



FIRST Science Team Mtg#6 (FST6)

Minutes of Meeting, held at ESTEC, Noordwijk, 6-7 July 2000

1. Welcome and meeting agenda

All members of the FST were present, except as indicated:

Peter Barthel, Mission Scientist (PB)
José Cernicharo, Mission Scientist (JC)
Pierre Encrenaz, Mission Scientist (PE)
Thijs de Graauw, HIFI Principal Investigator (TdG)
Matt Griffin, SPIRE Principal Investigator (MG)
Paul Harvey, Mission Scientist (PH)
Martin Harwit, Mission Scientist (MH)
Thomas Paßvogel, FIRST/Planck Project (ThP) (not present for points 8-11, 13.1,13.2,13.4,13.5)
Tom Phillips, HIFI Co-Principal Investigator (TP)
Göran Pilbratt, Project Scientist (GP)
Albrecht Poglitsch, PACS Principal Investigator (AP)
Laurent Vigroux, SPIRE Co-Principal Investigator (LV)
Christoffel Waelkens, PACS Co-Principal Investigator (CW)

In addition the following non-FST members were participating for the indicated respective part of the time:

Pierre Estaria, FIRST/Planck project (point 4.1 action FST5-A2 only)
Francis Vandenbussche, FIRST/Planck Project Manager, acting (point 4.1 first part only)

The chairman (GP) welcomed everyone to this the 6th FST meeting (FST6). A draft agenda was circulated on 30 June 2000, and proposed in the meeting (cf. **Appendix 1**). The meeting adopted the proposed agenda.

2. FST5 minutes of meeting

The draft FST5-MOM - without appendices - were circulated on 10 March 2000, the final revised version - taking comments into account - was circulated by email on 22 March 2000, and put on DMS together with all the appendices on 23 March 2000. The meeting approved the FST5-MOM without comments.

3. Actions status

The current actions were listed (cf. **Appendix 2**). Action FST4-A2 was deferred, FST4-A4, FST5-A1 and A2 were to be dealt with later in this meeting, while actions FST5-A3, A4, and A5 had already been closed, although not necessarily on time.



4. Status reports on FIRST activities

4.1 FIRST/Planck Project

F. Vandenbussche reported that payload review at D/SCI level held on 23 May 2000, was seen as a success by Roger Bonnet. One concrete outcome of that meeting is that an aluminium optical bench will be specified in the ITT. A NASA telescope Peer Review took place at COI 19-21 June 2000, a NASA telescope is the baseline in the ITT, but still subject to confirmation by NASA which is expected in the October 2000 timeframe. The ITT documentation is still being updated, this is especially true for the IID-Bs. In the Statement of Work industry will be asked to assess the possibilities of a higher than specified (100 kbps 24 hr average) data rate. An industry briefing meeting was held in ESTEC on 30 June 2000 with about 75 participants. The ITT is on schedule to be issued on 1 September 2000. A second pre-TEB meeting is scheduled for 26 July. The deadline for proposals will be 1 December 2000, with phase B scheduled to commence 1 June 2001.

Concerning the relationship between the future prime contractor and the PI consortia, the ITT will ask the potential primes to propose a scheme as part of their proposals; they will not be instructed as to how this relationship should look like. The scheme will be settled during the first 3 months of phase B. Since the PIs are part of this agreement, they will be involved in this process. This closes action FST5-A1.

Subsequent to the 23 May meeting D/SCI has asked to have special sessions on instrument operability and cleanliness. The format is not yet clear, but the timeframe is October 2000.

Thomas Paßvogel (ThP) presented (cf. **Appendix 3**) the outcome of **industrial studies** performed. The 'Systems optimisation study' has been performed by Alcatel/Astrium, and recently concluded. By optimising the sunshade shape (more cylindrical) and simultaneously decreasing the height of PLM and improving the thermal design (an extra radiator on the PLM in combination with an SVM shield) there is ample clearance under the Ariane 5 fairing (even with the no longer considered 3.8 m telescope) and the lifetime requirement fulfilled.

In the 'Alternative cryostat study' performed by Air Liquide (completed in April 2000) resulted in a cryostat design superficially similar to the 'existing' Astrium design. Inside the CVV the support structure is different; the predicted numbers for heat lifts and required massflow are very similar to the Astrium numbers.

