PACS chopped line scan and high sampling range scan AOT release note

Prepared by the PACS ICC

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The following PACS spectroscopy AOTs have been released for scheduling of observations:

- Chopped line scan / standard faint line mode
- Chopped line scan / bright line mode
- Range scan / high sampling density for short ranges

These modes have been released for the following pointing modes

- Simple pointed observations
- Raster mapping with stepsize >30" (i.e tiling the sky rather than oversampled rasters)

This note provides a brief summary of the relevant performance parameters of these modes, gives guidelines to adapt AOR parameters in HSPOT to cope with changes in the scanning strategy, describes the status of the datareduction pipeline and calibration for these modes, and outlines prospects for the release of the dither and oversampled mapping pointing modes for these AOTs.

Sensitivity

a) The line and continuum sensitivities as a function of observing time have been verified in-orbit and are consistent with pre-launch predictions. Figure 1 and figure 2 show the comparison of pre-launch sensitivity predictions as documented in the PACS observers manual to noise determinations on in-orbit line scan observations.
b) Optimisation of integration ramp length, chopping frequency and grating scanning strategy have lead to a longer duration of a single line scan. The observer can therefore reduce the number of scan or nod repetitions to obtain the same observation sensitivity within the allocated observing time (see: Recommendations for HSPOT AOR updates).

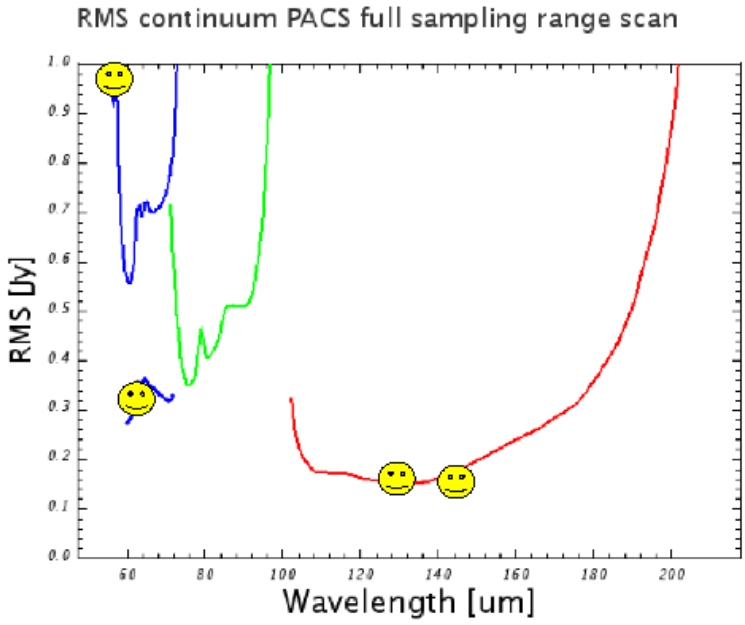

Figure 1: Continuum sensitivity predicted pre-launch compared to in-orbit spot checks

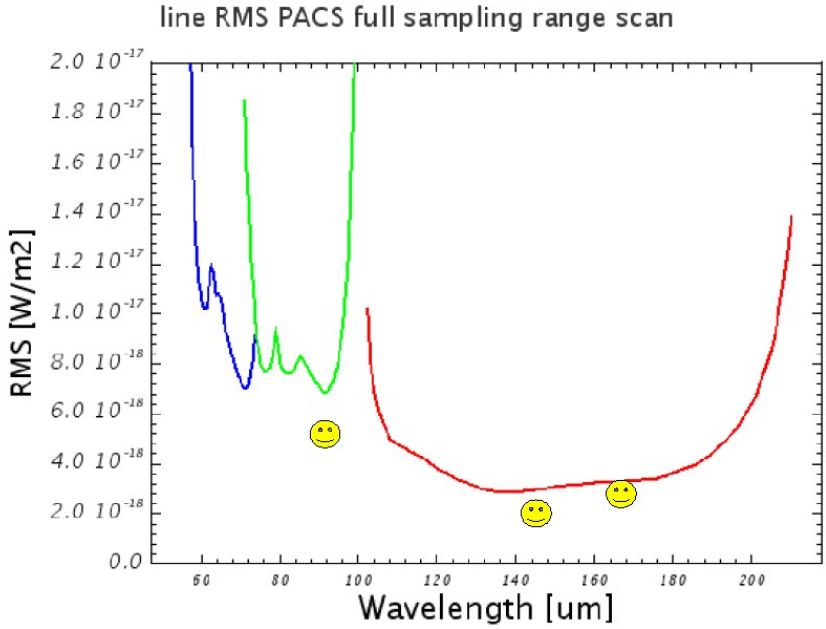

Figure 2: Line sensitivity predicted pre-launch compared to in-orbit spot checks

Saturation limits

The automatic selection of integrating capacitance based on estimated continuum and line fluxes in the uplink logic is still being implemented based on in-orbit measurements of the telescope background and detector responses. Until this is implemented, only observations within the saturation limits of the default, smallest capacitance are to be scheduled.

