SPIRE point source and jiggle-map observations

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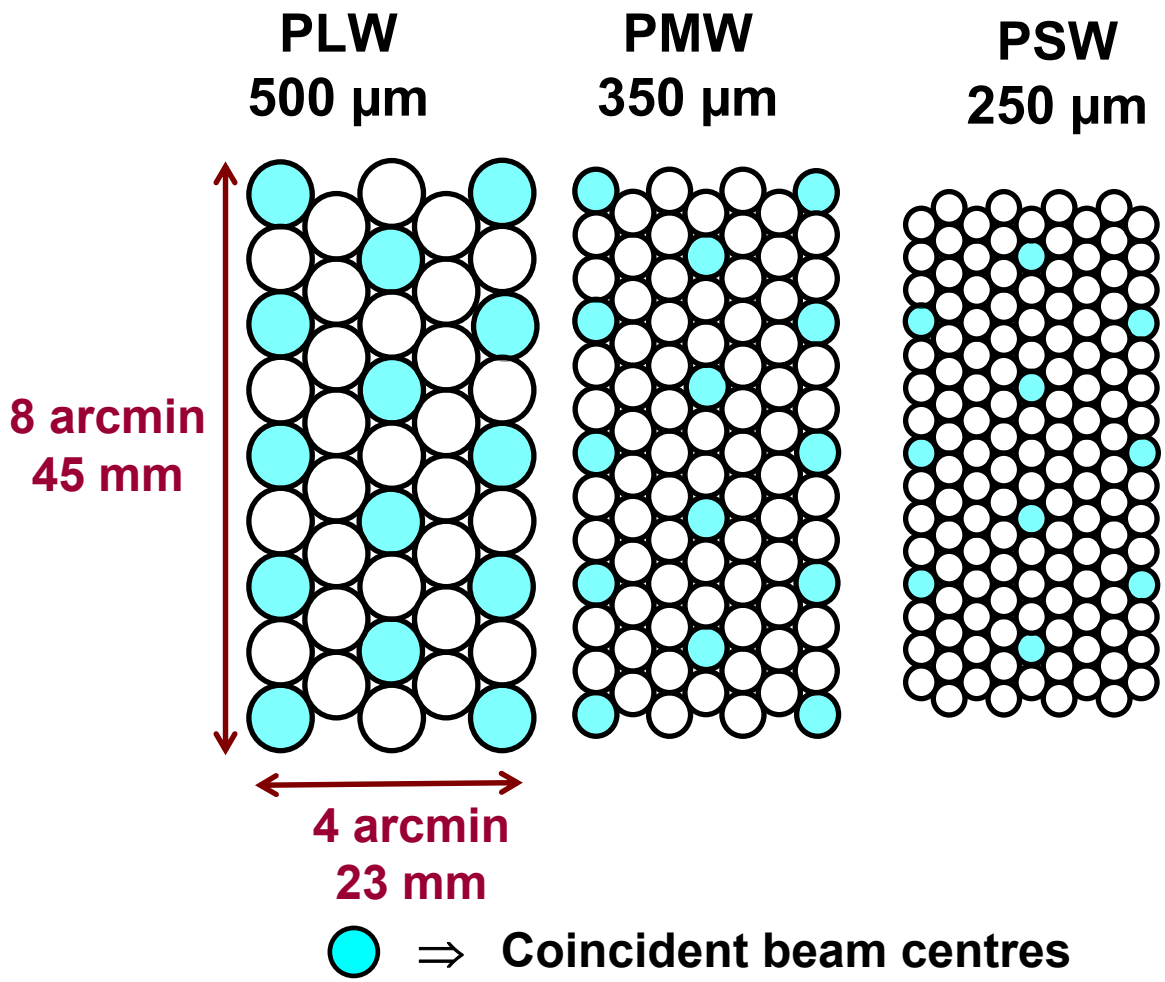
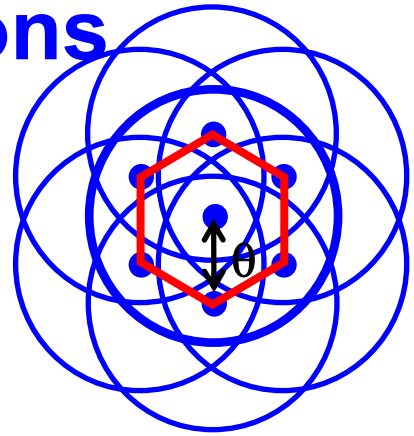
SPIRE Photometer Overview