In the 'Cryostat interfaces study' (concluded December 1999) by Dornier it was shown that the instruments (as defined at the time) could be accommodated in the cryostat.

The **NASA telescope** for FIRST was subjected to a Peer Review. It took place in COI 19-21 June 2000. The view of ThP (cf. **Appendix 4**) is that the technology is ready for the next phase, but with several comments. During the Peer Review we got good presentations and good handouts, but no additional documentation at all. The 2 m spherical test article has now been gold coated and successfully retested, and material improvements identified. By constructing a WFE budget it is clear that 'shaping' of the secondary reflector is necessary to fulfill the WFE specification (10 μm rms), and that it is unclear/unlikely whether the goal (6 μm rms) can be met.

Tom Phillips (TP) commented that in his report (attached as **Appendix 5**) to the NASA CRR he concludes that technologically the telescope is in good shape, and that the flight unit will clearly meet the specification, and possibly the goal, using M2 shaping to correct for low spatial frequency errors in M1.

There is a number of issues that directly influence the science. Baffling is such an issue, requiring interfacing with the spacecraft and instrument teams. The gold/protective layer reflectivity/emissivity has to be measured accurately, today we only know that the emissivity is lower than 2%, and could be as low as 0.5%. The obscuration specification has gone up to 5%, an unpleasant surprise to TP, it has to be carefully looked at what is actually seen. To reach the goal specification actuation of the secondary, probably in space, is likely required, which is not presently foreseen. It is not clear if the planned use of in-space actuation is increasing or decreasing risk.



A different issue is that implementing the various improvements has a cost impact. The current NASA proposal is to build one telescope only, which is inconsistent with current ESA requirements.

In response to a question from MG TP stated that NASA had evaluated the MMS SiC technology and concluded that it was a good technology for producing the FIRST telescope. The schedule would require manufacturing in Europe under NASA funding, and initial cost numbers were stated as high.

Pierre Estaria made a presentation in response to action FST5-A2 (cf. **Appendix 6**). He confirmed that the baseline during the routine operations is to have a DTCP every day (as indicated by its name), and that science observations can be scheduled subject to the constraints imposed by the DTCP activities. For clarification, the numbers given for the timeline are end times, thus e.g. the downlink of science data takes place between P+2 min and P+2 hours.

4.2 FIRST Science Centre

Göran Pilbratt (GP) presented the **FSC current activities**, and reported from the **NASA FIRST Science Support Center Peer Review** which took place at IPAC, Pasadena on 14 June 2000 (cf. **Appendix 7**).

4.3 HIFI consortium

Thijs de Graauw (TdG) presented the HIFI status (cf. **Appendix 8**). Points emphasized included:

Loss of band 7. The aluminium technology HEB development for potential HIFI adoption for bands 6 and 7 has been stopped. It is not considered viable to produce sufficient LO power for the highest frequencies (band 7 covering 2.4-2.7 THz) for Nb technology HEBs, and consequently band 7 has been dropped. Not using Al HEB technology also means that HIFI no longer need an internal sub-Kelvin cooler. The 'real estate' that was to be used for band 7 will be allocated to band 6 which will be split into two sub-bands. Thus, physically, HIFI will still have 7 mixer assemblies, each with 2 LO sub-bands.

NASA Peer Review. NASA Peer Reviews of its contributions to HIFI took place at JPL on 5-6 June 2000. It was concluded that 'technology has not been adequately demonstrated for a PDR'. Consequently delta reviews will be necessary in early 2001. JPL confirmed the delivery of band 5, but insisted of delivering band 6 only on a 'best effort' basis, which is unacceptable to TdG as long as 'best effort' includes the possibility of not delivering anything at all.

Delta-ISVR. A major recommendation from the HIFI (ESA) delta-ISVR held at SRON, Utrecht on 25 May 2000, was to look into the possibility of deleting the WBS (the AOS) system and at the same time slightly upgrade the HRS (the autocorrelator) to prevent any loss in scientific capabilities. The ISVR board also expressed its concern about the potential loss of band 6.

