wavelength (in microns):	157.741		
Plotted wavelength range (in microns):	156.938 - 158.544		
Interpolated values from data table :	Bandwidth =	0.803	microns
	MDLF =	2.087e-17	W/m^2
	MDCF =	0.570	Jy
Atmospheric Transmission :	0.807 (smoothed) 0.824 (unsmoothed)		
Integration time (t_on):	36.027 (smoothed) 34.555 (unsmoothed) minutes		



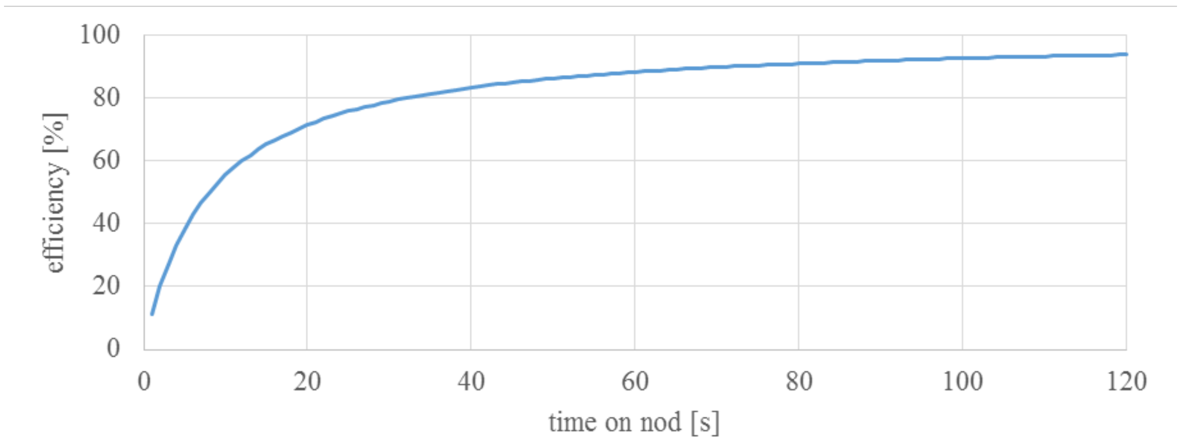
Plot of Atmospheric Transmission



- Blue: Atmospheric transmission as is
- Violet: Atmospheric transmission with FIFI-LS spectral resolution

Observing Modes

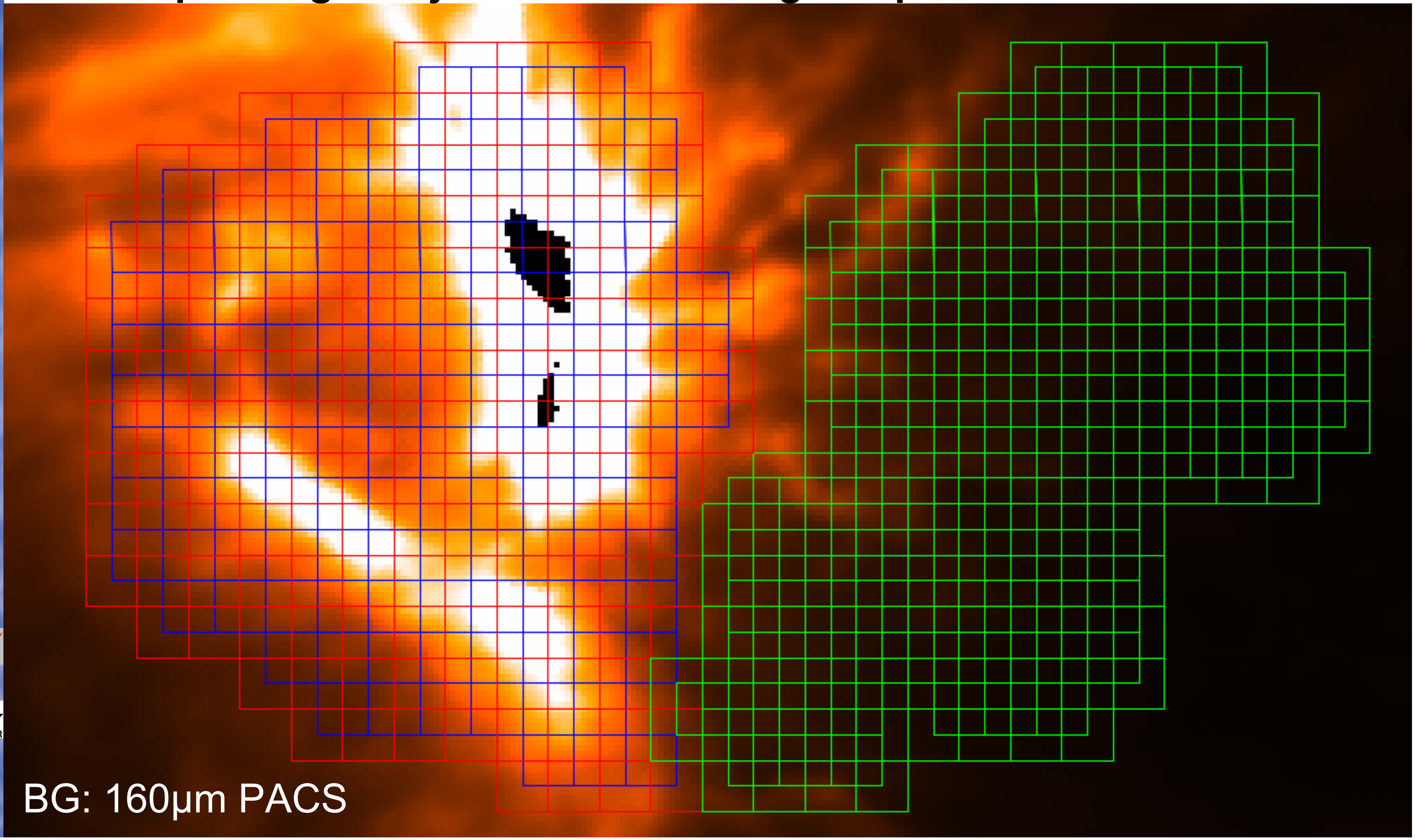
- Integration time is typically a multiple of:
  - 30s on source -> 76s with overheads (Symmetric chop)
  - 15s on source -> 57s with overheads (ABA asymmetric chop)
  - 10s on source -> 35s with overheads (AABAA asymmetric chop)
- SSPOT has a little more conservative values and a 5 min additional overhead per AOR



