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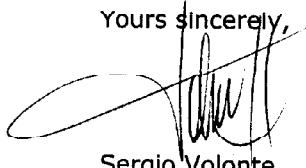
Paris, 12 November 1998

To: **Participants of the 2<sup>nd</sup> FIRST/Planck Payload Meeting**

Dear Colleagues,

Please find enclosed the summary minutes of the FIRST/Planck payload Meeting held on **21 October 1998 at ESA HQ in Paris.**

Yours sincerely,



Sergio Volonte  
Astronomy Missions Coordinator  
Directorate of Scientific Programme

Enclosures: ANNEX 1  
ANNEX 2

**European Space Agency**  
*Agencia espacial europea*

**Headquarters - Siège**

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**FIRST/Planck Payload**

**Summary Minutes of the meeting held on  
21st October 1998  
at ESA Headquarters, Paris**

The Agenda and the list of participants (Annex 1) are attached.

1. Introduction

The Chairman, S. Volonte, clarified the scope of the meeting. Since NASA was playing an important role in both payloads, a NASA delegation was participating in the meeting. Following the July meeting on the same subject the PI teams of both FIRST and Planck had proceeded in the definition of the technical, managerial and financial baseline of their instrument and data processing facilities. In view of the FIRST/Planck Payload confirmation at the February 1999 SPC a number of issues needed to be addressed which were:

- a. Level of definition of the instrument developments and compatibility with Project Schedule.
- b. Level of definition of the management structure and share of responsibility within the consortia.
- c. Level of compliance with FSEC and PSEC recommendations.
- d. Level of instruments funding and compatibility with project schedule.

The meeting was therefore an important step in assessing the status of these issues.

2. Project Status

This was introduced by the project manager F. Felici. The handouts are attached. The main points were:

- The overall schedule presented at the July meeting was unchanged.
- The short-term schedule was presented.
- A Planck straylight review by a panel of four independent scientists was planned to be starting in mid-November.
- A Planck Payload Architect would be selected by mid-November.
- The draft MOU for the procurement of the Planck reflectors by Denmark had been issued for agreement after some iterations. A reflector technology demonstration was now planned at the end of the year.

- The FIRST telescope technology developments were ongoing at NASA/JPL (CFRP) for the baseline with a SiC option under ESA Contract as a back-up.
- The X-Band downlink for scientific data had been assessed to increase the telemetry rate by a factor of 4 and appeared to become very likely.

### 3. Payload Status as seen by Project

This was presented by M. Anderegg. The handouts are attached. The main points were:

- The instruments model philosophy has been clarified by ESA.
- The PI teams were progressing slower than expected.
- The HFI/LFI interfaces were becoming critical (e.g. sorption cooler).
- A PACS data compression Working Group had been set up.
- The HIFI baseline was not yet established and the delivery of the development plan was being delayed.

Overall there was little visible progress on the management status. However, specific meetings were planned to take place between now and Christmas.

### 4. Ground Segment

This was presented by P. Estaria. The handouts are attached.

ESA expressed concern about low level of resources allocated by the PI groups to ground segment work, even taking into account the lower overall schedule criticality of this element.

### 5. Instruments Status & Problem Areas

These were introduced by the respective PI. All the handouts are attached.

#### ***LFI (R. Mandolesi)***

The PI expressed concern regarding the tight schedule and the criticality of funding.

The critical elements are the Sorption Cooler, the 4K load, the waveguide management and the Science Implementation Plan.

At this stage the delivery dates of the Flight Models were questioned by some. In particular the fact that the launch date delay introduced after the May SPC meeting was not reflected with an equivalent delay in the Flight Model deliveries was challenged by some delegations.

The ESA project showed a detailed post delivery AIV schedule at system level and referred to the ISO experience as supporting the interval between FM deliveries and Flight acceptance review as presently planned.

**HFI (J-L. Puget)**

The main critical points were:

- The mass & power of the 0.1 K cooler.
- The impact of the 20 K (Sorption) cooler power budget on the system.
- The QA level of the flight electronics components was not yet agreed.
- The lack of Planck Telescope overall lead.
- The US funding foreseen to alleviate the shortfall produced by the withdrawal of Israeli institute was not yet decided.
- The DPC Processing Centre Structure had been simplified.
- The PI finally complained on the situation of FIRST and Planck which had led to a one year launch shift per year in the last three years and appealed to the delegations to take into consideration the impact of introducing new missions before FIRST and Planck.

**HIFI (T. de Graauw)**

The main points were:

- The Canadian participation was still under discussion.
- HIFI was still not funded as a project. This was resulting in a slow start up.
- The ICC contribution from European partners unchanged, equivalent I.I.S. contribution was expected.

**PACS (A. Poglitsch)**

The main points were:

- The funding problems with Germany were still present although cost reductions within 10% of the agreed envelope had been implemented since July.
- The ESA TRP funding for detector development was uncertain (ESA stated that so far attempts to introduce this development in the TRP had not succeeded).
- The Belgium lack of funds in 1999 was a problem with the present schedule.
- The Italian contribution was still to be decided.
- PACS would be compatible with ESA schedule if work was to be started now but the detector work was a critical element.

**SPIRE (M. Griffin)**

The main points were:

- A decision between the two possible FTS options would be made in January 1999.
- The detector array selection would be made in January 2000.
- The Project Manager would also not be the ICC Manager (still to be appointed).
- Although the UK envelope was likely to increase, progress was slow on the instrument structure due to unofficial funding.

- The lack of early funding was slowing down progress on the generation of the major documents requested by ESA.
- The schedule had no margin.
- The CNES funding profile would make the PFM delivery schedule difficult;
- Canada had expressed interest in providing cold shutter.

6. Funding Status (by SPC Delegations and NASA/HQ representative)

- Austria (Not attending); was involved only in PACS: no problem foreseen by the PACS PI.
- Belgium Same situation as in July. There was no official budget yet. Some small funding for starting PACS activities had been found, but only in Spring next year would the exact amount be officially allocated. The funding level was expected to be adequate but a problem still remained for 1999. Some pre-financing with industry was expected to be possible. A formal commitment would occur in Spring '99 (probably not in time for the February SPC meeting).
- Denmark The level of funding for the DSRI contribution would have to be re-adjusted due to the slip in the schedule.
- Finland No final decision had yet been taken (this will occur after the November SPC meeting), but participation in Planck was a high priority. Some preparatory activities had been started.
- France The overall funding envelope was OK. However, there was a problem with the funding peak in 2001-2003 and therefore there was a problem with the payload development schedule (by about 1 year). As a result the development plan of the instruments should be made compatible with the funding profile. There was also a disagreement on the pace of the ground segment development (too early). The cryo-vibration tests for cryo-instruments would not be funded by CNES nor performed in Marseille, but could be moved elsewhere. This facility should not be run by CNRS-CNES.  
The funding sequence in 1999 and 2000 was giving problems for the support of the ongoing activities.
- Germany Progress had been made in reducing PACS and HIFI costs. Still a 10% difference remained between the estimates and the resources. Furthermore no funding would be possible until the year 2000, and the funding profile later was also a problem. A meeting by the end of October would clarify the German participation in HIFI, which was still unclear after the DLR/DARA merging. Some uncertainty could also come from the ongoing update of the space strategic plan by the new German government. The strategic plan was expected to be ready by end of the year.  
The German Delegation insisted on the request for partial ICC and technology development financing by ESA. The ESA Project stated that this request could not be satisfied given the well-known situation of ESA funding for the FIRST/Planck project.

- Italy The top priority was full backing of LFI participation endorsed by the ASI science committee. A conflict in funding with Rosetta did not allow to make positive recommendation for HFI contribution. The ASI committee was supporting in principle the involvement in FIRST (common DPUs), but final a decision was still pending (end October). The funding for science in 1999-2000 was still unclear therefore impacting on planned short term activities. In the succeeding years the peak spending ought to be replaced with a smoother profile for payload funding. ESA should set a firm launch date.
- Netherlands The overall contribution to HIFI would be available (1998-2006) including ICC. However, the spending profile was not OK but solutions were being sought. Further savings should be explored for the model philosophy and the component standards. A formal approval of funding was expected before February 1999.
- NASA The U.S. contribution to FIRST/Planck would see a significant increase in 1999-2000. However, some uncertainties in the overall NASA budget (ISS, AXAF) was making detailed commitments difficult today. FIRST/Planck had a high priority and visibility in NASA as well as in the U.S. community. This would help future approval by Congress. Letters of Agreements with PIs, and with ESA on the FIRST Telescope, were planned to be issued before the February SPC.
- Spain A fax sent by the delegation was read by the Chairman. The Spanish participation was confirmed, but formal decision had not yet been made.
- Norway The delegate agreed with France and Italy regarding the issue of the launch delay. In 1999 no money was available for FIRST/Planck because there was no space plan in Norway. However, a new 5 year plan was expected to be coming. Some study money had been allocated to Cluster/Soho/Planck until March 1999 when a final decision would be made on the allocation. If the March decision was in favour of Planck, then money would be available in 1999. No official position was possible as of today or at SPC in February 1999.
- Sweden Nothing had changed since July. A decision was expected before the SPC of February 1999. The biggest Swedish participation was in HIFI (correlator, HEB mixer work as a best effort). In SPIRE, the Instrument Simulator Software was foreseen as well as some help in the ICC. In Planck, the LFI support to the 70 GHz channel activities was possible. All these contributions were in the Swedish budget process and the Swedish position would be given at the SPC in February.
- Switzerland There was no change since the July meeting. Confirmation of the Swiss participation in the Planck DPCs was expected by the end of 1998.
- U.K. Some useful progress had been made since July in the funding of the SPIRE structure and the LFI 30 GHz amplifier (not the AIV). The ICC funding was still unsatisfactory. The delegation's position on the Planck DPC funding was still to be defined.

Some economies should be sought in the model philosophy. The delayed start would cause some problem but there was no problem with the funding profile. A formal approval in U.K. was confidently expected in February 1999.

#### 7. Discussion

The Chairman (S. Volonte) summarised the main points:

- 1) A funding problem existed for most countries in the next year or two (1999-2000).
- 2) The resources presently available in the national funding agencies were giving spending profiles incompatible with the delivery dates of the Flight Models identified in the latest project schedule.

A discussion followed without perceivable progress towards the definition a programmatic baseline allowing for the payload confirmation by SPC at the February 1999 meeting. Several Delegations insisted on a relaxed delivery of the Flight Models without shifting the early 2007 launch date. This was not accepted by the ESA FIRST/Planck Project.

It was finally agreed that during the forthcoming ESA/PI meetings, the following information would be requested from the PI's:

- a. For each instrument, the most likely schedule allowable with the level of funding support presently agreed by each contributing national agency.
- b. The extra national funding necessary to each instrument to fulfil the delivery dates as identified in the latest project schedule.

These data would allow to quantify the extent and the time frame of the funding problem and would be discussed in a further meeting with delegations, tentatively planned before Christmas 1998.

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**Second FIRST/Planck Payload Meeting**  
**21st October 1998**  
**ESA/HQ, Paris**  
Room 123 (Cinema)  
(starting 09.00 hrs)

**DRAFT AGENDA**

- |    |                                     |                           |
|----|-------------------------------------|---------------------------|
| 1. | Introduction                        | ESA                       |
| 2. | FIRST/Planck Project Status         | Project                   |
| 3. | Payload Status as seen by ESA       | ESA                       |
|    | - Design                            |                           |
|    | - Development Plan                  |                           |
|    | - Management                        |                           |
|    | - Software Developments             |                           |
|    | - Other FSEC/PSEC Comments          |                           |
| 4. | Instrument Status and problem areas | PI's                      |
| 5. | Funding Status                      | SPC delegations<br>& NASA |
| 6. | Conclusion and actions              |                           |
| 7. | Any other matters                   |                           |



**FIRST/Planck Payload meeting**

**ANNEX 1**

**21st October 1998  
ESA Headquarters**

**LIST of PARTICIPANTS**

<b>SPC Delegations</b>	<b>Participants</b>
Belgium	J. Bernard
Finland	S. Urpo
France	R. Bonneville M. Rougeron M. Joubert
Germany	A. Himmes H. Blome
Italy	G. Setti
The Netherlands	P. Wesselius
Norway	B. Andersen
Sweden	L. Nordh
Switzerland	S. Berthet
United Kingdom	D. Hall A.M. Cruise R. Carvell

Excuses were received from the Danish, Irish and Spanish delegates who were unable to attend.

**PI teams**

<b><u>HIFI</u></b>	T. de Graauw H. Aarts	E. Caux J. Stutzki
<b><u>PACS</u></b>	A. Poglitsch O.H. Bauer	C. Waelkens
<b><u>SPIRE</u></b>	M. Griffin L. Vigroux	K. King
<b><u>HFI</u></b>	J.L. Puget G. Efstathiou	J. Charra
<b><u>LFI</u></b>	N. Mandolesi R. Davis	
<b><u>TP</u></b>	H.U. Nørgaard Nielsen P.R. Christensen	
<b><u>NASA</u></b>	H. Thronson G. Parks	
<b><u>CSA</u></b>	G. Leclerc	
<b><u>ESA</u></b>	S. Volonte M. Anderegg P. Estaria	F. Felici G. Pilbratt J. Tauber

**ANNEX 2**



**2<sup>ND</sup> FIRST/PLANK PAYLOAD MEETING**

**MAIN ISSUES TO BE CLARIFIED**

1. LEVEL OF DEFINITION OF INSTRUMENT DEVELOPMENTS AND COMPATIBILITY WITH PROJECT SCHEDULE
2. LEVEL OF DEFINITION OF THE MANAGEMENT STRUCTURE AND SHARE OF RESPONSIBILITIES WITHIN CONSORTIA
3. LEVEL OF COMPLIANCE WITH FSEC AND PSEC RECOMMENDATIONS
4. LEVEL OF INSTRUMENT FUNDING AND COMPATIBILITY WITH PROJECT SCHEDULE



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# **FIRST/Planck**

# **Project Status**

Paris, 21 October 1998

FIRST/Planck Project



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## Project Status

### Summary

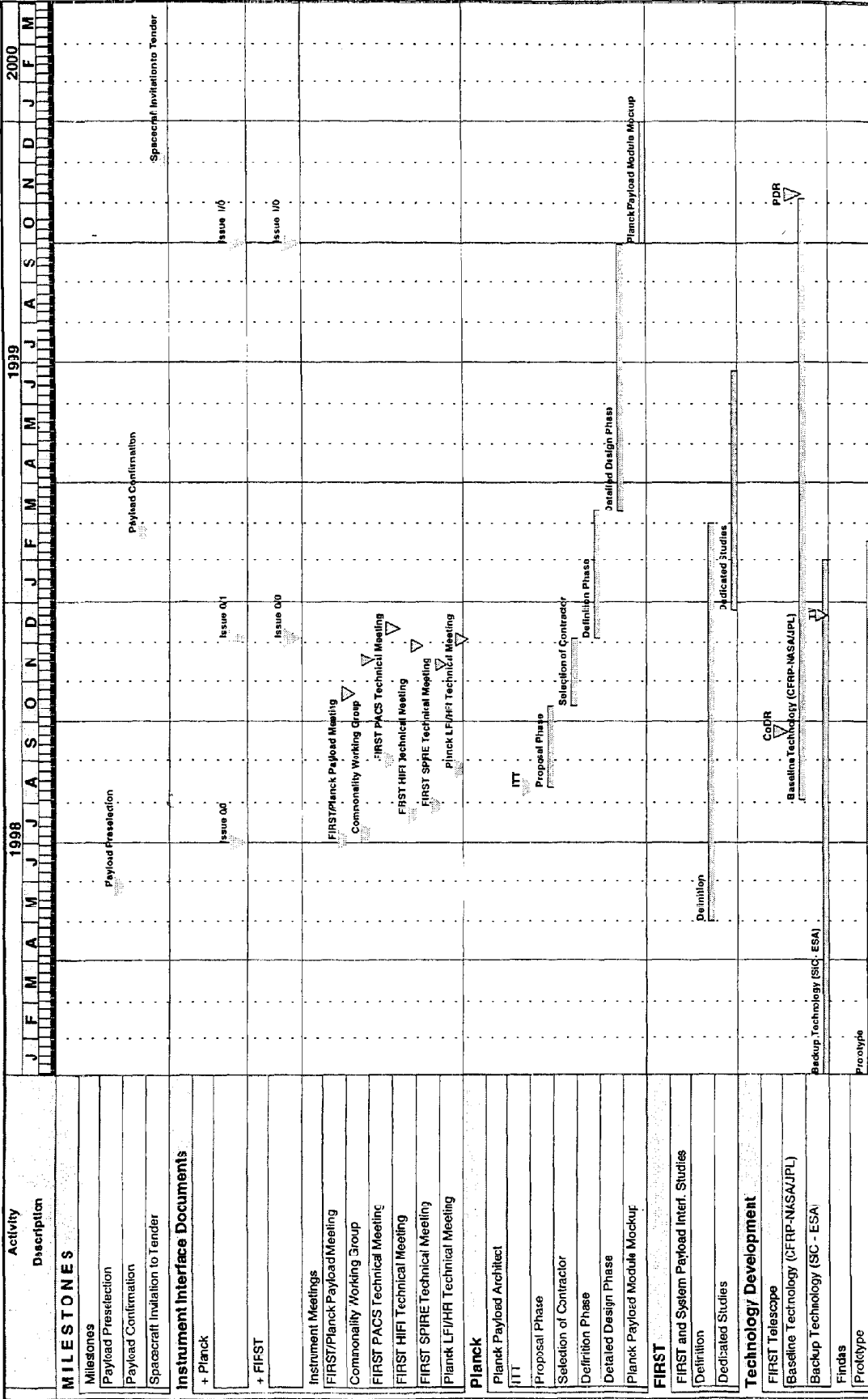
- Schedules
- Planck Payload Architect
- Planck Straylight review
- Planck Reflectors
- FIRST Telescopes Technology Development
- Larger FIRST Telescope Study
- Contacts with Canadian Space Agency
- X-Band Telemetry for Science



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21 October 1998

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FIRST/Planck Carrier Concept  
Pre Phase "B"

