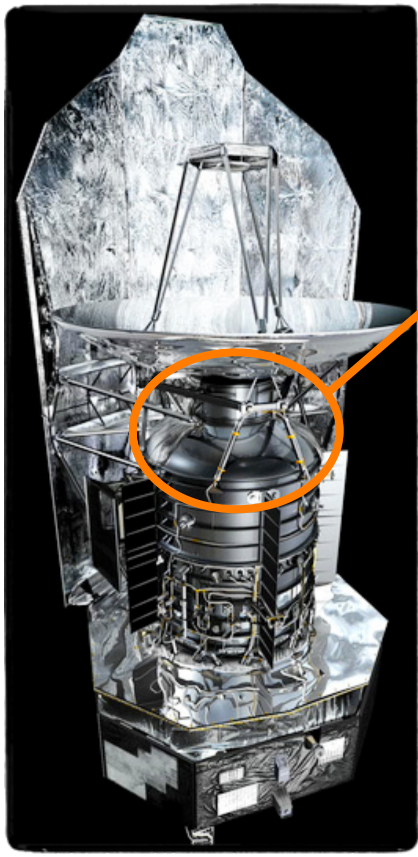
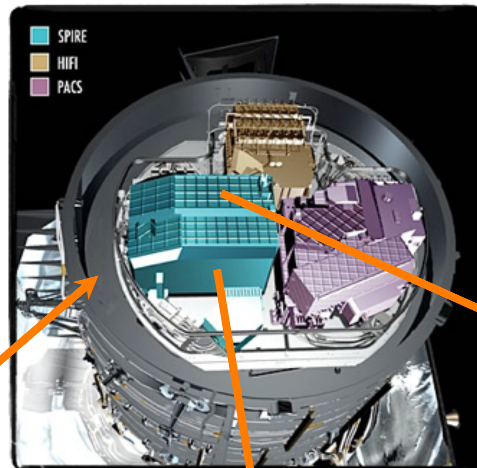
SPIRE Instrument Spectrometer Overview

Bernhard Schulz (NHSC/IPAC)

on behalf of the
SPIRE ICC, the HSC and the NHSC

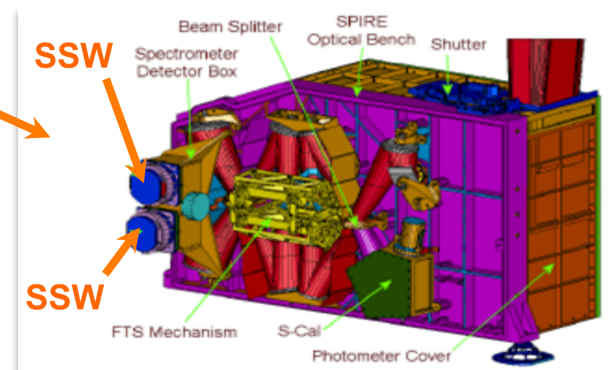
The Instrument

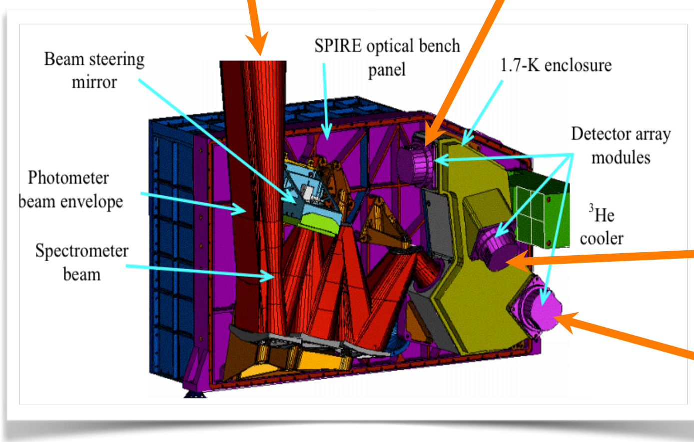




Imaging Fourier Transform Spectrometer

Simultaneous imaging observation of the whole spectral band
37 and 19 pixels
Wavelength Range: 194-313, 303-671 μm
(447 – 989 GHz, 959 – 1545 GHz)
Resolution: 24.98, 7.207, 1.193 GHz
Circular FOV 2.0' diameter, beams: 17-21", 29-42"