- Dominated by telescope move time

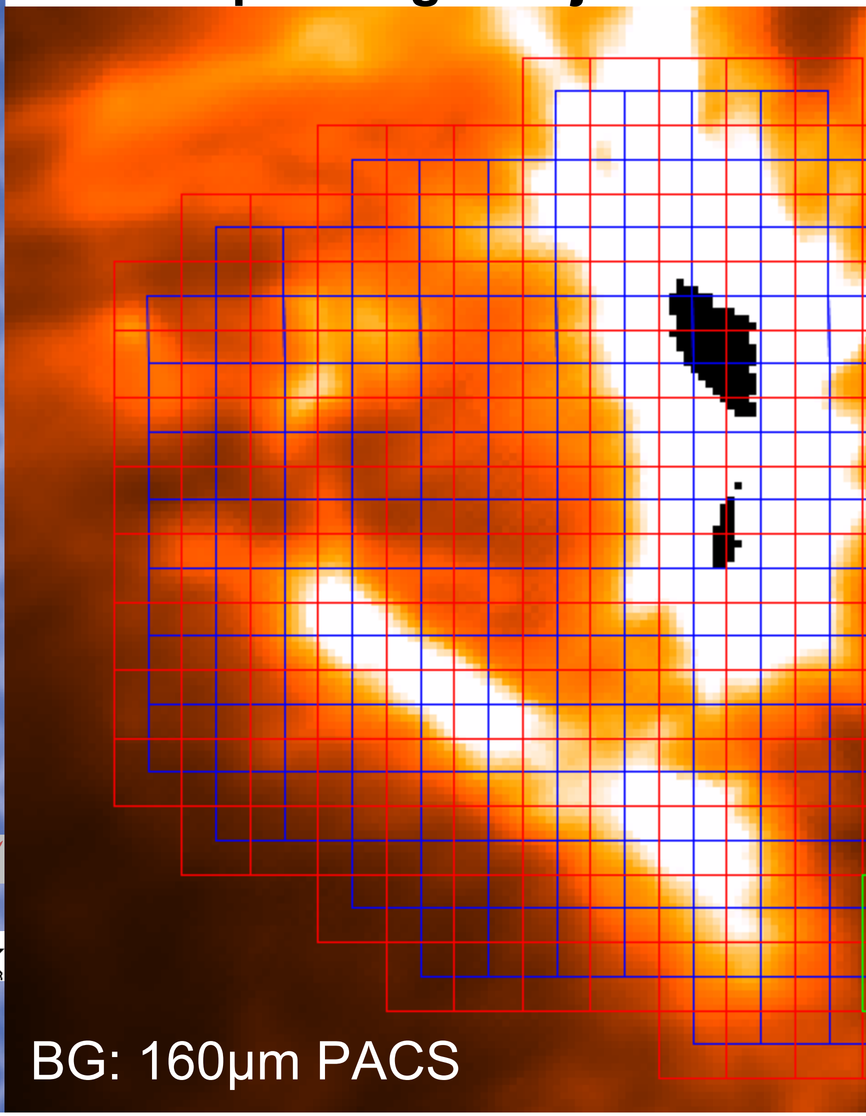
Observing Modes

- **Example: bright object mode for a large map**



Observing Modes

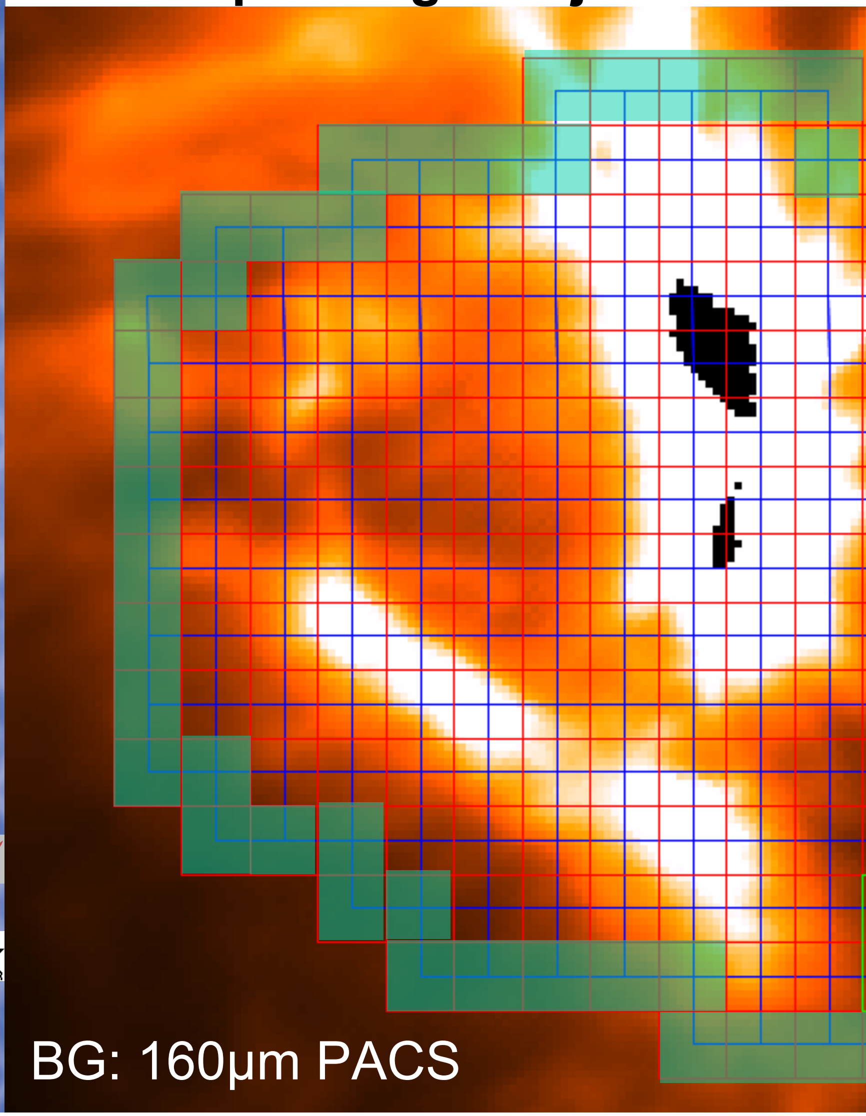
- **Example: bright object mode for a large map**



- **30'' raster**
- **10s on source per field**
- **Will yield 40s on source for red channel**
- **Be aware of outer area with half integration time and non ideal sampling**
- **3e-17 W/m² noise level (line flux per spaxel) for [CII] 157.741µm**
- **1.6e-16 W/m² noise level W(line flux per spaxel) for [OI] 63.184µm**
- **76 min total time (130 fields)**
- **Half pixel sampling in red channel**
- **full pixel sampling in the blue channel**
- **Half pixel sampling for blue channel recommended but would double the integration time**
- **Multiple chop setups**
  - **Please use PACS data for chop feasibility!**
  - **Please contact us for large throws!**
- **Total power reduction possible in case of self chopping**