Show 1 of 1

Project Start: 13SEP96 Project Finish: 11OCT10 Data Date: 19SEP97 Run Date: 18OCT98	Entry Bar Progress Bar
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Activity Description	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
<b>MISSION</b>											
+ Project Approval & Assigned Launch			IPC	SRR	SDR	CDR	CTR		FAR	FRR	Launch
+ Project level milestones											
+ ESA assigned Project Phases											
<b>INSTRUMENTS</b>											
+ ESA Assigned milestones											
<b>AVONICS DEVELOPMENT Programme</b>											
FIRST/Plank Avionics Definition & Procurement											
Avionics HW & SW Procurement											
<b>CRYOGENIC QUALIFICATION Programme</b>											
Plank QM HW Procurement & AV											
FIRST CQM (ISO) HW Procurement & AV											
<b>STRUCTURE &amp; THERMAL Programme</b>											
FIRST PFM PLM Procurement & AV											
Plank System PFM AV											
<b>FLIGHT MODEL Programme</b>											
Plank PLM FM Procurement & AV											
FIRST SVM PFM Procurement & AV											
FIRST PLM PFM AV											
Plank SVM PFM Procurement & AV											
FIRST System AV											
Plank System FMAIV											
FIRST/Plank Carrier AV											

Sheet Lot 1

**FIRST/Plank  
CARRIER Concept**  
ESA/ESTEC Scientific Projects Dept.

URCP/PSPL

Project Start: 23SEP96  
Project Finish: 01OCT10  
Data Date: 23SEP97  
Run Date: 26JUN98

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## Project Status

### Planck Payload Architect

- Three proposals were received from Industry on 13.10.98
- Adjudication of contract foreseen by 2nd half of November
- Kick-off of activities linked to the ongoing definition of the Planck Payload baseline

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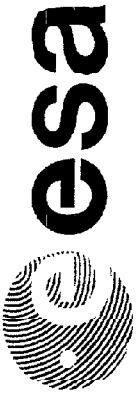


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## Project Status

### Planck Straylight Review

- The ESA Director of Science has decided to invite a group of independent scientists to review the overall Planck straylight approach, from requirements through the analyses and verification methods
- Four scientists have been identified and have agreed to support this activity
- A first meeting is planned on November 16th and activities are expected to last for a couple of months



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## Project Status

### Planck Reflectors

- Co-operation ESA/DSRI
- MOU available for agreement
- Technology Demonstration this year
  - available secondary mirror demonstrator model
  - test at cryogenic temperatures in CSL

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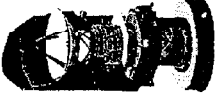
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## Project Status

### Planck Telescope - Optimisation of Optical Definition

- Optimisation study started by LFI (Aplanatic Telescope)
- Preliminary Concept distributed by LFI
- AO-telescope remains the baseline

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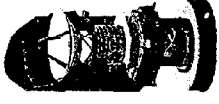
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## Project Status

### FIRST Telescope

Two separate pre-developments - selection end 1999

#### *CFRP - Technology (NASA-JPL/COI)*

- Conceptual Design and Development Plan Review held at JPL early Sept.
- Open design issues identified - actions initiated
- Development Plan under review (JPL/ESTEC)
- Target to achieve technology readiness on 2m demo model end 1999

#### *Silicon Carbide (SiC) (MMS-T)*

- Demonstrator development: since 1997
- Demonstrator Model under final grinding, polishing in November
- Technology readiness tests in December (cryotest) and Jan. (vibration)
- Design review (3.5m) in mid-November '98



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## Project Status

### FIRST Telescope - Increase of diameter

#### *FIRST telescope diameter up to 3.8 m*

- Technical feasibility studied by JPL in parallel to the baseline
- Impact on Instrument design evaluated by FIRST Instrument teams
- Impact on S/C design and cost to be evaluated by ESA
- Decision of size increase in summer 1999



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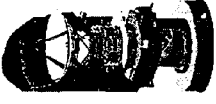
## Project Status

### Contacts with Canadian Space Agency

- CSA has expressed, through its Director of Space Science, interest in participating in the FIRST/Planck Project
- Two introductory meetings have taken place in the Summer in Canada and Belgium
- The next step is the start of discussions between CSA and ESA on type of contribution of CSA and its participation in the scientific exploitation of the mission



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## Project Status

### X-Band Science Telemetry

- Benefits from increased science telemetry rates, particularly for FIRST, has been highlighted by the Scientific Evaluation Committee of the scientific proposals
- Benefits of a change from S to X-Band have been investigated at ESTEC
- Rosetta and Mars Express will use dual band transponders with X-Band Science Telemetry
- This and further pressures from Frequency Allocation international bodies make the use of X-band for FIRST and Planck Science Telemetry very likely

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**Payload Status**  
**as seen by ESA**

Paris, 21 October 1998

FIRST/Planck Project

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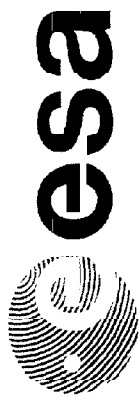
## Introduction

Payload status discussed in view of Reconfirmation in Feb. 99

- Detail/Optimise Design
- Close open issues from PSEC/FSEC Reports
- Delivery of Payload to S/C, i.e. already now identified criticality of Payload Development

## Presentation Structure

- Main activities since July meeting
- Technical Status of Instruments
- Management Status of Instrument teams
- Status of PSEC/FSEC recommendations
- Status of Ground Segment



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## Main activities

### Planck Straylight Analysis

- Straylight Analysis at 30 GHz carried out (ESA inhouse study)
- Compliance with requirement for external sources
- Self emission appears most critical
- Review of analysis (results and approach) with External Experts planned for 16.11.1998
- Future detailed analysis through Planck Payload Architect (S/C) and Instrument Teams (Detailed Instrument Design)

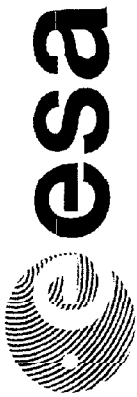
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## Main activities

### Instrument Model Philosophy

- Instrument Model Philosophy further detailed by ESA
  - AVM = Avionics Model
  - CQM = Cryo Qualification Model
  - FM = Flight Model
  - FS = Flight Spare
- Model Philosophy driven by Verification Objectives
  - AVM + CQM = one full instrument Model /two verification objectives
- For FIRST:
  - Criteria to be agreed in FIRST Science Team for exchange of FM with FS
  - ISO criteria as starting point



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## Main activities

### Use of X-Band

- This will allow an increased of telemetry rate by a factor of four (FIRST only)
- Not possible presently for Planck

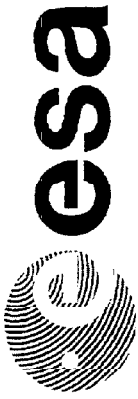
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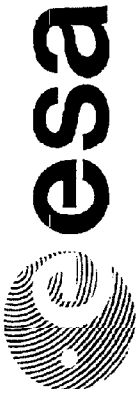
**Telemetry Link Equation**

$$\frac{E_b}{N} = \frac{P \cdot L_l \cdot G_t \cdot L_a \cdot G_r}{k \cdot T_s \cdot R} \cdot \left( \frac{\lambda}{4\pi \cdot D} \right)^2$$

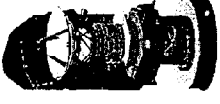
- where :
- $\frac{E_b}{N}$  = Signal to Noise ratio for 1 bit
  - $P$  = Power of the satellite transponder
  - $L_l$  = Loss between transponder and emitting antenna
  - $G_t$  = Gain of emitting antenna
  - $L_a$  = Loss in the atmosphere
  - $G_r$  = Gain of receiving antenna
  - $\lambda$  = Wavelength
  - $k$  = Boltzman constant
  - $T_s$  = Receiver noise temperature
  - $R$  = Telemetry rate
  - $D$  = Distance satellite receiving antenna

$$\left( \frac{\lambda}{4\pi \cdot D} \right)^2 = \text{Transmission loss}$$

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## Technical Status of Instruments

Planned technical meetings held with all teams

- HIFI      17.07.1998
- SPIRE    29.07.1998
- PACS     02.09.1998
- HFI/LFI   01.09.1998

Status of instrument design and development discussed

- actions have been placed

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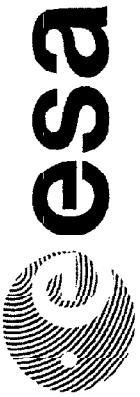
## Technical Status of Instruments (cont'd)

### General conclusions:

- Instrument activities have started
- Progress slower than expected (complex instruments, complex instrument organisation, difficult funding situation)
- Most teams still in the team definition/structuring phase,
- Structures not yet (fully) implemented

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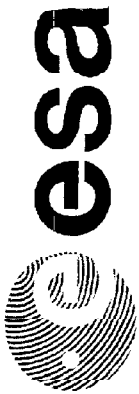
**FIRST/Planck**



## Technical Status of Instruments (cont'd)

### *High Frequency Instrument (HFI) of Planck*

- Focal Plane Unit (FPU) Design progressing:
  - Mechanical Problem identified - Actions defined within HFI team
  - Design of Detectors (Horns) open (impact on straylight analysis)
- HFI/LFI FPU Interface Definition
  - Identified as important and critical
  - Action placed on both teams - draft definition due now



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## Technical Status of Instruments (cont'd)

### *High Frequency Instrument (HFI) of Planck*

- Critical Developments:
  - Coolers, here 0.1 K cooler (20 K cooler refer to LFI)
    - Actions underway to define development plan
    - Development definition due now (part of instrument development plan)
    - No basic problems reported
- HFI Development Plan: expected now (due 20.10.1998)



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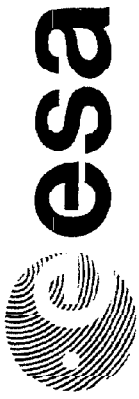
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## Technical Status of Instruments (cont'd)

### *Low Frequency Instrument (LFI) of Planck*

- Focal Plane Unit Design:
  - Adaptation from Merger to Carrier started (waveguides design and routing)
  - Waveguides trade off (flexible vs rigid) not yet closed
- HFI/LFI FPU Interface: (See HFI)

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**Technical Status of Instruments (cont'd)**

*Low Frequency Instrument (LFI) of Planck*

- Critical Developments:
  - 20 K Cooler:
    - Major increase of S/C resources requested recently
    - Project and teams in discussion to find solution
      - \* Adapt instruments to decrease cooling needs
      - \* Review of cooler design and development to identify risks
      - \* Search for technical alternatives
    - Further plan of actions TBD
  - 4 K/20 K loads : In Conceptual Design Phase
  
- LFI Development Plan: expected now (due 20.10.1998)



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## Technical Status of Instruments (cont'd)

### *Photo-conductor Array Camera & Spectrometer (PACS) Instrument of FIRST*

- FPU Design
  - Details evolving from baseline
  
- Critical Developments:
  - Detectors and Readouts: Problems (funding) identified
  - Data Compression: Working Group started
  
- PACS Development Plan: expected now



## Technical Status of Instruments (cont'd)

### *Spectral and Photo-metric Imaging Receiver (SPIRE) Instrument of FIRST*

- FPU Design
  - Details evolving from baseline
  - Design option/alternatives (e.g. detectors, FTS)
    - Options have system (S/C) impact
    - Definition/Overview/Selection criteria under preparation (including milestones/decision points)
- Critical Developments
  - Detectors (see options above)
  - 0.3 K cooler: see development plan
- SPIRE Development Plan: expected now



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**Technical Status of Instruments (cont'd)**

*Heterodyne Instrument for FIRST (HIFI) Instrument*

- FPU Design:
    - Establishment of design concept underway
    - Frequency definition sent to ESTEC in September 1998
    - No clear baseline concept yet
  - Local Oscillator Unit (LOU):
    - Establishment of design concept underway
  - Critical Developments:
    - Detectors
    - Mixers
    - Local Oscillators
    - 0.3 K cooler
- } Development approach expected to be covered in Development Plan
- HIFI Development Plan: delayed to TBD

(39)



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## Management Status

- Little visible progress
- Management Meetings planned with each PI group adjacent to next technical meeting
- PI's are requested to provide monthly progress report starting first week of November 1998

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21 October 1998

PT-05979

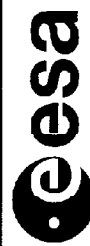
26



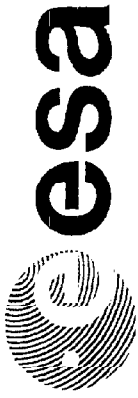
## Recommendations of PSEC: Performance

Recommendation		Status
<i>Sensitivity (stability)</i>	development and testing plans to be established for all critical components	Part of instrument development plans (expected now)
<i>Foreground subtraction</i>	more simulations/surveys if possible	Simulations ongoing: coordination via Science Team*
<i>Straylight</i>	more work needs to be carried out before the impact and requirements (e.g. testing) can be considered to be understood	ESA part: ongoing, will continue under Payload Architect. PI part: to be coordinated via Science Team*
<i>Telescope</i>	current design is adequate -- but if possible accommodate a slightly larger one	Some progress in definition of wished-for telescope by PIs

\* First meeting of Science Team planned end November



# PLANCK



**FIRST/Planck**



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Ground Segment status

- FINDAS
- Planck SIPs
- DPCs - PSEC recommendations
- ICCs, FSC and MOC

**Commonality Activities**

- Steering Committee, Working Groups
- Short term plans

(42)



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**FIRST/Planck**

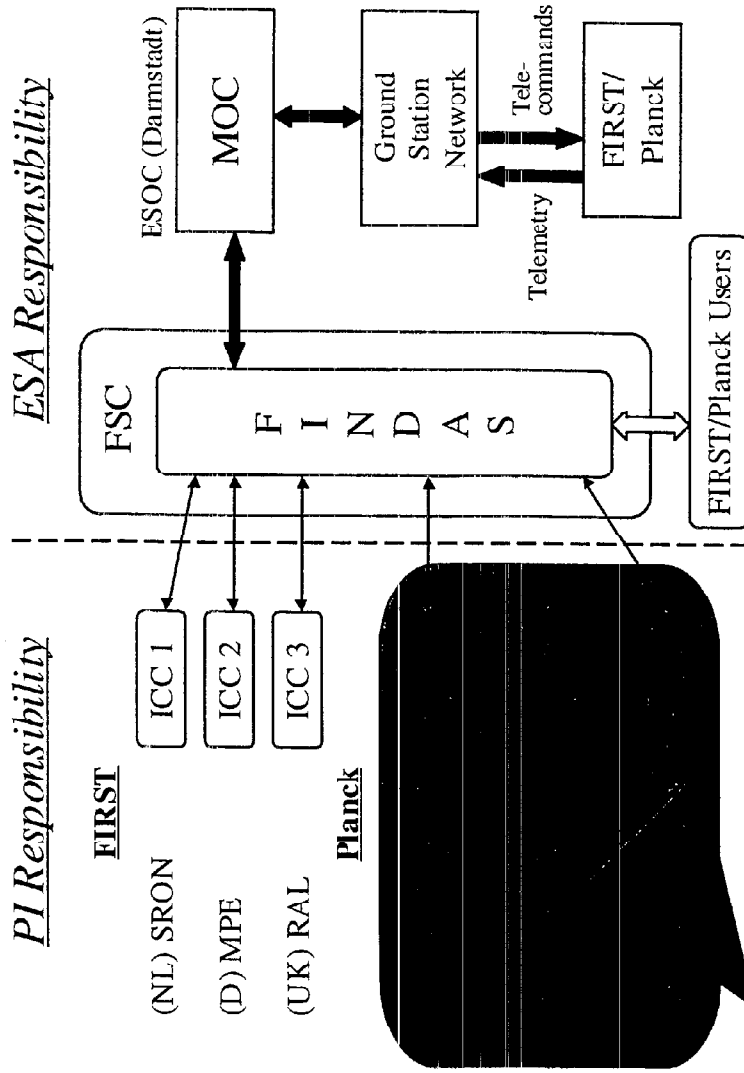


Fig. 1 FIRST/Planck Ground Segment (Simplified View)





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**FIRST/Planck**



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**FINDAS (FIRST Integrated Network and Data Archiving System)**

- **Prototype implementation continues satisfactorily**
- **Object oriented approach validated**
- **Adequacy of prototype database (O2) confirmed**  
(Initial difficulties have been solved)
- **Level of ESA-contractor interaction increasing (technical level)**
- **Initial prototype demonstration: 08.12.98 at VEGA**
- **Tutorial (programmer's guide) available on 15.12.98 (1st version)**
- **Final Prototype delivery early March 1999 (~ 1 month delay)**
- **Hardware/Software specification document for the 'operational' FINDAS also available early March 1999**

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(44)

21 October 1998

PT-05979

30



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**FIRST/Planck**



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**Planck Science Implementation Plans (SIPs)**

- Effort has been concentrated on Planck SIPs for the DPCs
- Review of draft #2 has taken place on 15.10.98 at ESTEC
- Overall framework in place
- The three major mission phases (development/operations/ post-operations) clearly identified
- Two SIPs: one LFI-SIP and one HFI-SIP but with identical structure
- More work - work package definition - bottom-up is required
- Next iteration on 9/10 December 1998

(45)

## Data Processing Centres (DPCs) and Integrated Data and Information System (IDIS)

Recommendation	Status
IDIS must emphasize "minimum objectives"	Principle has been accepted
IDIS and FINDAS must coordinate and/or share developments	Working group has been set up
Producing a realistic and more detailed plan for Planck processing and the actual resources required must be a high priority item.	Preliminary Science Operations Implementation Plan for LFI has been received; further milestones for LFI and HFI have been set
IDIS must be under strong management and have the full backing of both Consortia	Being addressed
DPC organisation must be rationalised (smaller number of locations)	LFI: best compromise already achieved HFI: difficult issue; progress has been made
Network availability/capacity to be assessed	Not immediately critical; to be addressed as appropriate



**PLANCK**



**FIRST/Planck**



### ICCs (Instrument Control Centres)

- No major activity involving ESA has taken place since meeting in July

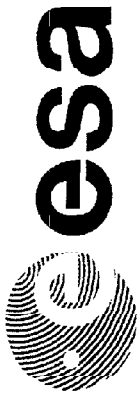
### FIRST Science Centre (FSC)