Figure 3 shows the saturation limit in jansky for the default integration capacitance. This is the limit for continuum and peak line flux together. Figure 4 shows the saturation limits for unresolved lines on a zero

continuum. Both figures should allow to judge if the observation can be executed with the default integration capacitance.

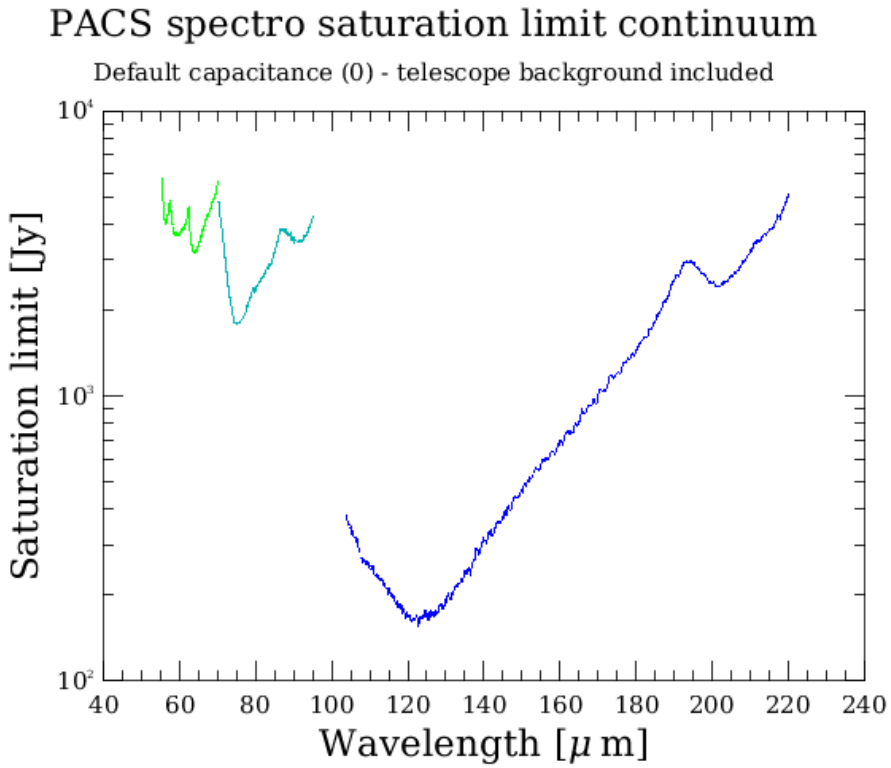

Figure 3: Saturation limits for the default integrating capacitance

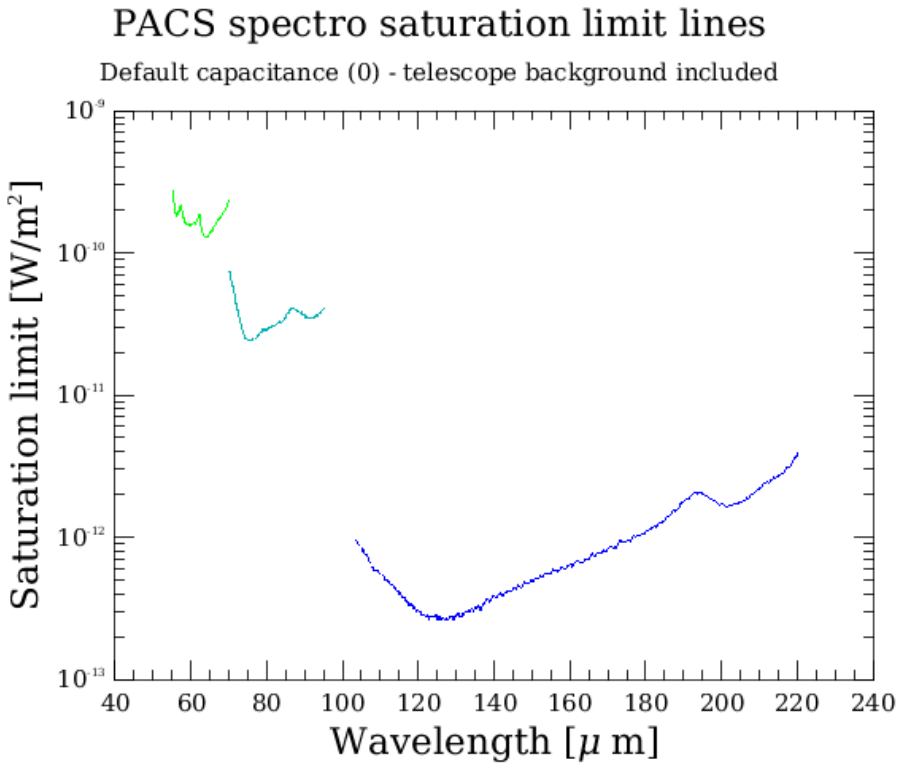

Figure 4: Saturation limits for the smallest capacitance for unresolved lines

Spatial and Spectral resolution

The spatial and spectral resolving power have been verified in-orbit and are consistent with the values given in the observers manual.

Pointing

The focal plane geometry for the three chopper throws has been established, and the uplink logic parameters have been updated accordingly. The two nod positions center the intended target coordinates to about ~2 arseconds. This has been evaluated to provide the necessary accuracy to combine the spectra obtained at the two nod positions and establish the full power flux calibration for point sources, compensating for differences in the telescope background seen in the two chop positions.

Calibration and pipeline status

The 1.2 track of the PACS spectrometer pipeline, which is at the moment the operational pipeline at the HSC used to provide the observer with data, provides level1 and level2 data which allows the user to verify the successful execution of the observation. Deep observations of faint lines might require interactive inspection using the 2.0 track of the Herschel dp system. This will be done routinely at the HSC as part of the quality checks on every observation.

Important sky calibration sources for the wavelength, flux and spatial calibration only became visible in the course of October. Therefore the 1.2 pipeline is still based on ground calibration values. The wavelength calibration accuracy is well within the uncertainties in wavelength imposed by the dependence on source position in the slit. The ground flux calibration is estimated to be valid for in-orbit conditions to within 50%. The spatial calibration applied in the pipeline is accurate to ~2 arcseconds, partly due to the limited accuracy of the early implementation of the aberration correction algorithm, partly due to alignment differences of the instrument-level ground test setup versus the integrated instrument-telescope system.

Updates to these three calibration aspects is well under way, and is expected to be available in the 2.0 track of the herschel dp system by the end of November. The HSC will provide stable beta-versions of the 2.0 track to the observers as the updates to the calibration are validated. The PACS data reduction guide documents well how to reprocess data of the released observation modes from level-0 to rebinned spectra in the individual spaxels, and how the observer can inspect and verify the success of the intermediate processing stages.

