



# SPIRE/PACS Parallel Mode

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# Definition of Parallel Mode

PMODE is treated as a 4<sup>th</sup> Herschel instrument

- PACS & SPIRE operates in photometry mode simultaneously, carrying out 5 band large area scanning observations
- **3 SPIRE bands**
  - 250, 350 and 500 μm
- **2 PACS bands**
  - 170 and 70/110 μm

# Parallel Mode operational constraints

- Both SPIRE and PACS cryo coolers have to be recycled, their hold time is ~48 hrs
- PMODE is used during 2x21 hrs observing windows
- No single observation can last longer than 18 hrs
- PACS has to apply a higher science data compression ratio compared to PACS prime operations
  - PACS prime: 4 frames averaged (10 Hz)
  - PMODE: 8 frames averaged (5 Hz)

# Scientific benefits of PMODE

PMODE offers a major mapping efficiency gain or major additional scientific data wrt two separate PACS and SPIRE coverages without significant degradation of instrument performance

## BUT

- Only for programmes relaxed in (PACS) sensitivities
- If relative PACS/SPIRE sensitivities fit to the science goal
- If primary science interest requires SPIRE bands
- If mapping area exceeds at least ~1 sq degree (typically >10 sq degrees)

# Additional benefits of PMODE



- Operating PACS and SPIRE increases the load on the Helium tank of Herschel by much less than a factor of 2. It is favourable in terms of science per litre of Helium.
- Improved astrometry
- Improved mission planning efficiency (minimize on-target slew times)



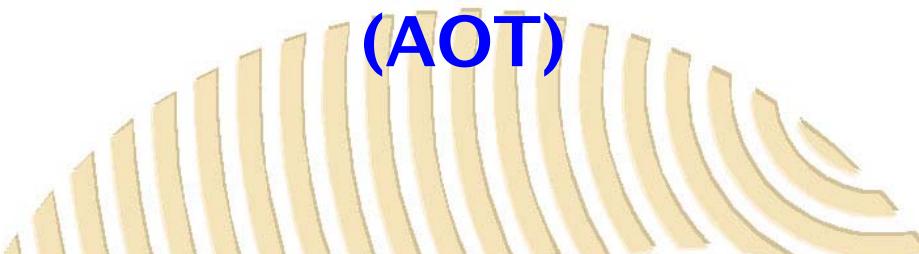
# Key Programmes exploring PMODE

- Programmes involving shallow galactic surveys over large area of sky
  - Nearby molecular clouds (see SAG3 GTKPs on star formation)
  - Galactic plane survey (see Hi-Gal OTKP)



- Extragalactic mapping programmes
  - Applications can be found in Poster Section

