



PACS photometer mapping

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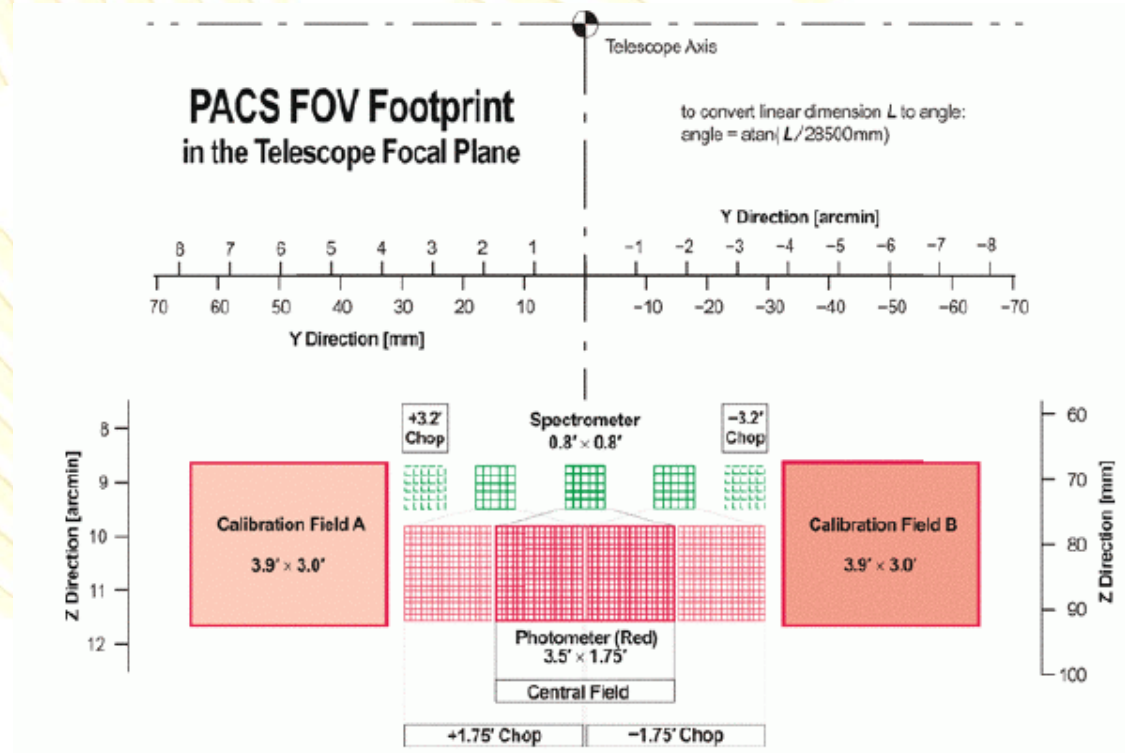
Astronomy Science Operations Division
Research and Scientific Support Department

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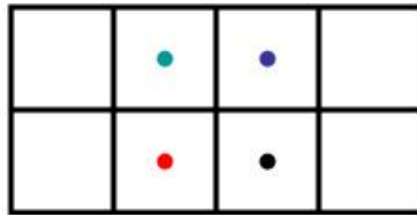
PACS photometer

- Relatively small rectangular 2x1 footprint, FOV = 3.5'x1.75'
- 2 channels simultaneously imaged :
 - Blue channel 64x32 array, pixel size = 3.2", 60-85 μm or 85-130 μm
 - Red channel 32x16 array, pixel size = 6.4", 130-210 μm

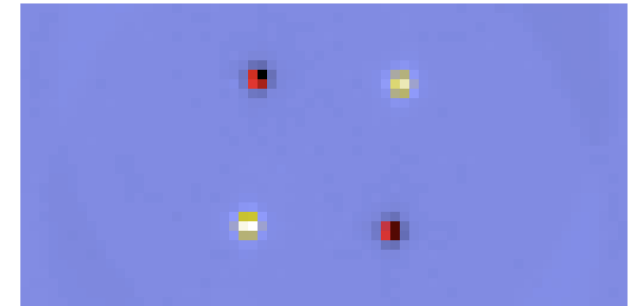
- On-board readout frequency : 40Hz
- On-board averaging, downloaded frequency : 10Hz