- 3-band imaging photometer
  - 250, 350, 500 μm (simultaneous)
  - λ/Δλ ~ 3
  - 4 x 8 arcmin field of view
  - Diffraction limited beams (18, 25, 36")

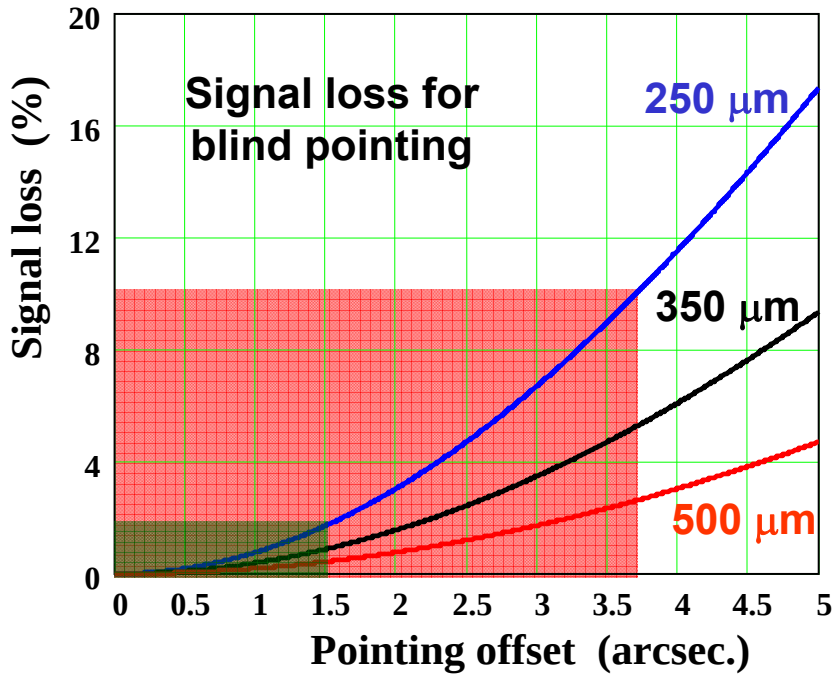


Point Source Observations



- 7-point map (+ repeat the central point)
- Angular step θ ~ 6 arcsec (> pointing or positional error)
- Total flux and position fitted
- Compared to single accurately pointed observation, S/N for same total integration time is only degraded by

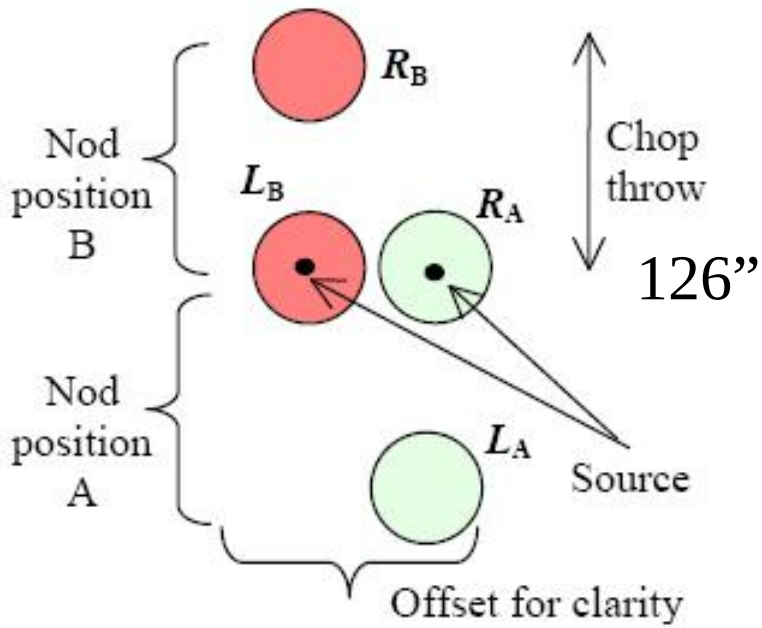
  ~ 20% at 250 μm
  ~ 13% at 350 μm
  ~ 6% at 500 μm



