SPIRE

SUBJECT: **SPIRE PV Phase Plan**

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Glossary

AOT	Astronomical Observation Template
ICC	Instrument Control Centre
ILT	Instrument Level Test
IST	Integrated System Test
LEOP	Launch and Early Orbit Phase
OE	Optical Encoder
OPD	Optical Path Difference
PTC	Photometer Thermal Control
PV	Performance Verification
SPIRE	Spectral and Photometric Imaging REceiver
SPT	System Performance Test
ZPD	Zero Path Difference

1. Scope

2. Documents

2.1 Applicable Documents

AD1	Herschel/Planck Commissioning and Performance Verification Plan	H-P-1-ASP-TN-1383
AD2	Sciops document (TBW)	
AD3	SPIRE Calibration Requirements Document	
AD4	SPIRE Operating Modes	

2.2 Reference Documents

RD1	Ken's infrastructure document	SPIRE-RAL-DOC-000000
RD2	SPIRE Calibration Observation Definitions	SPIRE-RAL-DOC-000000

3. INTRODUCTION

This document is the top level PV phase plan for SPIRE. It starts in section 4 by laying out the objectives and top level requirements of PV phase and science demonstration phase. The working framework is then detailed in section 5. An approach to prioritisation is stated in section 6. Section 7 then describes how each calibration table will be populated in flight.

4. OBJECTIVES OF PV PHASE AND SCIENCE DEMONSTRATION PHASE

4.1 General Objectives of PV Phase

The main objectives of PV phase are:

- verification of basic instrument performance by comparison with results from similar tests on the ground and model calculations;
- population, with initial values, of all calibration files which require in-flight data;
- verification of instrument operating modes;
- validation and optimisation of AOTs;
- generation of data sets required to update instrument sensitivity

The main objectives of Science Demonstration Phase are:

- some further optimisation of AOTs;
- verification of the scientific performance of each AOT, including verification of instrument sensitivity via observations of faint sources;
- assessment of capabilities of the observatory to carry out, and achieve the scientific goals of, the approved Key Programmes;
- generation of results for PR purposes.

4.2 *SPIRE Requirements*

(This section contains the specific requirements on the SPIRE instrument team – to be updated and expanded in future versions)

To meet these requirements the SPIRE instrument team must:

- be able to execute AOTs during PV phase with different parameters;
- by the end of PV phase, be able to quote first-cut as-measured sensitivities for each mode and provide information for HSpot updates;
- provide first-cut astronomical/instrument calibration both for uplink and data processing purposes;
- have an adaptable plan to ensure that PV is used effectively

5. OPERATIONAL FRAMEWORK/ASSUMPTIONS

5.1 Spacecraft Operations

This section is mainly based on the information provided in the Herschel/Planck Commissioning and Performance Verification Plan (AD1). Where information is not yet available assumptions are made and stated here.

5.1.1 Overall Timeline

The overall mission timeline after launch consists of

1. Launch and Early Orbit Phase (Launch to Launch plus 3 days (AD1))
2. Commissioning Phase (Launch plus 3 days to Launch plus 1 month (AD1))

   a. Decontamination complete, telescope cooldown starts at launch plus 3 weeks (AD1)
   b. Cryo-cover opening at launch plus one month (AD1)
3. PV Phase (assumed to be 3 months in duration)
4. Science Demonstration Phase (assumed to be one month in duration)
5. Routine Operations Phase (remainder of the mission)

AD1 states 'End of commissioning 1 month after launch with opened cryo-cover', therefore it is assumed that the activity of establishing the focal plane geometry, which is a commissioning activity and requires the lid to be off, will take place early in the PV Phase. Similarly, some instrument performance verification activities may be performed with the cryo-cover closed, i.e. in the Commissioning Phase.

The definition of PV Phase used in this document is the set of activities which meet the requirements given in section **Error! Reference source not found.** irrespective of the mission phase in which they are performed. It should be noted that this covers confirmation of instrument performance, baseline calibration and basic validation/optimisation of AOTs operation and standard data processing.

Science demonstration phase is the phase where the data processing pipelines are verified and optimised and publicity images produced. This demonstrates the baseline calibration and a reasonably mature data processing pipeline.

5.1.2 Commissioning Outcome

The status of the instrument at the end of the Commissioning Phase is assumed to be:
- Functionally tested
- Instrument parameters which do not require astronomical observations established (e.g. we would re-tune the BSM and SMEC during commissioning phase).

The status of the observatory at the end of Commissioning Phase is assumed to be:
- Pointing accuracy must be good enough for SPIRE PV Phase measurements (To Be Specified (TBS))
- The spacecraft must be able to slew along a specified axis at a specified rate with good (TBS) pointing accuracy
- The straylight performance has been established. This can only be finally established once the telescope has reached its operating temperature and the instruments have been operationally optimised.

5.1.3 Ground Contact

AD1 (on page 17) states 'During the commissioning, the visibility for both satellite is fully 24h/24h using the three available stations (Kourou, New Norcia and Villafranca (TBC)). Considering shared visibility, each Satellite is in ground contact about 12h per day (TBC)'.

It is therefore assumed that during commissioning the instrument teams will have 10-12 hours of ground contact time available to them. For PV Phase the ground contact time arrangements are not yet known to us. We assume for now that there will be a transition from the 10-12 hours at the end of commissioning to two hours at the end of PV.

We assume that SPIRE PV Phase observations will be uploaded for autonomous execution and so will not require ground contact.

5.1.4 Division of Operational Time between the Instruments in PV

The division of operational time between instruments is TBD. For SPIRE a two day rotation through the three instruments is preferred: i.e. SPIRE operational for two days then non-operational for four days. This would allow flexibility in planning and scheduling observations taking into account the results of earlier tests and would maximise the efficiency with respect to the use of the cooler.

5.1.5 Telescope Cooldown

Figure 5-1 shows the telescope cooldown curve provided by Thales Alenia Space. The cooldown starts at Launch + 3 weeks following a period during which the telescope is maintained at ~320 K to allow decontamination. From this plot, at the end of commissioning phase (Launch + 30 days, also the start of PV phase) the telescope temperature is at about 125 K. The curve is not given for the end of PV phase (assumed to be launch plus 120 days) but it appears from the trend shown that the temperature reached will be around 90 K and this is adopted as the assumed end of PV phase temperature for this plan.

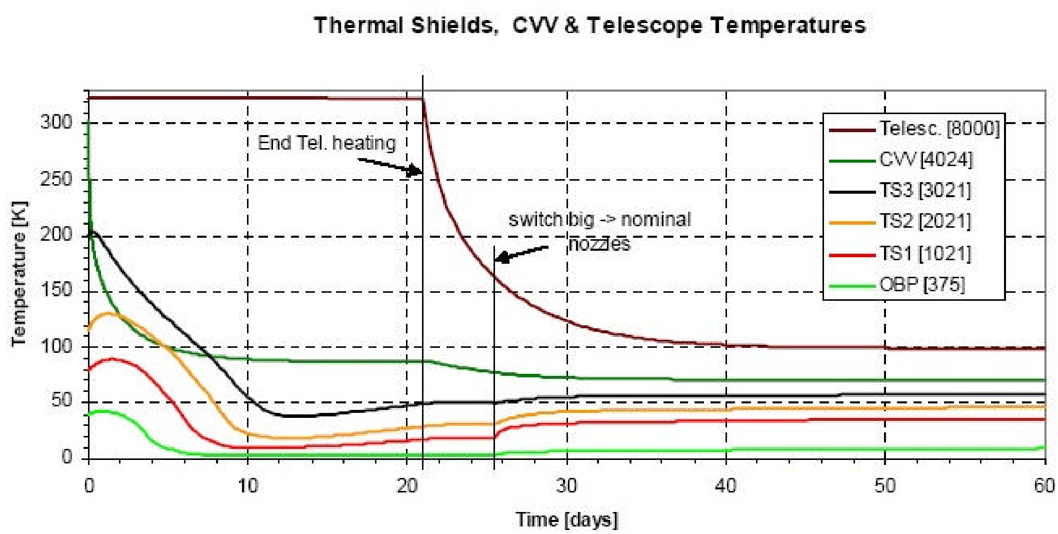

Figure 5-1: Modelled telescope cooldown provided by Thales Alenia Space

SPIRE can not complete the PV Phase activities until the telescope has reached its final operating temperature with TBS stability.

5.2 SPIRE Operations

5.2.1 Documentation

The governing documents are the SPIRE Calibration Requirements Document, the Sciops PV Plan (TBW), and the SPIRE Operating Modes document (SPIRE-RAL-DOC-000320).

This document then describes how these will be implemented. It should be used in conjunction with the Observation Templates Document which gives the procedures to be carried out.

As PV phase will require flexibility in planning, although an initial detailed plan scheduling the observations is listed in appendix 1, this will be maintained separately and updated regularly following each daily meeting in the PV Phase.

5.2.2 Assumed Mission Management during Commissioning and PV Phase

We currently assume that, during Commissioning Phase, TAS (Thales Alenia Space) will have overall management of the mission planning, transitioning to full HSC/Project control by the start of PV phase. Under this arrangement, SPIRE will initially report to a TAS-led planning team, then to the HSC/Project (SCOM?) led planning team. It is important the managerial arrangements during Commissioning and PV Phases are clearly defined and understood by all parties.

5.2.3 SPIRE Team Management during PV

The SPIRE ICC operational team management structure during PV phase will be similar to the ICC development team structure. Overall responsibility is held by the PI with the Instrument Scientist as his deputy, but the day-to-day coordination and planning of PV phase activities will be the responsibility of the Calibration Scientist.

The execution of the PV Phase activities will be carried out by the ICC teams under the control of the ICC Manager:

- The Operations Team – responsible for scheduling PV phase observations and entering these into the mission planning system; instrument health monitoring; data retrieval, processing and ensuring the data is available at RAL for use by the other teams; and delivery of updated calibration information for the Herschel planning and data processing systems.
- The Data Processing and Software Team – responsible for validation of the implementation, operation and scientific performance of the AOTs
- The Calibration Team – responsible for analysing the data and feeding the results back into the PV phase planning; producing updated calibration information both for uplink and downlink purposes; and for updating the sensitivity estimate.

These teams map on to the currently existing ICC operations, software and calibration teams respectively and will be led by the team leaders. During commissioning and PV, these teams, which involve overlapping membership, will operate in a highly integrated way.

5.2.4 Availability of Data

It is assumed that all data from an observation will be available at RAL for ICC use within 6 hours of the end of the DTCP.

5.2.5 Locations of People

5.2.5.1 ESOC

It is not expected that any staff will be located at ESOC as no real time operation is required during PV phase (TBC).