- FSC SIP to be available end October 1998
- Internal ESA Review to take place in November
- FSC team much involved in FINDAS prototyping activities

### Mission Operations Centre (MOC) - ESOC

- Ground Segment Manager nominated
- MOC involved in punctual activities (e.g. TM rate)





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**Commonality activities**

- **ESA has taken responsibility to coordinate FIRST/Planck commonality activities (proposal made on 14.09.98)**
- **One Steering Committee (ESA + Instrument Project Managers)**
- **Seven working Groups identified:**
  - **WG #1 : micro-processors & components**
  - **WG #2 : Spacecraft interfaces and H/W Simulators**
  - **WG #3 : Real-Time Assessment /Quick Look Assessment (RTA/QLA)**
  - **WG #4 : Instrument Operations**
  - **WG #5 : Operations and Test Language**
  - **WG #6 : FINDAS & IDIS**
  - **WG #7 : Other H/W Common elements**

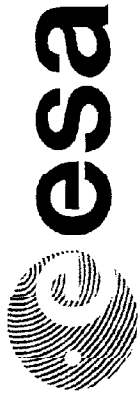
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**Commonality activities (cont'd)**

- **ESA provides Chairman + Secretary (all nominated - provisionally); one representative per Instrument (some nominations pending)**
- **Initial meeting of the Steering Committee planned on 11.11.98**
- **Most Working Groups to be kicked-off before Xmas (TBC)**
- **(Potential) Working Group Chair-persons have started to plan activities of their Working Groups (end October)**



**Short Term Plans**

- FINDAS activities (milestones: December '98 and March '99)
- Planck SIPs (milestone: December '98)
- FSC SIP (milestones: October and November '98)
- Commonality activities (milestones: November & December '98)
- FIRST/Planck Ground Segment meeting (Jan/Feb '99) - TBC
- 1-1 SIRD/SIPs meetings (Apr/May '99) -- TBC

**CONCERNS**

Level of resources in all teams "seems" insufficient to support the necessary ground segment activities (ground segment should not be second priority)

# FIRST/Planck Programme Carrier Concept

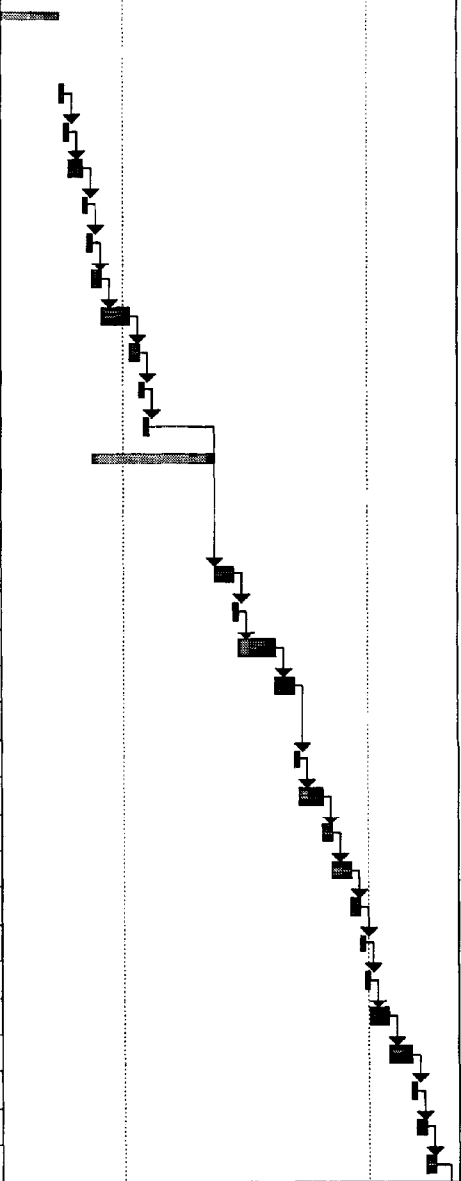
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		7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
1	<b>FIRST/Planck Carrier</b>																										
2	<b>FIRST S/C DEVELOPMENT</b>																										
3	<b>FIRST PFM Programme</b>																										
4	<b>FIRST Cryostat PFM (II)</b>																										
5	Integration																										
6	Test																										
7	Evacuation and Bake Out																										
8	Alignment check FPU's																										
9	Cooldown and filling																										
10	Alignment check cryogenic																										
11	He II production and top up																										
12	Integrated Module Test																										
13	Delivery to System AIT																										
14	<b>Spacecraft AIV</b>																										
15	Integration																										
16	Integration FM Telescope																										
17	Alignment Check/Reference																										
18	Integration external structures																										
19	Integration Sunshield/sunshade STM																										
20	Integration SVM																										
21	Test																										
22	Alignment check																										
23	Cryostat refilling, He II production																										
24	Integrated System Test																										
25	ESOC Compatibility Test																										
26	Cryostat refilling, He I																										
27	Vibration Test																										
28	Acoustic Noise Test																										
29	Alignment check telescope																										
30	Alignment check s/c																										
31	Cryostat refilling and He II production																										
32	EMC test																										
33	Cryostat top up/launch autonomy																										
34	TV test																										
35	Alignment check																										
36	ESOC Compatibility test																										
37	Conversion to He I																										
38	Delivery to Carrier programme																										
39																											

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# FIRST/Planck Programme Carrier Concept

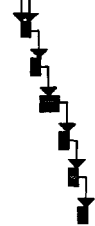
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40	<b>Planck S/C DEVELOPMENT</b>																										
41	<b>Planck PFM Programme</b>																										
42	<b>Planck Payload Module PFM</b>																										
43	<b>Integration</b>																										
61	<b>Test</b>																										
62	Telescope alignment check																										
63	Function test instruments																										
64	Vibration test																										
65	Telescope alignment check																										
66	Functional test																										
67	Cryogenic Test Preparation																										
68	Cryogenic Test																										
69	Post cryogenic test activities																										
70	Alignment check																										
71	Functional Test																										
72	<b>Planck SVM Structure PFM (II)</b>																										
75	<b>Planck Spacecraft AIV PFM</b>																										
76	<b>Integration</b>																										
77	Integration SVM to PLM																										
78	Alignment Check/Reference																										
79	Integration external structures																										
80	Integration Sunshield																										
81	<b>Test</b>																										
82	Alignment check																										
83	Integrated System Test																										
84	ESOC Compatibility Test																										
85	Vibration Test																										
86	Acoustic Noise Test																										
87	Alignment check telescope																										
88	Alignment check s/c																										
89	EMC test																										
90	TV test																										
91	Alignment check																										
92	ESOC Compatibility test																										
93	Delivery to Carrier programme																										



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# FIRST/Planck Programme Carrier Concept

ID	Task Name	04				2005												2006								
		7	8	9	10	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	
94	FIRST/Planck Programme																									
95	Mechanical integration FIRST/Planck																									
96	FIRST Cryostat He filling																									
97	Vibration test																									
98	Acoustic noise test																									
99	FIRST/Planck Clampband test and deintegration																									
100	Preparation for Transport																									



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# Planck HFI Status

Meeting with Delegations

ESA-HQ

1998, October, 21st

Jean-Loup Puget, IAS

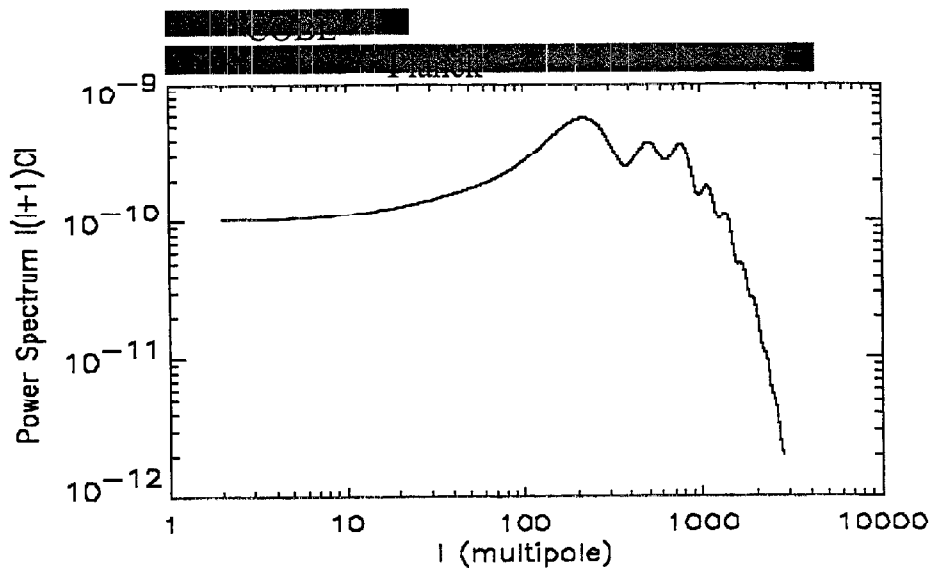
ESA, 1998 October 21st Meeting, J.-L. Puget

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# Planck-HFI : Scientific objectives

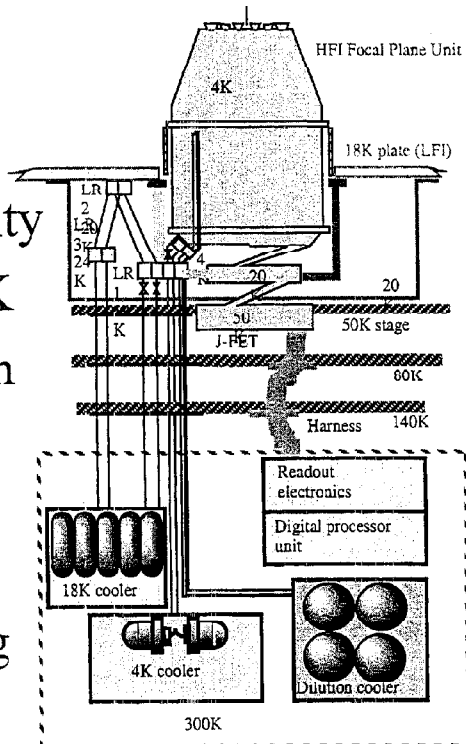
- Full sky map of CMB anisotropies (incl. polarisation) with sensitivity  $\Delta T/T < 2\mu\text{K}$  and angular resolution better than 5 arcmin
  - constraints on cosmological parameters with accuracy better than 1%
  - fundamental physics at ultra high energies
- All-sky maps in 6 bands (100-900 GHz)
  - accurate foreground subtraction
  - catalogue of several thousands of clusters of galaxies (S-Z effect)
  - catalogue of more than 20000 infrared galaxies
  - maps of galactic dust emission



ESA, 1998 October 21st Meeting, J.-L. Puget

# Planck-HFI : Instrumental concept

- 6 frequencies
- Polarisation measurement capability
- 48 bolometers at 0.1K
- Horns and filters from 4K to 0.1K
- Total power readout electronics
- 3-stage active cooling



Frequency (Ghz)	100	143	217	353	545	857
Beam (arcmin.)	10.7	8.0	5.5	5.0	5.0	5.0
DT/T (Intensity) $\mu\text{K}/\text{K}$	1.7	2.0	4.3	14.4	147	6670
DT/T (U and Q) $\mu\text{K}/\text{K}$		3.7	8.9		208	



# Planck-HFI :Critical developments

- **Complex cryogenic chain: 0.1K/4K/20K**
  - 0.1K demonstrator mock-up (full chain)
  - Development model of 0.1K dilution stage
  - Development model of 20K sorption cooler
- **Control of noises (EMI, Thermal, low frequency electronic noise, ...)**
  - Compatibility to be demonstrated by mock-up, integration and test plans
- **Some components : horns, 4K load**
  - Theoretical and experimental on-going developments
- **Overall payload integration**
  - Very close collaboration needed between P/L architect and PI teams
- **Iterative, massive and complex extraction of both sky signal and instrument parameters (beam patterns including far side lobes, low frequency noise, calibrations,...)**
  - Extensive simulations to validate the different stages of data processing and progressive construction of the pipeline

# Planck-HFI : Organisation

- **PI, PM, IS, DPCM, SM and Calibration manager in the same institute (IAS)**
  - **Instrument: work distribution following major subsystems :**
    - management, thermal architecture, mechanics, integration, final testing : IAS
    - cold optics : QMW
    - 4K cooler : RAL
    - bolometers and 20K coolers : Caltech/JPL
    - JFETs : Roma
    - readout electronics : CESR
    - general electronics : LAL
  - **DPC : for each level a single institute is in charge of integrating and running the pipeline :**
    - level 1 : Geneva (common with LFI)
    - level 2 : Orsay
    - level 3 : Cambridge
    - level 4 : MPA-Garching (common with LFI)
- but several institutes contribute to development tasks and pipeline infrastructure (IDIS)**
- **Budget : Major contributors for the development phase (1999-2005) :**

instrument	internal	external	DPC	internal	external
France	16.1	14.6	France	4.4	2.6
UK		9.6	UK		5.3
USA		4.4	Germany	0.4	1.8
Italy	0.9	2.1	SSD		1.1
			Switzerland		0.8
<b>Total</b>	<b>17.0</b>	<b>30.7</b>	<b>Total</b>	<b>4.8</b>	<b>12.0</b>

# Planck-HFI : Hard points

- 0.1K plate mass and cooling power
  - Mass reduction campaign + heat exchanger optimisation are continued
  - Caging of 0.1K stage is being designed
  - Both studies are on-going in parallel, selection by end of Jan. 1999
- 20K Cooler power budget
  - Sub-system requirement clarification on-going
  - Instruments System level trade-off meeting on 2d November
- Flight electronics components QA level is to be agreed on. For funding & procurement delay we propose:
  - Level B for interface circuits
  - Level C elsewhere
- Planck Telescope Leader is lacking
  - Design Optimisation
  - Integration and test plan

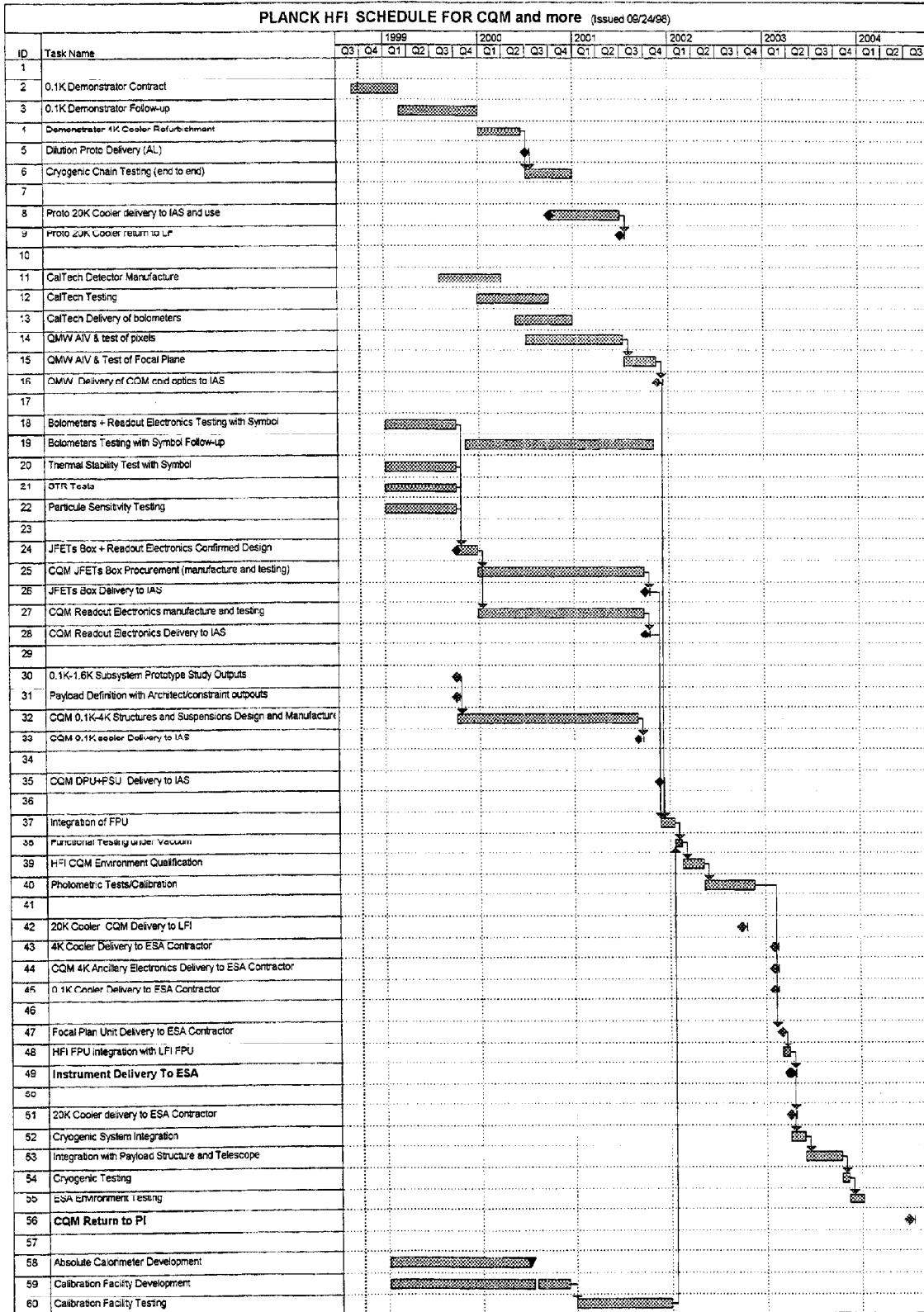
# Planck-HFI : Development Plan

- Components and Sub-systems are being tested at Breadboard level:
  - Detectors at Caltech
  - Filters at QMW
  - Readout Electronics at IAS, CESR, CRTBT,...
  - 0.1K Cooler "Demonstrator" at IAS
  - 20K Cooler Breadboard at JPL
  - A Readout Electronics full elegant breadboard shall undergo EMC tests (CESR)
  - Central Electronics full breadboard shall be used for early functional test, compatibility with other HFI Electronics and EGSE
- A Detection Chain, including all cooler chain, "end-to-end" compatibility test is foreseen early 2000
- HFI Thermo-Optical Model has been cancelled and replaced by the earlier availability of the CQM
- Avionics Model is representative of electric interface and on-board software