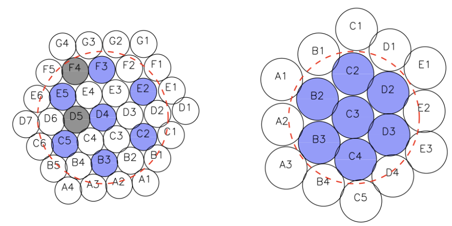
Imaging Photometer

Simultaneous observation in 3 bands
139, 88, and 43 pixels
Wavelengths: 250, 350, 500 μm
$\lambda/\Delta\lambda \sim 3$
FOV 4' x 8', beams 17.6", 23.9", 35.1"

Bolometer Arrays Projected on the Sky

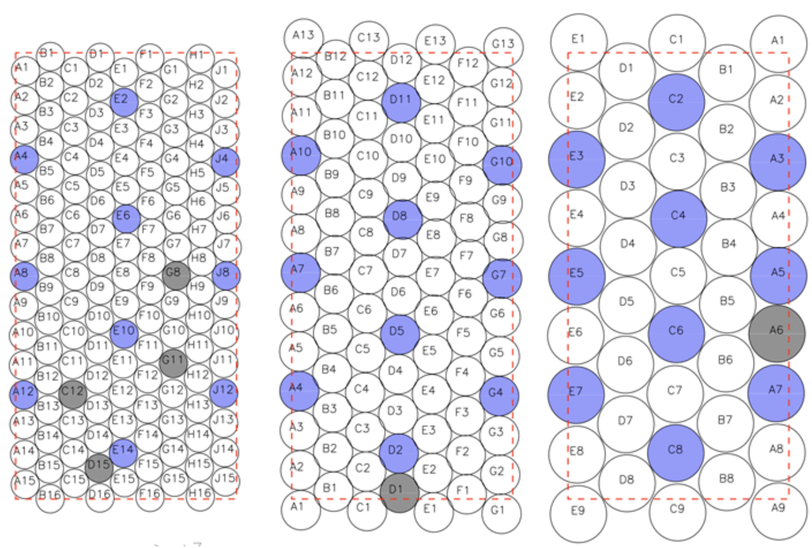
Feedhorn arrays

SSW SLW



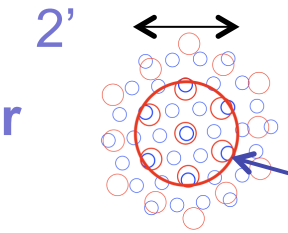
Beams: 16.8”..21.1” 37.3”..42.0”

PSW PMW PLW



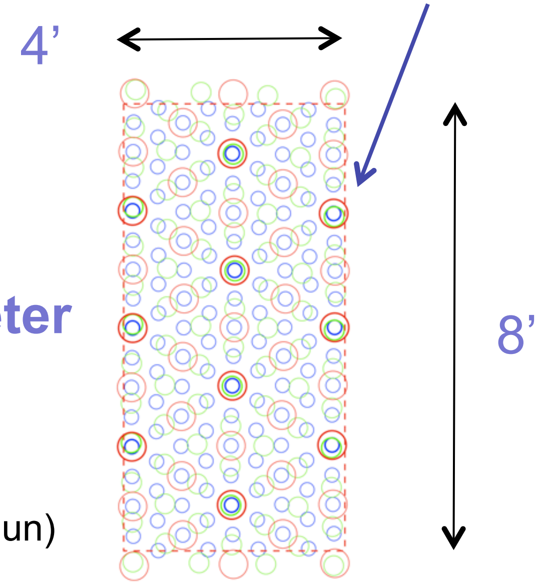
Beams: 18.3” x 17.0” 24.7” x 23.2” 33.4” x 35.1”

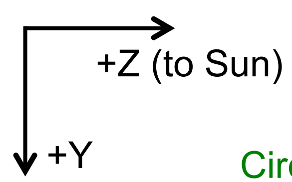
Spectrometer



Overlapping beam profiles as projected on the Sky.