5.2.5.2 ESAC

On the assumption that data will be made available promptly from ESOC to RAL (via ESAC) we do not envisaged SPIRE staff co-located at ESAC over and above the two ESA liaison staff.

5.2.5.3 RAL

It is currently assumed that all three ICC teams will work one shift per day, seven days per week, and that all shifts will be in office hours.

All key personnel will be co-located at RAL, these include:

- The PI
- The existing RAL team, including the ICC manager, the Instrument Scientist, and the Calibration Scientist
- The ICC Team Leaders
- Consortium experts who will participate in performance analysis activities. These include experts from CEA, (SBT and SAP) and JPL, IPAC, LAM, Lethbridge and Cardiff
- ICC members who will be part of the Operations and Calibration teams and who may participate in data analysis activities. This will include experts from the DAPSAS Centres (Imperial College, Lethbridge, CEA), IPAC and Cardiff.

People who will not be co-located will still be expected to participate in data analysis and may be able to attend the daily meetings via video link.

5.2.6 Staffing and Meetings

Seven day week working is assumed with individual team members working for 5 of each 7 days.

5.2.6.1 External Meetings

SPIRE will support HSC-chaired Ground Segment meetings. It is expected that this will usually be via telecon or videoconference (preferred) and will require a minimal number of SPIRE personnel. These meetings include:

- Daily schedule/planning meetings
- CCBs

In addition it is expected that at least one scientific review meeting will be held to evaluate the status of the scientific verification and performance of the satellite

5.2.6.2 Internal ICC meetings

A daily planning meeting will be held which will be chaired by the PI, Instrument Scientist or Calibration Scientist, depending on availability. The aims of this meeting will be to

- Assess current state of instrument (from health checks)
- Assess observations carried out with respect to the plan
- Assess data analysis results and implications
- Review planned observations

A standard agenda will be used to format each meeting. All SPIRE personnel will be expected to attend and each team must be represented with either the team leader or designated deputy.

We will also hold a data analysis review meeting once every 6 days (based on the assumed instrument rotation).

5.2.7 Planning Tools

Our understanding is that the PV Phase will, as far as possible, be executed from a mission timeline entered into (the expert version of) HSpot and scheduled through the HCSS Mission Planning System.

Another really important thing to get sorted out is how some of the more esoteric procedures get "wrapped" as observations.

At the start of PV phase it is assumed that the entire phase has been fully scheduled and that this schedule will be run as default. As the results of data analysis may require schedule changes it is assumed the SPIRE operations team may make changes as agreed at daily meetings. It is further assumed they may do so relatively close to the schedule being uplinked e.g. up to 24 hours before.

For this to be done effectively it is assumed that the mission planning tool will be made available to the ICC operations team which will allow them to schedule the SPIRE observations. This planning tool will enable the SPIRE operations team to produce a complete schedule for their allocated time period. Once the SPIRE operations team has produced a schedule it is assumed that this will be checked by the HSC before uplink.

5.2.8 Commissioning Phase (Placeholder, to be moved to Commissioning Plan)

ESOC
It is assumed that only one shift per day covering the ground contact time is required at ESOC. Therefore a staffing level of 3-4 people will be required. The SPIRE team members located at ESOC will have expertise in instrument commanding and instrument science and will have participated in the ILT, IST and/or the SPT.

RAL

For Commissioning Phase no external consortium or ICC members need to be co-located at RAL as the data will be made available in the same way as for ILT/IST. The following experts will be required to help with data analysis:

- JPL/IPAC: detector noise data and load curves
- LAM: SMEC functionality
- UKATC: BSM functionality
- Cardiff: internal calibrators
- CEA and IFSI: warm electronics

It is assumed that the ESA instrument/calibration scientists will be located at ESAC during this period but will be available to help with instrument activities.

6. PV Phase Priorities

6.1 Overview

The goal of PV Phase is to have a complete set of observing modes ready for routine operations. However, given time constraints, visibility constraints and the need for flexibility, it may be necessary to restrict the number of modes validated by the nominal end of the phase. Therefore observations carried out during PV phase will be assigned a priority (high, medium or low) which will determine, in general, the order in which the relevant observations will be executed and the corresponding data sets analysed. This priority will be based on a combination of considerations detailed here.

The priority order is governed by the need to release AOTs. The following set of priorities is adopted (1 is higher priority than 5):

1. Point source photometry
2. Scan Map
3. Jiggle Map
4. FTS point source
5. FTS Map

Then for each AOT the following general priority order is adopted:

i. calibration files required for uplink of an AOT (e.g. BSM position vs. angle on sky);
ii. setup of an AOT (e.g. for point source photometry this would include optimum jiggle offset; for scan map it would include the scan speed)
iii. calibration files required for data processing but not needed for uplink (e.g. spectral response function)

All calibration files are also categorised as follows:

A. has to be populated at the start of PV;
B. is dependent on being done at a certain time;
C. has to be properly populated definitively at end of PV;
D. must be populated but not definitively at end of PV;
E. could be populated later via routine calibration;

Category A files relate to detector setup - e.g. we will have to adopt a nominal in-flight JFET Vss from commissioning phase. Most category A files will be populated in commissioning phase but some may be populated early in PV phase.

Category B files include parameters derived from data which is time specific. The main example of this is the characterisation of the SCAL port which is planned to done by carrying out SMEC scans with the telescope at different temperatures as it is cooling.

Category C includes all uplink files associated with a particular AOT.

Category D files include all information which must be obtained via special PV observations and generally includes most of the calibration information required for data processing.

Category E files are similar to category D files but are considered as lower priority due to the ability to use ground calibration or routine phase calibration data to improve them. An example of a category E file is the spectrometer RSRF which has been well established on the ground and will be confirmed in PV phase. Routine observations of a well known source such as Uranus will then be used to refine file produced at the end of PV phase.

6.2 Uplink Files

This section will include a list of uplink files, the information contained and attached priorities. It is intended to be a summary table with the next section covering the gory details.

Filename	Description	Populated In PV	AOTs	Priority
BSM Configuration	Minimum Power dissipation position	No, Commissioning	All	High
Chopping Configuration	Observing parameters when chopping	Updated plus Commissioning	Phot Point Source, Phot Small Map, Spectrometer Step and Integrate	High
Command Lists	VM table locations	No, ground	All?	N/A
Flash	PCAL Flash Parameters	Updated	All	High
Photometer Sensitivities	Photometer sensitivities	Updated	All photometer	High
Spectrometer Sensitivities	Spectrometer sensitivities	Updated	All spectrometer	High
Spectrometer Configuration	Scan parameters	Updated	All spectrometer scanning	High
SPIRE Configuration	Observing parameters, time between flashes etc	Updated?	All	High
Operations	Fundamental Observing parameters	Updated	All	High
7-Point Jiggle Map Positions	7-Point Jiggle Map Positions	Updated	Phot Point Source, Phot Small Map	High
64-Point Jiggle Map Positions	64-Point Jiggle Map Positions	Updated	Phot Point Source, Phot Small Map	High
Spectrometer Sparse Sampling	BSM Position for Sparse Sampling	Same as BSM Configuration?	Sparse Spatial Sampling	High
Spectrometer Intermediate Sampling	BSM Positions for Intermediate Sampling (4 point jiggle)	Updated	Intermediate Spatial Sampling	Medium
Spectrometer High Sampling	BSM Positions for High Sampling (16 point jiggle)	Updated	Full Spatial Sampling	Medium
CREC Operations	Parameters required to do a cooler recycle	No, Commissioning	None	N/A
PTC Control	Parameters required to control the PTC	TBD, mostly done in commissioning	Scan Map Only?	High
SCAL Control	Parameters required to control SCAL	No, Commissioning	All Spectrometer AOTs	N/A

6.3 Data Processing Files

The table below contains a list of pipeline calibration files. For each file it is indicated whether it needs to be populated wit PV phase data, which AOTs it needs to be populated for and the priority. Where high priority is assigned it is because the information used to produce this file is also required for uplink. Medium priority is assigned to files which are populated for the first time with PV data and low priority is assigned to the remainder. (Placeholder priorities, this needs a group discussion)

Filename	Description	Populated In PV	AOTs	Priority
Photometer				
Files Not Populated in PV				
SCalPhotChanNum	Channel Number Table	No, ground	N/A	N/A
SCalPhotChanTimeOff	Pixel Readout Time Offsets	No, ground	N/A	N/A
SCalPhotChanGain	Electronic Gain Table	No, ground	N/A	N/A
SCalPhotElecPar	Electronic Parameter Table	No, ground	N/A	N/A
SCalPhotRsrf	RSRF	No, ground	N/A	N/A
Files Populated Continuously				
SCalTSync	Tsync History File	Yes	N/A	N/A
SCalPhotOffsetHist	Offset History File	Yes	N/A	N/A
SCalPhotPCAL	PCAL History	Yes	N/A	N/A
Files (Re-) Populated In PV Phase				
SCalPhotChanMask	Bad Channel Table	Updated	All	High
SCalPhotBSMPos	BSM Position vs Angle Table	Updated	Point Source, Small Map	High
SCalPhotBSMOps	BSM Operations Table	Updated	All	High
SCalPhotTeleBack	Telescope Background Power/Signal	New	Scan Map	Medium
SCalPhotGlitch	Pixel Glitch Table	Updated	All	Low
SCalPhotBolPar	Bolometer Parameters	Updated	All	Low[1]
SCalPhotElecCross	Electrical Crosstalk	Updated	All	Low
SCalPhotOptCross	Optical Crosstalk	New	All	Medium
SCalPhotPixAngOff	Pixel Offset Table	Updated[2]	All	Low
SCalPhotPixTimeConst	Pixel and Electronic Time Constants	Updated	All	Low
SCalPhotNonLinCorr	Non-Linearity Correction	New	All	Medium
SCalPhotUnitToAst	Conversion to Astronomical Units	New	All	Medium
SCalPhotSpecIndex	Spectral Index Conversion	No	N/A	N/A
SCalPhotPsf	Beam Profiles	Updated	All (TBR)	Low
Spectrometer				
Files Not Populated				
SCalSpecChanNum	Channel Number Table	No	N/A	N/A
SCalSpecChanTimeOff	Pixel Readout Time Offsets	No	N/A	N/A
SCalSpecChanGain	Electronic Gain Table	No	N/A	N/A
SCalSpecElecPar	Electronic Parameter Table	No	N/A	N/A
SCalSpecOeOpd	Optical Encoder to OPD	No	N/A	N/A
SCalSpecLVDTOe	Optical Encoder to LVDT	No	N/A	N/A