Point-source and small-sources modes

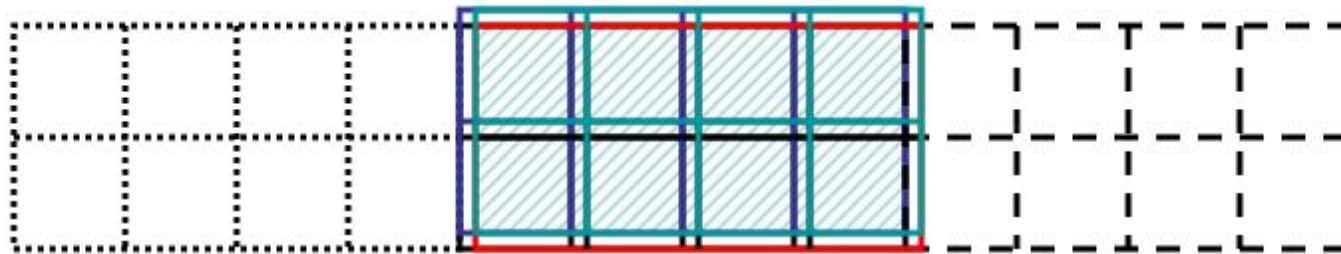


Nod 1 chop A
 Nod 1 chop B
 Nod 2 chop A
 Nod 2 chop B



$(\text{nod1 chop A} - \text{nod1 chop B}) - (\text{nod2 chop A} - \text{nod2 chop B})$

↔
 Chopper axis



chopped
 off-source
 nod1 chop B

on-source
 nod1 chop A
 nod2 chop B

nodded
 off-source
 nod2 chop A

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PACS large area mapping

- However Herschel was designed to make large scale surveys
- Two ways :
 - Raster mapping
 - Satellite goes through a rectangular grid pattern of points in internal reference frame
 - Scan mapping
 - Satellite slews continuously along parallel lines at constant speeds

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raster mapping

- Modulation of signal necessary because of $1/f$ noise
- Hence chopping imposed at 0.25Hz
 - Given by Allan variance (blue array), probably less later as compromise between blue and red detector
- Duration per raster point fixed at 64s (8 on/off cycles)
- Chopper-throw fixed at 3.5 arcmin, i.e one FOV (long side)
- **Raster mapping only allowed in instrument reference frame**
 - → orientation depends on position angle of day of observation
 - → to be immune against PA it is advised to define square maps
- Note : in FM ILT tests it has been noted that arrays are tilted by 3 degrees with the instrument reference frame



Raster mapping

PACS Photometry

Unique AOR Label: CI0024 raster

Target: CI0024+1654 Type: Fixed Single
Position: 0h26m33.00s,+17d11m23.0s

New Target Modify Targ... Target List...

Number of visible stars for the target: 10
Star tracker target: Ra: 186.638 degrees Dec:-17.19 degrees

Instrument Settings

Blue channel filter selection

60-85 microns band
 85-130 microns band

Source flux estimates and gain
Source Flux Estimates

Observing Mode Settings

Source type and mapping mode settings
Set the Observing Modes

Repetition factor
Repetition 1

To control the absolute sen
to adjust the number of

Observation Est... Add Comments... Visibility...

OK Cancel Help

Observing Modes

Observing Mode Settings

Choose one of the modes below.