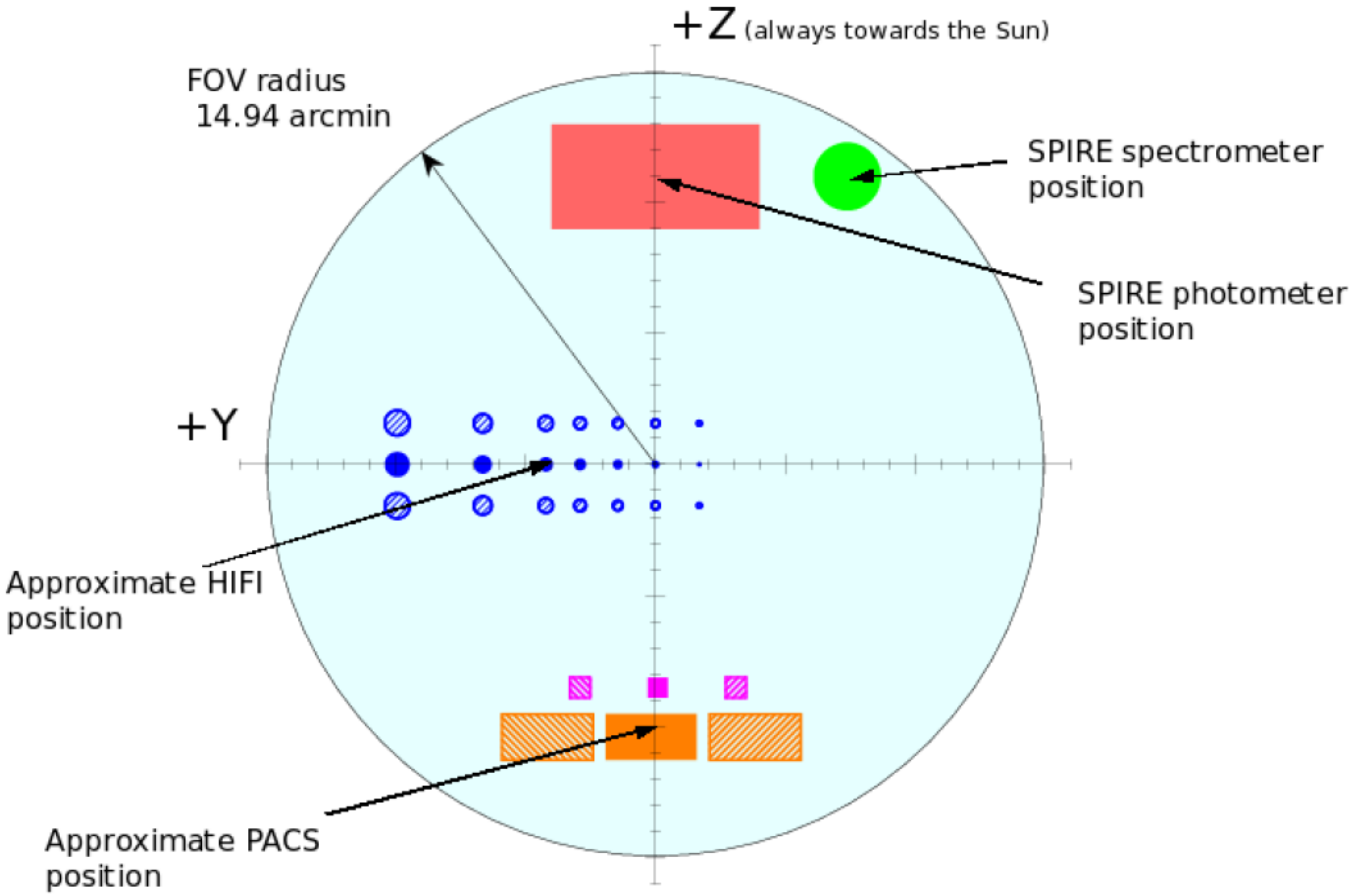
Photometer



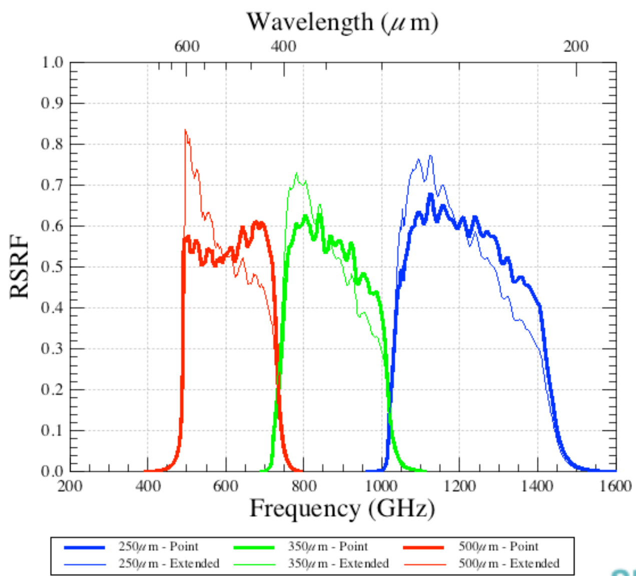