Files Populated Continuously				
SCalTSync	Tsync History File	Yes	N/A	N/A
SCalSpecOffsetHist	Offset History File	Yes	N/A	N/A
SCalSpecPCAL	PCAL History	Yes	N/A	N/A
SCalSpecScalTempHist	SCAL Temperature History	New	N/A	N/A
Files (Re-) Populated In PV Phase				
SCalSpecChanMask	Bad Channel Table	Updated	All	High
SCalSpecBSMOps	BSM Operations Table	Updated	All	High
SCalSpecBSMPos	BSM Position vs Angle Table	Updated	Point Source, Small Map	High
SCalSpecGlitch	Pixel Glitch Table	Updated	All	Low
SCalSpecPixTimeConst	Pixel and Electronic Time Constants	Updated	All	Low
SCalSpecBolPar	Bolometer Parameters	Updated	All	Low[1]
SCalSpecNonLinCorr	Non-Linearity Correction	New	All	Medium
SCalSpecElecCross	Electrical Crosstalk	Updated	All	Low
SCalSpecOptCross	Optical Crosstalk	New	All	Medium
SCalSpecPixAngOff	Pixel Offset Table	Updated[2]	All	Low
SCalSpecSmecZpd	ZPD Position	Updated	All	Low
TBD	Baseline Correction	TBD	All	TBD
SCalSpecModEff	Modulation Efficiency	Updated	All	Low
SCalSpecBack	Standard Interferogram	New	All	Medium
SCalSpecBandEdge	Spectral Band Edge	Updated	All	Low
SCalSpecNlp	Non-Linear Phase	Updated	All	Low
SCalSpecRsrf	RSRF	Updated	All	Low
SCalSpecILS	Instrumental Line Shape	Updated	All	Low
ScalSpecPsf	Beam Profiles	Updated	All	Low

1. This file has a low priority for DP because the empirical scheme is adopted; however the data taken to populate this file i.e. load curves will need to be analysed with high priority as this impacts the predicted sensitivity to be entered into HSpot.
2. The only update to this is via the telescope putting a point source on various pixels and noting the positions of maximum signal. This will only be done as a dedicated test for a few pixels but the normal surveys provide plenty of secondary data to confirm relative positions.

7. CALIBRATION FILES TO BE POPULATED FROM PV DATA

7.1 Uplink Files

7.1.1 BSM Configuration (To Move To Commissioning Plan)

Description
This file defines the positions of the BSM hold position.

Table Parameters

ChopPosn	Commanded Chop position for minimum power dissipation
JigglePosn	Commanded Jiggle position for minimum power disssipation

Templates
Commissioning Test

AOTs Using This Table
Will be used in all AOTs.

Observations
See commissioning plan

Analysis
See commissioning plan

7.1.2 Chopping Configuration

Description
This file defines the parameters for each of the SPIRE chopped observing modes. These modes are: POF1, POF2, POF3, POF4, POF6, SOF3, SOF4

Table Parameters

Period	Period of chop cycle (microsecs)
DcuFrame	DCU Sample Mode
DcuFreq	BIAS Frequency divider - gives DCU sample frequency
DcuSamples	Number of DCU Samples per chop position
DcuDelay	Delay to start of DCU sampling (microsecs)
BsmFreq	BSM Sampling Frequency
BsmSamples	Number of BSM samples per chop position

Note: many values in this file are dependant on the detector bias frequency, which is defined in the SPIRE Parameters table

AOTs Using This Table
The photometer AOTs using this table are:
AOT – Point Source
AOT – Small Map
AOT – Peakup Mode?
The spectrometer will use this table for step and integrate observations based on SOF3 and SOF4

Templates Required

Period	The 'Period' is the governing parameter of this table and is the entity tested
DcuFrame	What is this?
DcuFreq	The bias frequency will be established in commissioning phase (see commissioning plan). This will dictate the DcuFrame parameter. This parameter is independent of the Period.
DcuSamples	The Period combined with the DcuFreq constrains the DcuSamples parameter e.g. for 1 Hz chopping and 18 Hz sampling we have 9 samples per chop period
DcuDelay	This parameter is the delay time to the first sample, the baseline is to put the last sample at the end of the chop cycle, therefore this delay accounts for the remainder after n dcu samples are subtracted from the chop period.
BsmFreq	BsmFreq while variable is expected to remain at the ground (and design) value of 80Hz and therefore is considered to be constant at this value for both the photometer and spectrometer.
BSMSamples	The BsmFreq combined with the period constrains the BsmSamples parameter e.g. for 1 Hz chopping there will be 80 samples per second or 40 samples per chop period.

Expert 'Point Source' AOTs will be tested with different chop periods. These will utilise POF2 and SOF3.

Pre-Requisites

The BSM will need to have been tuned for the frequencies tested.

As the tuning depends in chop throw the nominal chop throw will need to have been established.
To nominal chop throw is established from the BSM FOV scanning.
The nominal bias frequency and sample rate is also required to have been established.

Observations

The source requirements for all observations are a stable bright point source which is isolated.

Source Type	Mode	S/N	Jiggle Offset	Spectral Resolution	Chop Frequency
Point source	POF2	TBD	Nominal, as established from offset set up tests, currently 6”	N/A	2 Hz
Point source	SOF3	TBD	N/A	Low	2Hz
Point source	POF2	TBD	Nominal, as established from offset set up tests	N/A	1.5 Hz
Point source	SOF3	TBD	N/A	Low	1.5 Hz
Point source	POF2	TBD	Nominal, as established from offset set up tests	N/A	1.0 Hz
Point source	SOF3	TBD	N/A	Low	1.0 Hz

Analysis

The standard demodulation scheme will be applied to data from each position in the 7 point jiggle. The positions will then be combined to recover the source flux.
The chopping scheme that then most accurately recovers the source flux in the minimal time taken should then be adopted for all AOTs.

7.1.3 Command Lists (Does Not Require an Update In-Flight)

Description
This file defines the VM Table location and parameters for executing a particular Command List. These command lists are: Flash, Chop, JiggleMap, BSMMove

Table Parameters
Id VM Table number
Index VM Start address
Nparms Number of parameters to the VM Table

7.1.4 Flash

Description
This file defines the parameters for a PCAL flash in the following instrument modes: Photometer, Spectrometer. Only one flash type is available per mode.

Table Parameters

LowBias	PCAL low current
HighBias	PCAL high current
Cycles	number of cycles
Period	period of cycle (usecs)
DcuFrame	DCU data mode (0 = Full Photometer, 4 = Full SPectrometer)
DcuSamples	number of DCU sampled per half cycle
DcuDelay	delay (usecs) from start of cycle to first DCU sample
ScuMode	SCU data mode (0 = 80Hz sampling)
ScuSamples	number of SCU samples per half cycle (should always be set to 0 - continuous data)

AOTs Using This Table
All AOTs will use the same parameters for PCAL but may have varying Dcu parameters.

Templates Required

LowBias	This is the low value of the PCAL current to use. From ground testing zero has always been used. No other values will be tested in-flight.
HighBias	This is the high value of the PCAL current to use. This will be established with a dedicated PCAL level test.
Cycles	The number of cycles currently used is 2, it is assumed this will remain the baseline parameter unless there is a large degradation in S/N, therefore no specific tests are planned for this.
Period	This parameter will be tested via a dedicated test.
DcuFrame	What is this?
DcuSamples	The Period combined with the DcuFreq constrains the DcuSamples parameter e.g. for 1 Hz chopping and 18 Hz sampling we have 9 samples per chop period
DcuDelay	This parameter is the delay time to the first sample, the baseline is to put the last sample at the end of the chop cycle, therefore this delay accounts for the remainder after n dcu samples are subtracted from the chop period.
ScuMode	The PCAL sample rate ground value of 80Hz will continue to be used without further testing.
ScuSamples	The ground value of zero will continue to be used.

Several templates feed in to this:
Phot (and Spec) PCAL Level Check – determines the PCAL high level to use, this test will be done at different PCAL chop frequiencies
Phot (and Spec) Standard PCAL Flash – we will use the longer ground sequence to compare on-ground and in-flight instrument reaction, this is considered to be a supporting test for this AOT
Phot (and Spec) PCAL AOT Flash – checks levels determined for AOTs standalone, it is TBD whether this will be required.

Pre-Requisites

The nominal detector settings (Vss, bias frequency, bias amplitude and associated phase) have been established.

Observations

Template	Source Type	Inst	Chop Frequency
PCAL Level Check	Dark Sky?	Phot	0.25 Hz
PCAL Level Check	Dark Sky?	Phot	0.5 Hz
PCAL Level Check	Dark Sky?	Spec	0.25 Hz
PCAL Level Check	Dark Sky?	Spec	0.5 Hz

1. These levels are hardcoded into the test which deliberately uses the full range.

Analysis

The minimum level which gives good (TBD) S/N will be adopted.

7.1.5 Photometer Sensitivities

Description
This table defines the sensitivity information for each of the SPIRE photometric observing modes. This information is defined in SPIRE-UCF-DOC-002554

Photometric observing modes are:
POF1, POF2, POF3,
POF5_F_scana, POF5_F_scanb, POF5_F_scanab
POF5_S_scana, POF5_S_scanb, POF5_S_scanab
Par_F_N, Par_F_O, Par_S_N, Par_S_O

Table Parameters
For each of the above observing modes the following parameters are required:

PSWTeff	Effective integration time for unit speed per repetition for PSW band
PMWTeff	Effective integration time for unit speed per repetition for PMS band
PLWTeff	Effective integration time for unit speed per repetition for PLS band
PSWFLuxUnc	flux density uncertainties (1sigma, 1sec) in mJyfor PSW Band
PMWFLuxUnc	flux density uncertainties (1sigma, 1sec) in mJyfor PMW Band
PLWFLuxUnc	flux density uncertainties (1sigma, 1sec) in mJyfor PLW Band
PSWBrightUnc	surface brightness uncertainties (1sigma, 1sec) in MJy/sr for PSW Band
PMWBrightUnc	surface brightness uncertainties (1sigma, 1sec) in MJy/sr for PMW Band
PLWBrightUnc	surface brightness uncertainties (1sigma, 1sec) in MJy/sr for PLW Band
PSWConfLim	Confusion Limit in the PSW Band
PMWConfLim	Confusion Limit in the PSW Band
PLWConfLim	Confusion Limit in the PSW Band

AOTs Using This Table
All Phot

Templates Required

Teff	This parameter is derived from the adopted scan rate, therefore depends on the AOTs used to establish scan rate.
FluxUnc	Observations of a set of standard sources on known flux will be used to establish this.
BrightUnc	Scan map of a known extended source at nominal rate will be used to check ground derived values.
ConfLim	Scan map of dark patch of sky will be used to confirm predicted values.