Chopping and Nodding

- **Chop with BSM to get a difference signal (background + source in one, just background in the other).**
- **Nod TELESCOPE to remove asymmetries in optics and in background thermal radiation field (the telescope).**
- **Note, always observing the source**

BSM=Beam Steering Mirror=Chopper



Chopping and Nodding (2)

- Each jiggle position is chopped (2 Hz, 16 cycles) while at nod at position A (total=64 s).
- Then telescope moves to nod position B
- Repeat chopped jiggle.
- Repeat chopped jiggle at nod B.
- Repeat chopped jiggle at nod A

The SPIRE Standard Point Source Observation

- Number of Repeats: 1 (1 ABBA cycle)
- On-source integration time : 256 s
- Instrument and observing overheads: 143 s
- Observatory overhead: 180 s
- Total Observation time: 579 s

- 1-σ noise (250, 350, 500): (1.4, 1.6, 1.3) mJy
- Note this produces an rms flux density limits that are already lower than the extragalactic confusion limits.

Some Points to Note

- The seven-point jiggle sensitivity assumes the ideal case in which the source is on-axis.
- A sparse (undersampled) map of a roughly 2 x 4 arcminute region around the source will also be generated by seven-point observations.

- Data will be fitted to find the flux density and position of the source.
- For faint sources
  - the flux density should be accurate but it will have low S/N
  - fitting the position will not be very meaningful

Jiggle/Small Map Observation

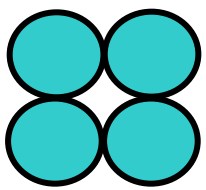
- As SPIRE arrays are not fully filled a 64-point “jiggle” pattern is performed to get full spatial sampling

  (16 points per AB cycle, 4 chop cycles per point)
- Chopping (and nodding) to 4 arcmin amplitude
- Available field of view = 4 x 4 arcmin
- Guarantees an area 4 arcmin diameter circle

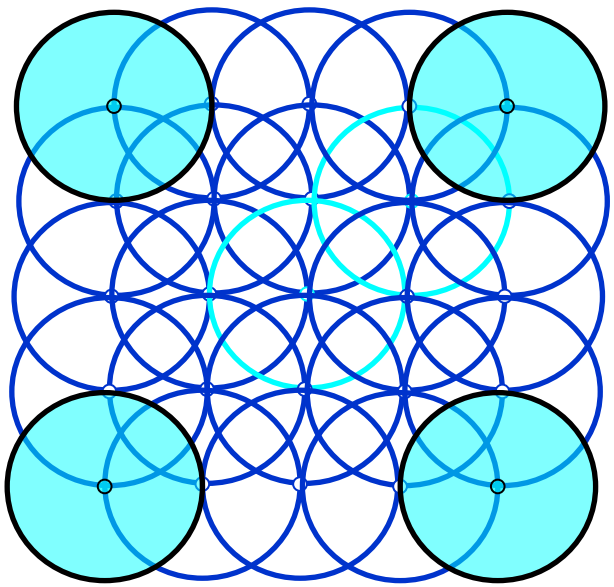
Sky Sampling with 2Fλ Feedhorn Arrays

Full sampling of the image require scanning or "jiggling" of the telescope pointing

