JPL array test dewar

Development plan

Prepared by: **Peter Hargrave**
Matt Griffin

General note – this document is a preliminary draft. It is the situation as QMW understands it. This needs URGENT attention and approval by JPL.

Distribution list

Jamie Bock	JPL	Matt Griffin	QMW
Gerald Lilienthal	JPL	Peter Ade	QMW
Hien Nguyen	JPL	Pete Hargrave	QMW
Bruce Swinyard	RAL	Alex Ellery	QMW
Ken King	RAL		

1. Scope

This document details the logistics for the acquisition, building and commissioning of the test bed for the JPL bolometer detector arrays (BDAs) for SPIRE.
There are significant changes to the program as described in the previous incarnation of this document (version 1.1), and these are written in blue typeface.

2. Applicable documents

Number	Document name & author	Reference
AD1	SPIRE Detector Subsystem Specification *J. Bock et al .*	SPIRE-JPL-PRJ-000456
AD2	SPIRE Major Milestone List *K.J.King*	SPIRE-RAL-PRJ-000455
AD3	JPL Array Test Dewar – Preliminary design *P.Hargrave*	
AD4	FIRST-SPIRE business agreement *J.Bock, M.Griffin, G.Lilienthal, K.King, R.Carvell, G.Parks*	

3. Glossary

BDA Bolometer Detector Array	
JPL Jet Propulsion Laboratory	
QMW Queen Mary, University of London	
SPIRE Spectral & Photometric Imaging Receiver	
FIRST Far-InfaRed Space Telescope	
GRT	
AD Applicable Document	
RD Reference Document	

4. Overview

The JPL array test dewar is the major component of the testbed for JPL bolometer detector arrays. Broadly, the design and construction of the testbed is the responsibility of JPL and the testing and commissioning process will be conducted by QMW.

5. Acquisition of components

5.1. Cryostat

Two cryostats are being supplied by Janis Research Company, INC., Wilmington, MA. These have been ordered by JPL, and the first unit is due for delivery by February 2001.
Both units will be shipped directly from Janis to JPL. The dewars will undergo cryogenic testing, integration and test of the optical system, and integration of the fridge and housekeeping harness at JPL (previously to have taken place at QMW) followed by integration of the electrical systems and final commissioning.

5.2. Fridge

Two fridges are being supplied by Chase Research, Sheffield, UK. These have been ordered by JPL, and the first unit is due for delivery to QMW 10 weeks after receipt of order. Both units will be tested at QMW in the SPIRE 300mK strap test dewar prior to delivery to JPL via Simon Chase.

- Connectors

MDM37PSB connector required for each Chase Research fridge from JPL/QMW?

5.3. Optics

- Mirrors

Mirrors will be supplied by Symons Mirror Technology, Stevenage, Herts. UK. They will be delivered to QMW and integrated to the optics module prior to test and shipment to JPL.

- Filters

Filters and mounts will be provided and shipped directly by QMW.

- Intermediate plate

Intermediate plate and support tubes to be manufactured by QMW sub-contracting to an external supplier (either Thomas Keating, Electromech or TMC – TBD)

5.4. Baffles, shields, supports and straps

- QMW will provide all support structure for the optics module (acts as replacement for Janis supplied He-4 shield).
- Detector mount – provided by JPL. This will be a thermally isolated structure on which the BDA is mounted. There will therefore be two isolated stages (one internal to the BDA structure) with the detector mount linked to the intermediate head of the He-10 fridge to allow heatsinking of any parasitic heat loads from the detector structure and wiring. Two stage thermal isolation is necessary to enable correct operation of the He-10 fridge. The estimated heat load from a BDA unit mounted directly from a 4K structure is around 25µW. This magnitude of load will cause the ultrahead, which would run unloaded at around 230mK, to run at about 300mK. While this is the nominal temperature for running the arrays in SPIRE, this kind of heat load on the ultrahead would give a hold time of only a few hours. Heatsinking the BDA structure and cables to the interhead will vastly reduce the loading on the ultrahead and increase the holdtime to greater than 24Hrs (the interhead is designed to run for 24Hrs with a

100μW load). This means that the structure will run at around 400mK, with the arrays at around 250mK. The array temperature can then be controlled by applying a small amount of power to the ultracold pump.