# PMODE Astronomical Observing Template (AOT)

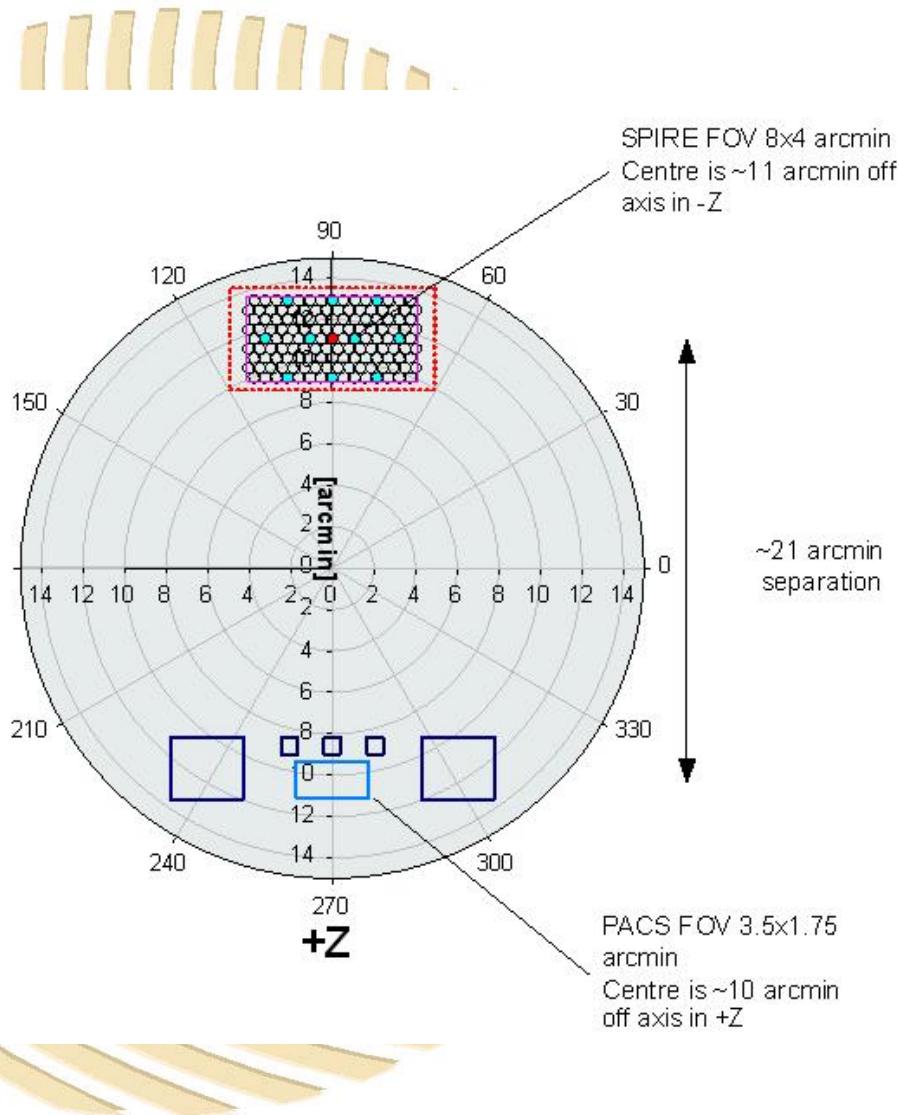


- PMODE AOT is offered with only one observing mode. Scanning is the most compatible operating mode of PACS and SPIRE. (*Scan maps are the default for PACS to map large areas of the sky. SPIRE always operates in scan mode for large mapping observations.*)
- PMODE is inherited from its PACS/SPIRE 'parent' AOTs

# Herschel Focal Plane image

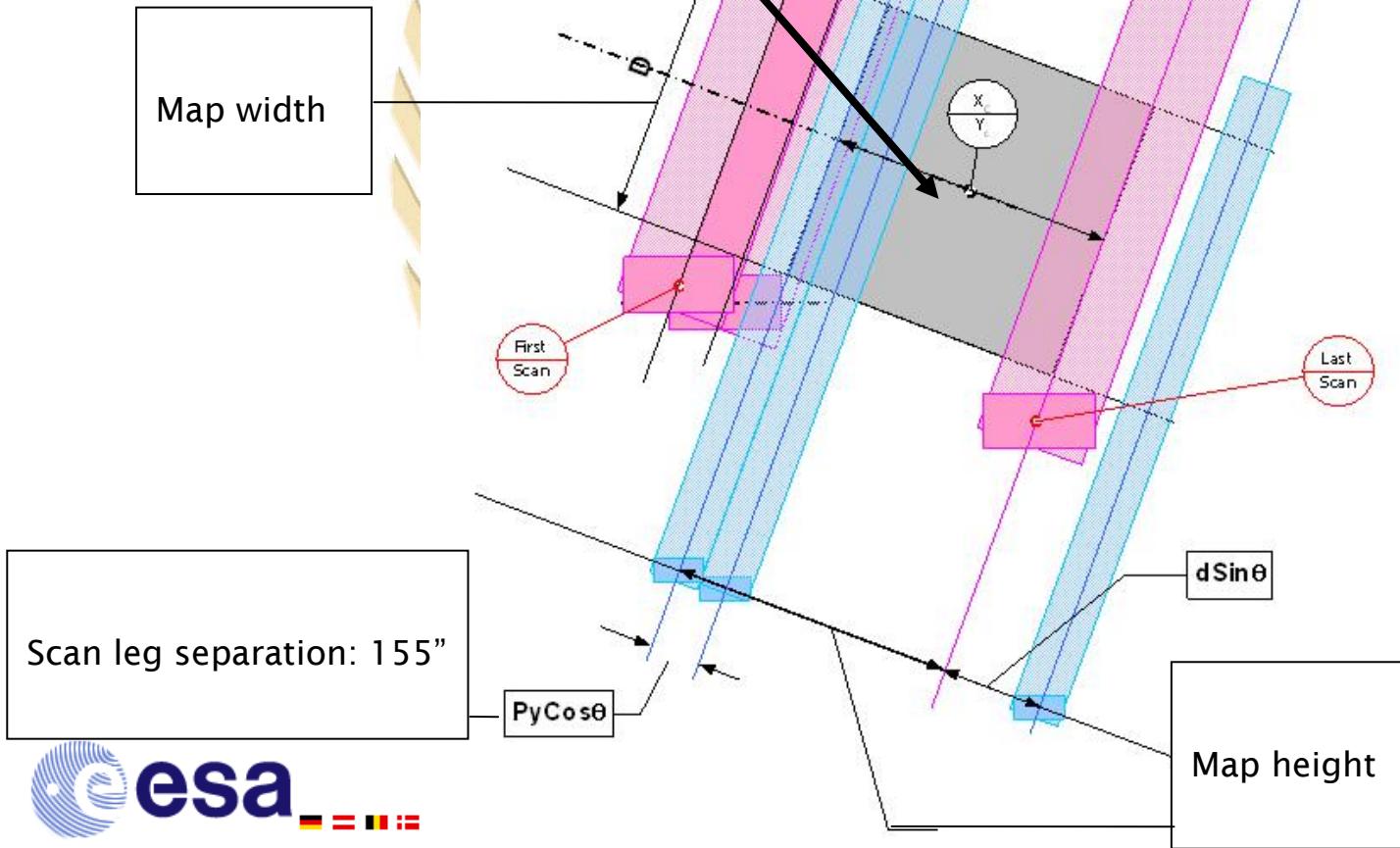
The PACS and SPIRE photometer footprints are separated by ~21 arcmin along the spacecraft Z-axis