Pre-Requisites
TBD

Observations
TBD

Analysis
TBD

7.1.6 Spectrometer Sensitivities

This table defines the sensitivity information for each of the SPIRE spectrometric observing modes. Values are defined at a set of fixed wavelength – the values at other wavelengths are interpolated (linearly) from these. This information is defined in SPIRE-UCF-DOC-002554

Table Parameters

HLineUnc	line flux uncertainty (10^-17 W/M^2) for high resolution scans
MLineUnc	line flux uncertainty (10^-17 W/M^2) for medium resolution scans
HContUncJ	continuum uncertainty (Jy) for high resolution scans
MContUncJ	continuum uncertainty (Jy) for medium resolution scans
LContUncJ	continuum uncertainty (Jy) for low resolution scans
HContUncW	continuum uncertainty (Wm-2um-1) for high resolution scans
MContUncW	continuum uncertainty (Wm-2um-1) for medium resolution scans
LContUncW	continuum uncertainty (Wm-2um-1) for low resolution scans

AOTs Using This Table

Spectrometer Sparse Map
Spectrometer Intermediate Map
Spectrometer Full Map

Templates Required

LineUnc	
ContUnc	
ContUncW	

Pre-Requisites

TBD

Observations

TBD

Analysis

TBD

7.1.7 Spectrometer Configuration

Description
This table defines the instrument-wide parameters for SPIRE spectrometer operations for each spectral resolution.

Spectral resolutions available are:

H	High resolution
M	Medium resolution
L	Low resolution

Table Parameters

Home	HOME position to use for while scanning
Osit	on-source integration time per scan (secs)
ScanTime	time taken to execute a single scan (secs)
Resolution	Expected spectral resolution (cm-1)
ScanStart	Scan Start position
ScanEnd	ScanEnd Position
ScanFSpeed	Scan Forward Speed
ScanRSpeed	Scan Reverse Speed
ScanFCmd	Scan Forward Speed command parameter
ScanRCmd	Scan Reverse Speed command parameter
Waveform	Scan Waveform (TRIANGULAR or SAWTOOTH)

AOTs Using This Table
Spectrometer Sparse Map
Spectrometer Intermediate Map
Spectrometer Full Map

Templates Required
TBW

Pre-Requisites
TBD

Observations
TBW

Analysis
TBW

7.1.8 Spire Configuration

Description

This table defines the instrument-wide parameters for SPIRE observations for each mode. The available modes are:

POF1, POF2, POF3,
POF5_F_scana, POF5_F_scanb, POF5_F_scanab
POF5_S_scana, POF5_S_scanb, POF5_S_scanab
Par_F_N, Par_F_O, Par_S_N, Par_S_O
SOF1, SOF2, SOF3, SOF4

Table Parameters

TSerendipity	minimum time required in a slew for a serendipity observation to be inserted
InitFlash	true if PCAL flashes alwyas inserted during initialisation
EndFlash	true if PCAL flashes always inserted at end of observation
Flashtime	minimum time (in seconds) between PCAL Flashes
CalTime	minimum time (in seconds) between Gyro calibrations
BiasFreq	master clock divider - gives the bias frequency

AOTs Using This Table

All

Templates Required

TSerendipity	This is currently set to be the minimum time possible as dictated by a slew of sufficient length to take one sample. There is no obvious reason to change this in flight therefore no specific tests will be done. It is assumed that PV phase will be done with serendipity mode enabled, therefore the slew data will be analysed and an assessment can be made as to whether this one sample minimum should be increased.
InitFlash	The baseline is that this will remain true while we continue with a scheme of flashing PCAL before and after each observation.
EndFlash	The baseline is that this will remain true while we continue with a scheme of flashing PCAL before and after each observation.
Flashtime	This parameter should be derived from analysis of long duration scan map observations
CalTime	It is assumed the spacecraft value will be reflected in the SPIRE calibration file therefore no observations needed.
BiasFreq	This parameter will be established in commissioning phase and is mode dependent.

The Scan Map AOT can be used, an expert mode is not required.

Pre-Requisites

TBW

Observations

TBW

Analysis

TBW

7.1.9 Operations

Description

This table defines the instrument-wide parameters for SPIRE operations for each mode. The available modes are:

POF1, POF2, POF3,
POF5_F_scana, POF5_F_scanb, POF5_F_scanab
POF5_S_scana, POF5_S_scanb, POF5_S_scanab
Par_F_N, Par_F_O, Par_S_N, Par_S_O
SOF1, SOF2, SOF2_int, SOF3, SOF4, SOF4_int

A value of -1, -1.0 or --- indicates that this parameter is not used in a particular mode

Table Parameters

Boresight	instrument boresight
DeltaY	offset to pixel centre from boresight in Y direction (arcsecs)
DeltaZ	offset to pixel centre from boresight in Z direction (arcsecs)
TableID	Jiggle Position Table number
TableSize	number of jiggle positions in Position Table (must be a multiple of NJiggs)
NChops	number of chop cycles per jiggle position
MinScans	minimum number of FTS scans to be taken
NHScans	number of FTS High Res scans (taken as a unit or per jiggle posn)
NMScans	number of FTS Medium Res scans (taken as a unit or per jiggle posn)
NLScans	number of FTS Low Res scans (taken as a unit or per jiggle posn)
NJiggs	number of jiggle positions per nod position
NNodInts	number of times to repeat Njigg jiggles at each nod position
NNodPosns	number of nod positions in a nod cycle
NNodCycles	number of nod cycles in a repetition
NMaps	number of times to repeat each small map in a raster, or each scan map in a repetition
Fixed	pattern angle definition
Patt	direction of telescope movement in D1 direction (degrees)
D1	distance between raster points or nod positions (arcsecs)
D2	distance beteween raster/scan lines (arcsecs)
HLoss	lost map height: Observed map height = (D2 * (No of Lines - 1)) + HLoss
LLoss	lost map length: Observed map length = (scan length - LLoss)
XRepeat	Number of times to repeat the cross scan map per nominal map
ScanRate	telescope scan rate (arsec/sec)
SrcTime	effective on source integration time per unit of operation (nod cycle, map, scan)

Parameters related to Spectrometer raster mapping – see ED's document

YShiftUnit	Units used to define steps in the Y direction (arcsecs)
ZShiftUnit	Units used to define steps in the Z direction (arcsecs)
YStep	step in Y direction between raster points (YShiftUnits)
ZStep	step in Z direction between raster points (ZShiftUnits)
YRowSep	separation in Y direction between raster rows (YShiftUnits)
ZRowSep	separation in Z direction between raster rows (ZShiftUnits)

AOTs Using This Table
TBW

Templates Required

Boresight	
DeltaY	
DeltaZ	
TableID	
TableSize	
NChops	
MinScans	
N(HML)Scans	
NJiggs	
NNodInts	
NNodPosns	
NNodCycles	
NMaps	
Fixed	
Patt	
D1	
D2	
HLoss	
LLoss	
XRepeat	
ScanRate	
SrcTime	

Pre-Requisites
TBW

Observations
TBW

Analysis
TBW

7.1.10 7-Point Jigglemap Positions

In order to perform a 7-point jiggle map the BSM is commanded to 8 positions (the last is a repeat of the first). At each of these the BSM chops between two positions, designated the on- and off-source positions. Thus 14 values are required defining these positions.

Each 32 bit value corresponds to a single BSM position and contains the Jiggle axis position in the most significant 16 bits and the Chop axis position in the least significant 16 bits.

JM7_01_On BSM position for position 1, on-source
JM7_01_Off BSM position for position 1, off-source
JM7_02_On BSM position for position 2, on-source
JM7_02_Off BSM position for position 2, off-source
:::::::::::::::::::: :::
JM7_06_On BSM position for position 6, on-source
JM7_06_Off BSM position for position 6, off-source
JM7_07_On BSM position for position 7, on-source
JM7_07_Off BSM position for position 7, off-source

AOTs Using This Table
Photometer Point Source

Templates Required
An expert AOT for 7 point jiggle map will be required.

Pre-Requisites
The logical sequence to establish this to do a BSM FOV scan, then tune the nominal chop throw found, then test the AOT with different angular offsets as established by the FOV scan. Here only the AOT testing is described as the BSM FOV scanning and tuning is dealt with elsewhere in this plan.

Observations

Source Type	Position of Source	Chop Freq	Chop Throw	Angular Offset (arcsecs)
Point Source	Centre	Nominal	Nominal	5
Point Source	Centre	Nominal	Nominal	6
Point Source	Centre	Nominal	Nominal	7
Point Source	2” offset	Nominal	Nominal	5
Point Source	2” offset	Nominal	Nominal	6
Point Source	2” offset	Nominal	Nominal	7

It is TBD whether we additionally vary the number of chop cycles and/or the chopping parameters.

Analysis
The observations will be processed, through the standard pipeline if possible and the point source reconstruction will be checked. The angular offset which best recovers the source flux will be adopted.

7.1.11 64-Point Jigglemap Positions

In order to perform a 64-point jiggle map the BSM is commanded to 64 positions. At each of these the BSM chops between two positions, designated the on- and off-source positions. Thus 128 values are required defining these positions.

Each 32 bit value corresponds to a single BSM position and contains the Jiggle axis position in the most significant 16 bits and the Chop axis position in the least significant 16 bits.

JM64_01_On BSM position for position 1, on-source
JM64_01_Off BSM position for position 1, off-source
JM64_02_On BSM position for position 2, on-source
JM64_02_Off BSM position for position 2, off-source
:::::::::::::::::::: ::
JM64_63_On BSM position for position 63, on-source
JM64_63_Off BSM position for position 63, off-source
JM64_64_On BSM position for position 64, on-source
JM64_64_Off BSM position for position 64, off-source

AOTs Using This Table
Only the photometer small map AOT uses this table.

Templates Required
As the 64 points fills the PLW pixel, unlike the 7 point case it does not make sense to vary the offsets. While not planned we may anticipate the need to change the chop parameters i.e. number of cycles and chop frequency.
Note the sequence the 64 points are done in is not planned to be changed but if a need is identified to test this, it only implies a change to the position order in this table.

Pre-Requisites
As with the 7 point jiggle map, the logical sequence to establish this to do a BSM FOV scan, then tune the nominal chop throw found, then test the AOT with different angular offsets as established by the FOV scan. Here only the AOT testing is described as the BSM FOV scanning and tuning is dealt with elsewhere in this plan.

Observations

Source Type	Position of Source	Chop Throw
Point Source	Centre	Nominal
Point Source	5” offset in Y	Nominal
Point Source	5” offset in Z	Nominal
Point Source	9” offset in Y	Nominal
Point Source	9” offset in Z	Nominal
Small Extended Source	Centre	Nominal

It is TBD whether we additionally vary the number of chop cycles and/or the chopping parameters.
The extended source should be a size less than 4x4’.