Feedhorns adjacent in the focal plane



But FWHM beams on the sky don't overlap



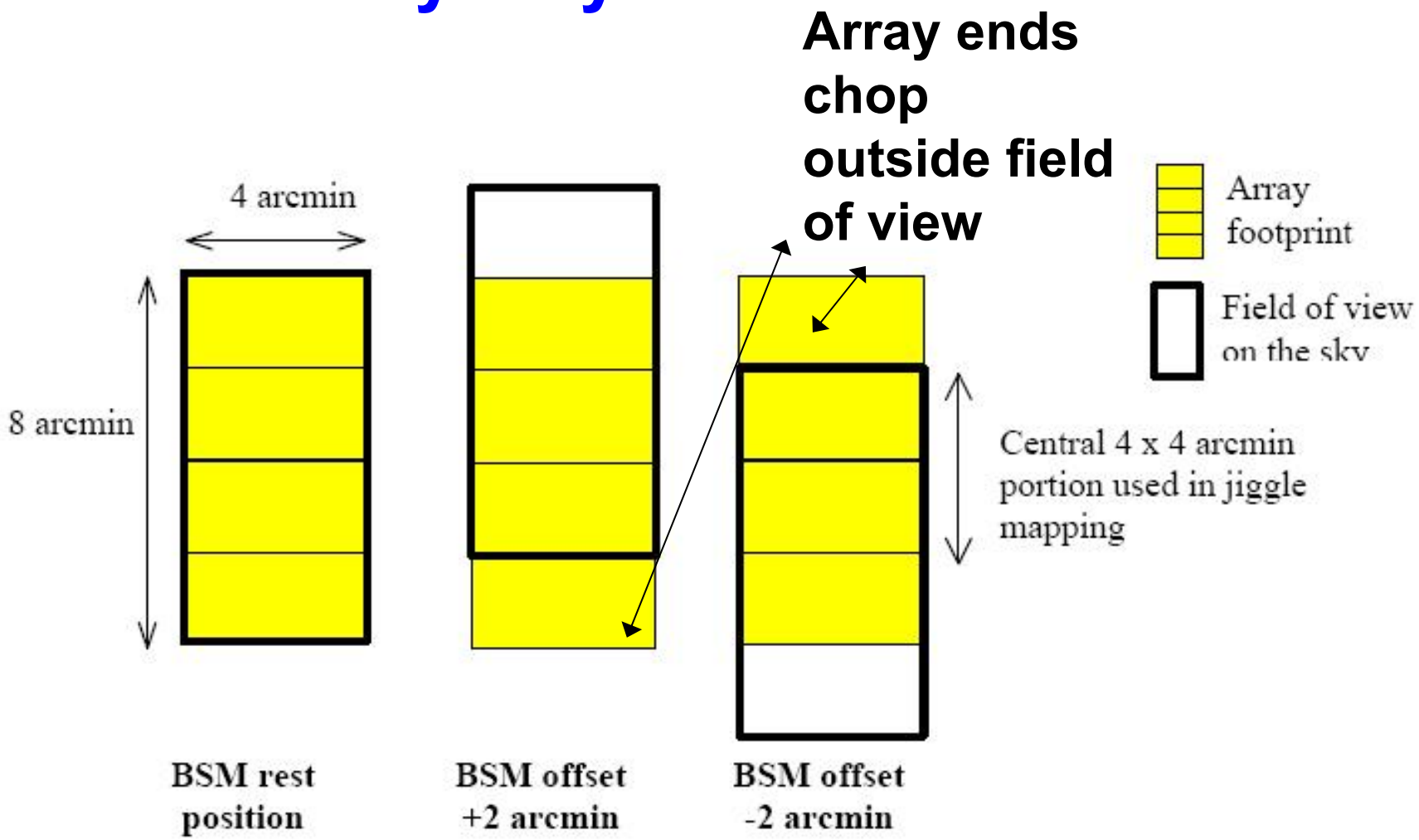
Beam FWHM ≈ λ/D

Beam separation ≈ 2λ/D

16 pointings needed for fully-sampled image

Chopping Outside Field of View

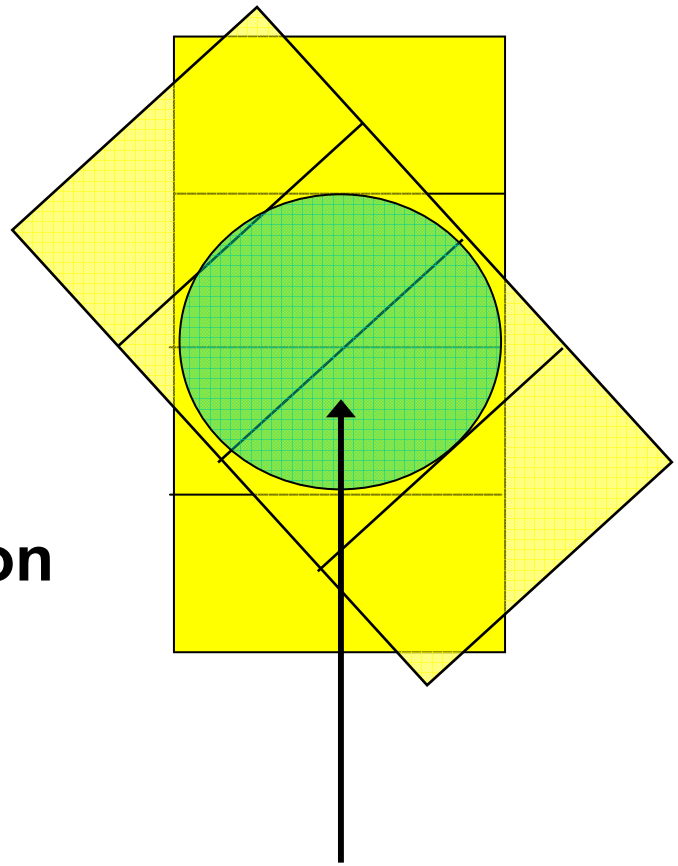
Why only a 4 arcmin area



Array orientation

Why only a 4 arcmin circle

- Array orientation on sky depends on date of observation
- Guaranteed area of 4 arcmin diameter circle
- Note for sources near the ecliptic the array orientation on the sky is fixed



Standard Observations

Number of repeats:	1 (1 AB cycle)
On-source integration time:	256 s
Instrument and observing overheads:	251 s
Observatory Overhead:	180 s
Total time=	687 s
1-σ noise (250, 350, 500):	(4.7, 6.3, 5.3) mJy

Number of repeats:	2 (1 ABBA cycle)
On-source integration time:	512 s
Instrument and observing overheads:	443 s
Observatory Overhead:	180 s
Total observation time:	1135 s
1-σ noise (250, 350, 500):	(3.3, 4.5, 3.8) mJy

Note that the 1-σ noise is below the confusion noise limit with one repeat. So one repeat should be adequate for most small map observations