Instrument design. The FPU design is being refined. It will have 7 independently exchangeable mixer assemblies, each one incorporating 2 orthogonally polarised mixers. The LOU will, in the same fashion, also have 7 independently exchangeable multiplier assemblies, each one incorporating 2 separate multiplier chains that each covers roughly half of the corresponding mixer band frequency coverage, feeding both mixers. Road maps for the development of mixers and LO chains have been constructed, in certain cases parallel options are still being pursued.

Planning and schedule. The development model (DM) of HIFI is foreseen to be fully tested by summer 2002 feeding into the production of the flight model (FM). The FM planning has delivery 5 months late with respect to the June 2004 delivery date required by ESA.

The potential **Canadian contribution** to HIFI is still not resolved, a less costly Canadian contribution than initially discussed is now being considered.

The meeting discussed the science capability implications of losing band 7, and agreed on a statement which the Project Scientist will supply to D/SCI (cf. **Appendix 9**).



4.4 PACS consortium

Albrecht Poglitsch (AP) presented the PACS status (cf. **Appendix 10**). Points emphasized included:

Detector arrays. The CEA bolometer array detectors are now the baseline for PACS photometer arrays. The Ge:Ga photoconductor arrays will be dedicated for spectroscopy. The bolometer technology will offer 64x32/32x16 pixel fully sampled arrays at 77/174 μm with 3.3/6.6 arcsec square pixels covering a 3.5x1.75 arcmin FOV, significantly larger than with the photoconductor arrays. The bolometers do require an operating temperature of 0.3 K forcing PACS to include an internal ^3He cooler, similar to that of SPIRE.

Optical design. With dedicated arrays the optical trains for the photometer and spectrometer can now be fully separated, which enables the optical design to be simplified, and to improve the baffling of the spectrometer. This optimisation involves a complete redesign of the PACS FPU, now containing 15 mirrors less, and will be completed by mid-July.

Photoconductor arrays. Manufacture of the QM arrays has started. The initial quantum efficiency measurement has not been repeated due to the failure of the only available CRE, these measurements will now be performed using a JFET/TIA temporary readout setup which has just been delivered.

Observing modes. Observations with PACS photometers during slews at 'full' slew speed are not technically possible. For short slews where 'full' speed is not attained, a significant fraction of the time is needed for post-calibration of the observation just performed, and pre-calibration of the observation to be performed. This means that the concept of 'serendipitous' observations is not likely to be useful.

The meeting discussed the science capability implications of the announced changes to the PACS design, and agreed on a statement which the Project Scientist will supply to D/SCI (cf. **Appendix 11**).

4.5 SPIRE consortium

Matt Griffin (MG) presented the SPIRE status (cf. **Appendix 12**). Points emphasized included:

Overall design. Since the Jan-Feb 2000 detector selection the overall instrument design has been elaborated upon. Design progress since detector selection includes definition of simplified electrical systems design and clarification of the observing modes. The decision, following the 23 May 2000 review at D/SCI level, to specify an aluminium optical bench in the cryostat has led to a simplified mechanical design.

ISVR. The ISVR is deemed to have been completed satisfactorily. Review Board's concerns over (i) the need for enhanced project team and (ii) the need to consolidate the schedule and establish margin with respect to the delivery dates, are to be addressed by SPIRE as a matter of urgency.

NASA Peer Review. NASA Peer Review (Rieke panel) outcome has required some adjustments of the SPIRE Work Breakdown Structure which are currently being defined.

ICC. The SPIRE ICC definition team has decided to adopt an Object-Oriented (OO) approach for the ICC development. Subsystem URDs to be written, use-cases to be constructed and used for defining work packages and to estimate/allocate resources by October 2000.

Science optimisation. SPIRE is considering updating the photometer bands from 250/350/500 μm to 250/350 or 425/600 μm . Not a clearcut situation, no quick decision foreseen, no change for the QCM.

5. NASA FIRST/Planck CRR

The NASA FIRST/Planck Confirmation Readiness Review (CRR) will take place near Pasadena on 18-20 July 2000. The format is a first day of 'introduction' to the mission, followed by 'element' (e.g. telescope, contribution to SPIRE, etc.) presentations and conclusions of the preceding 'Peer Reviews'.



Michel Anderegge will represent ESA, Matt Griffin, someone from HIFI, Tom Phillips, and Paul Harvey will be attending.