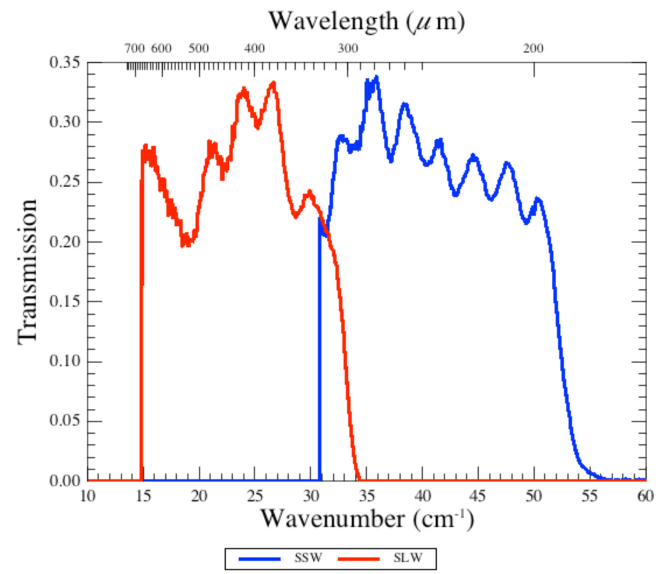
Circles in diagrams to the right show FWHM of detector beam profiles