Analysis

The observations will be processed, through the standard pipeline if possible. The positions the BSM went to will be checked. The recovery of the source will be checked.

7.1.12 Spectrometer Sparse Sampling

This parameter gives the BSM chop and Jiggle commanded positions for the spectrometer single point observations, with sparse spatial sampling.
The 32 bit value corresponds to the BSM position and contains the Jiggle axis position in the most significant 16 bits and the Chop axis position in the least significant 16 bits.

SP_Sparse BSM sparse position e.g. 0x986B9270

AOTs Using This Table
Spectrometer point source
Spectrometer raster (sparse sampling)

Templates Required
This parameter is the BSM minimum current position which will be derived in commissioning phase.

Pre-Requisites
None

Observations
None in PV phase

Analysis
The BSM jiggle and chop positions where the current is the minimum value will be adopted.

7.1.13 Spectrometer Intermediate Sampling

These parameters give the BSM chop and Jiggle commanded positions for the spectrometer single point observations, with intermediate spatial sampling. There are currently 4 positions.

Each 32 bit value corresponds to a single BSM position and contains the Jiggle axis position in the most significant 16 bits and the Chop axis position in the least significant 16 bits.

SP_Int_01 BSM position for intermediate position 1
SP_Int_02 BSM position for intermediate position 2
SP_Int_03 BSM position for intermediate position 3
SP_Int_04 BSM position for intermediate position 4

AOTs Using This Table
Point Source (Intermediate Sampling)
Raster (Intermediate Sampling)

Templates Required
The AOTs can be used without the need for expert templates.

Pre-Requisites
The BSM FOV mapping will establish the positions to use for this table.

Observations

AOT	Source Type	Position of Source	Spectral Resolution
Point Source	Point Source	Centre	High
Point Source	Point Source	5” offset in Y	Medium
Point Source	Point Source	5” offset in Z	Medium
Point Source	Small Extended Source	Centre	High

Analysis
The observations will be processed, through the standard pipeline if possible. The positions the BSM went to will be checked. The recovery of the source will be checked.

7.1.14 Spectrometer Full Sampling

Description
These parameters give the BSM chop and Jiggle commanded positions for the spectrometer single point observations, with full spatial sampling. There are currently 16 positions.

Each 32 bit value corresponds to a single BSM position and contains the Jiggle axis position in the most significant 16 bits and the Chop axis position in the least significant 16 bits.

SP_Full_01 BSM position for full position 1
SP_Full_02 BSM position for full position 2
:::::::::: ::::::::::::::::::::::::::::::::::::::
SP_Full_15 BSM position for full position 15
SP_Full_16 BSM position for full position 16

AOTs Using This Table
Point Source (Full Sampling)
Raster (Full Sampling)

Templates Required
The AOTs can be used without the need for expert templates.

Pre-Requisites
The BSM FOV mapping will establish the positions to use for this table.

Observations

AOT	Source Type	Position of Source	Spectral Resolution
Point Source	Point Source	Centre	Medium
Point Source	Point Source	5” offset in Y	Low
Point Source	Point Source	5” offset in Z	Low
Point Source	Point Source	9” offset in Y	Low
Point Source	Point Source	9” offset in Z	Low
Point Source	Small Extended Source	Centre	Medium

Analysis
The observations will be processed, through the standard pipeline if possible. The positions the BSM went to will be checked. The recovery of the source will be checked.

CREC Operations (Commissioning Phase)

Description

These parameters define the operational characteristics of the Cooler Recycle command list (See RD03). It is assumed the ground values will be retained for in-flight operations and that these will be checked via manual cooler recycles early in the mission.

Table Parameters

All parameters are provided in raw ADU, if not otherwise defined

CREC_A	Heat Switch ON current (during Recycling)
CREC_B	Heat Switch OFF current
CREC_C	Pump Heat Switch Actuation Temperature
CREC_D	Pump Heater Dissipation 1
CREC_E	Pump Condensation Temperature 1
CREC_F	Pump Heater Dissipation 2
CREC_G	Pump Condensation Temperature 2
CREC_H	Pump Heater Dissipation 3
CREC_I	Pump Heater Dissipation 4
CREC_J	Pump Condensation Temperature Threshold
CREC_K	Evaporator Condensation Temperature
CREC_L	Evaporator Heat Switch Actuation Temperature
CREC_M	Pump Threshold Temperature
CREC_N	Heat Switch ON current
CREC_O	Sampling Interval (sec)
CREC_P	Heatswitch Timeout (min)
CREC_Q	Pump Heating Timeout 1 (min)
CREC_R	Pump Heating Timeout 2 (min)
CREC_S	Evaporator Timeout (min)
CREC_T	Pump Cooling Timeout (min)
CREC_U	Global Timeout (min)

AOTs Using This Table

None

Templates Required

None

Pre-Requisites

TBD

Observations

None

Analysis

TBW

7.1.15 PTC Control

Description

These parameters define the operational characteristics of the PTC Control command list (See RD04). It is assumed the ground values will be retained for in-flight operations and that these will be checked via manual cooler recycles early in the mission.

Table Parameters

All parameters are provided in raw ADU, if not otherwise defined

PTC_00	Required Temperature (ADC Units) - int
PTC_01	PTC Temp Cmd - command to get the controlling temperature This can be a direct DRCU GET command or the SDEX entry for the detector channel required: PSW T1 = 0x00040000 TC1 = 0x83CF001A PSW T2 = 0x001C0000 TC2 = 0x83CF001C PMW T1 = 0x00C30000 TC3 = 0x83CF001E PMW T2 = 0x00DC0000 PLW T1 = 0x009E0000 PLW T2 = 0x00B50000
PTC_02	Loop Period (us) - int
PTC_03	Kp (PID parameter) - float
PTC_04	Ki (PID parameter) - float
PTC_05	Kd (PID parameter) - float
PTC_06	Ki Limit - float
PTC_07	Low pass filter Gain - float
PTC_08	Low pass filer coefficient b1 - float
PTC_09	Low pass filer coefficient b2 - float
PTC_10	DAC constant offset - float
PTC_11	Maximum DAC value allowed - int
PTC_12	PWM flag - if non-zero, Pulse width modulation is used
PTC_13	TM flag – if non-zero, TM packets containing a copy of the data storage area are generated
PTC_14	Additional initialisation count – if non-zero, this additional number of values will be read into the signal registers before starting the PID

AOTs Using This Table

TBD – The most likely AOT needing the PTC is scan map. If adopted the PTC may also be used for the other two photometer AOTs, small map and point source.

Templates Required

PTC Tuning

Pre-Requisites

TBD

Observations

TBD – It is expected that any PTC tuning will take place in commissioning phase. The open question remaining is does the PTC require any re-tuning one the telescope is cold?

Analysis

TBW

7.1.16 SCAL Control (Commissioning Phase)

Description
These parameters define the operational characteristics of the SCAL Control command list (See RD05).

Table Parameters
All parameters are provided in raw ADU, if not otherwise defined

SCAL_00	Required Temperature (ADC Units) - int
SCAL_01	SCAL Temp Cmd - DRCU command to get the SCAL temperature
SCAL_02	SCAL Htr Cmd – DRCU command to set the SCAL Heater voltage. Only the command ID should be set
SCAL_03	Loop Period (us) - int
SCAL_04	Kp (PID parameter) - float
SCAL_05	Ki (PID parameter) - float
SCAL_06	Kd (PID parameter) - float
SCAL_07	Ki Limit - float
SCAL_08	Low pass filter Gain - float
SCAL_09	Low pass filer coefficient b1 - float
SCAL_10	Low pass filer coefficient b2 - float
SCAL_11	Maximum DAC value allowed - int
SCAL_12	PWM flag - if non-zero, Pulse width modulation is used
SCAL_13	TM flag – if non-zero, TM packets containing a copy of the data storage area are generated
SCAL_14	Additional initialisation count – if non-zero, this additional number of values will be read into the signal registers before starting the PID

AOTs Using This Table
TBW

Templates Required
TBW

Pre-Requisites
TBD

Observations
TBW

Analysis
TBW

7.2 Data Processing Files

7.2.1 SCalPhotChanMask and SCalSpecChanMask

Description
This file provides a set of masking parameters. Each masking parameter is in the form of an integer mask i.e. a 1 or 0. Currently only a dead pixel mask is defined although the file structure is flexible enough to allow other masks to be added.

Table Parameters
Table containing two columns, pixel id and integer mask

AOTs Using This Table
All

Templates Required
None – The dead pixels will be apparent from commissioning phase observations

Pre-Requisites
None

Observations
No specific observations are required, the dead pixels will show up in all of them.

Analysis
Dead pixels are apparent from load curves. As the bias amplitude changes, the signal level on the channel does not.

7.2.2 SCalPhotChanGain and SCalSpecChanGain

Description
These files give the gains of the electronics which need to be accounted for in order to obtain the volts out the detectors as opposed to the volts out the system.

Table Parameters

refBiasFreq	Reference bias frequency in the equation to determine the dependence of LIA gain on bias frequency.
param	Parameter in the equation to determine the dependence of LIA gain on bias frequency.
channelName	Unique name for each channel. For example optical pixel C5 on the PLW array would be 'PLWC5'.
totGain	Value of LIA plus amplifier gain for each channel at the reference bias frequency.
jfetGain	Value of JFET gain for each channel.

AOTs Using This Table
All

Templates Required
None – This file is derived using design values.

Pre-Requisites
None

Observations
No observations required

Analysis
Dead pixels are apparent from load curves. As the bias amplitude changes, the signal level on the channel does not.

7.2.3 SCalPhotBSMPos and SCalSpecBSMPos

Description
This table provides the calibration between BSM sensor signal in raw units (in chop and jiggle directions) and angular distance on the sky from its zero position (in spacecraft Y, Z coordinates).

Table Parameters

chopSens	Sensor signal in chop direction
jiggSens	Sensor signal in jiggle direction
yangle	Angle in spacecraft Y direction
yangleError	Error in Y angle
zangle	Angle in spacecraft Z direction
zangleError	Error in Z angle

AOTs Using This Table
Photometer Point Source
Photometer Small Map
Photometer Scan Map (to check rest position only)
Spectrometer Point Source (sparse, intermediate and full)
Spectrometer Raster (sparse, intermediate and full)

Templates Required
This is established via FOV scanning

Pre-Requisites
The effective chop and jiggle ranges will need to have been established. This will either be done in commissioning phase or the ground values will be adopted.