6. FIRST/Planck synergy

GP reported that at this point in time he only had the reports of group 3 and 4, out of the 5 groups that were defined in common FST/PST meeting, cf. the FST5-MOM. The groups were to report before the end of June in time for the PST meeting held earlier this week, and FST6. However, it took longer time than hoped to form the groups, and therefore, although unfortunate, it is not surprising that some groups are late.

A general discussion re. FIRST and Planck synergy took place. An important issue re. most aspects of FIRST follow-up of Planck sources is how to choose what sources to follow-up, given what the objectives for the follow-up observations are. Here comparisons with existing catalogs will be crucial, e.g. if a source is in the IRAS catalog, then it is unlikely to be a high z source.

ASTRO-F data combined with Planck should be very useful (PH). A lot of work re. cross identification will be performed in connection with XMM, this work can/should be extended to FIRST (LV).

From an astronomical perspective Planck is performing shallow all-sky surveys, while FIRST will be performing both deeper surveys and follow-up on individual sources (MG).

At the moment it is not possible to select appropriate subsamples one way or another, all we can hope to do is to set up the necessary structures to get the job done (MG).

FIRST observations will be necessary for Planck to subtract background. In a SPIRE FOV there will be many sources, but this represents only a couple of Planck beams (LV).

FIRST and Planck are both time finite lifetime missions, to enable maximum synergy upfront planning is necessary, that's why we are discussing this (AP).

The key projects need to be structured so that a Planck synergy program has a chance to win time (PH).

It was agreed that the underlying basic point was to identify areas of science that depends on observations from both missions. It was agreed that the next step is to make sure that the five groups finish their tasks and the five reports are generated. It could be a good idea to present these results in the Toledo meeting and to have discussions on this subject. This will be considered when constructing the scientific programme for the Toledo meeting.

Action 1: Remind the five groups and set new deadline (end of August) for the FIRST Planck synergy reports. **Actionee:** GP. **Deadline:** 15 July 2000.

7. FIRST Optical Systems Scientist

The background is a request by D/SCI. In the monthly projects scientists' meeting held after the 23 May 'deliverables' (FIRST and Planck instruments, FIRST telescope, Planck mirrors) review D/SCI expressed a worry that there was no single 'entity' in place to follow up the telescope development, and making sure that the telescope not only would deliver as specified, but would be what was required/desired in terms of compatibility with instruments and spacecraft. He requested that (what he in this meeting called) a 'FIRST telescope scientist', possibly modelled after the XMM telescope scientist, would be put in place.

GP has discussed this request within the Astrophysics Division. For XMM the telescope scientist was identified very early, his duties and rewards were described and approved in the XMM Science Management Plan (SMP). The situation for FIRST is different; the concept of a telescope scientist does not exist in the SMP. Also the needs are different, the XMM telescope scientist actually 'supplied' a test facility for the XMM telescope.



The current proposal to D/SCI is to have a 'FIRST Optical Systems Scientist'. This person would have an end-to-end responsibility for the optical system including telescope, baffle, cryostat, and instruments; particularly important areas are straylight and alignment. He/she would be appointed by issuing an Announcement of Opportunity (AO), the reward would be in observing time at the same level as for a Mission Scientist.

The FST finds the task of the FIRST 'Optical Systems Scientist' a very responsible one, and not an easy one. This person needs to be closely 'integrated' with the people performing the actual work, i.e. the telescope and instrument teams, and later to also with the spacecraft/baffle contractor. He/she will be important as a 'flag-raiser' in case of (suspected) problems. **The FST supports the idea of a FIRST 'Optical Systems Scientist' as described.**

8. Toledo symposium

There was a discussion as to when the 3rd announcement will have to be issued (before or after the summer holidays) and whether to call for papers or not. The FST decided that we should have contributed talks and posters, as well as 'workshop' type discussions. Thus, the meeting will have three main components: invited talks, contributed talks and posters, and the discussion sessions.

It was also decided that we need to issue the '3rd Announcement and Call for Papers' by the end of July, i.e. next week. The deadline for the Call for Papers/Registration will be 1 October. This is also driven by the need to book rooms in the conference hotel. It was decided that the scientific programme of the conference should be placed on the web on 15 October. The poster will be finalised, put on the web, but also printed in 500 copies and distributed.