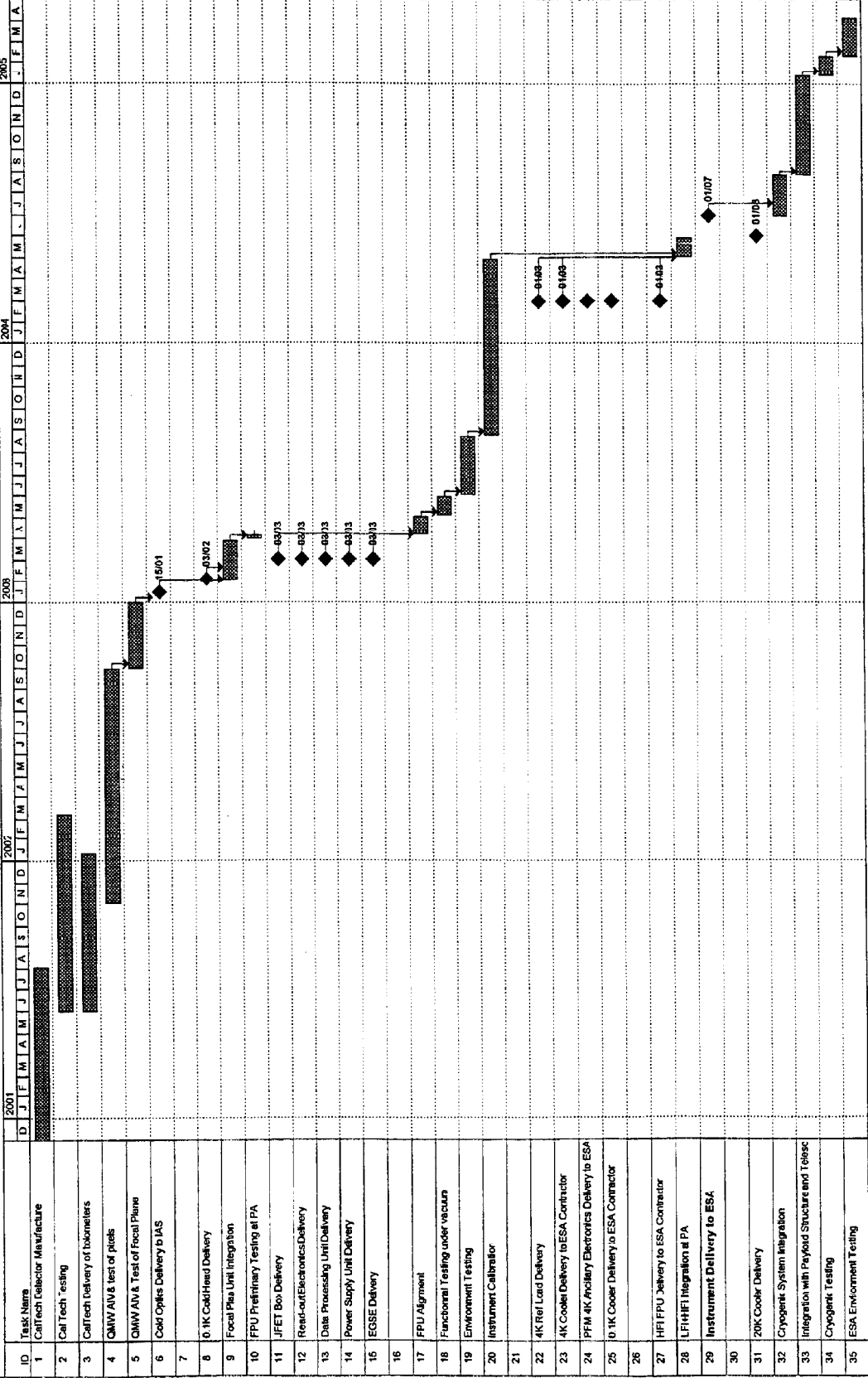
# Planck-HFI: Development Plan (cont ')

- HFI CQM includes sample of all type of detectors, on-board electronics and coolers (EMC and thermally representative)
- Full PFM shall be qualified, or “accepted” depending on units, calibrated and delivered in due time
- Agreed set of Flight Spares shall be prepared for quick swap
- IAS ISOCAM Calibration Cryostat evaluation test is imminent. It shall be adapted for HFI and validated by use of absolute bolometers prior to HFI CQM calibration

PLANCK HFI SCHEDULE FOR CQM and more (Issued 03/24/98)



PLANCK HFI SCHEDULE FOR FFM (Issued 09/24/04)



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# HFI : Evolution of DPC Concepts

- Simplification of operational structures during operations :
  - DPC-Switzerland : HFI-LFI Data processing: data reordering, RTA-QLA (Geneva, Level 1, real time processing)
  - DPC-France : HFI Core Data Processing Pipeline (Orsay, Level 2, monthly processing)
  - DPC-UK : Planck Data merging and component separation (Cambridge, Level 3, processing for each complete survey)
  - DPC-Germany : Preparation and Distribution of Final products (Garching, Level 4, final release)
- Coherence of contributions to software development from several institutes assured by
  - Close collaboration between HFI and LFI DPCM
  - Single responsible for the integration of each level of data processing
  - Overall control by the Science Team
  - Development of components technology (IDIS)



## HFI-DPC : On going activities

- IDIS Development with a clear interface with FINDAS and a clarification of the specific role of IDIS Components in the Planck DPC Development
- Participation of Planck DPC Teams to FINDAS Activities
- Preparation of Work Packages Breakdown and distribution of tasks within the teams according to the development philosophy (successive implementation of pipeline models)
- Co-ordination of simulation activities between LFI and HFI
- Preparation of the new HFI Science Implementation Plan by the end of 99

## MISSION SCHEDULE vs FUNDING

The call for ideas for M3 was released in 1992 for a launch in 2003.

The selection took place in 1995, the launch was then planned for 2004.

The AO for the instruments was issued in 1997 announcing a launch in 2006.

After we replied to the AO the launch date was shifted to 2007.

**THIS IS ONE YEAR PER YEAR FOR THE PAST 3 YEARS !!**

National agencies readjust the planned spending profile at each shift of the launch date making it very difficult to secure resources for the Planck project.

This situation is due to the introduction of a number of new missions which were not in the plan at the time of the AO for M3 outside of the competitive process which was the strength of the scientific program.

The PLANCK HFI team urges the SPC to take into account the consequences of the introduction of any new mission in the program for the ability of Europe to carry out the PLANCK project.

FIRST/PLANCK Payload Meeting Oct. 21 1998

PLANCK Mirror status:

preparation of thermal vacuum tests of our PLANCK test mirror  
at CSL

DK-PLANCK funding status:

details presented at last meeting

1) ESA/DSRI agreement

2) PLANCK Telescope Programme Plan

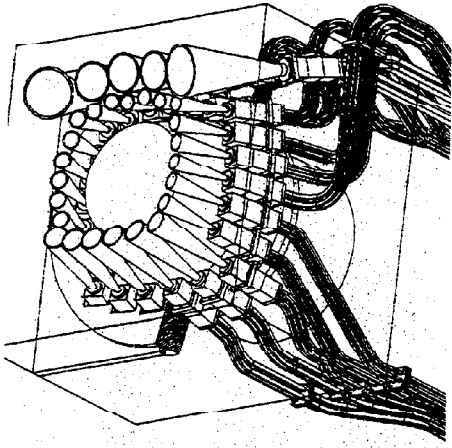
new financing plan to be negotiated with the Danish Natural  
Science Research Council

# Planck / LFI

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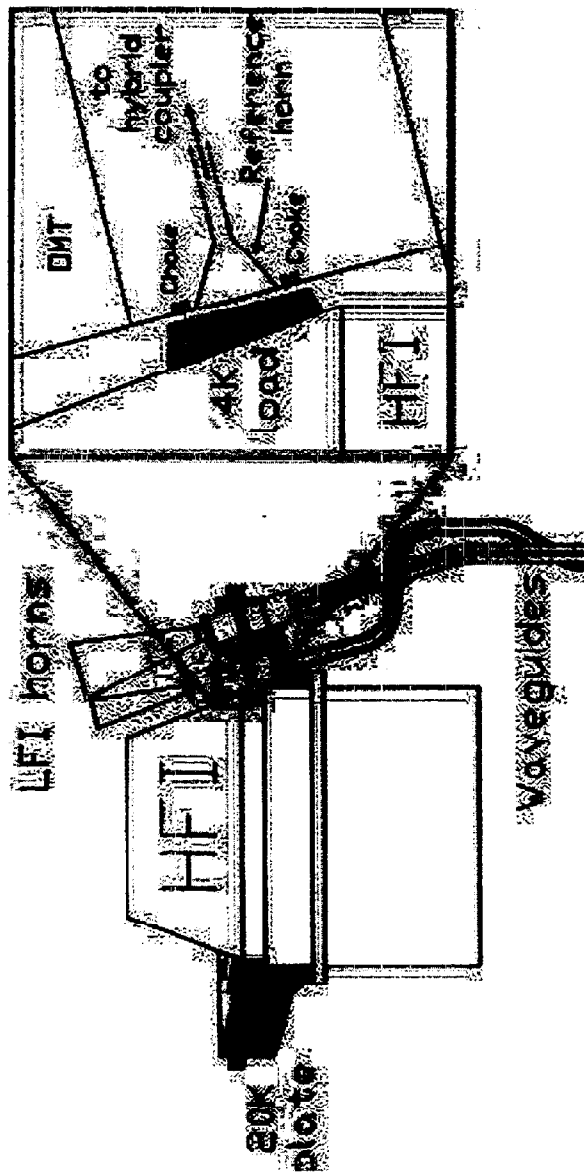
## INSTRUMENT CONCEPT

- 4 Frequencies
- Polarization Measurement Capability
- 28 Corrugated Feed Horns
- 56 InP HEMT Radiometers
- Front-End Unit @ 20K, Reference Load @ 4K
- Back-End Unit @ 300K
- 92 Waveguides, 20 Coax Cables

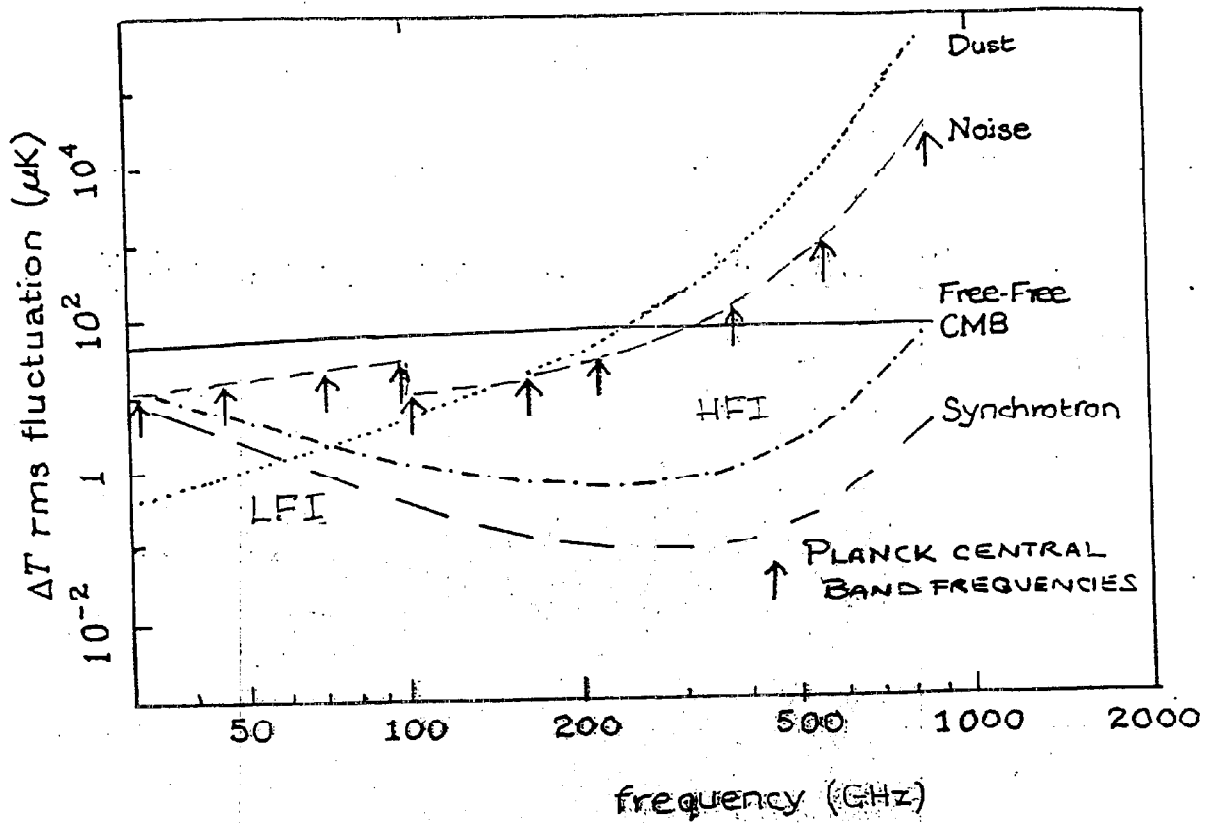


Center Frequency [GHz]	30	44	70	100
Number of Feeds	2	3	6	17
Number of Radiometers	4	6	12	34
Angular Resolution [arcmin]	33	23	14	10
Bandwidth [%]	20	20	20	20
Noise/Res. Element [ $\mu$ K]	4	7	10	12
Noise $dT/T * 10^6$	1.6	2.4	3.6	4.3

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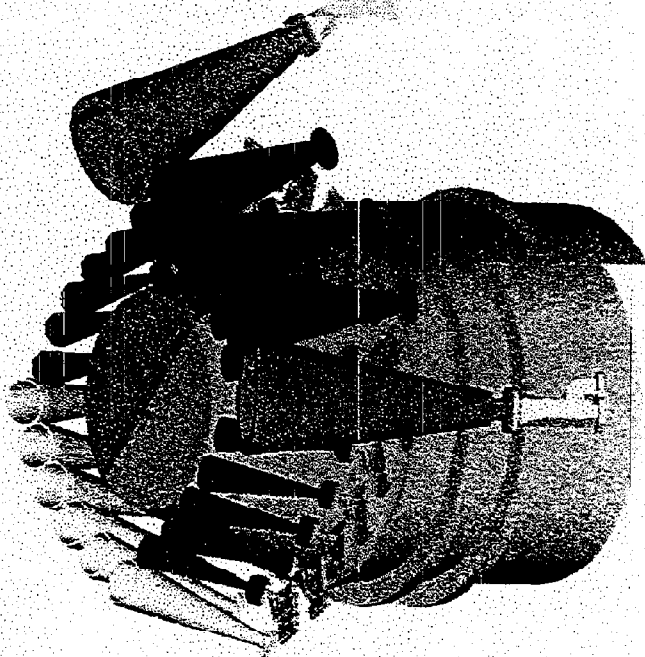


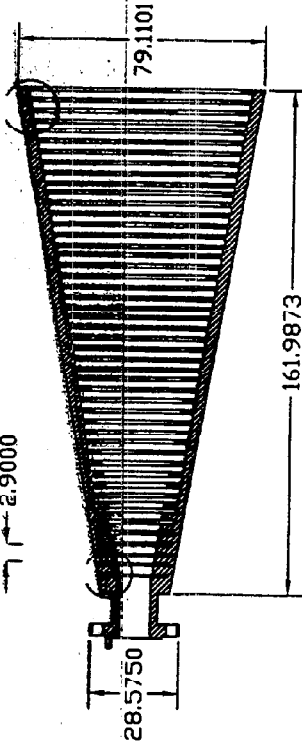
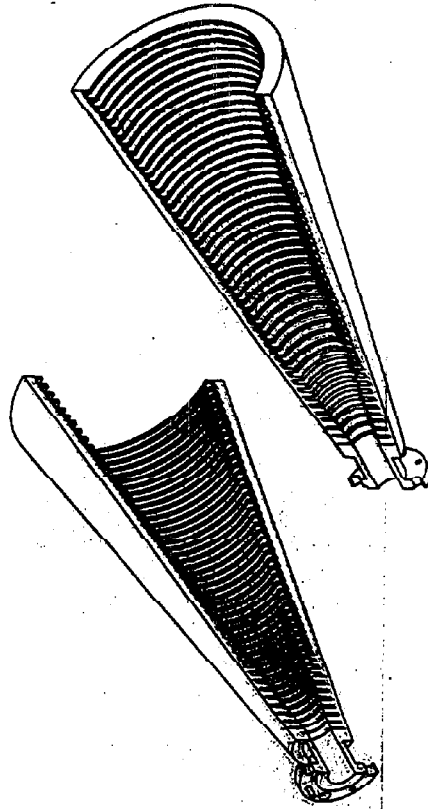
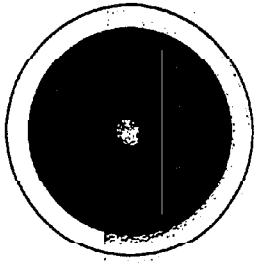
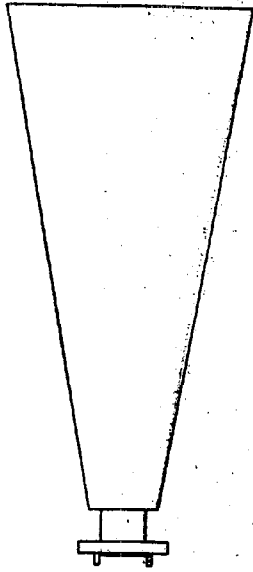
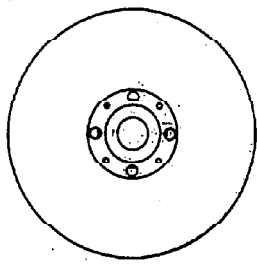
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Rms thermodynamic temperature fluctuations at each Planck Surveyor observing frequency.