The area that the s/c boresight paints on the sky is larger than the common PACS/SPIRE survey area



# PMODE Geometry

Common PACS/SPIRE  
area



SPIRE magic angle  
 $\Theta=42.4$  deg wrt  
 the +Z-axis

HERSCHEL SPACE OBSERVATORY

# PMODE AOT

**SPIRE PACS Parallel Mode**

Unique AOR Label: SPParallel-0005

Target: Cha III Type: Fixed Single  
Position: 12h45m00.00s, -79d49m00.0s

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

Number of visible stars for the target: 12  
Star tracker target: Ra: 11.25 degrees Dec: 79.817 degrees

PACS Blue channel filter selection    Scan Speed

- 60–85 µm filter     Fast
- 85–130 µm filter     Slow

Large Map Parameters

Length (arcmin) 80    Height (arcmin) 156  
Scan Direction Nominal

Orientation

Map Orientation Array    Angle from (degrees) 0  
Angle to (degrees) 360

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

OK    Cancel    Help

PACS blue band

Common  
PACS/SPIRE  
survey area

Map orientation  
constraint

Scan speed  
→ 60"/sec  
→ 20"/sec

Scan direction  
→ Nominal  
→ Orthogonal

Observing time,  
sensitivity and  
confusion noise  
estimator



# PMODE AOT Particularities

- Magic angle applied is  $\Theta=42.4$  deg
- Cross-scan step size decreased to 155"
- 5 extra scans
- 20 arcmin extra length for scan legs
- Scan speed 60"/sec or 20"/sec (SPIRE 30"/sec)
- PACS applies double compression (8 frames averaged)
- PACS PSF degrades at 60"/sec (effect of ~60 ms bolometer time constant and double compression)