GP informed that to date there were (only) 63 responses to the online 'expression of interest' form. He stressed that when (next week) the 3rd announcement and registration form go online all members of FST should make an effort to 'spread the word' e.g. by sending email to existing suitable distribution lists - the ISO helpdesk and the most recent 'Ringberg' conference lists were mentioned.

The FST also discussed the actual program, and how to split the time, and especially how to organise the discussion sessions. The general feeling was not have too small groups - start with two and let them decide themselves whether they want split further - and to allocate about 1.5-2 hours each day except the last for the discussions; the last day we should have some kind of wrap up session. It was decided that the Mission Scientists, coordinated by Peter Barthel and Martin Harwit, would draw up concrete plans for the discussion sessions so that their organisation and necessary preparation can be discussed in FST7.

Action 2: Organise the discussions sessions, invite and brief the discussion Toledo symposium leaders. **Actionee:** Mission Scientists coordinated by Peter Barthel and Martin Harwit. **Deadline:** 30 September 2000.

Action 3: Write the Toledo meeting '3rd Announcement and Call for Papers', put it on the Web together with the online registration form etc. **Actionee:** GP. **Deadline:** 15 July 2000.

9. Key projects

There is a need to start elaborating on the concept of 'Key projects' in general, and there will be a need to explain what is meant by key projects in the Toledo meeting in particular. The only 'definition' as to what a 'Key project' amounts to, is what is said in the FIRST Science Management Plan (SMP) section 5.1.2. (The SMP is available both on the FIRST website and in DMS.)

There is a need to define the important characteristics of a 'Key program' such as e.g. a program that is large in terms of observation time, a program that collect datasets that ultimately will be used for a variety of scientific issues, etc.



To have a basis for a structured discussion of this topic in FST7 it was decided to start by collecting everyone's 'definition' of what a 'Key project' is/ought to be. In addition, each instrument team should suggest a couple of examples of 'Key programs'. For the memory: SPIRE maps about 1 square degree per day to its confusion limits; HIFI needs 1-2 days to perform a spectral survey of a strong source.

Action 4: Each member of the FST to write down - in bullet form - the defining properties of a 'key project'. **Actionee:** Each FST member. **Deadline:** 31 October 2000.

Action 5: Each instrument team to propose at least two potential key projects. **Actionee:** Each PI. **Deadline:** 31 October 2000.

10. PACS/SPIRE partner/parallel mode

The issue of simultaneous multiple instrument operation has basically been reduced to whether the use of SPIRE in conjunction with PACS (with PACS being the prime instrument) makes scientific/operational sense or not. This is referred to as the SPIRE parallel mode (to PACS). The 'original' 'partner' mode where both PACS and SPIRE were to operate in 'prime' mode is not considered viable within the data rate of 100 kbps, but could be of interest if a higher data rate could be obtained in phase B.

A large shallow survey could be a good example of a program which is (potentially) more efficiently carried out in parallel/partner mode. It is recognised that the FIRST/Planck project would like to 'kill' all discussions of multiple instrument operation, and that this would simplify operations by some as yet undefined degree, but the FST is not prepared to go this far with the present uncertainties of both potential benefits and level of extra complications. As a first step the potential benefits will be further looked at.

Action 6: MG already has an action from the SPIRE ISVR to perform further analysis of the potential benefits of a parallel/partner mode. MG will interact with AP/PACS in performing this action. The result of this action should be submitted to the FST. **Actionee:** MG. **Deadline:** 31 October 2000.

11. Written material on FIRST science

The written material agreed upon to be provided initially by 30 November 1999 (action FST4-A4) is still desired. GP has received from PH, and also from MH (although not on action...) The **action is still open** and not forgotten! HIFI has set up a HIFI science page (current URL is <http://www.sron.rug.nl/hifiscience/>), which at moment has not 'gone public'. It would be desirable with some kind of coordination here, although generally the more the better.

12. Date of next two meetings

It was confirmed to hold FST7 as planned on **13-14 November 2000 in QMW**. The provisional date and venue for FST8 is **8-9 March 2001 in ESTEC**.

13. AOB

13.1 Gyros

The gyros to be used for SOFIA (made by SAGEM(?)) have outstanding longterm stability performance. The gyros are important for the scanning modes. The SOFIA gyros are certified by the FAA.