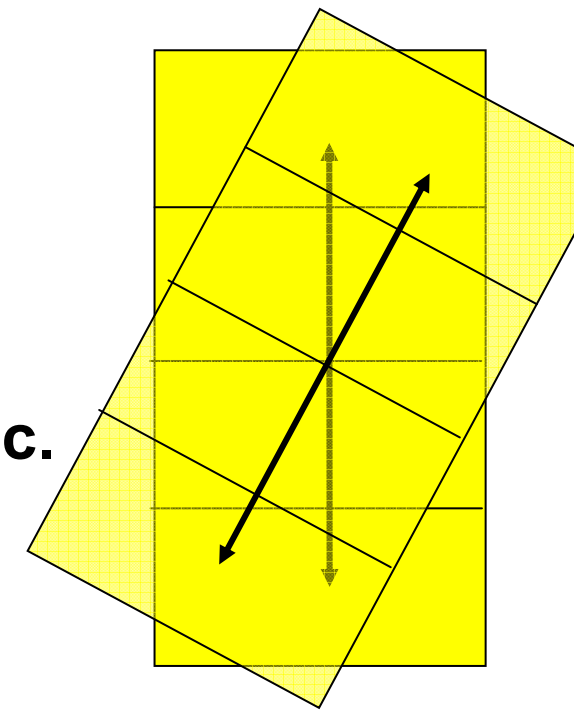
Small Map Data Products

- Jiggle (Small) Map observations produce a product of a fully sampled map
- It is assumed that there is nothing in the reference beam.

Chop Constraint

- **Point Source and Small Map have the option to constraint the chopping, this allows the user to avoid chopping onto a bright source.**
- **Effectively a scheduling constraint hence the observatory overhead is increased to 600 s.**
- **The angle range and the range +180 degrees will be avoided.**
- **Note that the array projection on the sky does not change near the ecliptic.**

Chop/nod direction



More Details

- **Refer to the AO documentation for more details, including HSpot examples and how to implement observations:**
- **SPIRE Observers' Manual**

http://herschel.esac.esa.int/Docs/SPIRE/html/spire_om.html

Specifically:

- **Chapter 3,** Chapter 3 ("*General Performance*")
- **Chapter 4,** Section 4.1 ("*Photometer AOT Modes*")
- **Chapter 6,** Sections 6.3 and 6.5

("*HSpot Components for Setting up a SPIRE Photometer Observation*" and Example Photometer Observations)