Observations

Template	Source Type	Position	Direction	Step Size	Integration Tme
BSM FOV Scan	Point Source	PSW E8	Chop	0x100	10 s
BSM FOV Scan	Point Source	PSW E8	Jiggle	0x200	10 s
BSM FOV Scan	Point Source	PMW D6	Jiggle	0x200	10 s
BSM FOV Scan	Point Source	PMW D7	Jiggle	0x200	10 s
BSM FOV Scan	Point Source	SSW D4	Chop	0x100	10 s
BSM FOV Scan	Point Source	SSW D4	Jiggle	0x200	10 s

Analysis
The data produced by the template observations will be analysed in the following steps:

1. For Each Scan
2. For Each Pixel
    a. Demodulate the data obtained at each BSM position
    b. Plot demodulated signal vs BSM position
    c. Fit a Gaussian to find FWHM of beam in BSM position units and BSM position for centre of the beam
3. Plot beam centre positions vs pixel offset angle on the sky for all scans
4. Fit this plot to obtain Angle vs position calibration

5. Repeat using the BSM chop/jiggsenssig parameter instead of chop/jiggpos.

7.2.4 SCalPhotBSMOps and SCalSpecBSMOps

Description

This file gives all the BSM positions required for each observing mode, single pointing, photometer seven point jiggle, photometer 64 point jiggle, spectrometer intermediate sampling (4 point jiggle), spectrometer full sampling (16 point jiggle). These are equivalent to the uplink files described in sections 7.1.10, 7.1.11, 7.1.12, 7.1.13, and 7.1.14.

Table Parameters

chopBeamId	Chop beam identifier
jiggId	Jiggle position identifier
chopSens	Sensor signal in chop direction
chopLoTol	Negative tolerance in the sensor signal in the chop direction
chopHiTol	Positive tolerance in the sensor signal in the chop direction
jiggSens	Sensor signal in jiggle direction
jiggLoTol	Negative tolerance in the sensor signal in the jiggle direction
jiggHiTol	Positive tolerance in the sensor signal in the jiggle direction

Templates

None

AOTs Using This Table

Photometer Point Source
Photometer Small Map
Photometer Scan Map (to check rest position only)
Spectrometer Point Source (sparse, intermediate and full)
Spectrometer Raster (sparse, intermediate and full)

Pre-Requisites

Two main steps are required to establish this table, the first is the establishment of the BSM angle calibration and the other is the finalisation of the uplink tables which determine which positions are used. The only further step required here is an understanding of the relationship between commanded position and the position given by the sensor signal. Effectively the angle calibration has to be done for both the commanded position and for the sensor signal although the same observations can be used.

Observations

The observations described in section 7.2.3 (for the angle calibration) and in sections 7.1.10, 7.1.11, 7.1.12, 7.1.13, and 7.1.14 (for the AOT positions).

Analysis

The angular calibration is first established. For the 7 point jiggle, this is used to derived the BSM positions for the angular offsets tested for the AOT uplink tables. For the remainder of the AOTs the offset positions can be fed into the tables directly. Once the angular offset is established, the downlink table described here can then be populated with the equivalent angle in sensor signal (rather than commanded position as used for the uplink tables).

7.2.5 SCalPhotTeleBack

Description
This file describes the background due to the telescope as it appears in each SPIRE detector pixel under a given set of detector conditions and a given telescope temperature.

Table Parameters
The file format is not yet defined.

AOTs Using This Table
Photometer scan map

Templates Required
TBD – We could use a scan map of a dark patch of sky to derive this i.e. some scanning will be required in order to smooth over any sky variation.

Observations
TBD

Analysis
The signal obtained under the conditions tested will be retained in the calibration file. The cal file is still TBD but it will either store a set of signals obtained under different conditions or an algorithm will be provided to convert the signal from one set of conditions to another.

7.2.6 SCalPhotGlitch and SCalSpecGlitch

Description
This file is not yet defined but is intended to contain any parameters necessary for deglitching.

Table Parameters
TBD

AOTs Using This Table
All

Templates Required
TBD

Pre-Requisites
TBD

Observations
TBD

Analysis
TBD

7.2.7 SCalPhotBolPar and SCalSpecBolPar

Description

This table contains the fundamental bolometer parameters required to convert detector volts into absorbed power in a model based pipeline.

Table Parameters

tempT0	T_0 : reference Temperature for Bolometer Thermal Conductivity.
channelName	Unique name for each channel. For example optical pixel C5 on the PLW array would be 'PLWC5'.
loadResPos	R_{load}^{+}: load resistance on positive bias side of bolometer.
loadResNeg	R_{load}^{-}: load resistance on negative bias side of bolometer.
resR0	R_0: constant resistance parameter used to calculate bolometer temperature from R_{bolo}: the resistance at temperature *?*
delta	*?*: parameter used to calculate bolometer temperature from R_{bolo}: the reference temperature for the bolometer resistance (in units of K).
capac	*C*: electrical cable capacitance, used to calculate the RC roll off correction.
condG0	G_0 : bolometer thermal conductivity at temperature T_0
beta	*ß*: the power law index for relationship between thermal conductance and temperature.

AOTs Using This Table

All AOTs

Templates Required

TBD

Pre-Requisites

TBD

Observations

TBD

Analysis

TBD

7.2.8 SCalPhotElecCross and SCalSpecElecCross

Description
This file is not yet defined and is it still TBD whether it is needed. If used, it will essentially contain for each pixel in an array, a correction factor for all other pixels in the same array, plus the other channels e.g. thermistor channels.

Table Parameters
TBD

AOTs Using This Table
All

Templates Required
None – The parameters to derive this table will be derived from glitch data.

Pre-Requisites
None

Observations
None

Analysis
From ground data and in flight, data will be sifted to find a set of glitches for each pixel. The response of all other pixels to those glitches will be determined and recorded in the calibration file.

7.2.9 SCalPhotOptCross and SCalSpecOptCross

Description
This file is not yet defined and is it still TBD whether it is needed. If used, it will essentially contain for each pixel in an array, a correction factor for all other pixels in the same array.

Table Parameters
TBD

AOTs Using This Table
All

Templates Required
Expert Point Source AOT – To determine the optical cross talk for each pixel we need to put a source on that pixel and look at the reaction of all other pixels. This is slightly complicated by the need for a modulated signal, hence we are actually putting the signal on two pixels. To measure this in PV phase we will setup an expert AOT which just does simple chopping between two pixels without jiggling.

Pre-Requisites
TBD – To some extent chopping will need to have been setup, for these purposes we will need to be able to place the BSM on particular pixels, therefore the FOV scanning will need to have been done. As we are only looking for relative signals, it may not be necessary for the BSM to be finely tuned.

Observations
TBD

Analysis
We need to look for demodulated signals on each pixel, the amplitude and 'sign' of the signal on any other pixel will then show the crosstalk.

7.2.10 SCalPhotPixAngOff and SCalSpecPixAngOff

Description
This table gives the angular offset of each pixel from the SPIRE boresight.

Table Parameters

pixelName	Unique name for each optical pixel. For example pixel C5 on the PLW array would be 'PLWC5'.
zangle	Angular offset of pixel from SPIRE boresight in instrument coordinates: Z direction (arcseconds).
zangleError	Error on pixel angular offset in Y direction (arcseconds).
yangle	Angular offset of pixel from SPIRE boresight in instrument coordinates: Z direction (arcseconds).
yangleError	Error on pixel angular offset in Y direction (arcseconds).

AOTs Using This Table
All AOTs

Templates Required
This is set up initially with the Focal Plane Geometry observations. It is TBD how to do this, one alternative is to scan the telescope across a point source and check the pointing when the source crosses a particular pixel compared with when the source crosses the boresight. Another alternative is to use the telescope to place a source where a pixel is expected to be then to do a cross raster with either the telescope or the BSM to locate the pixel centre. For the photometer the BSM will be required to modulate the signal. For the spectrometer low resolution scans can be used.

Pre-Requisites
TBD

Observations
TBD – See Templates

Analysis
The angular offset obtained for each pixel in chop and jiggle separately will be put into the file.

7.2.11 SCalPhotPixTimeConst and SCalSpecPixTimeConst

Description

This file contains both the detector time constants and the electronic time constants. Note the electronic time constants are defined by the system design and therefore are not measurable in PV phase. Therefore only the detector time constants are addressed.

Table Parameters

pixelName	Unique name for each optical pixel. For example pixel C5 on the PLW array would be 'PLWC5'.
timeConst	Detector time constant.
error	Error on detector time constant.

AOTs Using This Table

All AOTs

Templates Required

The Photometer Scan map AOT will be used in Expert Mode as we require different sky scan speed. The Spectrometer Sparse Map AOT will also be used in Expert Mode as different mechanism scan speeds

Pre-Requisites

None

Observations

Template	Source Type	Resolution	Scan Speed
Photometer Scan Map	Point Source or Field with a number of point sources	N/A	60”/s
Photometer Scan Map	Point Source or Field with a number of point sources	N/A	45”/s
Photometer Scan Map	Point Source or Field with a number of point sources	N/A	30”/s
Photometer Scan Map	Point Source or Field with a number of point sources	N/A	75”/s
Photometer Scan Map	Point Source or Field with a number of point sources	N/A	90”/s
Spectrometer Sparse Map	Continuum Point Source	High	1 mm/s
Spectrometer Sparse Map	Continuum Point Source	High	0.7 mm/s
Spectrometer Sparse Map	Continuum Point Source	High	0.5 mm/s
Spectrometer Sparse Map	Continuum Point Source	High	0.25 mm/s

Analysis

TBW

7.2.12 SCalPhotNonLinCorr and SCalSpecNonLinCorr

Description

This table gives the coefficients required to correct for detector non-linearity. The file is not yet defined in detail.

Table Parameters

TBD

AOTs Using This Table

All AOTs

Templates Required

Photometer Point Source AOT with standard astronomical sources will be used for the photometer observations. Similarly the Sparse Map AOT will be used for Spectrometer observations.

Pre-Requisites

The AOT's do not need to have been fully commissioned but a minimum for the photometer will be that the BSM calibration needs to have been established and the 7-Point Jiggle uplink table updated.

Observations

Template	Source Type	Resolution
Photometer Point Source	Uranus	N/A
Photometer Point Source	Neptune	N/A
Photometer Point Source	Ceres or equivalent	N/A
Photometer Point Source	Vesta or equivalent	N/A
Photometer Point Source	Juno or equivalent	N/A
Photometer Point Source	Arcturus or equivalent	N/A
Photometer Point Source	Aldebaran or equivalent	N/A
Spectrometer Sparse Map	Uranus	High
Spectrometer Sparse Map	Neptune	High
Spectrometer Sparse Map	Ceres or equivalent	High
Spectrometer Sparse Map	Vesta or equivalent	High
Spectrometer Sparse Map	Juno or equivalent	High
Spectrometer Sparse Map	Arcturus or equivalent	High
Spectrometer Sparse Map	Aldebaran or equivalent	High

Analysis

The detector outputs will be compared with the known signals.

