

The FIRST mission: Science objectives and this meeting

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Overview

- **Introducing the FIRST mission as a user facility**
 - implementation by the PM
 - science instruments by the PIs
- **Summarising the Science Management Plan**
- **Purpose of this meeting**
 - introduce the mission and its science capabilities
 - have a dialog with the future user community

FIRST mission

- **FIRST is an ESA cornerstone observatory mission**
 - instruments 'nationally' funded, int'l collaborators
- **FIRST is the first space facility to completely cover this part of the far infrared and submillimetre (60 - 670 μm) range**
 - large (3.5 m), low emissivity (~5%), passively cooled (70-90 K) telescope
 - cryogenically cooled focal plane science instruments, >3 years lifetime
 - total absence of (residual) atmospheric absorption - full spectral access - and emission - low and stable background
- **FIRST has unique and complementary characteristics**
 - much larger aperture than missions with cryogenically cooled telescopes (IRAS, ISO, SIRTf, Astro-F,...)
 - larger colder aperture, better 'site', and more observing time than balloon- and airborne instruments (~1000 SOFIA flights per year)
 - larger field of view than interferometers

FIRST major science objectives

- **Study the formation and evolution of galaxies in the early universe**
 - how and when did galaxies form?
 - is there an unknown population of high-z IR galaxies?
 - star formation rates? bolometric luminosities? 'fraction AGN'?
 - 'connect' near-IR and submillimetre galaxies
- **Study the formation of stars and physics of the interstellar medium**
 - how do stars form out of the interstellar medium?
 - circulation/enrichment of the interstellar medium - astrochemistry
 - detailed studies of nearby (resolvable) galaxies - templates
- **Study cometary, planetary, and satellite atmospheres**
 - history of the solar system
 - pristine material in comets
 - water important line

FIRST science instruments

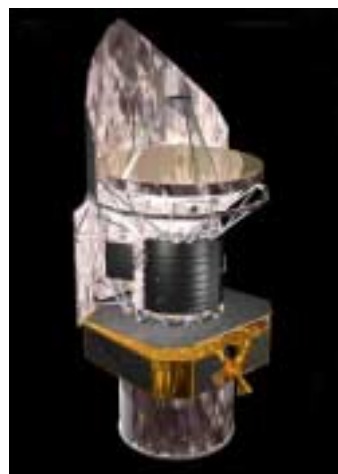
- **PACS - Photodetector Array Camera and Spectrometer**
 - PI: Albrecht Poglitsch, MPE, Garching, Germany
 - imaging photometry and spectroscopy over 57-210 μm
 - 2 bolometer arrays for photometry, 2 stressed Ge:Ga arrays for spectroscopy

- **SPIRE - Spectral and Photometric Imaging Receiver**
 - PI: Matt Griffin, QMW, London, United Kingdom
 - imaging photometry and spectroscopy over 200-670 μm
 - 3 bolometer arrays for photometry, 2 bolometer arrays for spectroscopy

- **HIFI - Heterodyne Instrument for FIRST**
 - PI: Thijs de Graauw, SRON, Groningen, The Netherlands
 - very high resolution spectroscopy over 480-1250 and 1410-1910 GHz
 - SIS and HEB mixers, auto-correlator and AOS spectrometers

FIRST 'carrier' spacecraft

- telescope diameter 3.5 m
- telescope WFE 10 μm (6 μm)
- telescope temp 70-90 K
- abs/rel pointing (68%) < 3.7" (1.5")/ 0.3"
- science instruments 3
- science data rate 100 kbps
- operational lifetime >3 years
- height 9 m
- width 4.5 m
- launch mass 3300 kg
- power 1 kW
- orbit Lissajous around L2
- launch vehicle (with Planck) Ariane 5



FIRST observatory capabilities

- **Photometry**
 - PACS - simultaneous 2 colour fully-sampled ($0.5F\lambda$) imaging with FOV 1.75×3.5 arcmin and $R \sim 2.5$ centred at 75/110 and 170 μm
 - SPIRE - simultaneous 3 colour $2F\lambda$ imaging with FOV 4×8 arcmin and $R \sim 2.5$ centred at 250, 350, and 500 μm
 - for larger fields 'on-the-fly' mapping, mosaicing
 - sensitivity is somewhat wavelength and observing mode dependant, very roughly $1\text{mJy} - 1\sigma - 1$ hour, confusion limit is important
- **Spectroscopy**
 - PACS - 5×5 spatial x 16 spectral pixels, FOV 0.8 arcmin, $R \sim 1000$
 - SPIRE - FTS spectro-photometry/scope, $R \sim 20-100$, FOV 2.6 arcmin
 - HIFI - heterodyne spectroscopy with R up to 10^7 , 2 orthogonal polarisations, 4000 spectral channels per polarisation, single pixel on the sky, mapping by 'on-the fly' or mosaicing observations