*Planck / LFI*





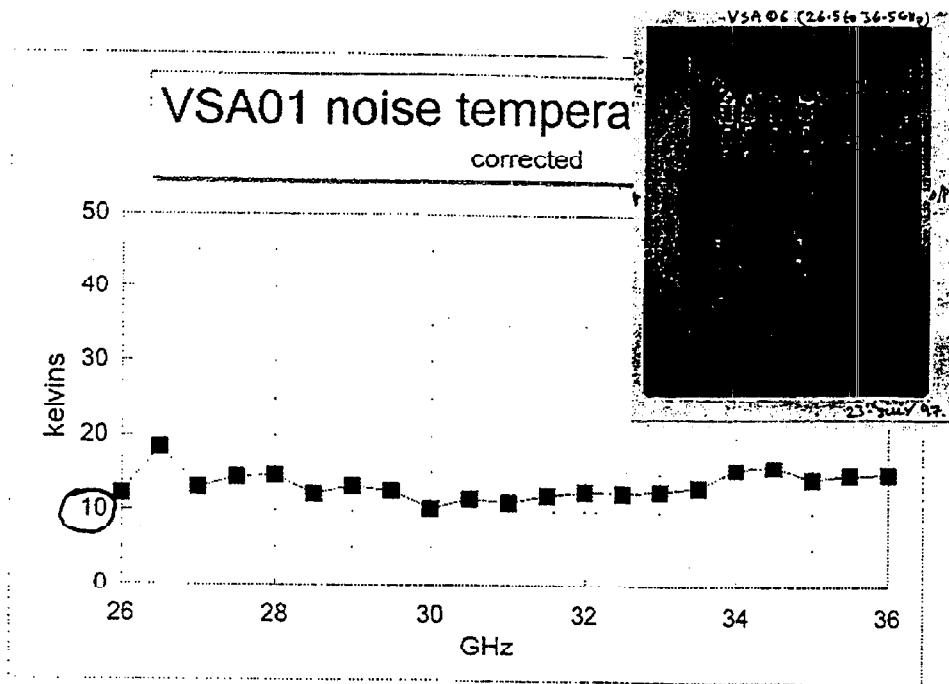
Item/Quantity	Title/Name, designation, material, dimension etc	Article No./Reference
Designed by G Cazals	Checked by Approved by - date	Date 30/09/98
Owner	ECR306Hz	Scale 1/5
Title/Name HORN 30GHZ		Drawing number
Edition		Sheet

Rev'd	Revision note	Date	Signature	Checked
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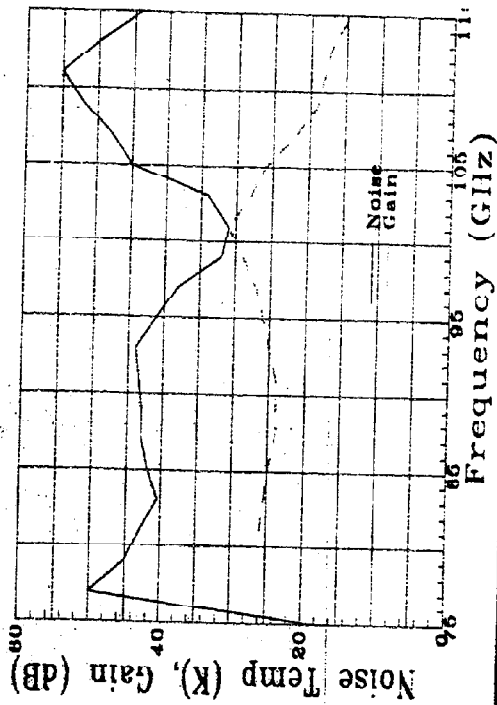


# JPL

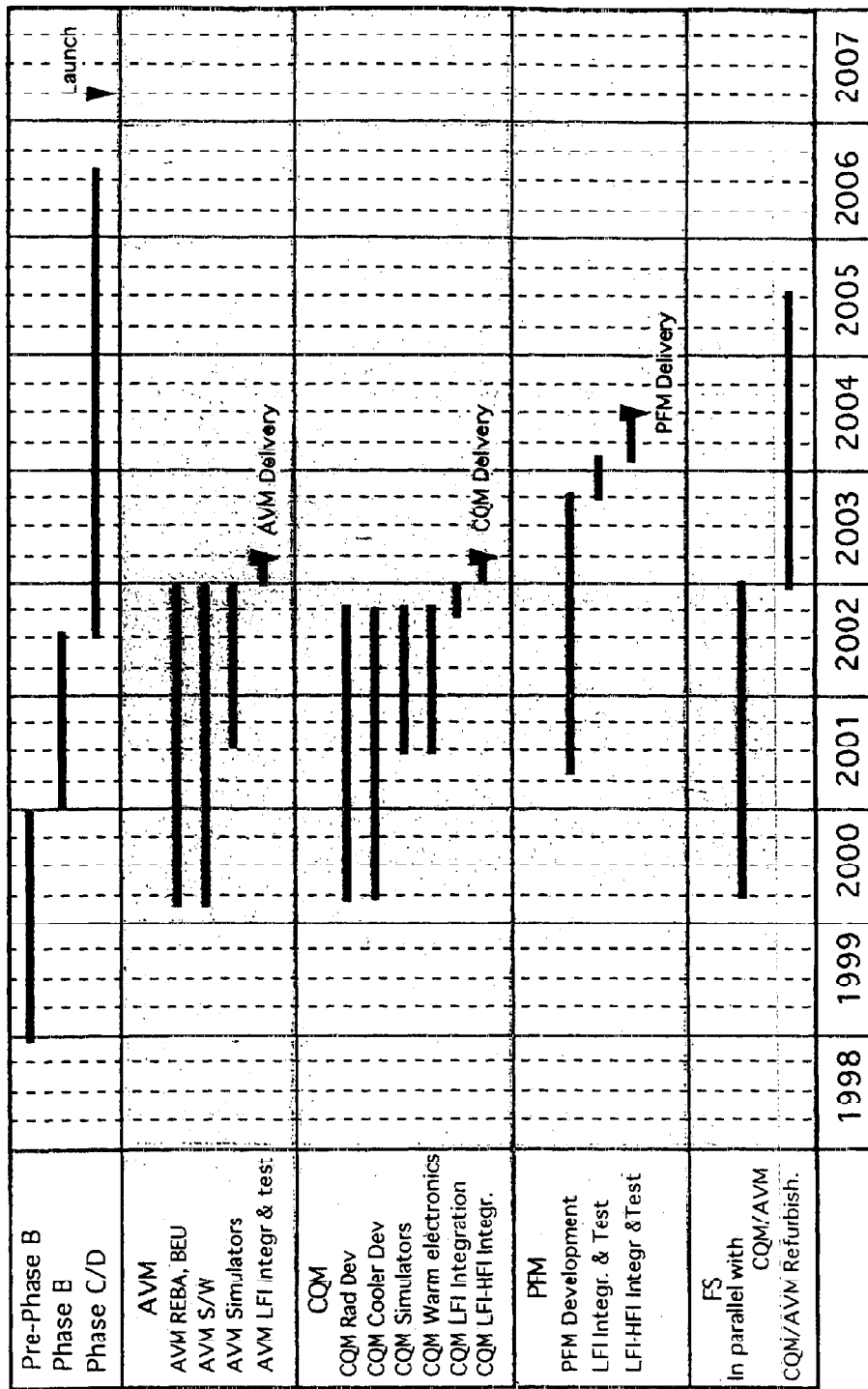


## 4-Stage CPW 80-115 GHz Amplifier

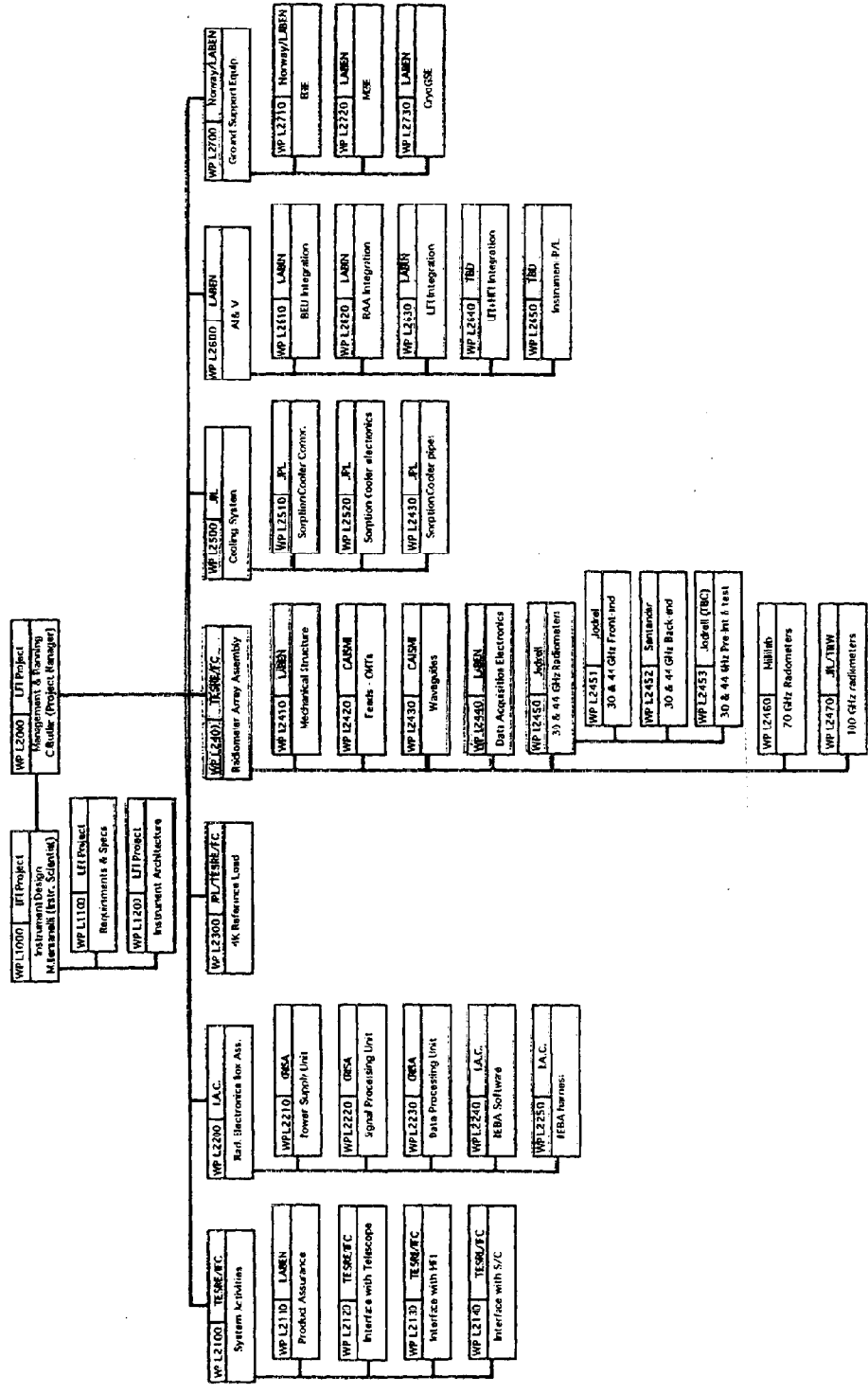
- Design by S. Weinreb
- 80-115 GHz >17 dB gain
- NF ~ 3-4 dB at room temp
- Record low noise at cryo temps:
  - < 45 K from 85-105 GHz
  - < 40 K from 96-104 GHz
  - 30 K noise at 100 GHz
- Yield: 105 chips per wafer
- Ultra-low power operation
  - 20 dB gain at 1.4 mW
  - 15 dB gain at 0.54 mW
- Excellent Gain and Phase match



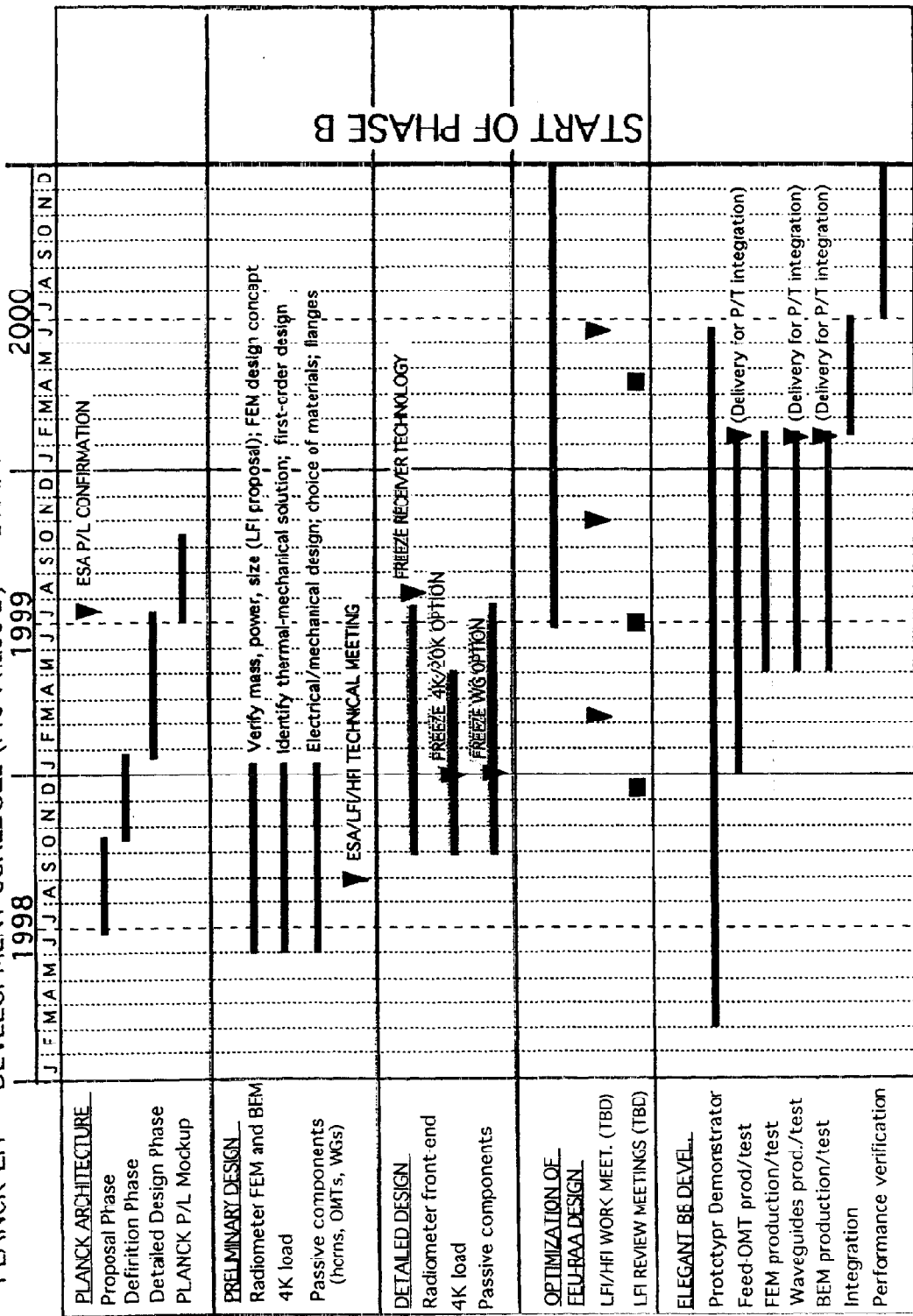
PLANCK-LFI --- DEVELOPMENT SCHEDULE (Phase B & C/D) --- DRAFT