7.2.13 SCalPhotUnitToAst

Description
This file applies a conversion between the volts out the detector and astronomical units. The units adopted are Janskys and a flat spectrum is assumed. The file is not yet defined in detail.

Table Parameters
TBD

AOTs Using This Table
All Photometer AOTs

Templates Required
The standard Point Source AOT will be used.

Pre-Requisites
The AOT does not need to have been fully commissioned but as a minimum the BSM calibration needs to have been established and the 7-Point Jiggle uplink table updated.

Observations

Template	Source Type
Point Source	Uranus
Point Source	Neptune
Point Source	Ceres or equivalent
Point Source	Vesta or equivalent
Point Source	Juno or equivalent
Point Source	Arcturus or equivalent
Point Source	Aldebaran or equivalent

Analysis
The detector outputs will be compared with the known signals.

7.2.14 SCalPhotSpecIndex

Description
This file will give correction factors to colour correct the in-band fluxes of the photometer. This file is not yet defined in detail. It is not a file used as part of SPG but is expected to be used by an astronomer processing data interactively.

Table Parameters
TBD

AOTs Using This Table
All Phot AOTs

Templates Required
This file can be obtained by standard point source observations of sources with a known (modelled) spectral shape.

Pre-Requisites
There are no pre-requisites. The file is not critical for uplink and it is expected that an adequate version will be generated on the ground. The in-flight observations are only intended to confirm this is the case.

Observations
The sources are TBD depending on visibility but are likely to consist of the primary calibrator, Neptune, possibly Uranus, 2-3 asteroids, 2-3 stars.

Template	Source Type
Point Source	Uranus
Point Source	Neptune
Point Source	Ceres or equivalent
Point Source	Vesta or equivalent
Point Source	Juno or equivalent
Point Source	Arcturus or equivalent
Point Source	Aldebaran or equivalent

Analysis
Fluxes from these sources can be predicted by convolving the model fluxes with the spectral response profiles obtained on the ground. Therefore this file can be derived without observations. Observations of sources with known spectral shape will confirm this derivation.

7.2.15 SCalPhotPsf

Description
This file will contain the beam profiles of the photometer pixels. The file definition is not yet finalised but it is likely that we will adopt one beam profile per photometer array which is applicable to all pixels on the array. This is likely to be stored as two 1-D beam profiles in the spacecraft Y and Z directions.

Table Parameters
TBD

AOTs Using This Table
This file is not currently part of SPG as the mapping algorithms adopted do not require it. However it is required for astronomers who are analysing sources with complex structures and who may wish to use their own mapping algorithms.

Templates Required
Detailed beam profiles will be obtained by doing 64 point jiggle maps with isolated point sources. Therefore the standard small map AOT is all that is required.

Pre-Requisites
The positions of the pixels are known and the SPIRE apertures have been commissioned.
The 64 point jiggle map AOT is commissioned.

Observations

For these observations we require the telescope to place the point source on the pixel specified as the BSM does not have to range to offset to each pixel.

Template	Source Type	Source Position
Small Map	Point Source	PSW E8
Point Source	Point Source	PSW E6
Point Source	Point Source	PSW E10
Point Source	Point Source	PSW G8
Point Source	Point Source	PSW C8

Analysis
The beam profile is obtained directly from the maps.

7.2.16 SCalSpecSmecZPD

Description

This file gives the lookup table for the zero path difference position both in terms of the optical encoder position and the LVDT position.

Table Parameters

pixelName	Unique name for each optical pixel. For example pixel C5 on the PLW array would be 'PLWC5'.
optEnc	The optical encoder value at zero path difference.
optEncError	The error on the optical encoder value at zero path difference.
lvdt	The LVDT signal at zero path difference.
lvdtError	The error on the LVDT signal at zero path difference

AOTs Using This Table

All spectrometer AOTs

Templates Required

The expert AOT for sparse map is required

Pre-Requisites

TBD

Observations

In principle a normal scanning AOT can be used to determine this. By varying the scan speed we are better able to decouple effects of the detector time constants.

Template	Source Type	Scan Speed
Sparse Map	Continuum Point Source	Scan at 1 mm/s
Sparse Map	Continuum Point Source	Scan at 0.7 mm/s
Sparse Map	Continuum Point Source	Scan at 0.5 mm/s
Sparse Map	Continuum Point Source	Scan at 0.25 mm/s

Analysis

The ZPD is determined as the midway position between the forward and reverse scans.

7.2.17 SCalSpecModEff

Description

This table provides a correction for the modulation efficiency as the SMEC moves away from ZPD. This causes a multiplicative change in the interferrogram modulation with OPD due to changing overlap between the telescope and SCAL beams.

Table Parameters

optEnc	Optical Encoder value.
optEncError	Error on Optical Encoder value.
effA1	The modulation efficiency at the given OE value for channel A1.
effA2	The modulation efficiency at the given OE value for channel A2.
eff##	The modulation efficiency at the given OE value for channel ##.
optEncError	Error on Optical Encoder value.
effErrorA1	The Error in modulation efficiency for channel A1.
effErrorA2	The Error in modulation efficiency for channel A2.
effError##	The Error in modulation efficiency for channel ##.

AOTs Using This Table

All spectrometer AOTs

Templates Required

The normal Spec Sparse Map AOT can be used

Pre-Requisites

Spec Sparse Map needs to have been commissioned

Observations

Template	Source Type	Scan Speed
Sparse Map	Source with as few as possible bright lines in SSW	Nominal Rate
Sparse Map	Source with as few as possible bright lines in SLW	Nominal Rate

Analysis

A strong single line will give the modulation efficiency directly.

7.2.18 SCalSpecBandEdge

Description
This product provides the band limit edges for the SLW and SSW bands.

Table Parameters

pixelName	Unique name for each optical pixel. For example pixel C5 on the PLW array would be 'PLWC5'.
low	Wavenumber of the low frequency band edge for the specified pixel. This is defined as the 50% point of the in band transmission in the single mode region.
high	Wavenumber of the high frequency band edge for the specified pixel. This is defined as the 50% point of the in band transmission in the single mode region.

AOTs Using This Table
All Spectrometer AOTs

Templates Required
The template for the telescope backgrounds with different SCAL levels will be used.
The AOTs on standard sources will provide supporting data for one pixel

Pre-Requisites
As the results are not strongly dependent on scan speed; the nominal value from the ground can be adopted.

Observations

Template	Source Type	Pixels	Scan Speed
Telescope Background With Different SCAL Levels	Dark Sky	All	Nominal Rate
Telescope Background With Different SCAL Levels	Dark Sky	All	Nominal Rate
Sparse Map	Uranus	SSWD4	Nominal Rate
Sparse Map	Neptune	SSWD4	Nominal Rate
Sparse Map	Ceres or Equivalent	SSWD4	Nominal Rate
Sparse Map	Vesta or Equivalent	SSWD4	Nominal Rate

Analysis
The temperatures of SCAL and the telescope will be inputs to model spectra used to derive the spectrometer RSRF and confirm transmission in flight. Once the RSRF is obtained the band edges can be found.

7.2.19 SCalSpecNlp

Description
This product contains the known non-linear optical phase as a function of wavenumber. It may be useful to have a high resolution and low resolution version of the product. The wavenumber grid should range from 0 to 200 cm-1. The wavenumber grid must be regularly spaced. The phase-error will be different depending on input and output port of the FTS, making it necessary to store four different phases.

Table Parameters

resolutionSsw	The resolution of the calibration file wavenumber grid for SSW.
resolutionSlw	The resolution of the calibration file wavenumber grid for SLW.
wavenumber	Wavenumber grid for this sub-array.
telePhase	The amplitude of the phase correction for the telescope port.
teleError	The error in amplitude of the phase correction for the telescope port.
scalPhase	The amplitude of the phase correction for the SCAL port.
scalError	The error in amplitude of the phase correction for the SCAL port.

AOTs Using This Table
All Spectrometer AOTs

Templates Required
The template for the telescope backgrounds with different SCAL levels will be used.
The AOTs on standard sources will provide supporting data for one pixel

Pre-Requisites
As the results are not strongly dependent on scan speed; the nominal value from the ground can be adopted

Observations

Template	Source Type	Pixels	Scan Speed
Telescope Background With Different SCAL Levels	Dark Sky	All	Nominal Rate
Telescope Background With Different SCAL Levels	Dark Sky	All	Nominal Rate
Sparse Map	Uranus	SSWD4	Nominal Rate
Sparse Map	Neptune	SSWD4	Nominal Rate
Sparse Map	Ceres or Equivalent	SSWD4	Nominal Rate
Sparse Map	Vesta or Equivalent	SSWD4	Nominal Rate

Analysis
In principle the non-linear phase can be obtained from any continuum source observation, as it is derived during processing. These observations are good to use because all pixels are illuminated.

7.2.20 SCalSpecRsrf

Description
This file will contain the relative spectral response function of the spectrometer. It is not yet defined in detail.

Table Parameters
TBD

AOTs Using This Table
All Spectrometer AOTs

Templates Required
To set up the RSRF the observation of the telescope with different SCAL levels during cooldown and again when cold will be used. This provides an extended source allowing derivation for all pixels. To check this for different scan rates, the sparse map AOT can be used, in expert mode.

Pre-Requisites
TBD

Observations

Template	Source Type	Pixels	Scan Speed
Telescope Background With Different SCAL Levels	Dark Sky (Telescope cooling)	All	Nominal Rate
Telescope Background With Different SCAL Levels	Dark Sky (Telescope cold)	All	Nominal Rate
Sparse Map	Continuum Point Source	SSWD4	Scan at 1 mm/s
Sparse Map	Continuum Point Source	SSWD4	Scan at 0.7 mm/s
Sparse Map	Continuum Point Source	SSWD4	Scan at 0.5 mm/s
Sparse Map	Continuum Point Source	SSWD4	Scan at 0.25 mm/s

Analysis
The RSRF is derived directly.

7.2.21 SCalSpecILS

Description
This file contains the instrumental line profile. The file does not yet have a detailed definition.

Table Parameters
TBD

AOTs Using This Table
TBD

Templates Required
To derive this, a high resolution scan of a line source is required, the standard sparse map AOT can be used.

Pre-Requisites
The sparse map AOT can be used without having been fully commissioned e.g. the adopted scan speed is not important although the scan range is.

Observations

Template	Source Type	Pixels	Scan Speed
Sparse Map AOT	Unresolved Line Source (preferably extended although a point source is also OK)	SSWD4	Nominal Rate

Analysis
Providing the line is unresolved the line profile will be obtained directly after transform into the spectral domain.