SPIRE in the Herschel Focal Plane



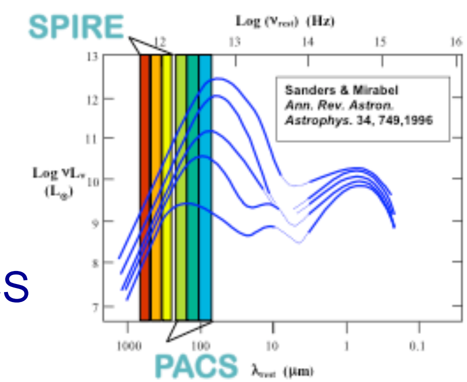
SPIRE Wavelength Coverage



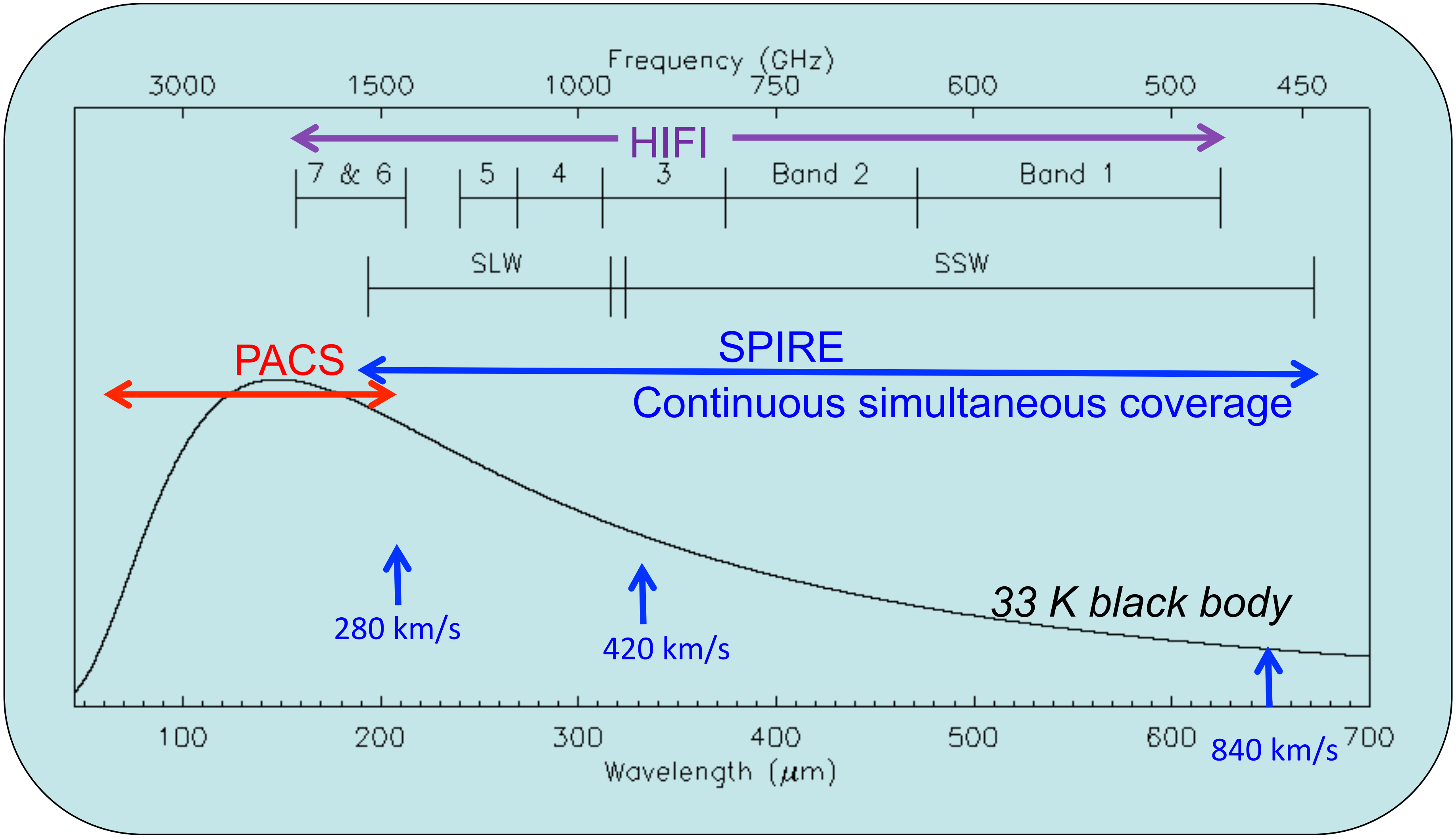


Photometer

Spectrometer

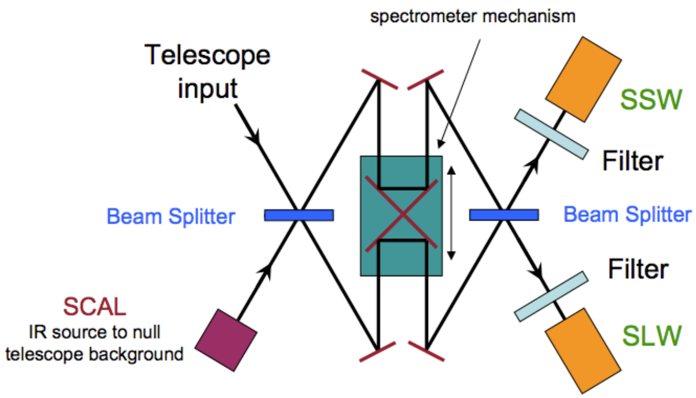


Complementary to PACS

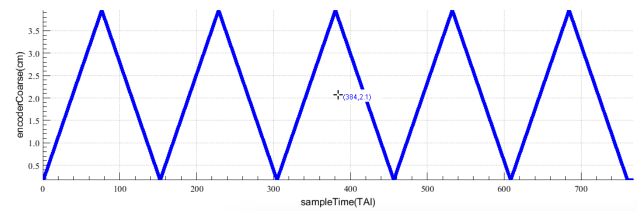

Frequency (GHz)
3000
1500
1000
750
600
500
450
HIFI
7 & 6
5
4
3
Band 2
Band 1
SLW
SSW
PACS
SPIRE
Continuous simultaneous coverage
280 km/s
420 km/s
33 K black body
840 km/s
100
200
300
400
500
600
700
Wavelength (μm)

Spectrometer Observing Modes

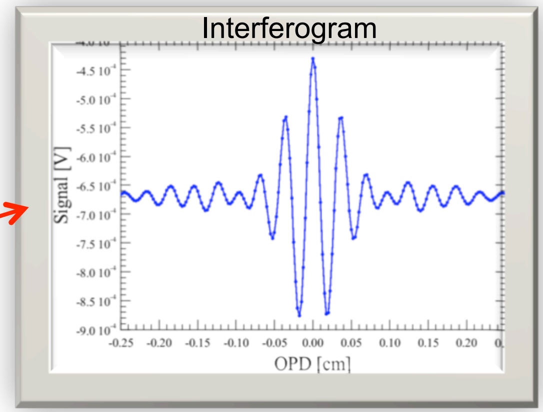
Fourier Transform Spectrometer (FTS)

