

Overview of SPIRE Photometer Pipeline

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Goal:

- Show how SPIRE Photometer pipeline works (functionalities of major modules).
- Will concentrate on scan map "user pipelines" (covering small map, large map, SPIRE/PACS parallel mode).

Reference: "SPIRE Data Reduction Guide" in HIPE (under "Help") or in: http://herschel.esac.esa.int/hcss-doc-9.0/load/spire_drg/html/spire_drg.html







- User pipelines (Jython scripts): Simplified version of Standard Product Generation (SPG) pipelines.
- You can find these "user pipelines" in HIPE:

	000	
	File Edit Run Pipelines	Scripts Window Tools Help
	📬 🗁 🔚 SPIRE	Photometer Large Map user pipeline Photometer Parallel user pipeline
	📮 Console 🗙	Photometer Small Map user pipeline
	HIPE>	Photometer Point Source user pipeline
		Pointing user pipeline
		🥏 Spectrometer Mapping user pipeline
		SPG scripts





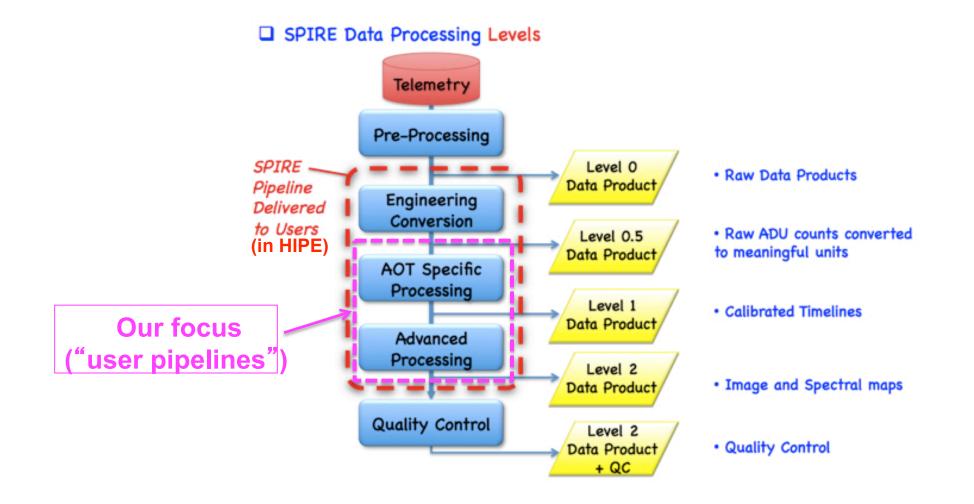
• Other useful HIPE scripts:

000	HIPE 9.1.0
File Edit Run Pipelines Scripts Window Tools	Help
· · · · · · · · · · · · · · · · · · ·	 Photometer Astrometry Correction Photometer Baseline Removal and Destriper Photometer Bolometer Finder Photometer Calculate Ephemeris SSO Position Photometer Map Merging Photometer Solar System Object Motion Correction Spectrometer Array Footprint Plot Spectrometer Background Subtraction Spectrometer Line Fitting
	Spectrometer Thumbnail Mosaic Plot Spectrometer Convolve Spectrum Spectrometer Noise Estimate