7.2.22 ScalSpecPsf

Description
This file will contain the beam profiles of the spectrometer pixels. The file definition is not yet finalised but it is likely that we will adopt one beam profile per photometer array which is applicable to all pixels on the array. This is likely to be stored as two 1-D beam profiles in the spacecraft Y and Z directions.

Table Parameters
TBD

AOTs Using This Table
TBD – The re-gridding of spectral data during level 2 processing is not yet finalised therefore it is not yet know if the beam profiles will be used.

Templates Required
Spec Fixed SMEC Beam Profile
Spec Scanned Beam Profile

Pre-Requisites
The BSM calibration must have been established.

Observations

Template	Source Type	Resolution	Pixels	Scan Speed
Spec Fixed SMEC Beam Profile	Point Source	N/A	SSWD4	Nominal Rate
Spec Scanned Beam Profile	Point Source	Low	SSWD4	Nominal Rate
Spec Fixed SMEC Beam Profile	Point Source	N/A	SLWC3	Nominal Rate
Spec Scanned Beam Profile	Point Source	Low	SLWC3	Nominal Rate
Fully Sampled Map	Point Source	High	SSWD4	Nominal Rate

Analysis
The Spec Fixed SMEC Beam Profile measurement will produce a broadband beam map. The Spec Scanned Beam Profile measurements will show the dependence on wavelength. The Full Map observation will confirm the profiles produced.

8. TEST FLOW

1. Requirements for ordering the tests (interdependence/pre-requisites)
   1.1. Master flow-chart of tests/analysis/test inputs/outputs

9. Detailed Implemetation

Inst	Mode	Tests	Source	Table Name
Phot	Jigg	7 point jiggle, nominal offset, chopping 2 Hz	Point	Chopping Configuration
Phot	Jigg	7 point jiggle, nominal offset, chopping 1.5 Hz	Point	Chopping Configuration
Phot	Jigg	7 point jiggle, nominal offset, chopping 1 Hz	Point	Chopping Configuration
Spec	Step	low res step and look, chopping 2 Hz	Point	Chopping Configuration
Spec	Step	low res step and look, chopping 1.5 Hz	Point	Chopping Configuration
Spec	Step	low res step and look, chopping 1 Hz	Point	Chopping Configuration
Phot	Special	PCAL Level Check 0.25 Hz	Dark Sky	Flash
Phot	Special	PCAL Level Check 0.5 Hz	Dark Sky	Flash
Spec	Special	PCAL Level Check 0.25 Hz	Dark Sky	Flash
Spec	Special	PCAL Level Check 0.5 Hz	Dark Sky	Flash
Phot	Jigg	7 point jiggle, nominal settings, on Neptune	Neptune	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Uranus	Uranus	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Ceres	Ceres or equivalent	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Vesta	Vesta or equivalent	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Juno	Juno or equivalent	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Arcturus	Arcturus or equivalent	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Jigg	7 point jiggle on Aldebaran	Aldebaran or equivalent	Photometer Sensitivities, SCalPhotSpecIndex, SCalPhotUnitToAst, SCalPhotNonLinCorr
Phot	Scan	Scan map of known extended source at nominal rate	Known Extended	Photometer Sensitivities, Spire Configuration
Phot	Scan	Scan map of dark patch of sky	Dark Sky	Photometer Sensitivities
Spec	Point	High Resolution scan of a line source with known line fluxes in both bands	Line	Spectrometer Sensitivities
Spec	Point	Medium Resolution scan of a line source with known line fluxes in both bands	Line	Spectrometer Sensitivities
Spec	Point	High Resolution Spectrum of Uranus	Uranus	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Neptune	Neptune	Spectrometer

				Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Ceres	Ceres or equivalent	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Vesta	Vesta or equivalent	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Juno	Juno or equivalent	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Arcturus	Arcturus or equivalent	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	High Resolution Spectrum of Aldebaran	Aldebaran or equivalent	Spectrometer Sensitivities, SCalSpecNonLinCorr, SCalSpecBandEdge
Spec	Point	Scan of Point Source at 1 mm/s	Point	Spectrometer Configuration, SCalSpecSmecZPD, SCalSpecPixTimeConst
Spec	Point	Scan of Point Source at 0.7 mm/s	Point	Spectrometer Configuration, SCalSpecSmecZPD, SCalSpecPixTimeConst
Spec	Point	Scan of Point Source at 0.5 mm/s	Point	Spectrometer Configuration, SCalSpecSmecZPD, SCalSpecPixTimeConst
Spec	Point	Scan of Point Source at 0.25 mm/s	Point	Spectrometer Configuration, SCalSpecSmecZPD, SCalSpecPixTimeConst
Phot	Scan	Telescope scan along chop axis with source at boresight, BSM at zero current position	Point	Operations
Phot	Scan	Telescope scan along jiggle axis with source at boresight, BSM at zero current position	Point	Operations
Phot	Scan	Telescope scan along jiggle axis with source at boresight, BSM offseting source by approx +16" in chop	Point	Operations
Phot	Scan	Telescope scan along jiggle axis with source at boresight, BSM offseting source by approx -16" in chop	Point	Operations
Spec	Scan	Telescope scan along chop axis with source at boresight, BSM at zero current position	Point	Operations
Spec	Scan	Telescope scan along chop axis with source at boresight, BSM offseting source by approx +18" in jiggle	Point	Operations

Spec	Scan	Telescope scan along chop axis with source at boresight, BSM offseting source by approx -18" in jiggle	Point	Operations
Spec	Scan	Telescope scan along jiggle axis with source at boresight, BSM at zero current position	Point	Operations
Phot	Scan	Scan map at TBD angle 1	Known Extended	Operations
Phot	Scan	Scan map at TBD angle 2	Known Extended	Operations
Phot	Scan	Scan map at TBD angle 3	Known Extended	Operations
Phot	Scan	Scan map at TBD angle 4	Known Extended	Operations
Phot	Scan	Scan map at TBD angle 5	Known Extended	Operations
Phot	Scan	Scan map at TBD angle 6	Known Extended	Operations
Phot	Scan	Scan map row 60"/s nominal speed, field with a number of sources	Known Extended	Operations, SCalPhotPixTimeConst
Phot	Scan	Scan map row 45"/s nominal speed, field with a number of sources	Known Extended	Operations, SCalPhotPixTimeConst
Phot	Scan	Scan map row 30"/s nominal speed, field with a number of sources	Known Extended	Operations, SCalPhotPixTimeConst
Phot	Scan	Scan map row 75"/s nominal speed, field with a number of sources	Known Extended	Operations, SCalPhotPixTimeConst
Phot	Scan	Scan map row 90"/s nominal speed, field with a number of sources	Known Extended	Operations, SCalPhotPixTimeConst
Phot	Jigg	7 point jiggle, 5" offset, source centre, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	7 point jiggle, 6" offset, source centre, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	7 point jiggle, 7" offset, source centre, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	7 point jiggle, 5" offset, source 2" offset, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	7 point jiggle, 6" offset, source 2" offset, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	7 point jiggle, 7" offset, source 2" offset, nominal chop freq	Point	7-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, point source centred on pixel	Point	64-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, point source 5 " offset in Y	Point	64-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, point source 5" offset in Z	Point	64-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, point source 9" offset in Y	Point	64-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, point source 9" offset in Z	Point	64-Point Jigglemap Positions
Phot	Jigg	64 point jiggle, small extgended source	Point	64-Point Jigglemap Positions
Spec	Raster	4 point raster High Res Scan, Point Source centre SSWD4	Point	Spectrometer Intermediate Sampling
Spec	Raster	4 point raster Medium Res Scan, Point Source offset 5" in Y SSWD4	Point	Spectrometer Intermediate Sampling

Spec	Raster	4 point raster Medium Res Scan, Point Source offset 5" in Z SSWD4	Point	Spectrometer Intermediate Sampling
Spec	Raster	4 point raster High Res Scan, Extended Source SSWD4	Known Extended	Spectrometer Intermediate Sampling
Spec	Raster	16 point raster Medium Res Scan, Point Source centre	Point	Spectrometer Full Sampling
Spec	Raster	16 point raster Low Res Scan, Point Source offset 5" in Y	Point	Spectrometer Full Sampling
Spec	Raster	16 point raster Low Res Scan, Point Source offset 5" in Z	Point	Spectrometer Full Sampling
Spec	Raster	16 point raster Low Res Scan, Point Source offset 9" in Y	Point	Spectrometer Full Sampling
Spec	Raster	16 point raster Low Res Scan, Point Source offset 9" in Z	Point	Spectrometer Full Sampling
Spec	Raster	16 point raster Medium Res Scan, Extended Source	Known Extended	Spectrometer Full Sampling
Phot	Special	BSM FOV Scan in chop, Point source on PSWE8	Point	SCalPhotBSMPos
Spec	Special	BSM FOV Scan in chop, Point source on SSWD4	Point	SCalSpecBSMPos
Phot	Special	BSM FOV Scan in jiggle, Point source on PSWE8	Point	SCalPhotBSMPos
Phot	Special	BSM FOV Scan in jiggle, Point source on PMWD6	Point	SCalPhotBSMPos
Phot	Special	BSM FOV Scan in jiggle, Point source on PMWD7	Point	SCalPhotBSMPos
Spec	Special	BSM FOV Scan in jiggle, Point source on SSWD4	Point	SCalSpecBSMPos
Phot	Jigg	64 point jiggle map source centred in PSW E8	Point	SCalPhotPsf
Phot	Jigg	64 point jiggle map source centred in PSW E6	Point	SCalPhotPsf
Phot	Jigg	64 point jiggle map source centred in PSW E10	Point	SCalPhotPsf
Phot	Jigg	64 point jiggle map source centred in PSW C8	Point	SCalPhotPsf
Phot	Jigg	64 point jiggle map source centred in PSW G8	Point	SCalPhotPsf
Spec	Point	High Resolution Scan of a line source in SSW band	Line	SCalSpecModEff
Spec	Point	High Resolution Scan of a line source in SLW band	Line	SCalSpecModEff
Spec	Point	Low Resolution scan, source centred on SSW D4, with 16 point raster	Point	ScalSpecPsf

10. INDICATIVE DAY-BY-DAY SCHEDULE

TBW……

1. Test implementation timeline
2. Analysis plan
   - 2.1. Include
     - 2.1.1. High-priority results that are required from the tests and the form in which they'll be reported
     - 2.1.2. Second-priority outputs
   - 2.2. Identification of the individuals/teams to be responsible for the analysis

11. OPEN ISSUES WISHES/RECOMMENDATIONS

TBW