Observing Modes

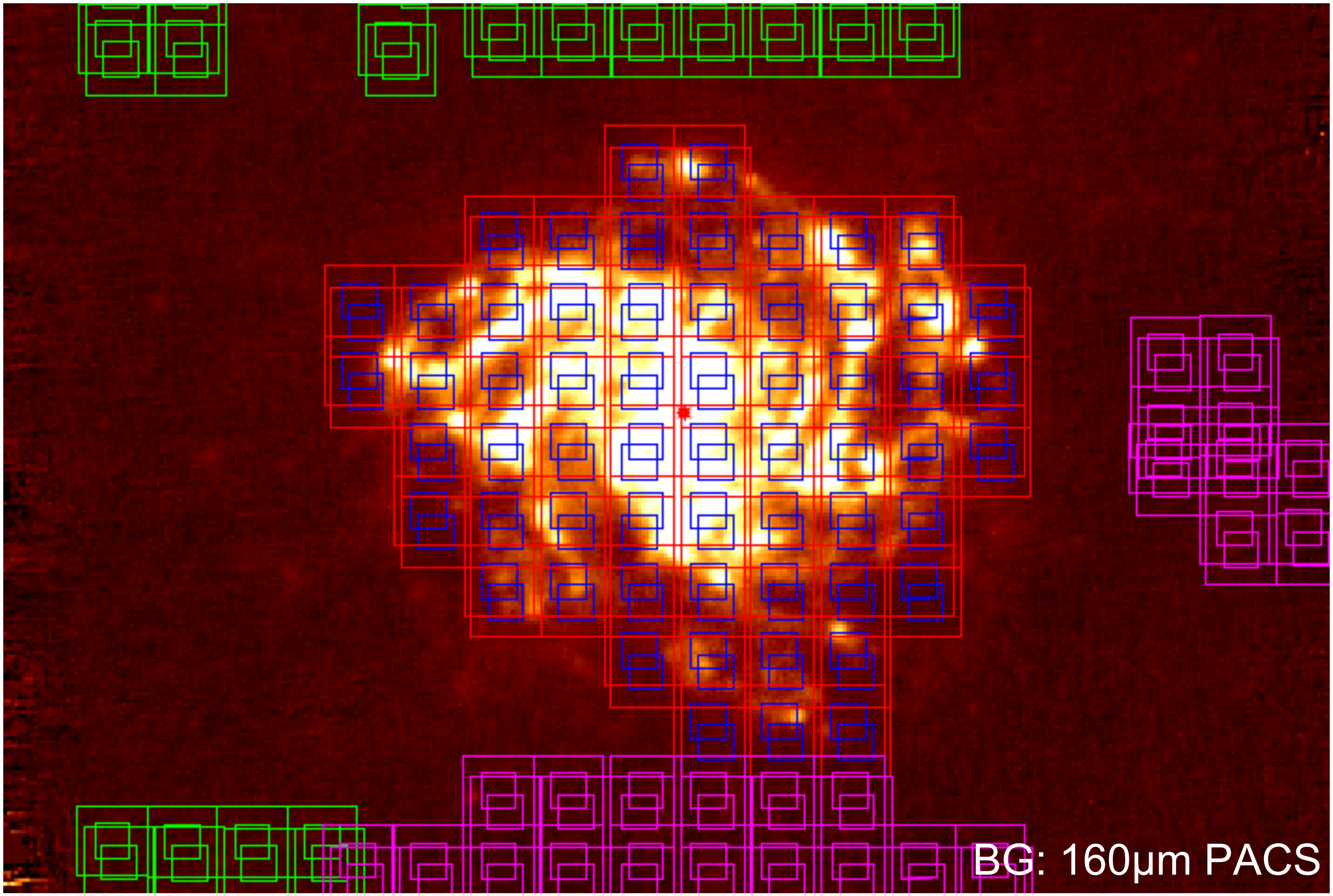
- **Example: bright object mode for a large map**



- 30’’ raster
- 10s on source per field
- Will yield 40s on source for red channel
- Be aware of outer area with 0.25-0.75 integration time and non ideal sampling
- 3e-17 W/m² noise level (line flux per spaxel) for [CII] 157.741µm
- 1.6e-16 W/m² noise level W(line flux per spaxel) for [OI] 63.184µm
- 76 min total time (130 fields)
- Half pixel sampling in red channel
- Full pixel sampling in the blue channel
- Half pixel sampling for blue channel recommended but would double the integration time
- Multiple chop setups
  - Please use PACS data for chop feasibility!
  - Please contact us for large throws!
- Total power reduction possible in case of self chopping