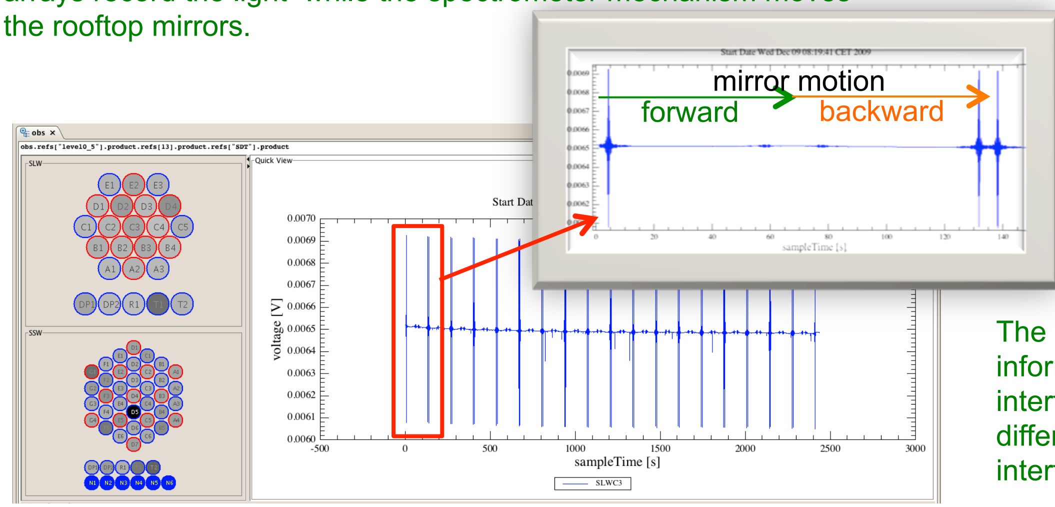


The rooftop mirrors are moved back and forth, changing the optical path length of both branches relative to each other.



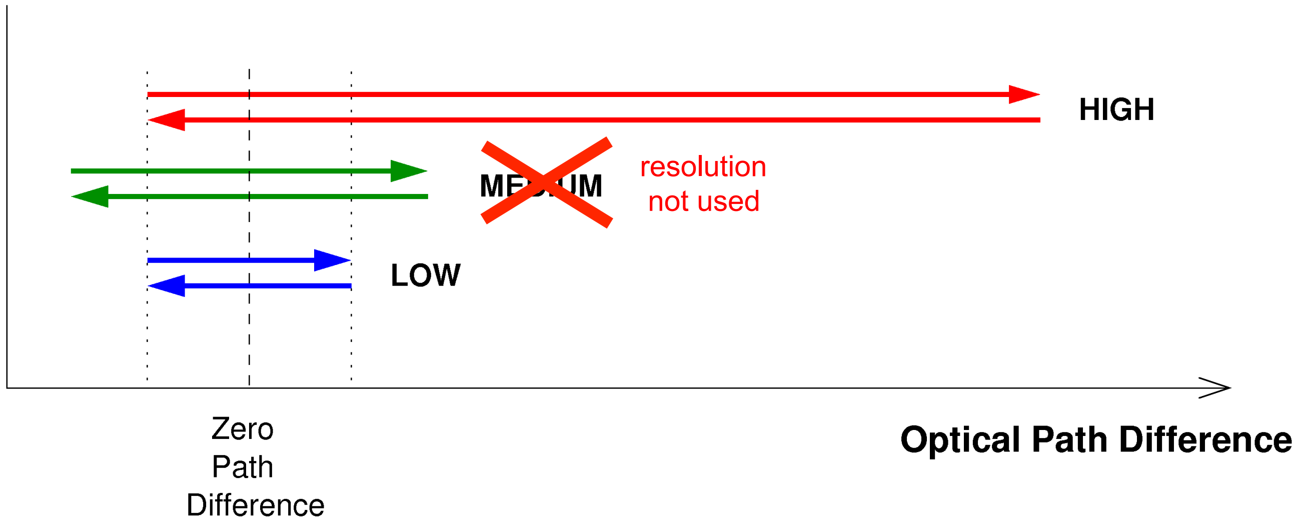
Light from the telescope is split into two optical pathways and interferes with itself at the second beam splitter. Two detector arrays record the light while the spectrometer mechanism moves the rooftop mirrors.





The detectors record intensity versus time. With sensor information from the mechanism this data is turned into interferograms, i.e. intensity depending on optical path difference (OPD). A discrete Fourier Transform turns interferograms into spectra.