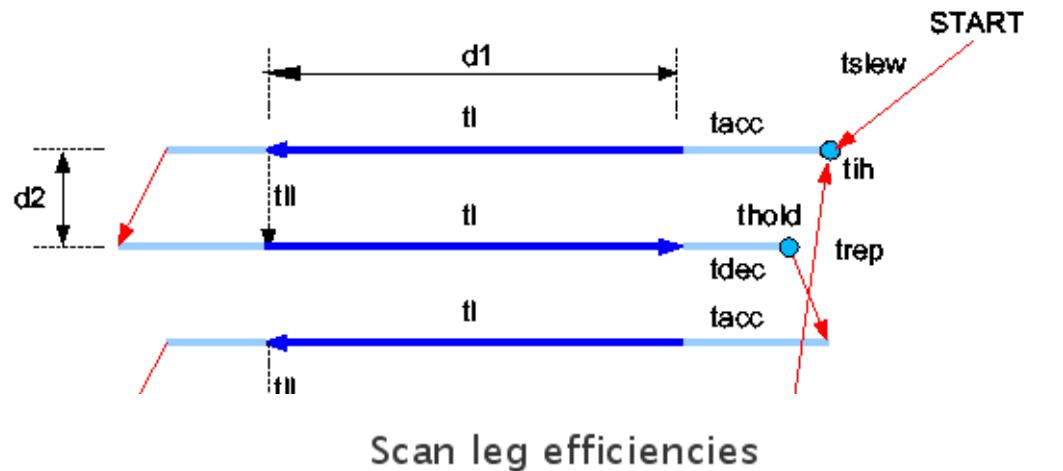
# PMODE AOT sensitivities

PMODE  $5\sigma$  sensitivities for a single coverage

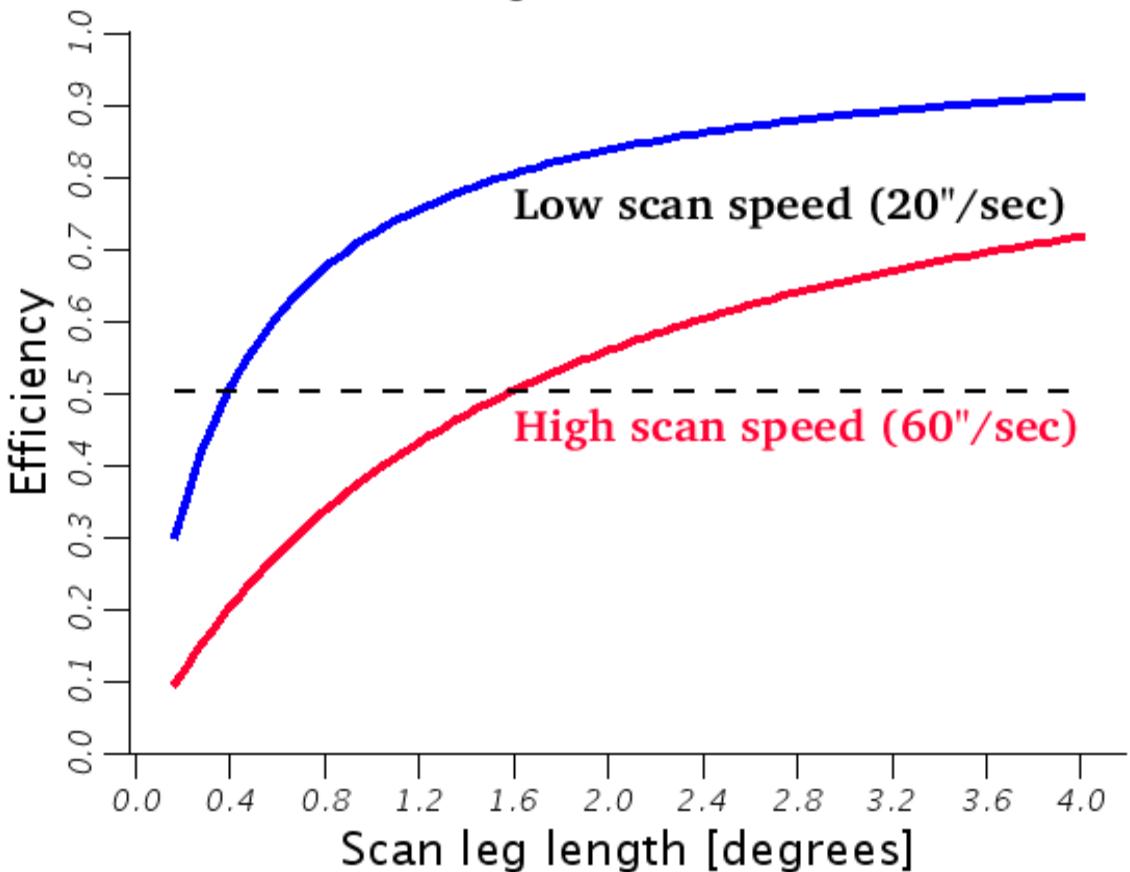


Scan speed	60''/second	20''/second
PACS 60-85 $\mu\text{m}$	171.0	99.0
PACS 85-130 $\mu\text{m}$	171.0	99.0
PACS 130-210 $\mu\text{m}$	195.0	113.0
SPIRE 250 $\mu\text{m}$	60.0	34.5
SPIRE 350 $\mu\text{m}$	83.0	48.0
SPIRE 500 $\mu\text{m}$	70.0	40.5

# AOT scanning overheads



Scan leg efficiencies



Overhead per  
scan leg

- Slow: 70 sec
- Fast: 95 sec

# Case study: Star forming complex Cha I-II-II & Musca



HERSCHEL SPACE OBSERVATORY

**Herschel Planning Tool**

File Edit Targets Observation Tools Images Lines Overlays Options Window Help

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

avhk\_cham\_ragno.fits

Observations avhk\_cham\_ragno.fits

Target: Musca Type: Fixed Single

Proposal - File Name: chamaeleon.aor

Total Duration (hrs): 22.6  
Total AORs: 7 / Active: 7  
ac.esa.int/

Net Up

A screenshot of the Herschel Planning Tool software. The main window displays a grayscale astronomical image of a star-forming complex, specifically Cha I-II-II and Musca, showing dense clusters of young stars and surrounding interstellar dust. The software interface includes a menu bar, toolbars with various icons, and a status bar at the bottom providing observational parameters like target name, proposal file, total duration, and active AORs. A legend on the right side of the image window indicates different data layers: 'Base Image' (checkbox checked) and other options like 'X', 'Y', '%', and 'Color'.

VS 21 Feb 2007  
VG # 14  
ac.esa.int/

# Case study: Star forming complex Cha I-II-II & Musca



HERSCHEL SPACE OBSERVATORY

**Herschel Planning Tool**

File Edit Targets Observation Tools Images Lines Overlays Options Window Help

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

avhk\_cham\_ragno.fits

S 21 Feb 2007  
VG # 15  
c.esa.int

Observations avhk\_cham\_ragno.fits

Target: Cha II Type: Fixed Single  
Proposal - File Name: chamaeleon.aor

Total Duration (hrs): 22.6  
Total AORs: 7 / Active: 7

Net Up

The screenshot shows the Herschel Planning Tool window. The main area displays a grayscale astronomical image of a star-forming region, likely Cha I-II-II and Musca. A green and pink rectangular overlay is positioned on the image, defining the target area. The left sidebar contains various icons for file operations and target selection. The right sidebar includes sections for 'SPParallel - 000' and 'Base Image', each with its own set of checkboxes and controls. The bottom status bar provides information about the target (Cha II), proposal name (chamaeleon.aor), total duration (22.6 hrs), total AORs (7), and active AORs (7). A small 'Net Up' button is also visible in the bottom right corner.