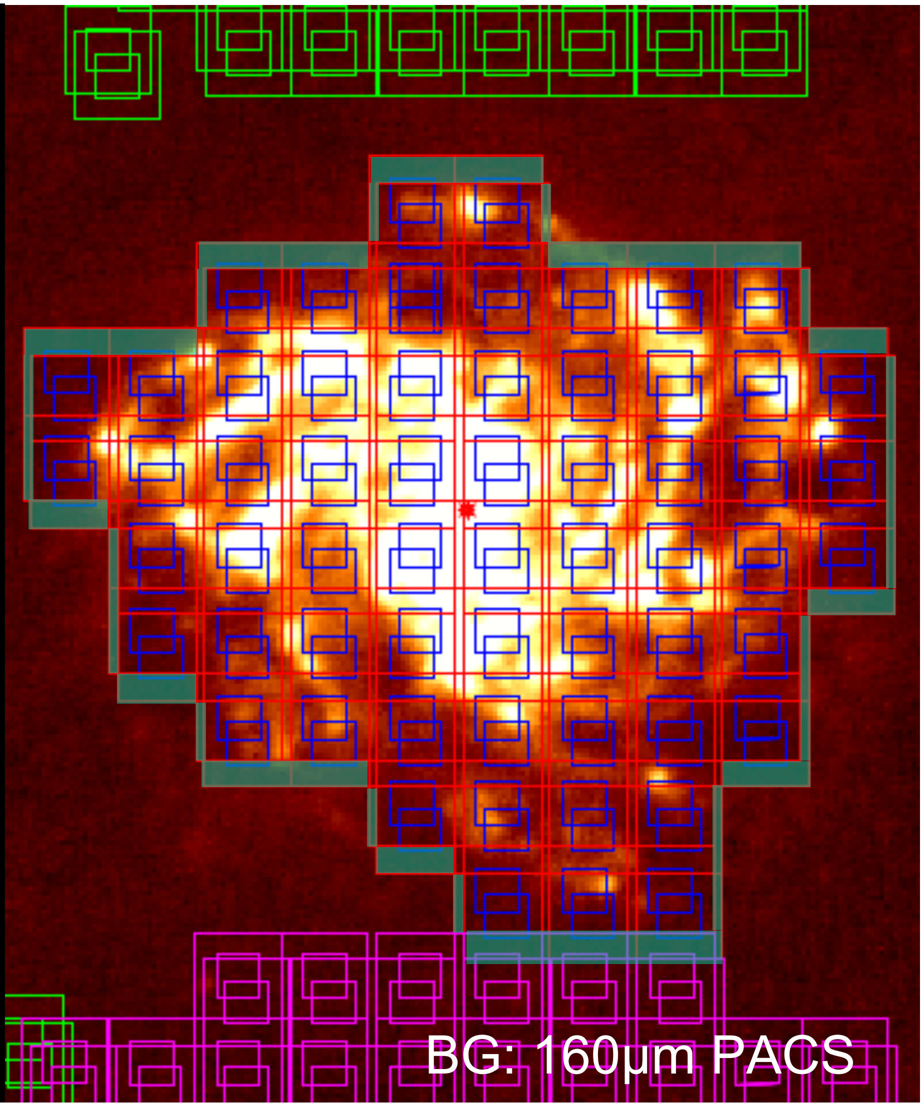
Observing Modes

- **Example: large map of a galaxy**



Observing Modes

- Example: large map of a galaxy
- 2 x 60'' raster
- Double coverage for the red map
- Incomplete coverage for the blue map
- Symmetric chop with 4 nod cycles per field (120s on source)
- 1.2e-17 W/m² noise level (line flux per spaxel) for [CII] 157.741μm
- 10h total time (120 fields)
- Half pixel sampling in red channel
- Be aware of outer area with half integration time and non ideal sampling
- Multiple chop setups
  - Please use PACS data for chop feasibility!
  - 8 arcmin total throw will potentially degrade blue channel image quality
- Possible alternative:
- 30'' raster -> 240 fields -> 90s on source -> 1e-17 W/m² noise -> 15h



Observing Modes

- Spatial dithering
  - Things get easier for deeper integrations
    - More time to use nod cycles for new positions
    - Example: 4'',4'' ; 0'',0'' ; -4'',-4''
    - Will result in 2''/4'' sampling for blue/red channel