SPIRE Pipeline & Data Products

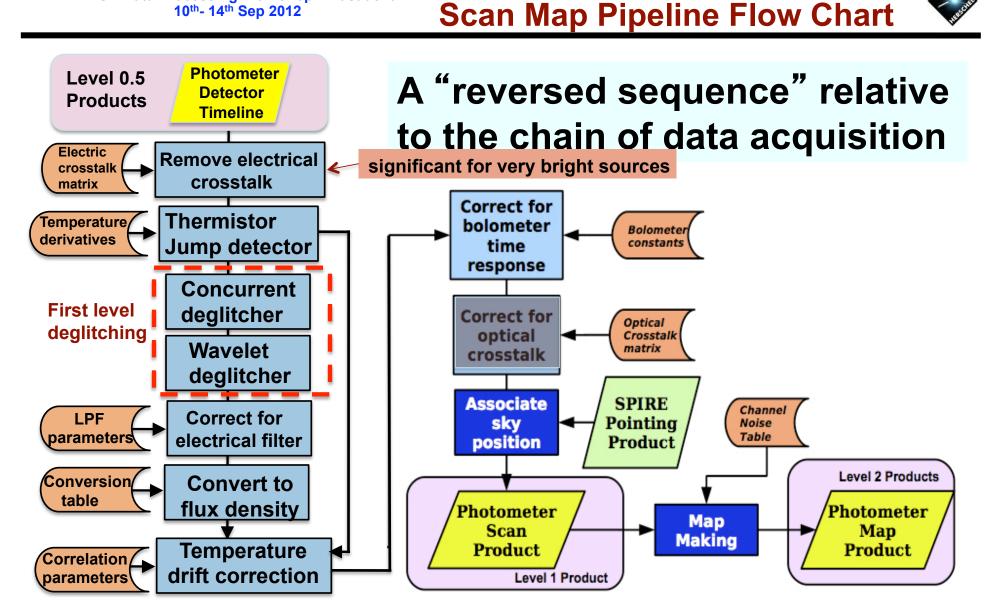




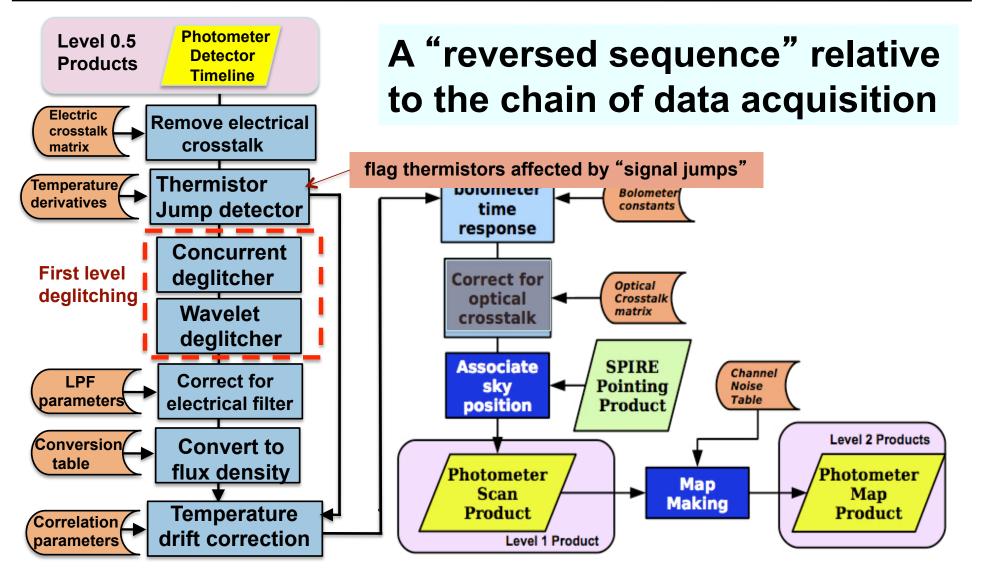


Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix Correct for Thermistor Temperature/ bolometer Bolometer derivatives constants **Jump detector** time response Concurrent First level dealitcher **Correct for** Optical deglitching optical Crosstalk **Wavelet** matrix crosstalk deglitcher Associate SPIRE Channel **Correct for** LPF Pointing sky Noise Table barameters electrical filter position Product Level 2 Products Conversion Convert to table flux density Photometer Photometer Мар Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product