# Case study: Star forming complex Cha I-II-II & Musca



HERSCHEL SPACE OBSERVATORY

**Herschel Planning Tool**

File Edit Targets Observation Tools Images Lines Overlays Options Window Help

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

avhk\_cham\_ragno.fits

SPPParallel - 000  
SPPParallel - 000  
Base Image

Observations avhk\_cham\_ragno.fits

Target: Cha III Type: Fixed Single

Proposal - File Name: chamaeleon.aor

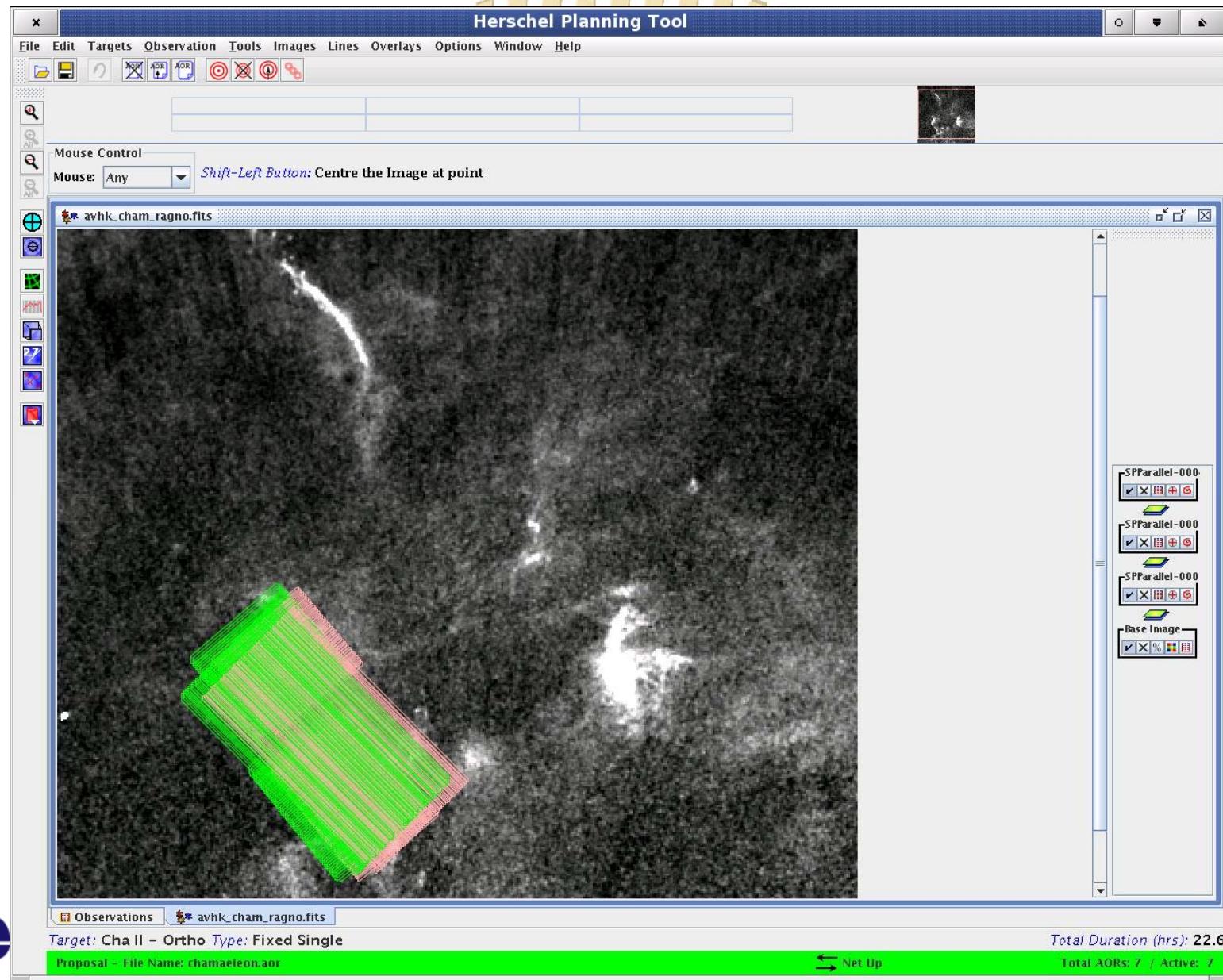
Total Duration (hrs): 22.6

VG # 16

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Net Up

# Case study: Star forming complex Cha I-II-II & Musca



HERSCHEL SPACE OBSERVATORY

# Case study: Star forming complex Cha I-II-II & Musca



HERSCHEL SPACE OBSERVATORY

**Herschel Planning Tool**

File Edit Targets Observation Tools Images Lines Overlays Options Window Help

1 Pixel: 120.000"

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

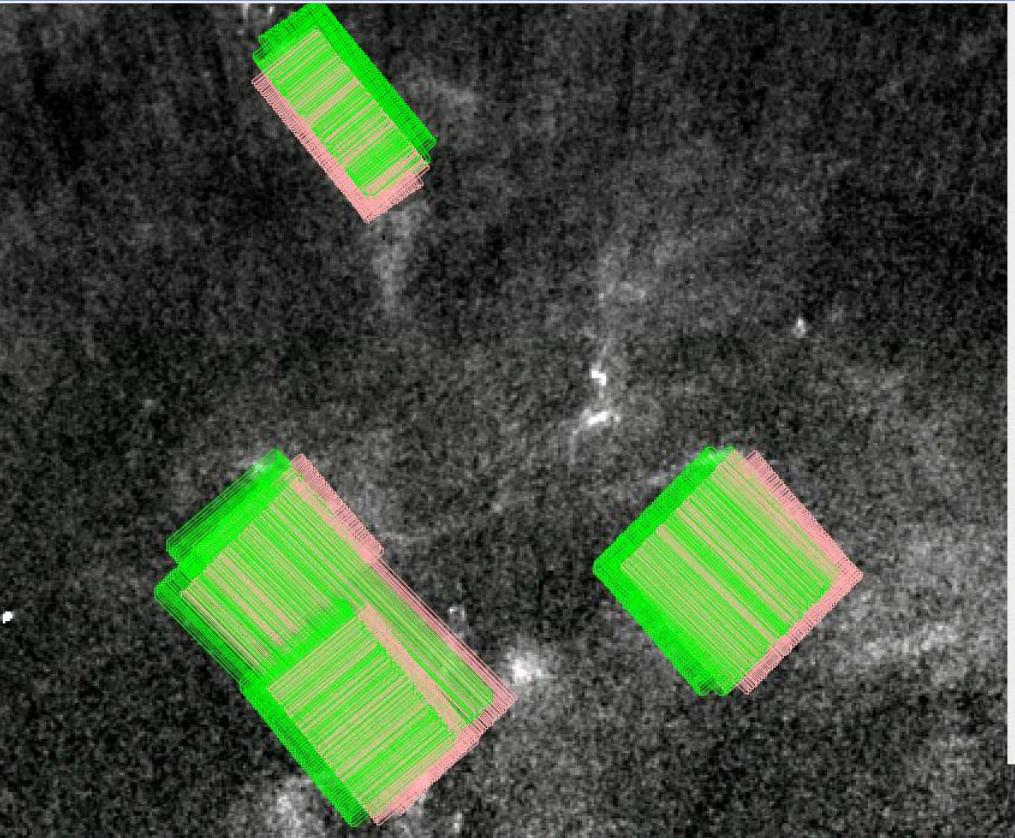
avhk\_cham\_ragno.fits