Small-source photometry Chopped raster Scan map
None selected Point-source photometry

Observing mode parameters

Raster Map

Number of raster points per line 8
Number of raster lines 32
Raster point step (arcsec) 5.0
Raster line step (arcsec) 12.0

Map orientation
Orientation angle reference frame Array

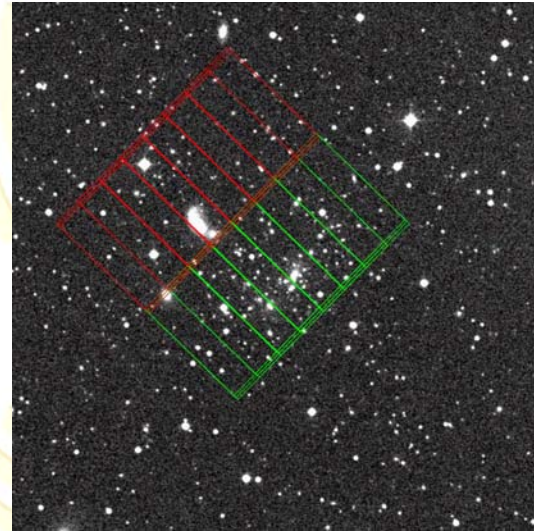
Orientation constraint
Angle from (degrees) 0.0
Angle to (degrees) 360.0

OK Cancel

Raster strategy: 2 cases

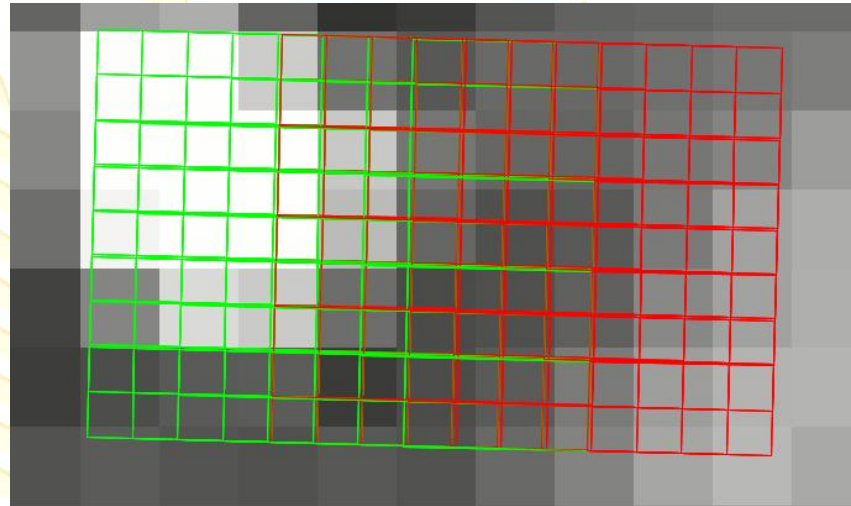
- Very small maps always chopping out of FOV

- Δx = few arcsec
- High redundancy



- Larger maps chopping inside map

- Note : if $\Delta x = 3.5$ arcmin, chop/nod like





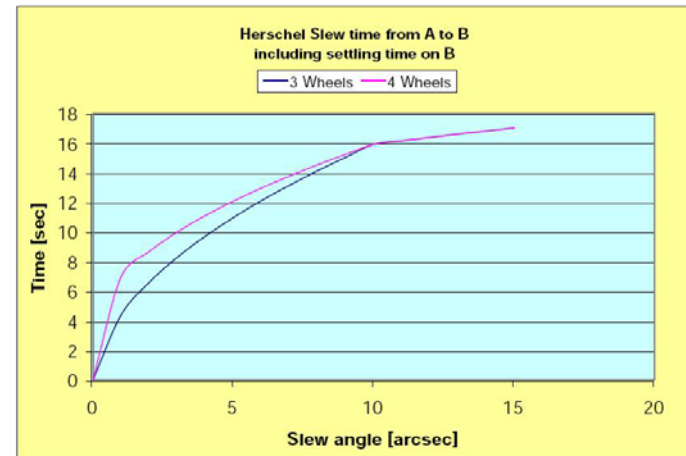
Overheads : raster point slew times

- Observation efficiency limited by the duration of small slews between raster points,
 - typically of the order of 20-30 sec..
 - → ~1/3 of overheads