FIRST Science Management Plan

- **Top level document - ESA/SPC(97)22 rev.1**
 - approved by the SPC (Science Programme Committee) in August 1997
 - available on the web <http://astro.esa.int/FIRST>
- **Scope is to outline the FIRST mission with special emphasis on**
 - science operations
 - external involvement
 - science (data) management
- **Structure**
 - scope
 - FIRST mission overview
 - science management and operations
 - programme participation
 - observing time and science data products
 - announcement of opportunity (PIs and MSs)

Participation of the scientific community

The scientific community will be invited to participate in the FIRST mission in several ways:

- **by becoming Principal Investigators (PIs)**
 - by providing science instruments and their associated ICCs through an AO
- **by becoming Mission Scientists (MSs)**
 - through an AO
- **by becoming observers**
 - through submission of observing proposals in response to calls for observing proposals
- **by accessing data**
 - available after proprietary period of time has expired
- **by accessing 'final' data products**
 - available after the completion of the post-operational phase

Responsibilities

The ESA Director of Scientific Programmes has the overall top-level responsibility for all aspects of the FIRST mission - 'implementation':

- **the Project Manager (PM)**
 - manages the project until successfully commissioned in orbit
- **the Project Scientist (PS)**
 - responsibility to manage the scientific programme
 - represents the interests of the scientific community at all times, and is ESA's interface to this community
 - liaises with PM and project team, co-ordinates all scientific issues
 - manages the project in routine and later phases
- **the FIRST Science Team (FST)**
 - safeguards the scientific interests, advises the PM on all aspects which affect scientific performance
 - composition: PS (chair), PI teams, MSs, project
- **in addition FOTAC (time allocation) and FGSAG (ground segment)**

Observing time

- **FIRST is an observatory - guaranteed (~1/3) and open (~2/3) time**
 - foreseen need for dedicated technical time
 - roughly 7000 hours per year available
- **Guaranteed time**
 - Principal Investigator team time 3x30%
 - FSC time 7%
 - Mission Scientists 3%
- **Open time**
 - available to world-wide scientific community
 - targets of opportunity
 - 'generic'
 - 'serendipitous'
 - discretionary time (max 4%), including 'serendipitous' ToOs
- **All proposals to be**
 - screened for technical feasibility by FSC
 - graded by FOTAC

Data products and proprietary time

- **All data to be archived and made available to the entire scientific community after expiration of proprietary time**
- **Data products strategy**
 - enable observer to generate products with best available means (software)
 - 'enable' is the responsibility of the FSC
 - 'best available means' is the responsibility of the PIs (ICCs)
 - in post-operational phase populate archive with 'final' products using the 'final' best means
- **Data rights policy**
 - FIRST data will become public when
 - two (2) years has elapsed since the successful completion of the performance validation phase, or when
 - one (1) year has elapsed since the data of the observation, whichever is later
 - one (1) has elapsed since the data of the observation for all 'survey' observations
 - Post the proprietary period all observers have equal access to the data
 - Balance between legitimate rights of different 'classes' of observers

'Key' programmes

FIRST is first space facility covering this wavelength range:

- There is a need both to survey, *and* to do 'follow-up' observations

This is what lead to:

- **The concept of 'key' programmes**
 - 'key' means large (we tried to find a word without preconceived meanings)
 - forcing guaranteed time holders to spend min. 50% of their time on these
 - requires involvement of 'community'
 - separate up-front call for observing proposals open to all
- **The idea of a 'phased' approach**
 - schedule 'key' programmes early to enable follow-up observations
- **FST entrusted to implement a suitable scheme**
- **FSEC recommended to organise a (series of) meeting(s) to address in particular what the optimum amount of 'key' programme time is**

Purpose of this meeting

The Scientific Organising Committee i.e. the FST wants to:

- Announce FIRST and its foreseen scientific capabilities
- Identify areas of astronomy where the impact of FIRST will be the greatest
- Consider the issue of large 'key' programmes vs. smaller 'traditional' ones, and how to implement large programmes
- Establish complementarity to other facilities

This is done by having:

- Invited talks - introducing FIRST and specific areas of astronomy
- Oral talks
- Poster talks
- 'Panel' sessions - give opportunity to two-way discussions => we want to know what **you** think

Another way of looking at it

- From ~ summer 2007 we will have 3 years of FIRST observatory time
- **How should that time best be used to maximise the science return?**
 - Important for us astronomers
 - Legitimate right of all tax payers
 - The FST wants a dialog with the wider future user community!
 - **Objective is to address these issues in an open and productive way - FIRST is worth it!**