Remarks on unreleased flavours of the chopped line and range scan modes

Oversampled maps
Offsets of the source photocenter with respect to the center of the spectrometer (in IFU terms: the center of the central spaxel) induce a shift in observed wavelength and line shape. Analysis is ongoing on verification observations to establish recommended mapping raster step sizes to oversample the PACS beam and be able to construct an oversampled line flux map.

Dithering
The dithering scheme of PACS performs a small 1x3 raster with 2” stepsize. For sources with a well known and confined photocenter, observers can use the released simple pointing mode, increasing the nod or scan repetitions by a factor of 3 to maintain the observation integration time needed for the required observation sensitivity. Further recommendations on the use of dithering depend on ongoing analysis.

Extended ranges and SEDs
As part of the ongoing activities towards the release of the SED mode, the PACS ICC is working on a scanning strategy to cover the full range within the pre-launch time budgets.

Recommendations for HSPOT AOR updates

- As a general rule, the sensitivity for a given observing time has remained unchanged with respect to pre-launch predictions. Scan and nod repetitions need to be adapted to remain within the originally allocated time for the programme, but the intended sensitivity in the observation will be achieved.
- Faint line mode: Nod repetitions and/or scan repetitions should be lowered until the original observing time is maintained.
- Faint line observations with a single scan / single nod cycle can be replaced by two repetitions in bright line mode
- Bright line mode: Scan repetitions should be lowered until the original observing time is maintained. The observer's manual recommended to have a minimum of 2 repetitions. Should your observations have one repetition anyway, then programme should be revised to compensate for the ~10% observing time increase. The exact fraction depends on the overheads in the observation (map size, number of lines, etc)
- Range scan / high sampling mode: Scan/nod repetitions should be lowered until the original observing time is maintained
- Range scans with a single scan / single nod cycle : wavelength range should be adapted, map sizes decreased or sources dropped from the programme.
- Dithering observations: for sources with a well confined photocenter (see above), the pointing mode can be changed from 'Pointed with dither' to 'Pointed'. To maintain the observation integration time, nod repetition and/or scan repetitions should be increased until the original observing time is reached. Nod repetition x 3 should be the appropriate change for most observations.