Herschel approximate slew times



Herschel approximate slew times



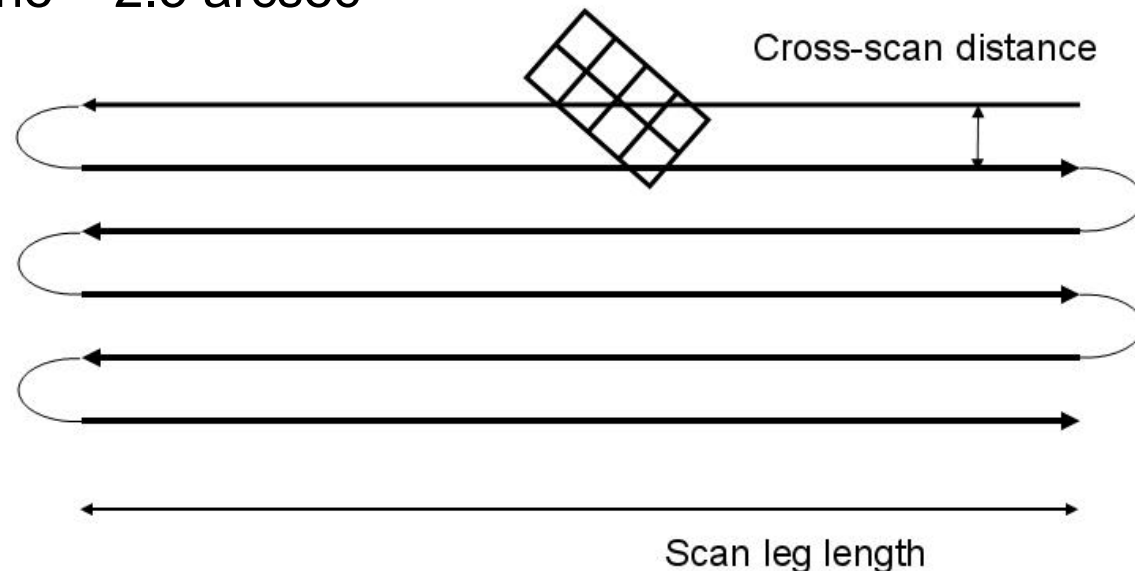


Raster limitation

- Chopping :
 - introduces negative sources/beams
 - degrades the sensitivity by $\sqrt{2}$ because of differential imaging
 - and another factor $\sqrt{2}$ because if sources seen only in one chop position (as half of the time spent on source).
- Only relatively small areas can be mapped, up to 10'x10' or 15'x15'
- → For larger area: scan mapping