- JPL are currently designing these mounts – QMW will not manufacture these as:
  (i) manufacturing costs are lower in the US
  (ii) this avoids needless shipping and customs cost
  (iii) this avoids extra costs for external contractors
  (iv) provision of detector mounts was not included in the business agreement.

- Thermal straps. Two thermal straps will be needed, one from the interhead to the first isolated stage, and the second from the ultracold head to the BDA. JPL will need to provide the thermal link from the ultracold head to the end of their 300mK strap. This is because the link will need to be changed to suit the array that is installed (conformation of JPL 300mK strap depends on location of that BDA in SPIRE). The interhead strap to the detector mount will be provided by the detector mount provider (JPL).
- Detector stray light shield – provided by QMW (manufacturer TBD). This will cover the BDA and the fridge, leaving enough space inside the shield to encompass all 300mK strap conformations. The fridge will have its own manufacturer-supplied shields to cover the 3 pumps.

5.5. Heat switch

QMW will provide mechanical heat switches to aid cooling of the array/fridge head from 300K to 4K and reduce warm-up times. Two heat switches per dewar are required.

5.6. Wiring harnesses

Wiring harnesses will be supplied by Tekdata. These will be ordered by JPL. A temporary housekeeping harness will be built by QMW to enable fridge tests to commence. This harness is only suitable for the QMW 300mK strap test dewar – it cannot be used in the BDA test dewars. The housekeeping wiring scheme was sent to JPL on 5th Dec. 2000, and is included in this document as an appendix.

5.7. Thermometers

JPL will order all thermometers from Lakeshore Cryogenics, and send them to the UK (Simon Chase) for integration.

Thermometry requirements:-

- For ***each*** fridge, the following is required:-
  1 off GR200A-50
  1 off GR200A-100
  5 off DT-470-SD/11A
  1off DT-470-SD/13
  These components need to be sent to Chase Research 1 month prior to the delivery of each fridge to QMW. ***These need to be ordered now (wk.1 October 2000)*** if the fridge delivery schedule is to be met (roughly 6 week leadtime for the GRTs)
- QMW will supply other thermometry needed (diodes – BCY71) for the cold plate & optics.

1. **Beam Mapper – plan to be developed**

Auto collimator from Jamie.

6. Shipping arrangements

Apart from small items (e.g. filters), all shipping costs will be borne by JPL.
All major transatlantic shipments will be handled on the UK side by RAL.
All necessary preparations must be made in the US to ensure that no import duty will be payable for items that will only be in the UK for integration and testing. This includes items such as thermometers that will be delivered to the UK direct from the manufacturer.

7. Testing and commissioning

One assembled test bed will be tested cryogenically and optically at QMW prior to delivery to JPL.
Both fridges will be tested at QMW before sending them back to Simon Chase for shipment to JPL.
While the first test dewar is at QMW, thermal transfer function tests will be conducted on the EM BDA. It may be possible to use another He-3 test dewar for these thermal BDA tests if the JPL test dewar is delayed.
QMW staff will assist with the final commissioning and array testing, within the limit of available resources.

8. Schedule

To be revised after consultation with JPL – need confirmation of the scheme laid out in this document. Below is a list of milestones (to be refined) – these have NO margin if delivery is to be Feb. 2001.

8.1. Milestones

Number	Milestone	Date	Responsible?
1	Dewar #1 to QMW	Dec. 2000	Janis
2	Fridge P.O. to Chase Research	Mid Oct. 2000	JPL
3	Mirrors to QMW	Dec.2000	JPL/Symons
4	Fridge #1 to QMW	Dec. 2000	Chase
5	Filters ready	Dec. 2000	QMW
6	Optics structure ready	Dec. 2000	QMW
7	Detector mount ready	Dec. 2000	QMW
8	Interhead thermal strap ready	Dec. 2000	QMW
9	Detector/fridge shield ready	Dec. 2000	QMW
10	Heat switches ready	Dec. 2000	QMW
11	Housekeeping wiring scheme to JPL	Mid Oct 2000	QMW
12	Housekeeping harness to QMW	Dec. 2000	JPL/QMW
13	Thermometers to Chase Research	Mid Nov. 2000	JPL/Lakeshore
14	Dewar #1 tested and shipped to JPL	Feb. 2001	QMW/RAL