Spectral Resolution



The spectral resolution, $\Delta\sigma$, depends on the maximum scan length L:

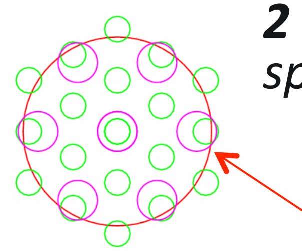
High Res: $\Delta\sigma = 1/(2L)$, where L =12.8 cm

FTS Spatial Sampling Modes

Point source spectroscopy (SOF1):

2 beam *spacing*

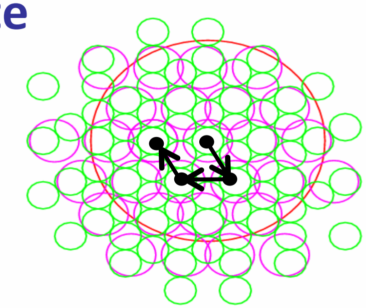
Sparse



2' circle

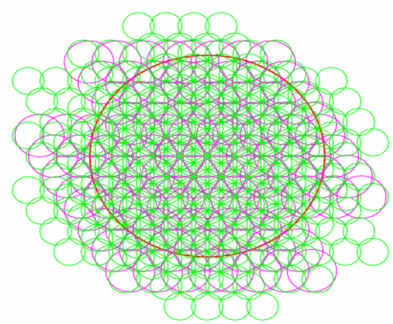
Jiggle Mapping (SOF2):

Intermediate



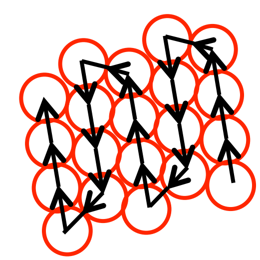
1 beam spacing (4 jiggle positions)

Full

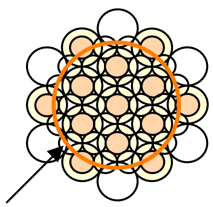


1/2 beam spacing (16 jiggle positions)

Raster Mapping (SOF1 or SOF2):



Spectrometer Observing Modes



unvignetted beam

Overlapping spectrometer arrays projected on the sky

Spatial Sampling

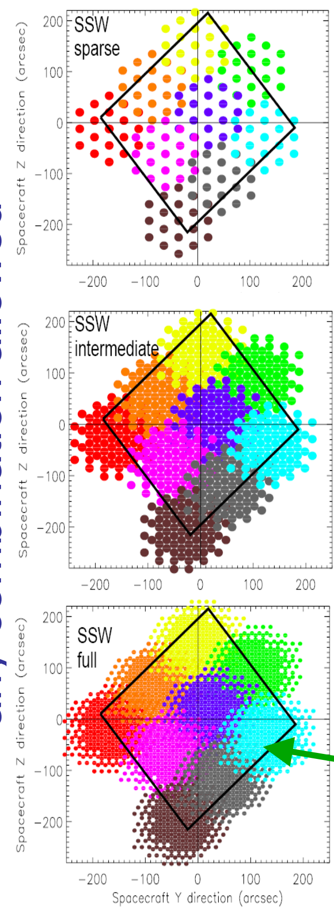
- **Sparse** (2 beam spacing)
- **Intermediate** (1 beam spacing)
- **Full** (1/2 beam spacing)

Telescope Pointing Mode

- **Single Pointing**
- **Raster Pointing**

any combination allowed

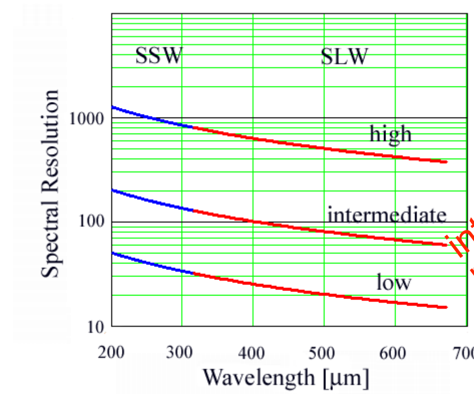
Example:
3 x 3 raster map



Each color shows the unvignetted beams of the same array for all sampling positions (jiggles) at one raster position.

Spectral Resolution

- High: 1.2 GHz (R = 1290-370)
  - suitable for line fluxes
- Low: 25 GHz (R =62-18)
  - suitable for dust continuum
- High & Low
  - Both high and low scans



intermediate res. not used