# LFI INSTRUMENT DEVELOPMENT - High level work breakdown structure

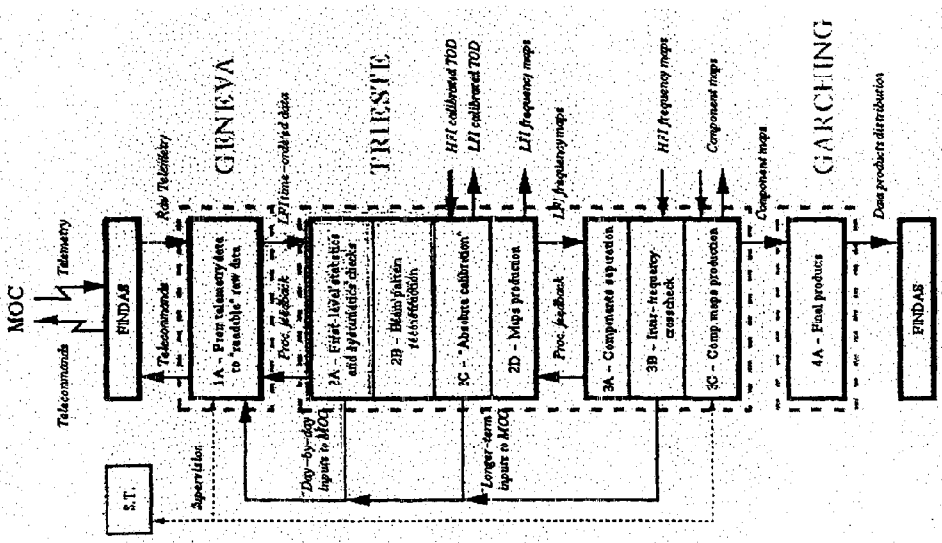


PLANCK-LFI --- DEVELOPMENT SCHEDULE (Pre-Phase B) --- DRAFT



# Planck / LFI

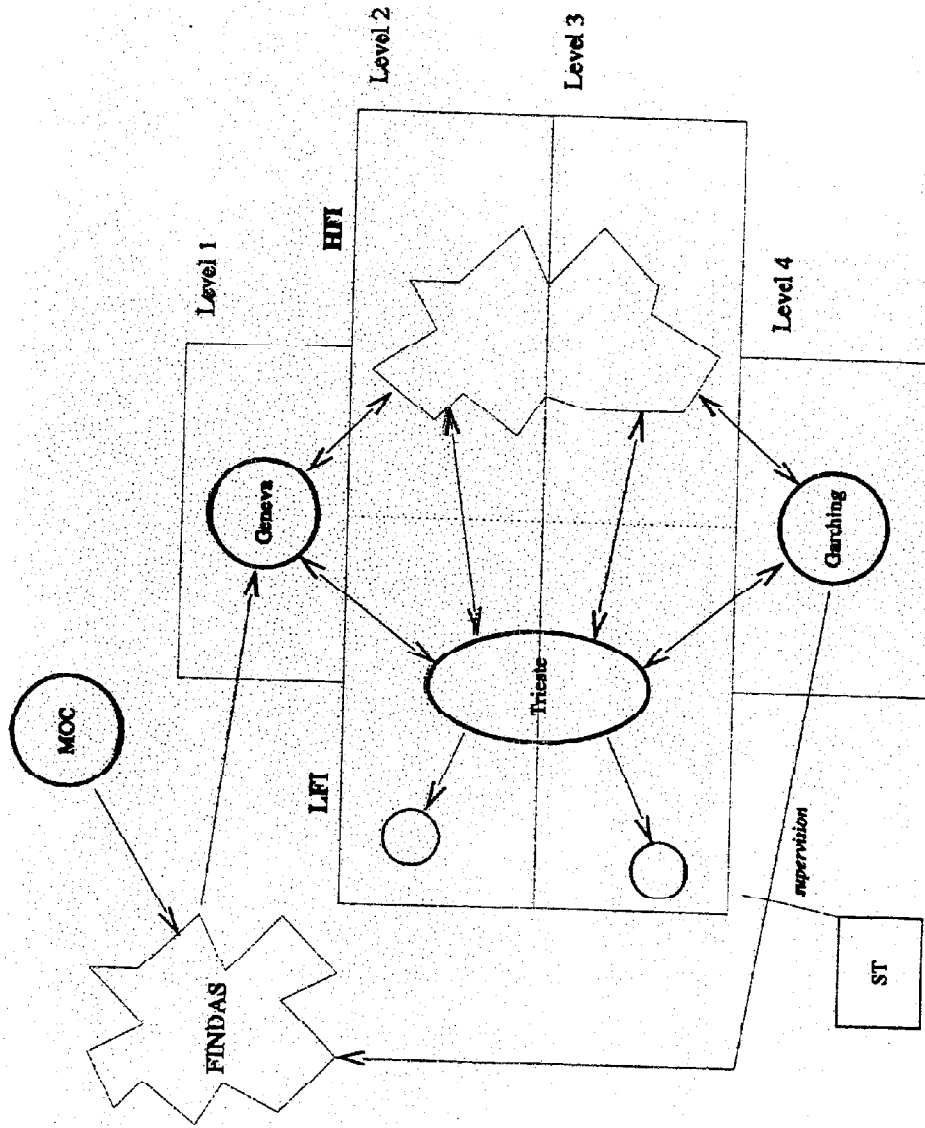
ESR



DENMARK  
GERMANY  
ITALY  
ESA-ESA  
SWITZERLAND  
USA(?)

# Planck / LFI

ESRS

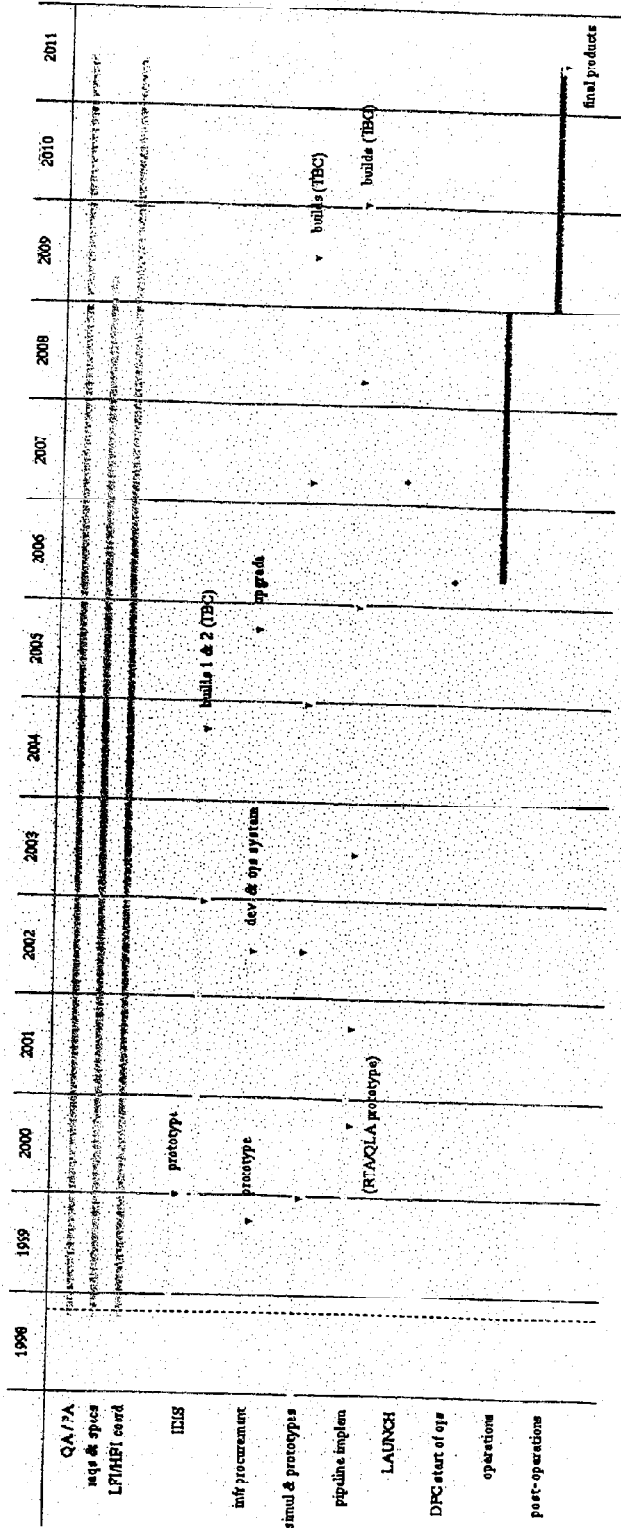






# Planck / LFI

ESRS

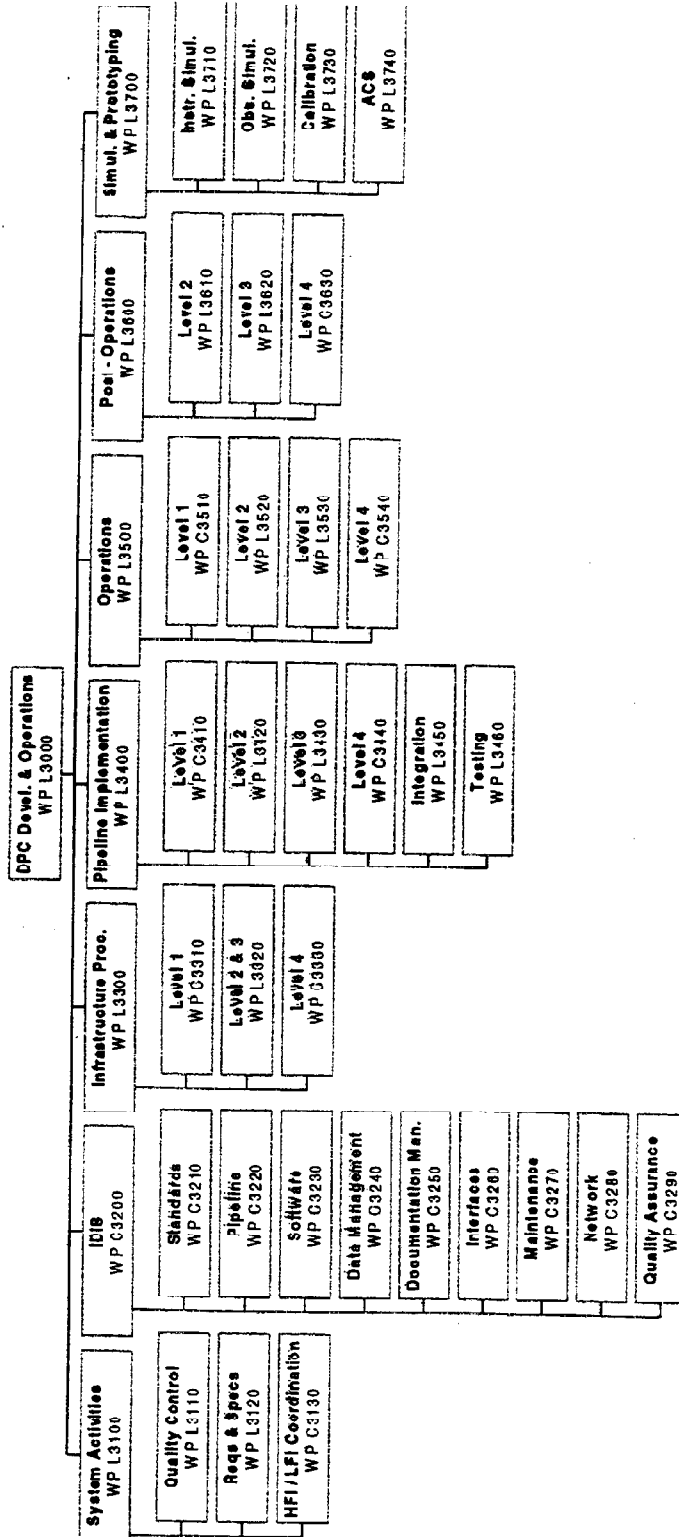


Continuous  
 Development  
 Operations  
 Post-operations

# Planck / LFI

*re*

## LFI DPC DEVELOPMENT - DRAFT

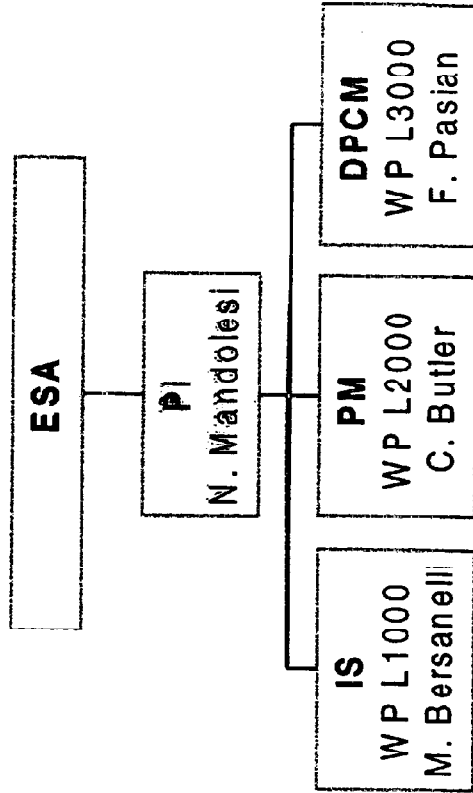


**AREAS WHICH REQUIRE ATTENTION**

- Sorption Cooler
- 4 K load
- Waveguides
- Management
- Science Implementation Plan

Planck / LFI

ESRE



# Planck / LFI

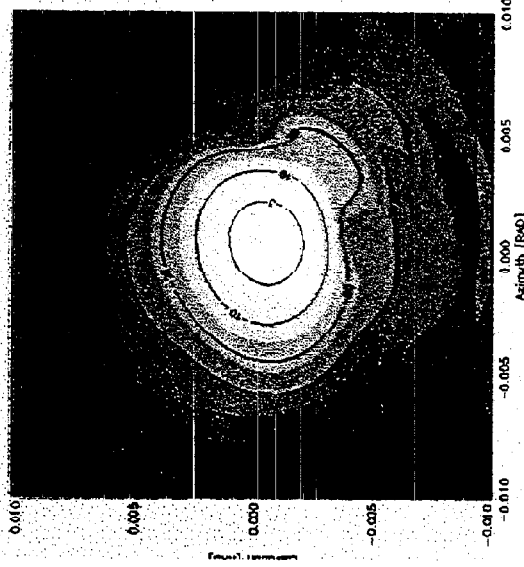
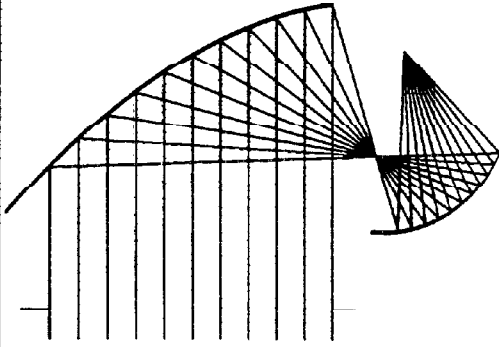
re

## 1.492 Gregorian - "carrier" baseline

1:01:53

PLANCK 1.5 meter BASELINE TELESCOPE Scale: 0.06 ORA 19-Oct-98

116.67 MHz



# Planck / LFI

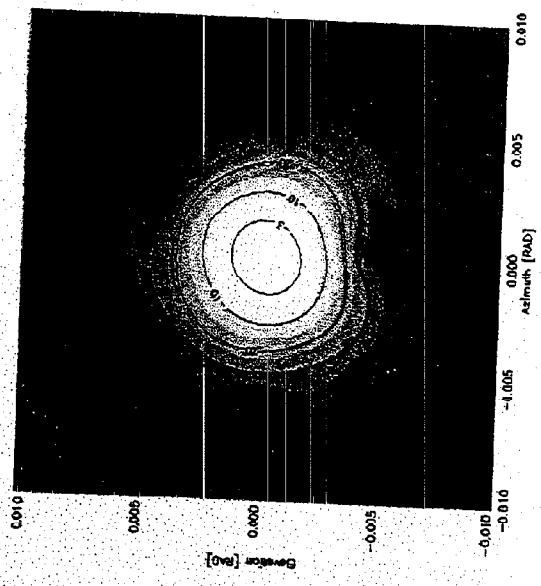
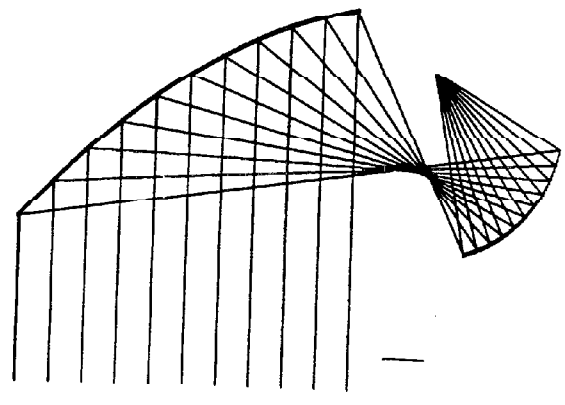
RES

## 1.492 Aplanatic - improved design

156113

Scale: 0.06 0RA 19-Oct-98

416.67 NM



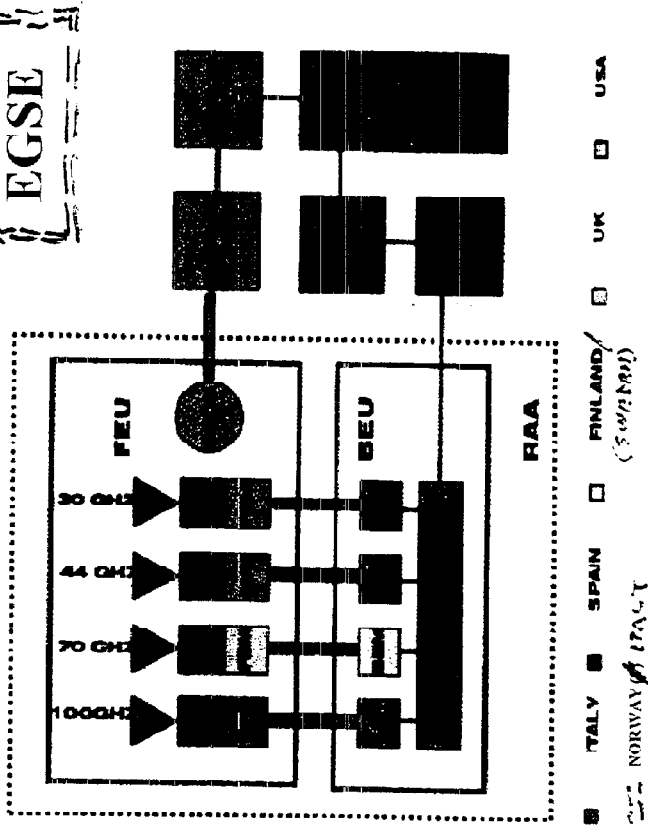
83

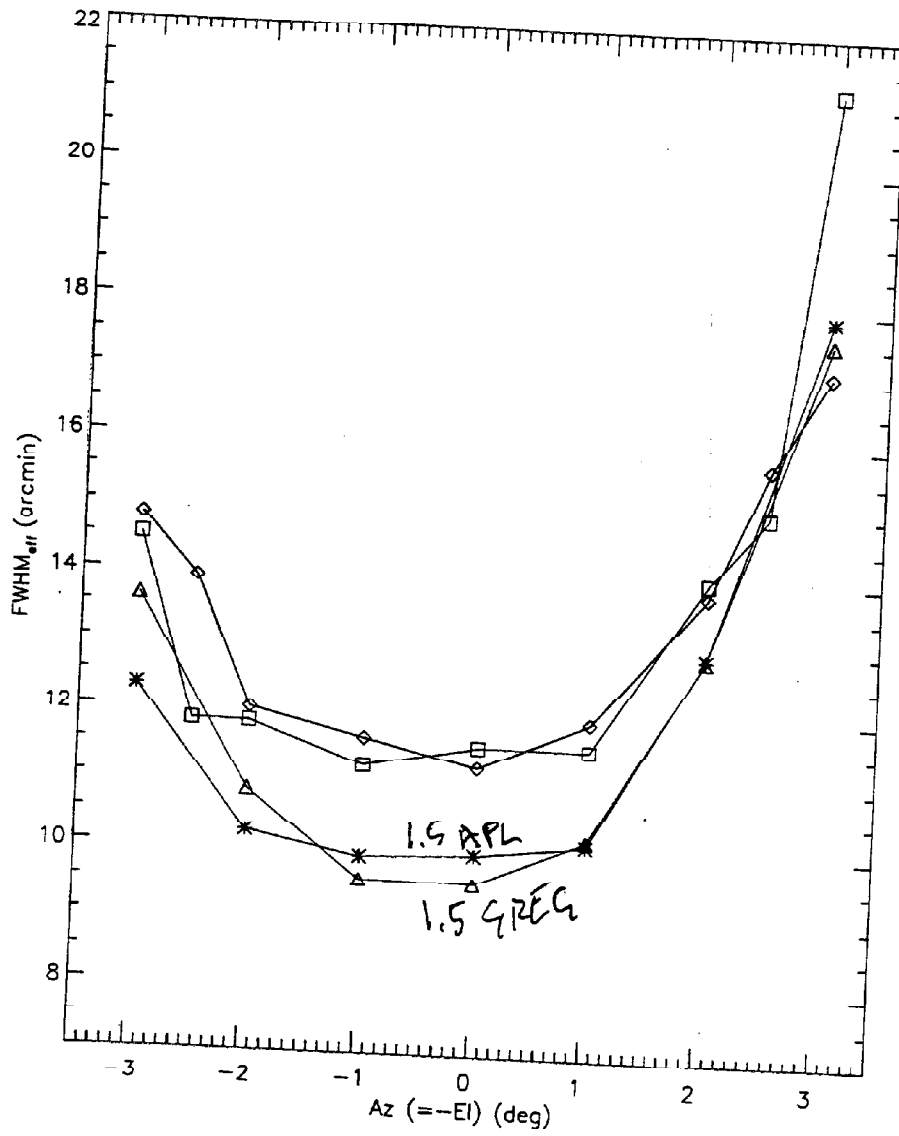
# Planck / LFI

*EGSE*

- BEM Back End Module
- BEU Back End Unit
- DAE Data Acquisition Electronic
- DPU Data Processing Unit
- FEM Front End Module
- FEU Front End Unit
- OMT Orthomode Transducer
- PSU Power Supply Unit
- RAA Radiometer Array Assembly
- SCC Sorption Cooler Compressor
- SCCE Sorption Cooler Electronic
- SCCU Sorption Cooler Cooling Unit