Observations avhk\_cham\_ragno.fits

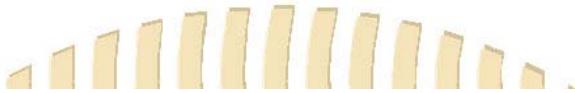
Target: Musca Type: Fixed Single

Proposal - File Name: chamaeleon.aor

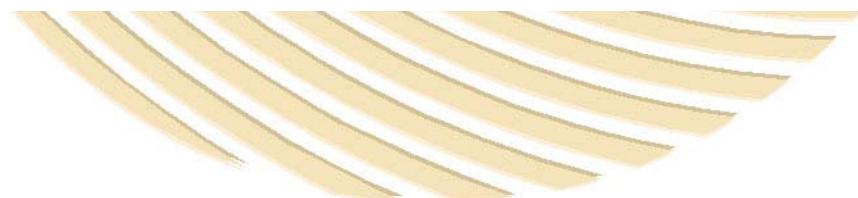
Total Duration (hrs): 22.6  
Total AORs: 7 / Active: 7  
[c.esa.int](http://c.esa.int)



# PMODE known bugs in Hspot V2.0



- Incorrect PACS red band sensitivities
- SPIRE sensitivities has to be multiplied by 0.63
- Add 26 arcmin to 'Height' parameter
- No time estimation if scan speed = slow and scan direction = orthogonal





# Some points to note for PMODE

- SPIRE has to be considered as the primary instrument
- PACS data quality is somewhat degraded due to enhanced compression and high scan speed
- For programmes relaxed in (PACS) sensitivity
- Optimize map dimensions for slewing overheads

SPIRE PACS Parallel Mode Observers' Manual:

[http://herschel.esac.esa.int/Docs/PMODE/html/parallel\\_om.html](http://herschel.esac.esa.int/Docs/PMODE/html/parallel_om.html)

