SPIRE Calibrators and Optical Filters DDR Report

Bruce Swinyard

30th September 2001

SPIRE-RAL-REP-001657

Introduction

The Detailed Design Review for the SPIRE Calibrators and Optical Filters has been held in order to fulfil the following:

1. Freeze the requirements on the calibration sources
2. Review and freeze the requirements on the optical filters
3. Review the design of the calibrators
4. Review and freeze mechanical and electrical interfaces for calibrators and filters

To these ends a detailed set of documentation has been produced and a presentation of the design has been made to the SPIRE system design team on the 18th September 2001

This report will follow the order of presentations at the review and will make detailed comments in the context of the documentation. These comments arise from discussion at the presentation.

Board Members

Ernst Kreysa -
Bruce Swinyard - RAL
John Delderfield - RAL
Doug Griffin - RAL
Berend Winter - MSSL

PA issues

PA plan complies with Herschel and SPIRE PA plans – configuration control will be based around MS Access database – backed up weekly – will also be available on the web.

Documentation has been restructured to split the specification into separate sub-systems for PCAL SCAL and Filters – need to renumber documents at project level.

PCAL

Design driver is to get S/N of 500 in 1 second – this means it needs eT ~ 40 K
Time constant 350 ms with goal of 70 ms

Basic devices from Haller-Beeman - has a flake of mica with Nichrome film on suspended off 25 um brass wires. This is a design change compared to the SIRTF type which were nylon suspended – time constant is much longer with the nylon suspensed which had sapphire substrate.

Ernst Kreysa: what is the effect of degradation on the output over the lifetime – not been used before. Some issue over the use of Mica? Need a test programme to test the lifetime issues.

Cardiff have tested both sapphire and mica devices.
Emissivity will be determined by the surface impedance – what is this?

Ernst Kreysa: Without integrating cavity the emissivity be no more than 50%

Sapphire type is more efficient in terms of photometric output per mW but is slower – mica device requires 3x the power for the same output.

Require guidance from review as to changes to interface design. Bring interface back behind the BSM to allow for not banging into each other. What does this do to the light output – what about presence of the redundant device.

Peter Ade: suggests moving the devices further back and having a trouser leg light pipe that feeds a single aperture.

With any detailed design changes there will be no change to the ICD – electrical and software interfaces will be in an overall Interface Document – need to address the build up of tolerances in the mounting of the PCAL – to go onto drawings. PCAL will have standoffs for attaching the wiring – detailed integration of PCAL not quite done yet.

AIV plan is to be written – will go up to integration into the BSM.

Design description is for information only – need to ensure that information is not repeated to cause confusion.

FMECA for PCAL needs to be made into a separate document.

Schedule – plenty of margin against "projected" delivery dates.

Vibration testing at room temperature will be done soon at MSSL. Could nylon wires be put in as end stops? Peter Hargrave will consider this.

Comments from Ian Pain may need to use aluminium for PCAL structure to allow for CTE.

Ernst Kreysa: what is split in testing between Geoff Beeman and Cardiff? Can he screen for certain aspects of the devices – he can do an output test – but there will be a cost impact at some level.

How is specification transferred to εT of illuminators? MathCad model is used and will be made available.

PCAL Recommendations

1. Go for the separation of the sources into the single lightpipe type
2. Encouragement to go for lots of testing to ensure design is robust
3. Considered end stops but perhaps not necessary given the very high resonant frequency and any likely failure modes.
4. No ICDs have been written yet so will need a sign off meeting in a month or so.

Optical Filters
Changes to filter specification since PDR – scheme changed slightly to meet science requirements.
Filters renamed and some filters have been removed from the scheme to improve through put. Sensitivity models need to be updated to reflect this.

350 band has been very slightly tweaked to make it identical to the Planck band.

Beam Splitters do have some variation in the effective reflective point as a function of frequency – removed by reversing one wrt the other.

Note that the waveguide in the P/SW channel cuts off the band not the filter

Failure modes – de-lamination usually picked up as infant mortality.
Cracking very unlikely and effect probably negligible?
Bowing – no problem for filters and transmission of dichroics. Bad for reflection off dichroics – if it is present will it get worse with cycling – yes? Bowing is prevented by allowing the filters to move in the mount

Filters are designed so that the mylar stretches because the iron ring doesn't but kept well within their failure limits.