## LFI HARDWARE







HIFI STATUS REPORT 21-10-1998:

INSTRUMENT DESIGN

PROPOSAL=BASELIN

FPU

- MAIN OPTICS: OPTICAL DESIGN CONTINUED:
  - \*COMPACT \*LESS MASS \*FLEXIBLE FOR RE-IMAGE
- MIXER ASSEMBLIES: DESIGN of DIPLEXERS (IF <10 GHz)
- MIXER DEVELOPMENT CONTINUED:
  - \*NbTiN MATERIAL \*Al HEB FABRICATION
- CRYO PRE-AMP: 8-12 GHz EXCELLENT RESULTS
- THERMAL MODEL STARTED
- DESIGN OF FCU STARTED

LOU:

- INTERIM COORDINATION by SRON
- DESIGN of UNITS TO BE INTEGRATED
- MULTIPLIER DEVELOPOMENT STARTED (NOT ALL)
- MECHANICAL DESIGN OF LOU STARTED

BACK-END:

- REDESIGN AND DISTRIBUTION OF TASKS:
  - \*SPLIT OF RESPONSIBILITIES FOR WARM IF, HRS, WBS
- DESIGN BACK-END CONTROL STARTED

ICU:

- DEFINITION OF DETAILED REQUIREMENTS STARTED

**HIFI ORGANISATIONAL MATTERS:**

**SCHEDULE:**

- **PROPOSAL HIFI FOR COMPATIBILITY WITH FUNDING PROFILE**

**DEVELOPMENT PLANS:**

- **TECHNICAL AND PERFORMANCE DEVELOPMENT PLANS**
- **PERFORMANCE DEVELOPMENT STARTED; THE PLAN IS UNDER CONSTRUCTION**
- **TECHNICAL DEVELOPMENT SCHEDULE UNDER CONSTRUCTION; NEEDS SCHEDULE CONFIRMATION**

**MANAGEMENT:**

- **EUROPEAN TEAMS UNDER CONSTRUCTION**
- **US TEAM PUT TOGETHER**

**RESOLVING "OVERLAP" ISSUES:**

- **AREAS OF CORRELATOR AND AOS**
- **APPROACH: SEPERATION TECHNICAL/FUNDING ISSUES**

**OPEN ISSUES:**

- **PARTICIPATION of CANADA**
- **NEEDS.DIRECT CONTACTS WITH CSA**

**FUNDING STATUS:**

- ADJUSTMENTS FOR FRANCE(MAJOR), GERMANY (MINOR), SWEDEN (SMALL)

**CONSORTIUM MEETING SCHEDULE:**

- 16, 17, 18 NOVEMBER
- 2nd HALF JANUARY 1999, HIFI CONCEPT REVIEW AS PREPARATION FOR FINAL ENDORSEMENTS

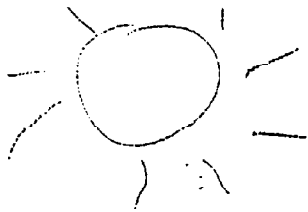
**CONCERN:**

- START UP IS SLOW; "HOW TO ACT AS A PROJECT, WHEN IT IS NOT YET A PROJECT"

# HIFI

Date: 20 Sept. 1998

		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	
First Project Timeline		▼ pre-selection	▼ Confirmation				▼ AVM	▼ QM	▼ FM		▲ Launch	
DM	Development Integration Test	[Timeline bar spanning 1998 to 2001]										
AM	Design & Production Integration & Test Delivery	[Timeline bar spanning 2000 to 2003]										
QM	Design & Production Integration Test Completion	[Timeline bar spanning 2001 to 2004]										
FM	Design & Production Integration Test Delivery	[Timeline bar spanning 2002 to 2005]										
Spares	Refurbishment Test Delivery	[Timeline bar spanning 2003 to 2006]										
ICC	Software Development ICC Testing Calibration & PV plans Calibration	[Timeline bar spanning 1999 to 2007]										



2

FIRST	HIFI	Doc. number: PT-HIFI-02125 Issue: Proposal Date: 16 February, 1998 Page: 20
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5.3 LOCATION AND ALIGNMENT

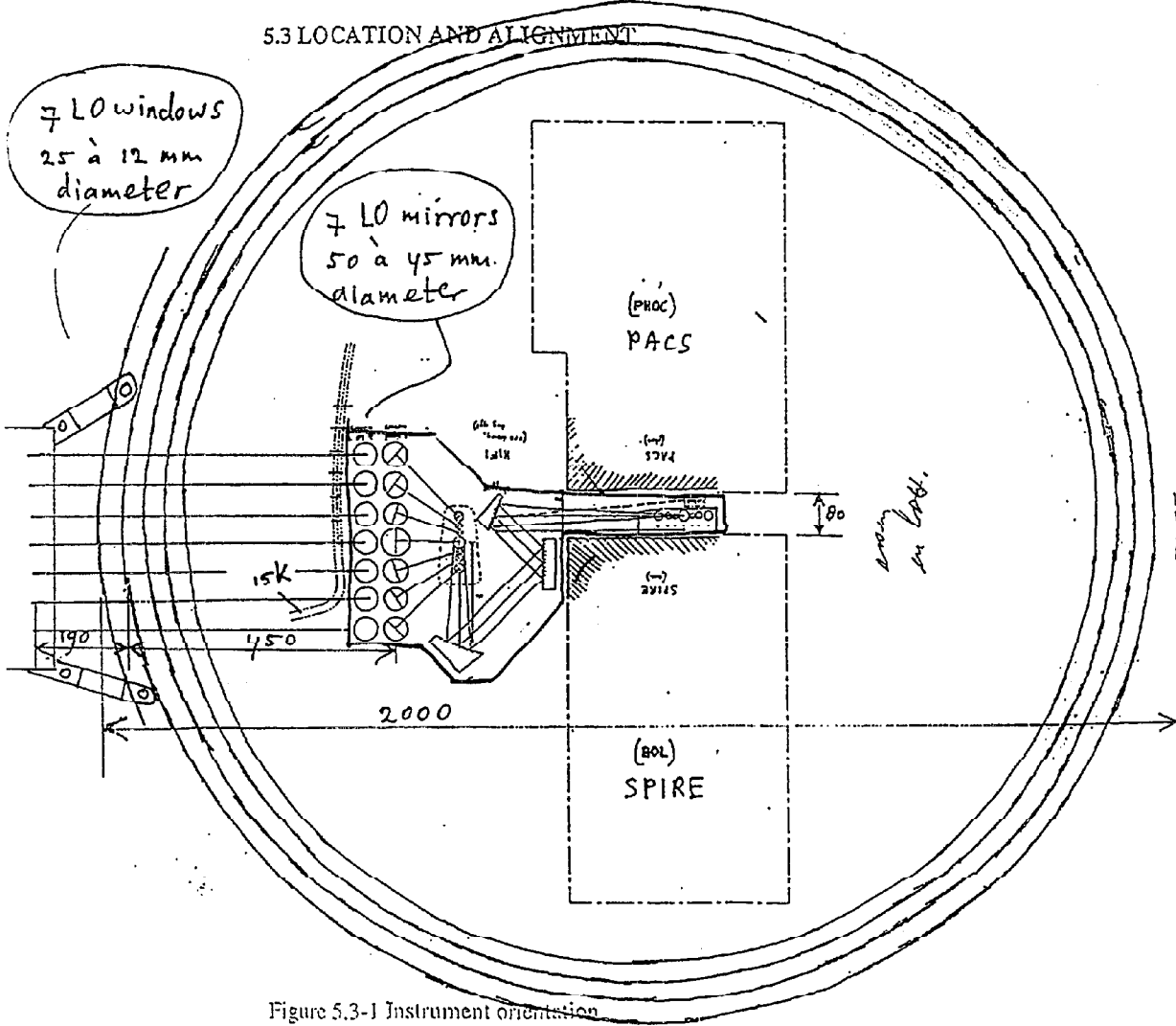
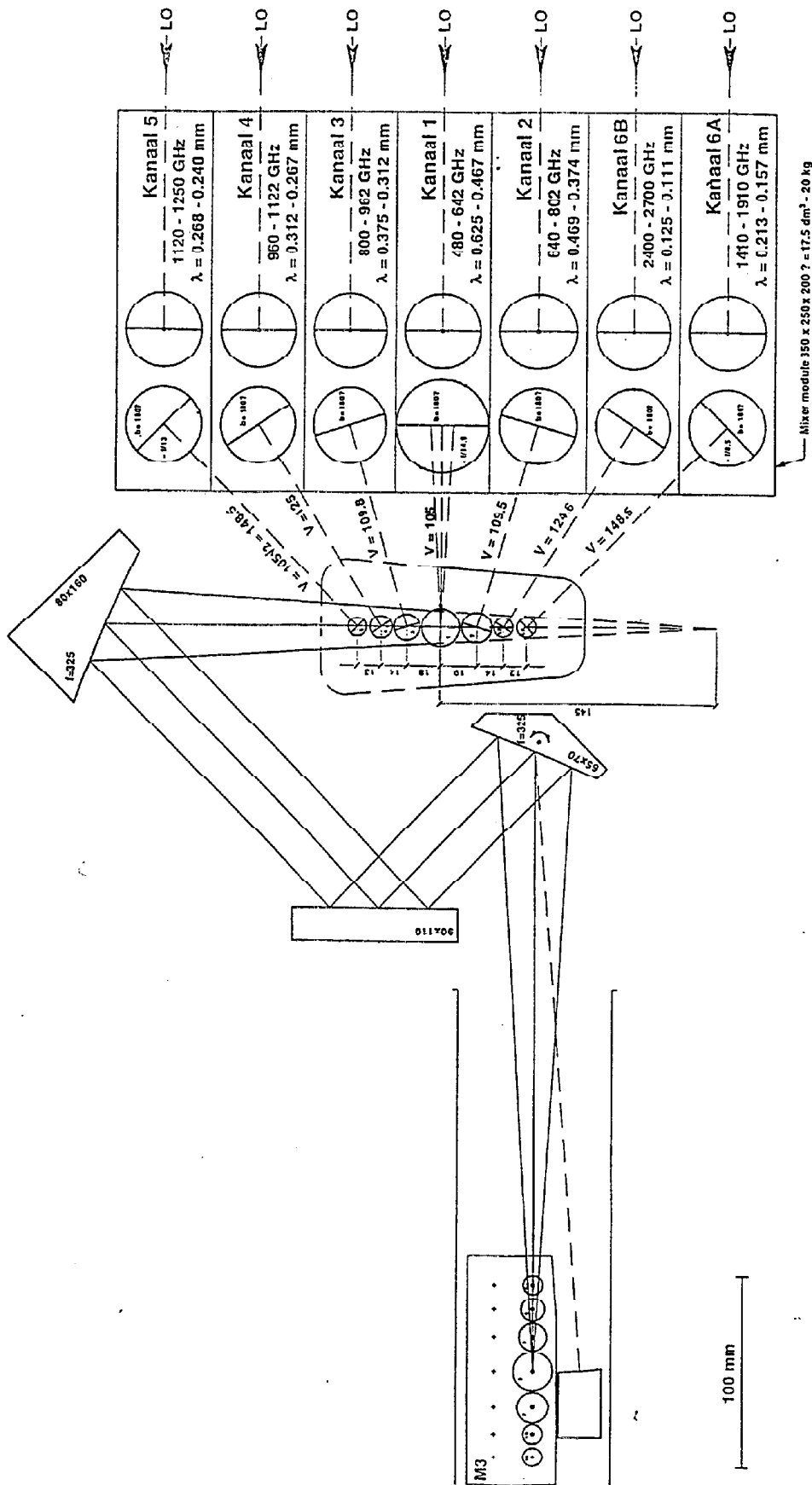


Figure 5.3-1 Instrument orientation

Figures 5.3-1 and 5.3-2 show the concept of the location of the three Focal Plane Units (FPUs) on the Optical Bench (OB) inside the cryostat and the concept of the location of the Local Oscillator Unit (LOU) external to the cryostat.

scale ~ 1 : 11.2

90

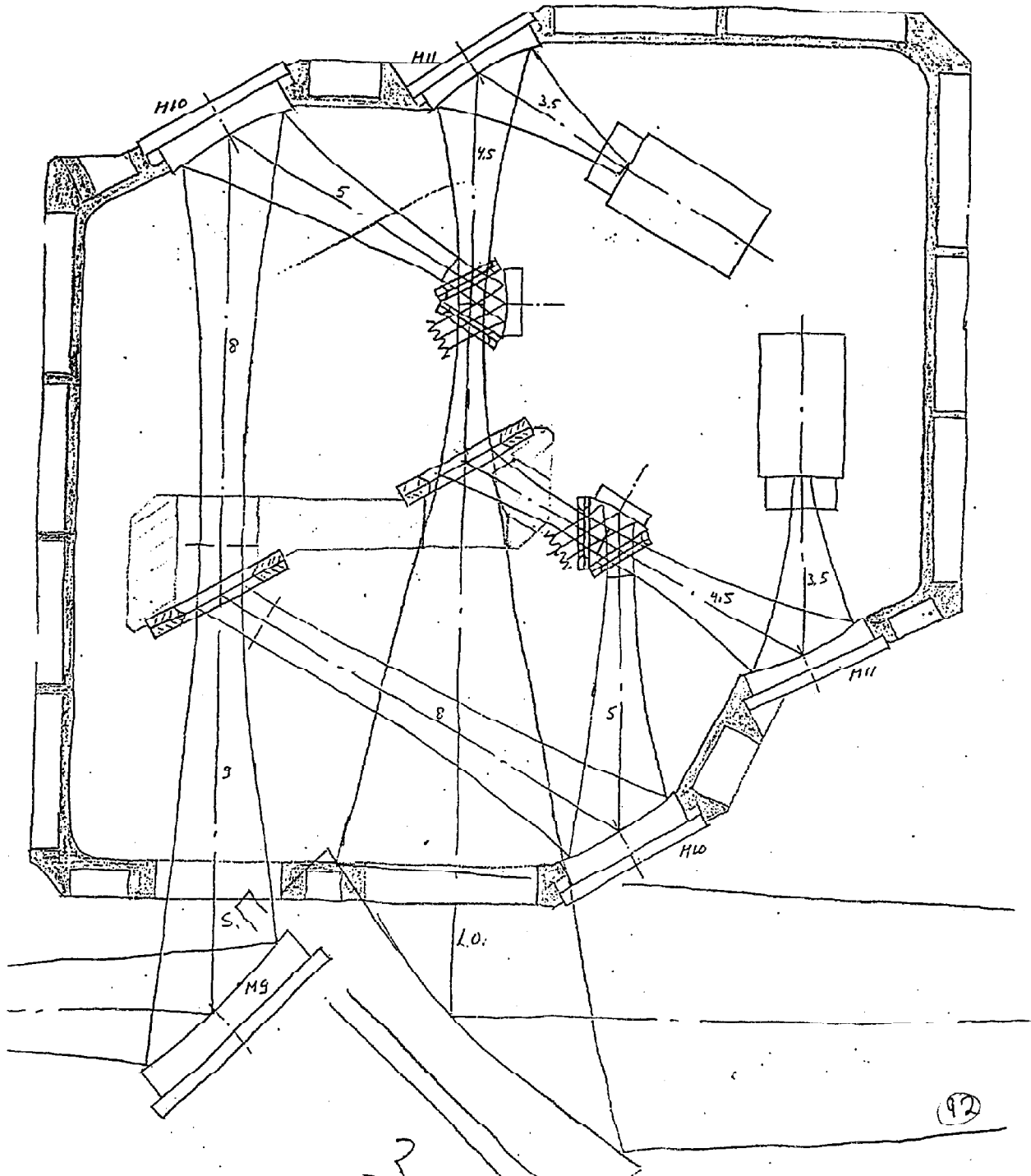


M3: 20mm ± 20 by.  
 30x110mm

(10)