Action 7: Provide information on the SOFIA gyros to ThP (manufacturer, model, available data, etc.). **Actionee:** AP. **Deadline:** 31 August 2000.



Action 8: Look into the potential use of the SOFIA gyros for FIRST. **Actionee:** ThP. **Deadline:** 30 September 2000.

13.2 Straylight

TP expressed a worry as to whom is responsible for straylight in general, and pointed out the baffling between the primary mirror of the telescope and focal plane as an area where the responsibility is not clearly defined. GP pointed out at that this is a good example of where the 'Optical Systems Scientist' could and should be useful. The prime contractor is responsible for the system straylight design, including the baffle, but will need input both from telescope and instrument side.

13.3 Telescope implementation

TP reported that building a flight spare and full qualification model of the telescope would bring the cost outside the allocated budget. Thus, the telescope implementation plan expected to be proposed to NASA at the CRR includes neither a spare (the cost of a spare is ~4 M\$), nor a full qualification model. ThP is unhappy about this, which is considered a major change, and a significant increase in risk. TP will ask Gary Parks to provide the details of the implementation plan, and a risk analysis report. The FST is not the appropriate forum for this discussion which will be continued elsewhere.

13.4 FIRSED

PB reported that the FIRSED meeting was held in Groningen 27-29 April 2000. Attendance was about 60 people. The proceedings will be available winter 2000/1.

13.5 Submillimetre spectroscopy meeting

PE reported that a meeting for submillimetre spectroscopy up to 3 THz for space will take place in Bratislava.

There were no further AOBs. The chairman thanked everyone, and closed the meeting.

List of Appendices:

Appendix 1: Proposed agenda

Appendix 2: Action status

Appendix 3: FIRST industrial studies results presentation by Thomas Paßvogel

Appendix 4: FIRST telescope Peer Review presentation by Thomas Paßvogel

Appendix 5: FIRST telescope Peer Review report by Tom Phillips

Appendix 6: Activities during the DTCP presentation by Pierre Estaria

Appendix 7: FIRST Science Centre status and IPAC Peer Review presentation by Göran Pilbratt

Appendix 8: HIFI consortium status presentation by Thijs de Graauw

Appendix 9: FST statement about the HIFI descopeing

Appendix 10: PACS consortium status presentation by Albrecht Poglitsch

Appendix 11: FST statement about the revised PACS concept

Appendix 12: SPIRE consortium status presentation by Matt Griffin



List of Actions:

Remaining open actions:

FST4-A2: Draft Go-NoGo criteria 'philosophy'. **Actionee:** GP. **Deadline:** FST5 meeting. **New deadline:** 15 October 2000.

FST4-A4: Produce first draft of FIRST science Web 'write-ups. **Actionee:** MG/PH/TdG/PE. **Deadline:** 30 November 1999. **New deadline:** ASAP.

New actions:

FST6-A1: Remind the five groups and set new deadline (end of August) for the FIRST Planck synergy reports. **Actionee:** GP. **Deadline:** 15 July 2000.

FST6-A2: Organise the discussions sessions, invite and brief the Toledo symposium discussion leaders. **Actionee:** Mission Scientists coordinated by Peter and Martin Harwit. **Deadline:** 30 September 2000.

FST6-A3: Write the Toledo meeting '3rd Announcement and Call for Papers', put it on the Web together with the online registration form etc. **Actionee:** GP. **Deadline:** 15 July 2000.

FST6-A4: Each member of the FST to write down - in bullet form - the defining properties of a 'key project'. **Actionee:** Each FST member. **Deadline:** 31 October 2000.

FST6-A5: Each instrument team to propose at least two potential key projects. **Actionee:** Each PI. **Deadline:** 31 October 2000.

FST6-A6: MG already has an action from the SPIRE ISVR to perform further analysis of the potential benefits of a parallel/partner mode. MG will interact with AP/PACS in performing this action. The result of this action should be submitted to the FST. **Actionee:** MG. **Deadline:** 31 October 2000.

FST6-A7: Provide information on the SOFIA gyros to ThP (manufacturer, model, available data, etc.). **Actionee:** AP. **Deadline:** 31 August 2000.

FST6-A8: Look into the potential use of the SOFIA gyros for FIRST. **Actionee:** ThP. **Deadline:** 30 September 2000.