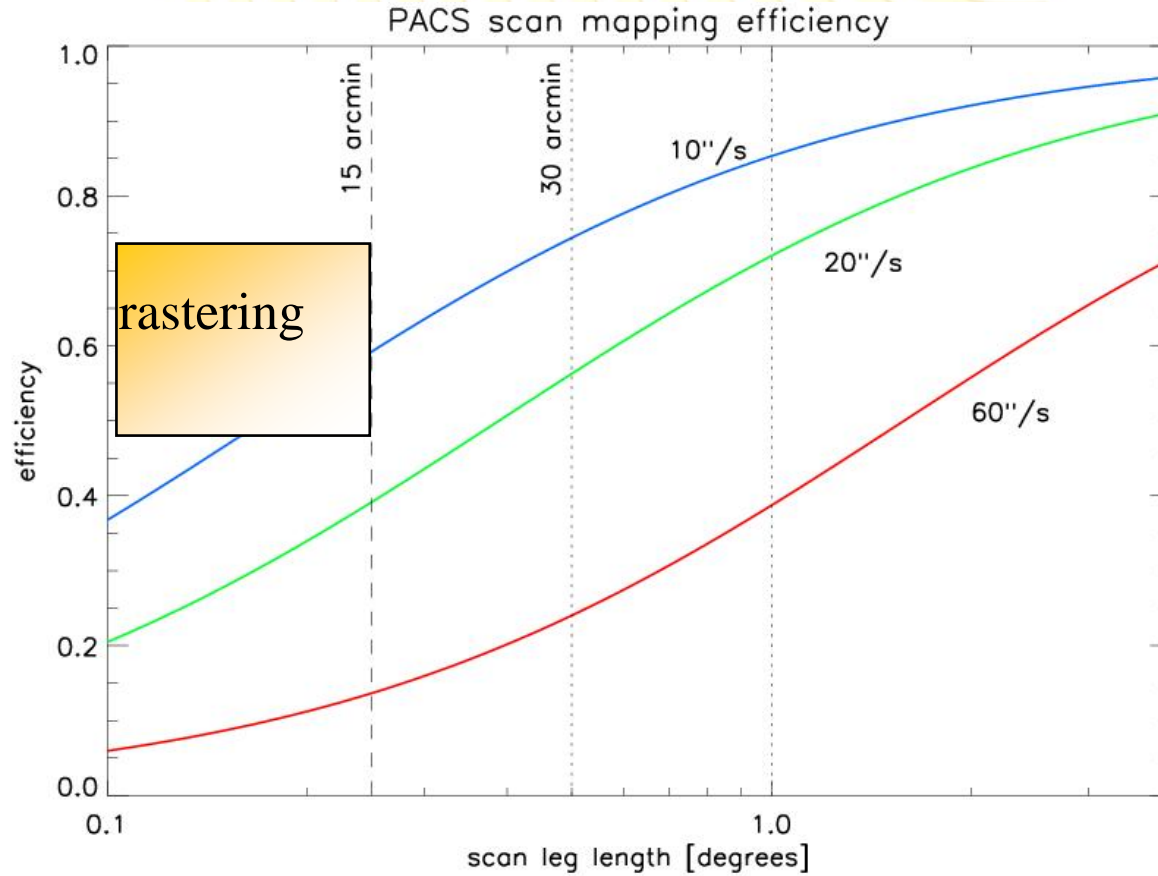
Scan mapping

- For large areas up to several square degrees
- 3 scan speeds
 - Slow : $10''/s$, for extragalactic mapping/surveys
 - Medium: $20''/s$, for larger areas >1 sq.deg
 - High: $60''/s$, for galactic surveys
- PSF degradation :
 - Shift and broadening of the PSF because of electrical (and thermal) time constants and 10 Hz averaging: minimal at slow and medium speed
 - Significant impact at the high speed, broadening by a factor 2.
- SRPE along a line = 2.5 arcsec



Scan mapping efficiency

- Large overhead for turn-around manoeuvre between scan legs
- Scan legs smaller than 15' are very inefficient.