Bijlage I

# Design of Mixer Assembly.



## **SPIRE FIRST/PLANCK PAYLOAD MEETING 21 Oct. 1998**

- **INSTRUMENT DESIGN**
- **DETECTOR ARRAY PROGRAMME**
- **DATA PROCESSING DEFINITION**
- **MANAGEMENT AND RESPONSIBILITIES**
- **DEFINITION OF THE DEVELOPMENT PLAN**
- **FUNDING STATUS AND IMPACT ON THE PROJECT**

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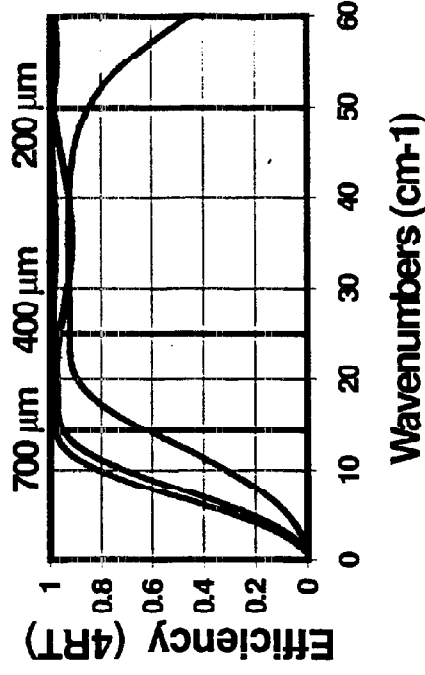


# **SPIRE INSTRUMENT DESIGN: SPECTROMETER**

- FTS options being studied to increase optical efficiency
- Productive working meeting with Mission Scientist Martin Harwit on spectrometer requirements and design options.
- Two options still being considered:
  - A. Modification of baseline (linear mechanism rather than swinging arm)
  - B. Mach-Zender configuration with novel broad-band beam dividers
- Bench-top FTS is being set up to test concept experimentally
- Decision planned for January 1999



**Broadband Beamdivider Options**

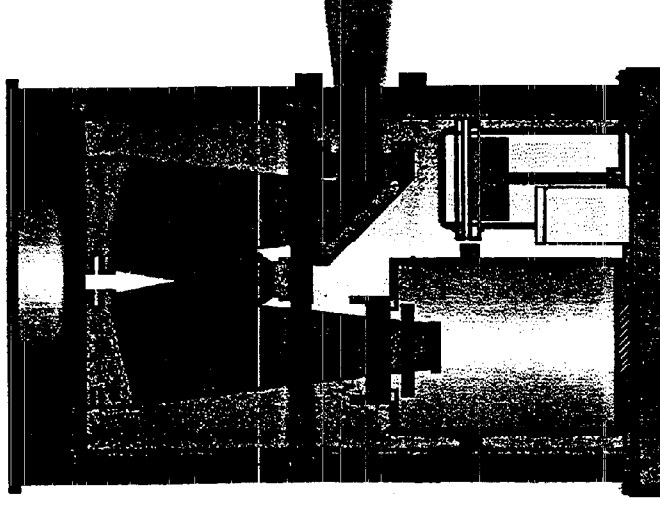


014

# **SPIRE DETECTOR ARRAY PROGRAMME**

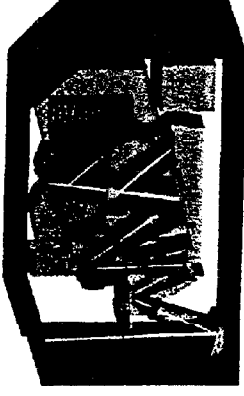
- **Detector Array Group meeting at NASA GSFC in September**
- **Progress positive on all options**
- **Array test facility being manufactured**
- **Systems designs for all options being drawn up for end 1998**
- **Regular meetings and tests throughout 1999**
- **Detector array selection in Jan. 2000**
- **Selection will be based on scientific performance and mature system design**

**BACUS Bolometer  
Array Test Facility**

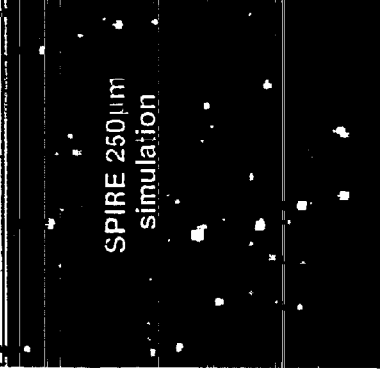
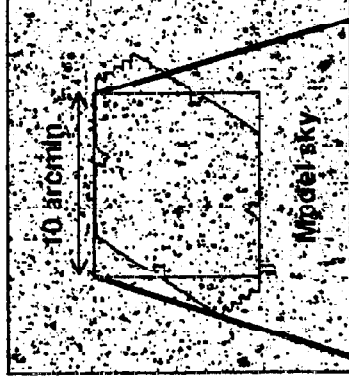


95

# **SPIRE INSTRUMENT DESIGN: PHOTOMETER**



- **Optical design study looking at optimising image quality and throughput**
- **Stray light model developed and will be extended to include telescope, cryostat, and detailed representation of SPIRE optics and physical layout**
- **Computer model simulation of SPIRE deep survey observations being developed to evaluate and optimise scientific performance and inform detector array choice**
- **Possible need for cold shutter for ground testing is being studied**



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## **SPIRE DATA PROCESSING DEFINITION**

- **FTS requirements (most severe) being studied initially**
- **Simulations, including use of processor with representative processing power, are underway. Preliminary results show that required processing within specification of SPIRE SPU**
- **Memory requirements for SPU are being defined.**
- **Improvement of factor of ~ 5 in data rate would allow all individual interferograms to be sent to the ground**



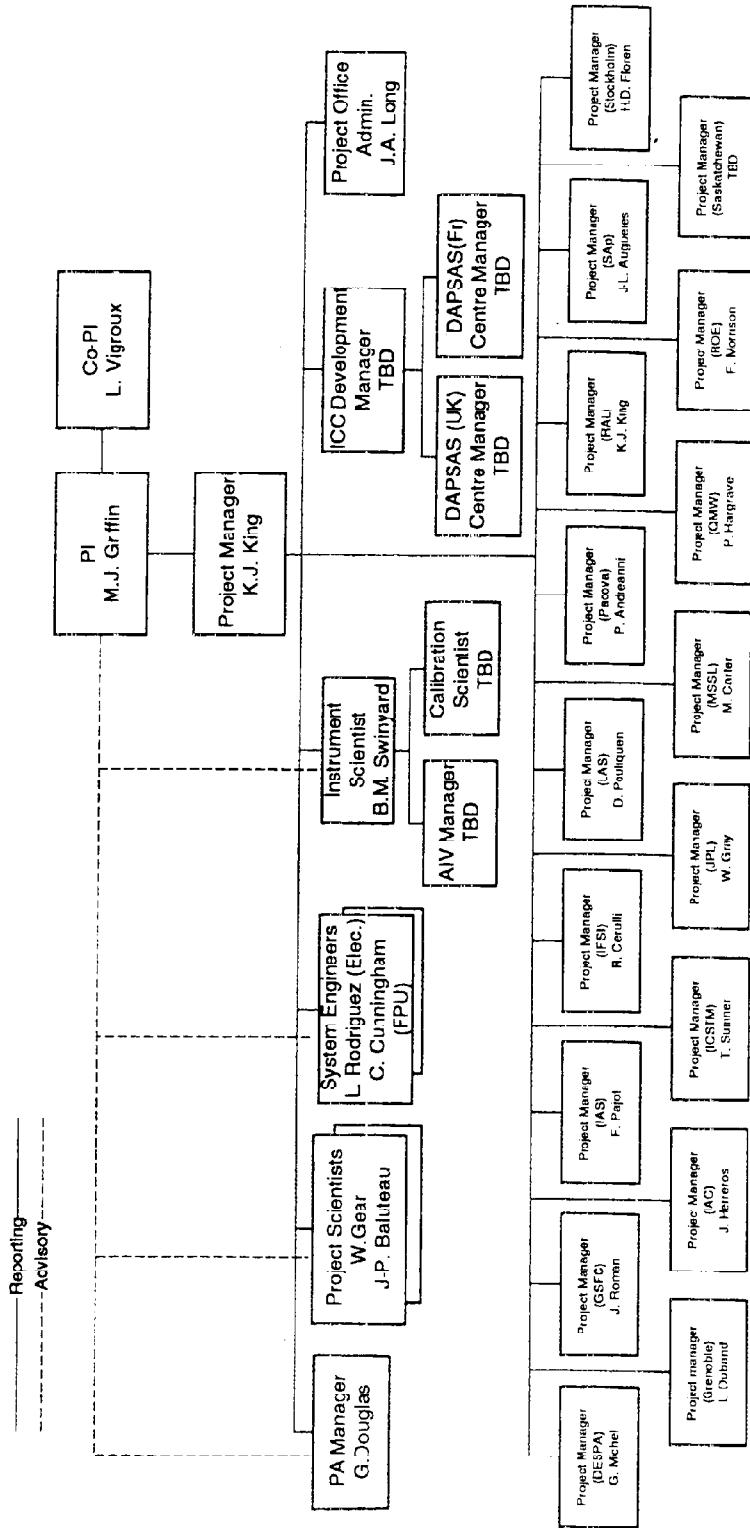
## **SPIRE MANAGEMENT AND RESPONSIBILITIES**

- **No major changes to management structure or division of responsibilities**
- **Project Manager will not be ICC Development Manager**
- **1<sup>st</sup> draft of *SPIRE Management Plan* provides more detail and has been circulated to ESA for comment**
- **SPIRE Systems Team is operating and includes all principal points of contact with ESA**

(83)

# SPIRE

# Organnogramme



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# **SPIRE** **DEVELOPMENT PLAN**

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The IID-A requires us to provide:

- Management structure, project control processes, regular reviews and reports
  - Addressed in the *SPIRE Management Plan* (provided to ESA, in draft form)
- Definition of deliverables
  - Addressed in the *SPIRE Product Tree* and *SPIRE Documentation Tree* (provided to ESA, in draft form)
- Programme schedule
  - Addressed in the *SPIRE Work Breakdown Structure* (provided to ESA, in draft form)
- Instrument Implementation Plan (in preparation, for end of year)
- Approved documents are planned to be issued early in 1999, provided the funding situation is clarified

(100)

# SPIRE

## Instrument Development Schedule

1998			1999			2000			2001			2002			2003			2004			2005			2006		
Q1	Q2	Q3	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
System design																										
PDR																										
Detail Design																										
Det. Array Section																										
CDR																										
AVM Manufacture																										
AVM AV																										
AVM Delivery																										
CCM Manufacture																										
CCM AV																										
CCM Readiness Review																										
CCM Delivery																										
PFM Manufacture																										
PFM AV/Cal																										
PFM Readiness Review																										
PFM Delivery																										
FS Build/Returbish																										
FS AV																										
FS Delivery																										
Launch																										



# **SPIRE FUNDING STATUS AND IMPACT ON PROJECT**

**UK: Budget envelope likely to be increased (PPARC to report)**

**Structure and Systems Engineering workpackages have not yet been formally funded in the UK**

**Structure: Low-level funding in 98/99 pending decision on support of this workpackage in the UK**

**Progress correspondingly slowed, and not as well advanced as we would like**

**Outline design will be available end 1999 to verify achievability of mass, thermal, vibration, and eigenfrequency requirements**

**Systems Engineering: adequately covered for this year**

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## **SPIRE FUNDING STATUS AND IMPACT ON PROJECT**

**France:** No shortfall apart from cold vibration facility  
CNES funding profile in early years makes it difficult to meet the current PFM delivery schedule

**Canada:** EGSE workpackage is subject of Canadian proposal (together with contribution to SPIRE ICC)

Canadian interest in providing cold shutter also

CSA will shortly issue contracts for brief industrial design studies of various options for FIRST and Planck

Funding decision not expected until early 1999

**Italy, Spain, Sweden, USA:** No adverse changes from July meeting

## PACS Status - 21 October 1998

- Meetings
- PACS Working Groups
- Hardware Developments
- Problem Areas

## Meetings

- FIRST/Planck Commonality Meeting #2, ESTEC, July 8
- PACS Consortium Meeting #4, MPE, July 9/10
- PACS Instrument Meeting #1 with Project, ESTEC, September 2
- FIRST Telescope Meeting, ESTEC, Sept. 30

## PACS Consortium Meeting #4

- Funding situation, schedule, spending curve, cost reduction strategy, model philosophy
- IID-B Update
- PACS ICC planning
  - definition of software systems (RTA/QLA, Interactive Analysis, Calibration Analysis, Trend Analysis)
  - personnel planning
  - participation in Commonality Working Group meetings

## PACS Consortium Meeting #4 (cont.)

- Project control
  - update of planning from all consortium partners
  - software definition
- Reporting
  - scheme defined
  - monthly reports, due date 10<sup>th</sup>
- Working Groups (monitor progress in critical areas)
  - data compression/reduction (on-board)
  - cryogenic readout electronics
  - straylight

## PACS Working Groups

- Cryogenic Readout Electronics WG #2, MPE, July 9
- Data reduction and compression WG #1, MPE, August 17
  - Doc: PACS Data Compression: Assessment of Feasibility, 31-Aug-1998
- Cryogenic Readout Electronics WG #3, MPIA, September 11
  - Doc: Specification for PACS CRE, PACS-MP-PL-001, 12-Oct-1998

## Hardware

- MPE
  - ITT for cold FPU: 3 companies, due Oct. 30
  - prototype of grating drive ordered (FUB-TTL)
  - start of detector redesign (ANTEC)
  - performance tests on CREs continued
  - optimisation/simplification of instruments by redistribution of space on optical bench under investigation (result of Telescope Meeting)
  
- MPIA
  - chopper conceptual design
  - 2 offers for development/manufacturing of chopper received



## Hardware (cont.)

- KUL
  - delivery of new CREs from IMEC, readiness for tests scheduled for Nov. 9
- CSL
  - specification for
    - \* grating drive
    - \* mechanism control
    - \* read-out control
  - in progress

## Hardware (cont.)

- IFSI
  - work on S/C interfaces started
  - on-board S/W: general scheme and simulation programme for T/C management under development
  - meeting on “Warm Electronics Interfaces” planned for Nov. 6 in Rome (MPE, IFSI, IAC, CSL, TUVIE)

## Problem Areas

- Funding
  - Germany
    - \* PACS still over DLR budget
    - \* waiting for FPU offers and for answer from ESTEC concerning TRP money for detector development (ANTEC)
  - Belgium
    - \* start of funding does not comply with PACS project plan; one year delay
    - \* solutions under investigation
  - Italy
    - \* decision about FIRST/PACS funding only end of October

## Problem Areas (cont.)

- Italy
  - \* decision about FIRST/PACS funding only end of October
- Cryovibration
  - relaxed to 10...20 K from 4 K by Project
  - no decision from CNES yet concerning support of activities at IGRAP

Schedule of PACS Instrument Test / Characterisation  
 Detector Testing at MPE / MPIA

event	1998	1999	2000	2001	2002	2003	2004	2005	2006
AVM ILT									
CQM ILT / CAL									
PFM ILT / CAL									
FS ILT / CAL									
CQM cryovibration (IGRAP)									
PFM cryovibration (IGRAP)									
CQM spectr. cal. (LENS)									
PFM spectr. cal. (LENS)									
FS spectr. cal. (LENS)									
Int. System Tests (ESTEC)									
EM array tests (cryovibr.)									
EM array spec. cal. (LENS)									
CQM array test									
PFM array test									
FS array upgrade / test									

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PACS Schedule Instrument Deliveries

event	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AVM delivery						▽				
CQM delivery						▽				
PFM delivery							▽			
FS & spare subassy's								▽		
FIRST launch										▽

(115)

PACS Schedule AVM and EM array

event	1998	1999	2000	2001	2002	2003	2004	2005
AVM delivery								
AVM ILT								
AVM integration								
PAX4A design								
PAX4A manuf.+ delivery								
S/C interface delivery								
PAX4B design								
PAX4B manuf.+ delivery								
PAX4B data compr. S/W								
PAX2 delivery								
PAX3 delivery								
PAX5 delivery								
EGSE delivery								
ICC package delivery								
FPU simulator delivery								
det. array simul. (or H/W)								
grating drive simulator								
EM detector array manuf.								
EM array test (spectr/prot)								

PACS Schedule CQM

event	1998	1999	2000	2001	2002	2003	2004	2005	2006
CQM delivery									
ILT, calibration									
FPU cryovibration									
FPU (PAX1) AIV									
FPU warm verif. + delivery									
FPU assembly/integration									
supply FPU mechanisms									
supply FPU grating/drive									
supply FPU det. arrays									
supply FPU struct. + optics									
CQM det. array assembly									
ANTEC det. mod man+test									
MPIA det. module test									
MPE det. module test									
ANTEC det. design+verif.									
other PAX comp. d/v/mit/d									
PAX4A (DPU) man+deliv.									
PAX4B manuf. + delivery									
data compression SW									
PAX3 manuf. + delivery									
PAX2 manuf. + delivery									
PAX5 manuf. + delivery									

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PACS Schedule PFM

event	1998	1999	2000	2001	2002	2003	2004	2005	2006
PFM delivery									
ILT, calibration									
FPU cryovibration									
FPU (PAX1) AIV									
FPU warm verif. + deliv.									
FPU assembly/integration									
supply FPU mechanisms									
supply FPU grating/drive									
supply FPU det. arrays									
supply FPU struct.+ optics									
full det. array assembly									
ANTEC det. mod man+test									
MPIA det. module test									
MPE det. module test									
ANTEC det. design+verif.									
other PAX comp. d/v/m/t/d									
PAX4A (DPU) manuf.+deliv.									
PAX4B manuf. + delivery									
data compression SW									
PAX3 manuf. + delivery									
PAX2 manuf. + delivery									
PAX5 manuf. + delivery									

PACS Schedule FS

event	1998	1999	2000	2001	2002	2003	2004	2005	2005
FS delivery									
ILT calibration									
FPU refurbishment:									
supply FS det. arrays									
CRE/array refurbishment									
MPIA det. module test									
MPE det. module test									
CQM redelivery from ESA									
ANTEC cet mod man + test									

(119)