Summary of JPL/CalTech meetings

9-11th May 2000

Last updated 25/05/2000 11:00

1. Outline

This document summarises the discussions between JPL/CalTech and QMW with respect to the JPL array testing and qualification program.
QMW have agreed to assist JPL with testing and qualifying detector arrays. A severe schedule means that if JPL were working alone, their PFM array manufacture has to start with very little input from test results on the CQM array.
QMW and JPL will therefore work in parallel, with two identical test beds, to maximize test throughput.

2. Requirements

2.1. Array test requirements

The test program should be designed so that the following tests may be performed on every array for each instrument model.

2.1.1. Closed dewar tests:-

- Dark noise
- Blanked loadcurves
- Cryogenic black body tests

2.1.2. Open dewar tests:-

- Optical responsivity
- Speed of response
- Beam profiling
- Spectral response
- Focal plane maps
- Noise with 300K & 77K loads
- Optical alignment

2.1.3. Other tests (either configuration):-

- Microphonics
- Gamma response

2.2. Options for testing other SPIRE components

When designing the test dewar, it would be useful to have the facility to test other SPIRE components, e.g. calibrators, fridge, thermometers, thermal straps etc. If possible, space will be reserved on the test dewar cold plate, along with an extra wiring loom to enable miscellaneous tests to be performed.

3. Dewar design

3.1. Cryostat

The original plan was to base the test cryostats on the Bolocam design. This has a co-axial OFHC copper finger to 77-K to dump power from the JFET box. As it stands, I foresee several problems with this idea:-

- The dewar (Precision Cryogenics) has only a 24 Hr LHe-4 holdtime for a 16 litre tank!
- The Bolocam design has the array mounted centrally, raised off the cold plate by G10 legs. This means the array is looking through a window in the end of the dewar, which would be awkward for tests using the optical bench, or for beam profiling.
- The cold plate is fairly small and a hole has to be cut in the LHe-4 shield to accommodate the RF filter box.
- Looking directly out of the dewar makes stray light control difficult.

I am working with JANIS research on other dewar options. They are preparing drawings for quotation at the moment, but they don't see any problem in providing 2 cryostats that will easily meet or exceed the following specifications:-

- Cold plate diameter = 14/16 inches (quoting/drawing for both)
- LHe-4 holdtime >48 Hrs (with 150mW load)
- Co-axial (TBD – alternate location on cold plate not a problem) OFHC Copper rod to 77-K (1/4 inch diameter)

The baseline is to run the dewars at 4.2-K, although we need the facility to pump on them if needed.
Estimates of the power dissipation from the JFETs are needed.

3.2. He-3 Fridge

The Bolocam fridge is a Chase He-10 design (1xHe-4, 2xHe-3). This allows the array to run at approx. 270mK from a 4.2-K bath. The baseline is to use these fridges in the test beds. However, there is a problem with cooling the Bolocam fridge to 4-K due to impairment of convection in the pipes, meaning that the dewar has to be tipped to 45 degrees to raise the condensation point. Before ordering these from Simon, a teleconference is needed (participants – Jamie, Pete, Simon, Peter Ade, Matt) to ensure that a proposed modification will cure the problem, and also that Simon can meet our schedule.
Use of these fridges will enable us to run on a 4-K bath with the following advantages:-

- Automatic, timed cycling of the fridge is possible.
- Faster turnaround.
- No pump microphonics.

I am also talking to JANIS research who may be able to supply fridges that meet these specifications.
Estimates of the heat loads to He-3 from the arrays and cables (for each array type) are needed from JPL.

3.3. Heat switch

It was decided that a heat switch should definitely be employed to speed up turnaround times. QMW will design & implement this.

3.4. Optics

It was decided to implement internal optics for the following reasons:-

- Better stray light control.
- Side window for ease of integration to external optics.
- Smaller filter apertures by the formation of a beam waist at the appropriate location.
- Production of a focus at a fiducial plane outside the dewar window.

The baseline design is to employ Offner-type optics to re-image the focal plane just outside the dewar window.

3.5. Filters

The filter scheme should exactly replicate the SPIRE filtering scheme. It may be possible to use the CQM filters, although we will work on producing 2 sets just for these test dewars.

3.6. Connectors and wiring

Tekdata (or similar) are to be used for the production of all wiring looms.
JPL will specify the array wiring scheme, PCH will specify the housekeeping scheme.
A spare loom will be made up for miscellaneous tests.
Compatibility with the RAL calibration facility would be useful.

4. DAQ system

Three options are being considered for the DAQ system:-

4.1. National Instruments – SCXI based system

This option would require a NI MIO card with SCXI modules to provide at least 320 analogue input channels (160 differential). With this arrangement, the maximum sampling rate per channel would be around 1kHz at 16-bits.
Additionally, lock-in amplifier modules would need to be built for each channel (160).