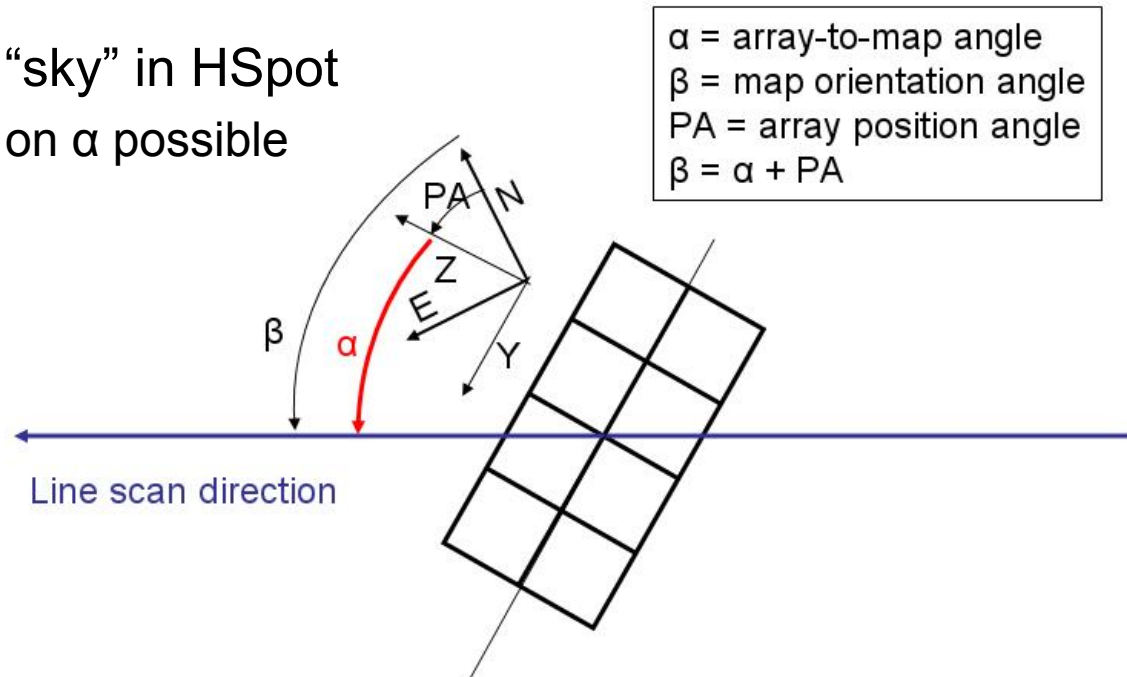


scan maps

- With filled array, no fixed magic angle like SPIRE
- Two types of scan maps
 - 1/ in instrument reference frame
 - Advantage: control on the geometry of the scan map
 - Drawback: no control on map orientation, hence maps shall be square
 - 2/ in sky coordinates
 - Advantage: control on map orientation
 - Drawback : limited control on homogeneity of the scan map
 - But 'magic distance' ? With a cross-scan distance of a matrix 51 arcsec : rather homogeneous coverage, whatever the array to map angle

Scan map orientation

- In reference frame “array” in HSpot
 - α fixed, constraint on β is possible
 - Selection of homogeneous coverage offered in HSpot.
- Oriented in the sky, “sky” in HSpot
 - β fixed, constraint on α possible



- Note: If $\alpha=45^\circ$ then orthogonal coverage has same depth

Scan maps in HSpot



PACS Photo

Unique AOR Label: Cosmos sky 51"

Target: COSMOS Type
Position: 10h00m28.6

New Target Modify Target

Number of visible stars for the target
Star tracker target: Ra: 330.119 d

Instrument

Blue channel filter selection

60-85 microns band

85-130 microns band

Source

Observing Mode

Source type and mapping mode settings

Set the Observing Modes

Observation Est. Add Conf

OK Cancel

Herschel Planning Tool

File Edit Targets Observation Tools Calibration Images Lines Overlays Options Window Help

Mouse Control
Mouse: Any Shift-Left Button: Centre the Image at point

ISSA- 100 μ m, COSMOS

Cosmos array 1
Base Image

Observations ISSA- 100 μ m, COSMOS

Target: COSMOS Type: Fixed Single Total Duration (hrs): 36.57

Proposal - File Name: PEP_Jan07_workshop.aor Net Up Total AORs: 12 / Active: 12

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sensitivities

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- HSpot returns the mean sensitivity across the map
- Exposure map tool to be made available for phase II entry,
 - under testing.
- HSpot sensitivities are very conservative, correspond to DDCCS readout mode, pessimistic case
 - DDCCS : to avoid spacecraft electromagnetic perturbations
 - In DM mode factor 2 better and 50% in red band.
- Goal : change sensitivities for KP OT entry June 2007 for the DM case
- KP GT: proposals shall be robust against change of sensitivity by a factor 2.



Data reduction

- Not defined yet, neither scan maps or raster maps.
 - Direct mapping
 - Direct mapping with $1/f$ noise removal
 - MADMap
 - MOPEX
 - Constrained Map-maker

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Questions ?

- PACS Observer's Manual :

http://herschel.esac.esa.int/ao_kp_documentation.shtml

- Herschel Helpdesk:

<http://herschel.esac.esa.int/esupport/>

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