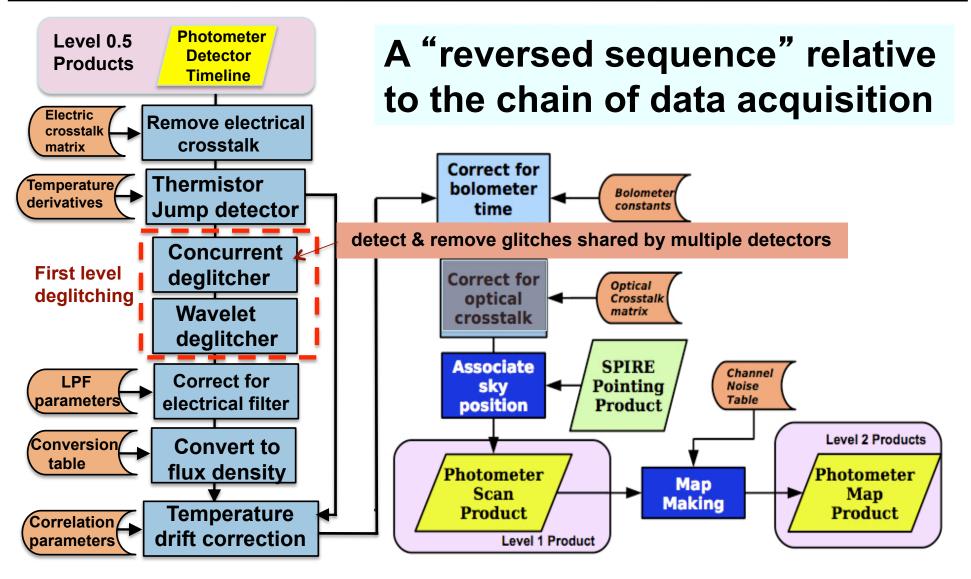




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Scan Map Pipeline Flow Chart

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Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix **Correct for** Thermistor Temperature/ bolometer Bolometer derivatives constants **Jump detector** time response Concurrent First level dealitcher Single detector deglitcher Optical deglitching Crosstalk Alternative: σ-κ deglitcher **Wavelet** matrix deglitcher Associate SPIRE Channel **Correct for** LPF Pointing sky Noise Table barameters electrical filter position Product Level 2 Products Conversion Convert to table flux density Photometer Photometer Мар Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product

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Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix Correct for Thermistor Temperature, bolometer Bolometer derivatives constants **Jump detector** time response Concurrent First level dealitcher **Correct for** Optical deglitching optical Crosstalk **Wavelet** matrix crosstalk deglitcher **FFT** based (run after deglitch^{iate} SPIRE Channel **Correct for** LPF Pointing Noise & repair Table barameters electrical filter ion Product to avoid ringing) Level 2 Products Conversion Convert to table flux density Photometer Photometer Мар Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product









Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix **Correct for** Thermistor Temperature, bolometer Bolometer derivatives constants **Jump detector** time response Concurrent First level dealitcher **Correct for** Optical deglitching optical Crosstalk **Wavelet** matrix crosstalk deglitcher Associate SPIRE Channel **Correct for** LPF Pointing sky Noise Table barameters electrical filter nosition Product Include: Level 2 Products Conversion Convert to (1) Non-linearity correction table (2) Volt to Jy/beam flux density Photometer Мар conversion Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product