Hot pressed for the dichroics is a design goal – baseline is airgap.

Specification document needs to be cleared up as there are some anomalies in the sketches.

Check what the acceptance peak to valley flatness should be – need to design the test of this with the Wyko at RAL.

UV irradiation of the filter – is this an issue for the entrance filter – no because whilst mylar degrades, polypropolene is unaffected.

Interface for CFIL-1 needs detailing

Alignment tools from LAM – Peter needs details of the alignment tools that Kjetil needs for alignment.

For STM Peter is planning for providing the first three filters through the system.

What tests are critical at instrument level at CQM in order to release the flight designs?

Optical Filters Recommendations
1. Need to test hot pressed filter in the dichroic mount – with thermal cycling to look at how the filter behaves and how flat it is.
2. The RF filter problem should be addressed very quickly – Doug/Matt will propose specification and Peter Ade will specify the inductive grid.
3. Milestone list for the filter production

SCAL
Power required: the dissipation should be increased to 5 mW average for the spectrometer. We can recover some dissipation margin by changing the a/l of the torlon legs. This could be done by making the inner diameter of the tubes larger, which has the added benefit of reducing the heat capacity. The majority of the heat leak goes down the torlon not down the leads

Note that Cardiff have specified a 12-bit voltage control.

Bruce Swinyard needs to set up a working group for looking at all aspects of the FTS calibration issues including spectral matching.

SCAL Recommendations
1. Compliance matrix needs to be generated, possibly as separate document
2. The cover is not necessary and should be removed from the design.

Action List:
Action CAL-DDR-01: Tony Richards to verify size of hole in BSM
Action CAL-DDR-02: Peter Hargrave to mockup the geometric set up to look at the output power of PCAL
Action CAL-DDR-03: Cardiff to produce AIV plan for calibrators with verification matrix and identified GSE.
Action CAL-DDR-04: Bruce Swinyard to look at the effect of using sharp waveguide cut off instead of filter in the spectrometer.
Action CAL-DDR-05: Cardiff to look at whether PFIL-1 can be made into an RF filter by grounding the inductive mesh.
Action CAL-DDR-06: Marc Ferlet to contact Peter Hargrave re: defining a test of the dichroic flatness.
Action CAL-DDR-07: Cardiff to study the thermal balance of the first filter to ensure that it stays isothermal.
Action CAL-DDR-08: Cardiff to provide model transmissions for each of the filters.
Action CAL-DDR-09: RAL to specify performance tests on CQM for verifying filter specification.
Action CAL-DDR-10: Cardiff need to provide the scattering characteristics of the filters to allow the straylight calculations to be completed.
Action CAL-DDR-11: Tony Richards to check size of pupil image at SCAL location
Action CAL-DDR-12: Peter Hargrave to provide drawing tree for all sub-systems.

SPIRE Filters & Calibrators

Detailed Design Review – 18th September 2001

Dept. of Physics & Astronomy, Cardiff University

Chart Room – 3rd Floor

Agenda (Chair - B.Swinyard)

10.00	Introduction & review format	PCH	15 min
10.15	Photometer Calibrator		
	• Design overview	PCH	20 min
	• Documentation structure, overview & status	PCH	20 min
10.55	Coffee		15 min
	• Design features/issues	PCH	20 min
	• Discussion & conclusions	Open	30 min
12.00	Filters		
	• Design overview /filtering scheme	PARA/CT	20 min
	• Documentation overview/status	PCH	20 min
	• Design features/issues	PARA/PCH	20 min
13.00	Lunch		60 min
14.00	Filters discussion & conclusions	Open	30 min
14.30	Spectrometer Calibrator		
	• Design overview	PCH	20 min
	• Documentation overview/status	PCH	20 min
	• Design features/issues	PCH	20 min
15.30	Tea		15 min
15.45	SCAL discussion & conclusions	Open	30 min
16.15	Board Meeting (closed)		60 min
17.15	Board feedback	BMS	