



Notes on the meeting on PACS/SPIRE focal plane hardware collaboration at QMW on Sept. 7 1999

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Attendance: SPIRE: Matt Griffin, Peter Ade, Carole Tucker
PACS: Albrecht Poglitsch, Norbert Geis, Jens-Peter Krumme

1. Introduction

This meeting was convened to discuss the provision of filters and dichroics for PACS and mechanical components for the SPIRE Beam Steering Mechanism (BSM). For the PACS filters, no alternative supplier other than QMW is identified. SPIRE BSM components could be provided by MPIA Heidelberg by procuring additional components as part of the industrial provision of the PACS chopper. This would maximise the technical overlap and exchange between the projects. Other suppliers could probably be identified for what SPIRE needs, but the cost implications are uncertain. It is important to arrive at an agreed solution and plan on a timescale of a few months. Heidelberg will need to formalise their contract with industry later this year. It will be essential to have clarified exactly what components, if any, are required for SPIRE. A costed proposal will need to be made to the UK FIRST/Planck Programme Manager on a similar timescale and ratified by the UK FIRST/Planck Steering Committee in March 2000

The aims of the meeting were

- (i) to review PACS filter/dichroic requirements and their specification;
- (ii) to consider the schedule and resource requirements and costs of PACS filter provision of SPIRE BSM hardware.

These informal notes include some information that has been updated since the meeting.

2. PACS instrument filter and dichroic specifications

These were reviewed and updated based on the document previously circulated by Albrecht Poglitsch and a summary table provided at the meeting.

For the PACS instrument, there will be 12 components per model (CQM and PFM). PACS plans for the Flight Spare are to be decided. If an FS model is provided, the default is that it will be a refurbished QM.

Filter delivery to PACS will need to be in time for instrument AIV begins:

- CQM Focal Plane Unit AIV begins Sept. 2001
- PFM Focal Plane Unit AIV begins May 2003

Filters are also needed for PACS detector module testing and for the calibration facility at the LENS Laboratory in Florence. Detector module testing at MPE starts early in 2000, and initial testing at LENS will commence at around the same time.

The test facility filter requirements were reviewed and specified. A total of *TBD* filters will be needed, to be provided by around the end of 1999.

3. Resource requirements for QMW provision of PACS filters and PACS provision of SPIRE BSM components

3.1 PACS filters

The components for the PACS test facilities will be produced this year using existing resources. They will have to be based on existing recipes as there is not time for a development and prototyping programme. This approach should be perfectly adequate for the purpose.

Development and manufacture of the PACS instrument filters and dichroics is a task of comparable magnitude to the provision of similar components for SPIRE. No new equipment or facilities would be required to make the PACS components, and the materials costs are small: the cost is dominated by staff effort.

The staff effort allocated for SPIRE filters in QMW's budget is 5.5 SY (Staff Years) [update on figure presented at the meeting] between 2000 and 2004. This does not include generic or SPIRE-specific development costs.

Assuming that no PACS FS is required, filter manufacture for PACS can start in early-mid 2000 and end in early- mid 2003 - a period of three years. The total staff effort required may thus be estimated as $(5.5)(3/4) \approx 4$ SY.

Some of this effort could be provided through savings at the ATC on hardware costs through provision of BSM components (flex pivots and actuator drive coils and readout sensors) by PACS. A *very provisional* estimate of £65k has been made by the ATC. At an average staff cost of ~ £40k pa, this could fund 1.5 SY at QMW, leaving around 2.5 SY still needed.

3.2 SPIRE BSM

A provisional estimate of the cost to PACS of providing the components for SPIRE is DM500k (\approx £150k). The cost is probably dominated by the flex pivots. It is not clear whether this figure includes development costs or is calculated pro rata based on the total industrial cost of the PACS chopper. The life-testing requirements are also uncertain, and may be different for PACS and SPIRE. PACS flex pivots may be over-designed for SPIRE use since the PACS chopper angular throw is much greater than that for SPIRE.

A summary of the SPIRE requirements for BSM hardware from PACS has been provided by the ATC and is given below:

Design information/consultancy:

- Detailed design of the flex pivot
- Diameter and material of the wire used in the drive coils
- Test results on power consumption of the device at various frequencies
- Parts list including materials
- Description and design of position sensors
- Details of drive coils
- Details of magnets
- Details of electronics design
- Continued informal communication between ATC and MPIA on design issues

Hardware:

- Required: 24 flex pivots
- Possible: 24 position sensors; 48 drive coils; 24 drive magnets

4. Arrangements for SPIRE and PACS hardware provision

Two possible arrangements for hardware provision were identified and discussed:

A. Collaboration

- SPIRE uses cost savings at ATC to fund some of the necessary staff effort at the ATC
- PACS provides the rest through secondment of appropriate staff at QMW
- PACS provides consultancy to ATC on mechanism design and control (mechanical, electrical)
- QMW provides consultancy on optimisation of PACS filtering scheme and occasional extra filters as required.

Advantages: - No exchange of funds
- Full collaboration - maximum exchange of hardware and intellectual property

Disadvantages: - PACS will have problems in funding the staff effort
- Logistical difficulties in providing appropriate staff for appropriate periods of time
- Uncertainties over savings at ATC and PACS industrial costs

B. Contractual

- QMW provides PACS filters through a contract, either through the College or through QMC Instruments Ltd.

The cost would have to be kept to a minimum (non-profit, low overheads).

Initial estimation is that this could be accommodated for around £150k (roughly 4 SY at £40k per SY - using low (PPARC) overhead costs).

- PACS does not provide BSM hardware to ATC, so no cost savings would be possible within the ATC programme.
- The ATC procures flex pivots and other components commercially or from NASA Goddard, who may be building the FTS carriage for SPIRE - perhaps the same flex pivot design could be used.

Advantages: - Filter procurement can be accommodated within the PACS budget
- Logistics of staff effort provision at QMW are simplified

Disadvantages: - This solution does not exploit the full potential for mutual exchange between the instrument teams
- The ATC no longer has benefit of PACS flex pivot hardware, introducing some cost and schedule risk into the SPIRE BSM programme

5. Conclusions

- PACS and SPIRE are both fully committed to arriving at a plan which will cater for the needs of both instruments.
- Regardless of the details of how the hardware provision is organised (contractual, collaborative), technical design assistance and advice and expert knowledge shall be freely shared between the PACS and SPIRE teams.

- The arrangements must be put in place on both sides on a short timescale (before the end of 1999).
- Following clarification of some important points (see actions below), another iteration will be necessary, preferably some time in October.

6. Summary of actions (some identified after the meeting):

Action	Responsibility	Due date
Estimate cost of providing PACS filters through a contract	Ade, Griffin	Sept. 21
Investigate possibility of funding 3 SY effort at QMW	Poglitsch	
Make initial assessment of the implications (cost, schedule) of manufacturing the SPIRE BSM without hardware provision from PACS (access to design expertise and consultancy should be assumed)	ATC (Cunningham, Morrison)	End. Sept
Provide a specification for SPIRE flex pivots (inc. life testing requirements)	ATC	End. Sept.
Provide cost estimates for provision of (flex pivots alone) and (flex pivots + drive coils + position sensors)	Poglitsch	Sept. 21
Investigate possibility of procuring flex pivots from NASA Goddard	ATC (Colin Cunningham, Fraser Morrison) + Bruce Swinyard	Oct. 15
Tabulate agreed PACS filter specifications	Tucker	Sept. 21