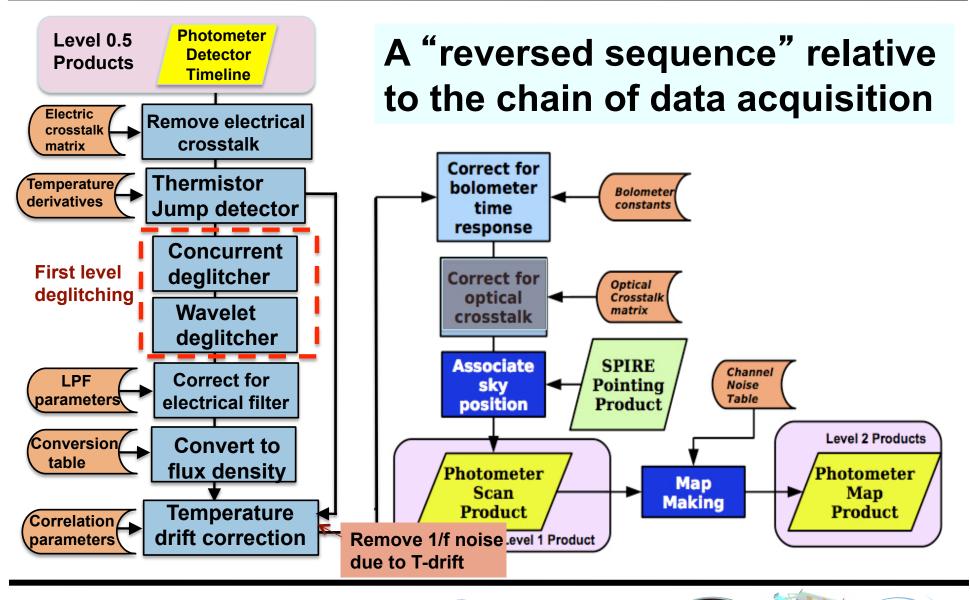




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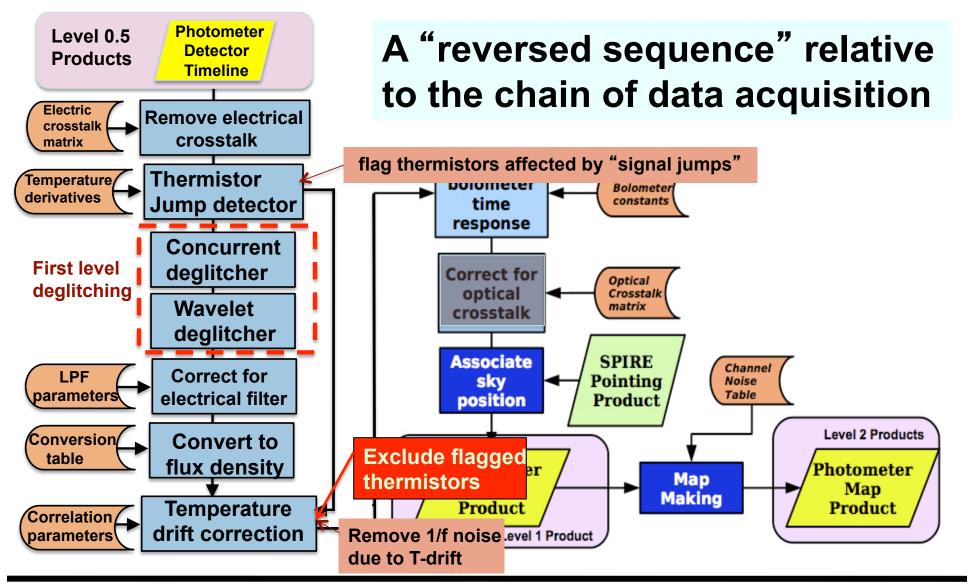
Scan Map Pipeline Flow Chart

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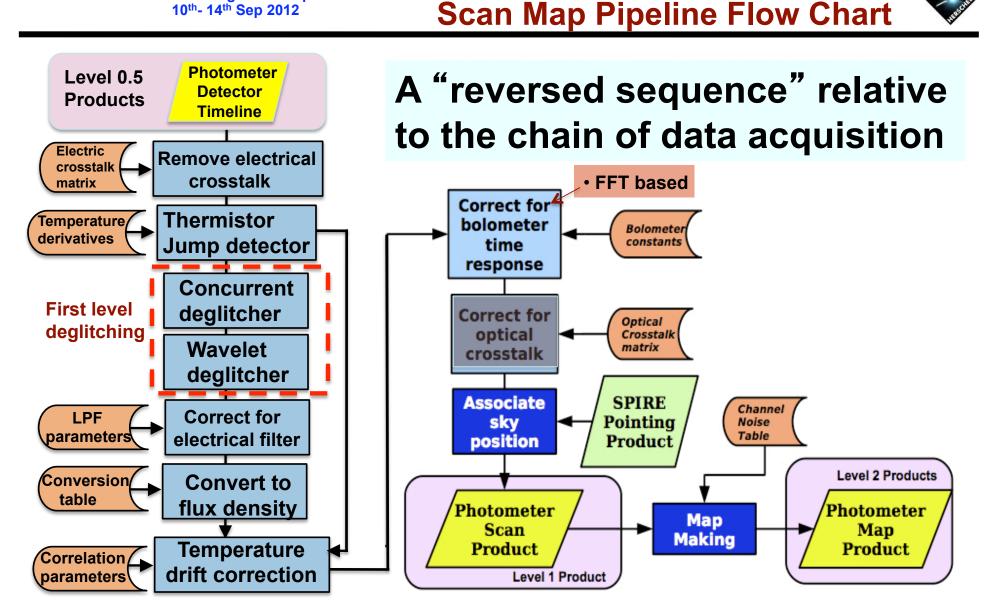


















Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix Correct for Thermistor Temperature, bolometer Bolometer place-holder derivatives constants **Jump detector** time response Concurrent First level dealitcher **Correct for** Optical deglitching optical Crosstalk Wavelet matrix crosstalk deglitcher Associate SPIRE Channel **Correct for** LPF Pointing sky Noise Table barameters electrical filter position Product Level 2 Products Conversion Convert to table flux density Photometer Photometer Мар Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product







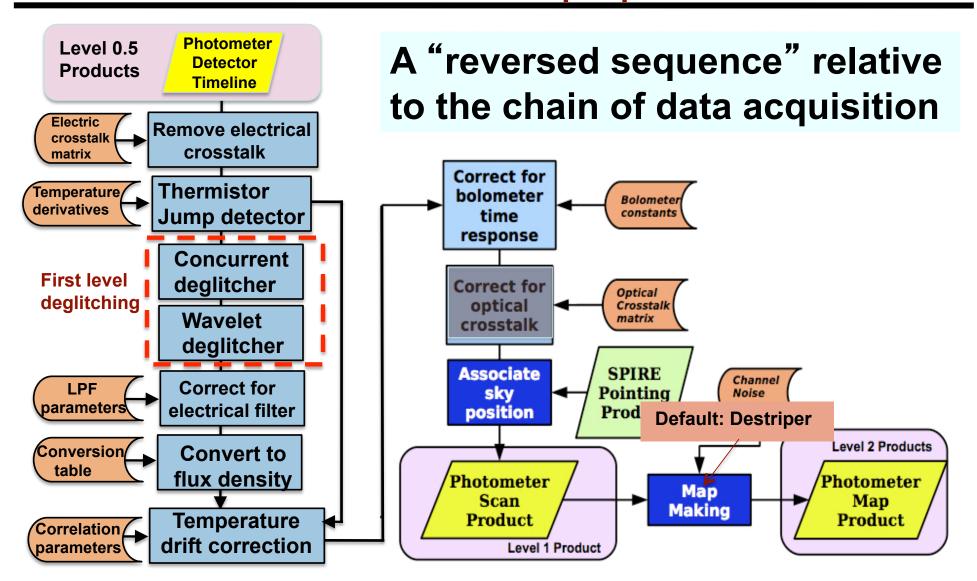
Photometer Level 0.5 A "reversed sequence" relative Detector **Products** Timeline to the chain of data acquisition Electric **Remove electrical** crosstalk crosstalk matrix Correct for Thermistor Temperature, bolometer Bolometer derivatives constants **Jump detector** time response Concurrent Telescope pointing & First level dealitcher orientation **Correct for** Optical deglitching optical Crosstalk SPIRE detectors **Wavelet** matrix crosstalk positions deglitcher Associate SPIRE Channel **Correct for** LPF Pointing sky Noise Table barameters electrical filter position Product Level 2 Products Conversion Convert to table flux density Photometer Photometer Мар Scan Мар Making Temperature Product Product Correlation/ drift correction parameters Level 1 Product







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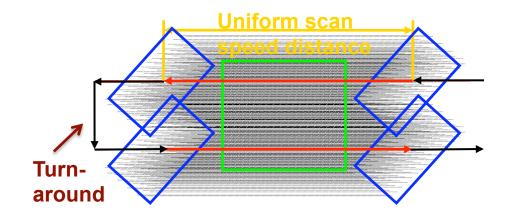


Scan Map Pipeline Flow Chart

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- The pipeline processes timelines scan by scan (to ease the demand on RAM).
- Problem: ringing at the two ends of each scan due to FFT based modules.
- Solution:
 - (1) Before the process, attaching "turn-around" data blocks to ends of the scan.
 - (2) During the process, the ringing is confined to the "turn-around" data.
 - (3) After the process, cut-off the "turn-around" data blocks from the scan.