JPL array test dewar - Development plan

JPL BDA Test Bed - Housekeeping Loom

Pin #	Function	Type 300K -> 4K	Th. Designation	Fridge MDM 37 SSB on dewar loom 37 PSB on fridge	Housekeeping 21 SSB on dewar loom 21 PSB on cold plate	Stand-off
A	GRT ULTRA HEAD V+	Mn		1		
B	GRT ULTRA HEAD V-	Mn		2		
C	GRT INTER HEAD V+	Mn		3		
D	GRT INTER HEAD V-	Mn		4		
E	NC			5		
F	DIODE ULTRA PUMP I+	Mn		6		
G	DIODE ULTRA PUMP I-	Mn		7		
H	HEATER ULTRA PUMP I+	Cu		8		
I	HEATER ULTRA PUMP I-	Cu		9		
J	HEATER INTER 3HE PUMP I+	Cu		10		
K	HEATER INTER 3HE PUMP I-	Cu		11		
L	HEATER INTER 4HE PUMP I+	Cu		12		
M	HEATER INTER 4HE PUMP I-	Cu		13		
N	DIODE INTER 4HE PUMP I+	Mn		14		
P	DIODE INTER 4HE PUMP I-	Mn		15		
R	HEATER INTER 3HE SWITCH I+	Cu		16		
S	HEATER INTER 3HE SWITCH I-	Cu		17		
T	DIODE INTER 3HE SWITCH I+	Mn		18		
U	DIODE INTER 3HE SWITCH I-	Mn		19		
V	GRT ULTRA HEAD I+	Mn		20		
W	GRT ULTRA HEAD I-	Mn		21		
X	GRT INTER HEAD I+	Mn		22		
Y	GRT INTER HEAD I-	Mn		23		
Z	DIODE INTER 3HE PUMP I-	Mn		24		
a	DIODE INTER 3HE PUMP I+	Mn		25		
b	DIODE INTER HEAT XCNG I+	Mn		32		
c	DIODE INTER HEAT XCNG I+	Mn		33		
d	HEATER INTER 4HE SWITCH I+	Cu		34		
e	HEATER INTER 4HE SWITCH I-	Cu		35		
f	DIODE INTER 4HE SWITCH I+	Mn		36		
g	DIODE INTER 4HE SWITCH I-	Mn		37		
h						
i	Heatswitch #1 I+	Cu			1	
j	Heatswitch #1 I-	Cu			2	
k	Heatswitch #2 I+	Cu			3	
m	Heatswitch #2 I-	Cu			4	
n	Pwr spare	Cu			5	
p	Pwr spare	Cu			6	
q	Pwr spare	Cu			7	
r	Pwr spare	Cu			8	
s	DIODE 4HE COLD PLATE I+	Mn			9	
t	DIODE 4HE COLD PLATE I-	Mn			10	
u	DIODE OPTICS I+	Mn			11	
v	DIODE OPTICS I-	Mn			12	
w	Th. Spare	Mn			13	
x	Th. Spare	Mn			14	
y	Th. Spare	Mn			15	
z	Th. Spare	Mn			16	
AA	GRT INTER-STAGE V+	Mn			17	
BB	GRT INTER-STAGE V-	Mn			18	
CC	GRT INTER-STAGE I+	Mn			19	
DD	GRT INTER-STAGE I-	Mn			20	
EE						
FF						
GG						
HH						

Astrophysics Group,
Physics Department,
Queen Mary & Westfield College,
Mile End Road,
London E1 4NS
+44 20 7882 3757/3760

Q:\Project Office\IIDR_23Apr01\IIDR\Dev Plans\QMW BDA_Test_Dewar_Development_Plan_(v1-3).doc
Last updated 12/04/01 15:43 by Peter Hargrave