4.2. Interactive Circuit Systems

This company can provide a system with the following specifications:-

- Simultaneous sampling of up to 512 channels
- 24-bit resolution
- 100 kHz sampling rate per channel

- 1 month delivery
- Labview based interface – effectively plug & play

This system could do the de-modulation digitally, hence removing the need for the construction of the LIA modules. JPL needs to visit ICS soon to test the digital de-modulation idea.

4.3. Replication of flight electronics

It would be very useful to be able to test the arrays with flight representative electronics. It is highly unlikely that CEA will be able to provide 2 sets of electronics for this purpose, but we will investigate the possibility of replicating their electronics with non-space-qualified components. My personal feeling is that the main purpose of this campaign is to properly evaluate the arrays without the uncertainty of using an unknown/uncalibrated acquisition system. The task of testing the array and flight electronics as a complete system will be carried out by the electronics interface test dewar. Unbeknown to QMW, CEA and JPL had arranged to use the QMW BACUS dewar for this purpose. This dewar is owned by QMW and is being used for SPIRE calibrator development & qualification. It is NOT available for use by JPL/CEA. However, there is no reason why, apart from schedule constraints, one or both of these array test dewars couldn't be used for electronics interface tests (is there?). It may also reduce the number of transatlantic trips if the QMW dewar could also be used for this purpose. If this is a viable option, the wiring schemes need to be produced in consultation with CEA.

5. Division of costs/labour

The proposal is to split cost as evenly as possible between JPL and QMW, and to avoid exchange of funds and large (non-pocketable!) items of equipment as far as is practicable.
The table below shows a VERY approximate breakdown of costs and responsibilities (agreed at CalTech). Please note that all costs shown are per system. This table will be updated as quotations are received.

Equipment	Approximate cost	Responsibility	Notes
Cryostat	$30k	QMW – design, integrate & test	JPL and QMW will purchase separately
He-3 fridge	$20k	QMW – integrate & test	JPL and QMW will purchase separately
Optics	$5k	QMW – design, build structure	JPL and QMW will purchase mirrors separately
JFET box	$5k	JPL – design QMW – build	Will probably use external contractor (e.g. TK)
JFET module	$15k	JPL – design, build, test	
Pre-amps	$10k	JPL – design, build, test	
Backpack	$5k	JPL – design, build, test	
Cryogenic RF filters	$15k	JPL – design, build/acquire, test	JPL and QMW will purchase separately if required
Data Acquisition system	$30k – NI $50k – ICS TBD – replica of flight electronics	JPL – design, build, test	NI system includes cost of LIA modules. ICS system means much less work for JPL.
Cables & connectors	$20k	JPL – array looms QMW – housekeeping looms	JPL and QMW will purchase separately from Tekdata or similar
Thermometry & housekeeping system	$5k	QMW – design, build, test	JPL and QMW will purchase components separately
Filters	Lots!	QMW – design, build, test	Filters will be supplied for both dewars
Shields	TBD	QMW – design, build	
Heatswitch	TBD	QMW – design, build, test	
Software (DAQ)		TBD – probably a bit of both	
Software (housekeeping)		QMW – write, test	

6. Actions

No.	Action	Actionee	Due by	Status
1	Dimensions/drawings of JFET box to QMW	Hien	22/5/00	Open
2	Dimensions/drawings of FPU to QMW	Hien	22/5/00	Open
3	Dimensions/drawings of RF filter box to QMW	Hien	22/5/00	Open
4	Contact SC and Lionel to discuss fridge requirements/schedule	Pete	25/5/00	Closed
5	Optics design	Pete	25/5/00	In progress – pending input from JPL
6	Optics mechanical design	Geoff	8/6/00	Not started – as above
7	Cold plate layout	Pete/Geoff	22/6/00	In progress – need confirmation of JPL components
8	Get quotes/drawings from cryostat suppliers	Pete	30/5/00	In progress
9	Order cryostats	Pete	23/6/00	Open
10	QMW need dimensions of FPU "flying leads" for each array – will determine cold plate connector locations and wiring looms	Jamie/Viktor	25/5/00	Open
11	Specifications for array wiring looms	Jamie/Viktor	30/5/00	Open
12	Estimated heat load to He-3 from arrays & cables	Jamie	25/5/00	Open
13	Interface between arrays & thermal strap defined	Dustin/Geoff	23/6/00	Not started
14	Warm electronics box mechanical design to QMW – need to know placement of hermetics on dewar	Viktor/Dustin	30/5/00	Open
15	Housekeeping & spare connector wiring scheme defined & agreed with JPL	Pete	30/5/00	In progress
16	Test validity of digital de-modulation with ICS system	Hien/Jamie	30/7/00	Open

7. Scheduling / Work breakdown

A first-cut schedule has been produced (JPL_array testing.mpp). At present, delivery/manufacture dates for most components are pure guesses. I need JPL to supplying me with realistic time estimates for the items & work packages for which they are responsible.

This schedule has the dewars becoming available for array tests by 20th Feb 2001. JPL would like their dewar up to a month before this date. This may be possible, and QMW will concentrate on building the JPL cryostat first.