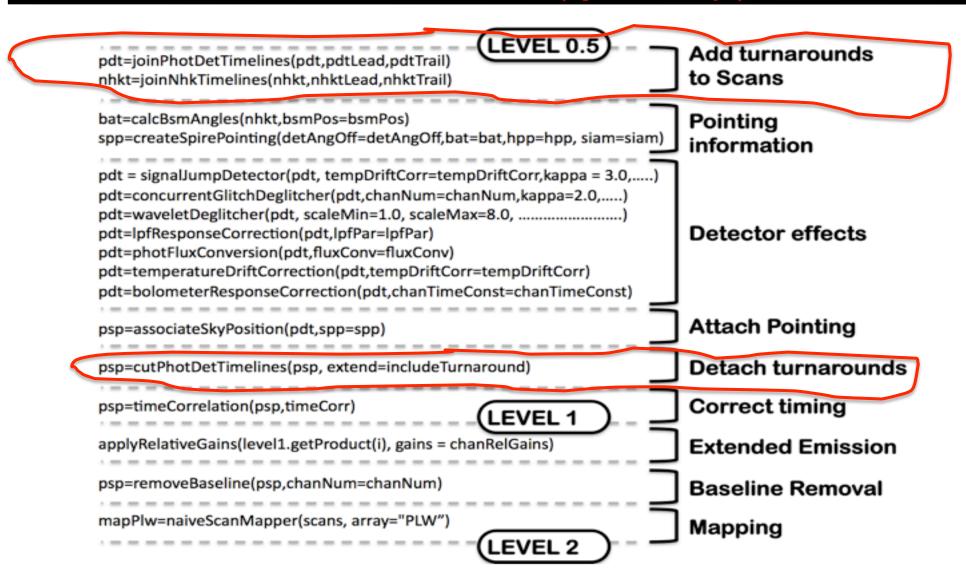
Scan-By-Scan Processing

Highlights of a User Pipeline (Jython Script)

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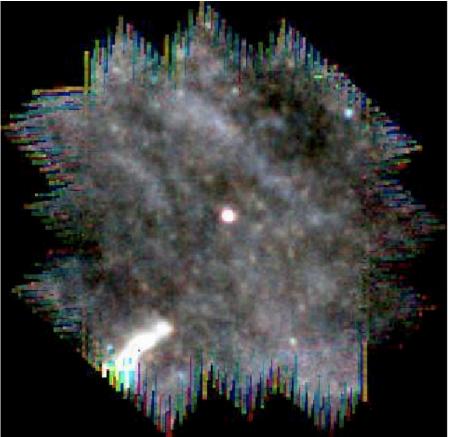


Status of SPIRE Scan Map Pipeline in HIPE 9.1



- General assessment: In most cases, data from HSA are already science quality!
- The official calibration accuracy is ±7% (5% from model, 2% RMS).
- An example (on the right): The image from HSA looks good.

SPIRE 3-color map of NGC 5315 (a planetary nebula)



(Public data taken from HSA)







- Scan-Map pipeline covers nearly all SPIRE PHOT AOTs (small map, large map, map in SPIRE/PACS parallel mode).
- It follows a "reversed sequence" relative to the chain of data acquisition.
- For a general user, Level0_5 should be the best starting point.
- From Level0_5 to Level 1, the pipeline processes any observation data set scan by scan (to ease the demand on the RAM).
- The current pipeline (HIPE 9.1) does a good job ("science ready") in general.
- Major remaining issues:
 - (1) A bug in HIPE 9.0 (affect current archive data): a wrong flag occurred in the temperature drift correction module. It may cause stripes in some maps. The bug is corrected in HIPE 9.1 (you have this one!).
 - (2) Maps of very bright regions are affected by poor temperature drift correction, which is in turn caused by cross-talks between detectors and thermistors (even after the cross-talk correction).

