**ISAS/JAXA’s ASTRO-F Satellite**

Due to launch in early 2006, ASTRO-F will perform an all-sky survey in six wavebands between 9 and 180 μm, at higher sensitivity, spatial resolution and larger wavelength coverage than IRAS. The resulting catalogues are expected to contain more than a million sources. Deep imaging and spectroscopic surveys with pointed observations will also be performed in selected areas of the sky.

### Focal Plane Configuration:

- **2 Focal Plane Instruments** (13 photometric bands + 7 spectroscopy elements)
  - **Far Infrared Surveyor (FIS)**
    - 4 photometric filters covering 50-170 μm in 2 short & 2 long wavelength bands
  - **Fourier Transform Spectrometer (FTS)** covering the range 50-200 μm
    - FTS Open Time use under consideration
      - The FIS channels share the same sky area
  - **Infrared Camera (IRC)**
    - 3 Cameras (NIR, MIR-S, MIR-L) x 3 = 9 NIR-MIR bands covering 2-26 μm
    - Two dispersion elements per camera for spectroscopy in the range 2-26 μm
    - Wide FoV (~10°x10°)
    - NIR & MIR-S cameras share same sky area
    - MIR-L camera offset by 20°

### Mission Phases:

The main objectives of the ASTRO-F Mission are legacy observations in the form of Large Area Surveys (LAS) and the conduction of large mission programs (MP). In addition, a significant phase of the mission will be dedicated to pointed observations of astronomical targets. 30% of these opportunities are available to the general astronomical community as **Open Time (OT)**, via the traditional route of Call for Proposals, followed by peer-review. Resulting from ESA’s collaboration in this mission, 10% are open to European users, the other 20% are for Japanese and Korean astronomers. These OT observations will be scheduled after the survey prioritised part of the mission, starting at about eight months after launch. Note that OT proposals may not duplicate MP proposals. In addition, European & Japanese proposals may not duplicate each other.

### ASTRO-F Data Products:

Survey Data Products: several catalogues sequentially produced with incremental contents that will become public around one year after they are internally released.
- All Sky Survey FIS/IRAS Catalogue (Known IRAS Sources Catalogue)
- All Sky Survey Bright Source Catalogue (BSC)
- All Sky Survey Faint Source Catalogue

Pointed Legacy Programs: have a one year proprietary period from receipt of data.
- Large Area Surveys
- Mission Programs

Open Time Programs: have a one year proprietary period from receipt of data.

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**ASTRO-F Observers’ Fact-sheet V 1.2 (31 May 2005)**

**http://www.astro-f.esac.esa.int/**

**helpdesk: astro-f@sciops.esa.int**

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**Observation Modes:** ASTRO-F operates either in survey mode or pointed mode. In survey mode, a continuous scan of the sky is performed while the satellite orbits around the Earth. The whole sky is thus covered in half a year. In pointed mode, ASTRO-F stares or scans at a single defined target, for an effective observation time of 10 min, at a cost of 30 min operation including maneuver and stabilisation. The observation parameters are specified in predefined Astronomical Observation Templates (AOTs). One pointed observation corresponds to 1 AOT.
The Far Infrared Surveyor (FIS) instrument will carry out an All Sky Survey and deep scans in pointed mode in 4 far infrared bands from 50-180 µm and is also equipped with a Fourier Transform Spectrometer (FTS) that enables imaging spectroscopy over the full FIS wavelength range with a resolution of ~0.36 cm⁻¹ (R = 450 – 170) or 2.0 cm⁻¹ (R = 75 – 30). FIS observations are made as pointed observations. However, it is not yet decided whether the FTS mode will be available for Open Time Use.

### Basic FIS Capabilities:
FIS is designed primarily to perform the All-Sky Survey in 4 photometric bands at wavelengths between 50 and 180 µm (two broad bands and two narrow bands). The instruments are operated such that data acquisition is continuous as the telescope scans the sky, resulting in sets of strip data of sky brightness. This operation can also be used for pointed observations in a slow-scan mode for deeper observations.

FIS is also equipped with a Fourier Transform Spectrometer (FTS) that enables imaging spectroscopy over the full FIS wavelength range with a resolution of ~0.36 cm⁻¹ (R = 450 – 170) or 2.0 cm⁻¹ (R = 75 – 30). FIS observations are made as pointed observations. However, it is not yet decided whether the FTS mode will be available for Open Time Use.

### FIS Photometric Mode

<table>
<thead>
<tr>
<th>FIS Band</th>
<th>N60</th>
<th>WIDE-S</th>
<th>WIDE-L</th>
<th>N160</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength [µm]</td>
<td>50 - 75</td>
<td>50 - 110</td>
<td>110 - 180</td>
<td>140 - 180</td>
</tr>
<tr>
<td>Central Wavelength [µm]</td>
<td>60</td>
<td>80</td>
<td>150</td>
<td>160</td>
</tr>
<tr>
<td>Array format</td>
<td>20 x 2</td>
<td>20 x 3</td>
<td>15 x 3</td>
<td>15 x 2</td>
</tr>
<tr>
<td>Pixel size [arcsec²]</td>
<td>27 x 27</td>
<td>27 x 27</td>
<td>44 x 44</td>
<td>44 x 44</td>
</tr>
<tr>
<td>Field of View [arcmin]</td>
<td>12.5 x 7.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### FIS Detection limits:
Single scan (5σ) and Absolute Saturation Levels for a point (left) and an extended (right) source.

### FIS Astronomical Observation Templates (AOT):
Two AOTs are prepared for the FIS OT pointed observations. These AOTs are still not final. Further optimization is expected in the coming few months both from the instrument performance and scientific requirements.

- **FIS01**: Photometry of point sources and/or mapping of small areas of sky of up to around ~25 x 10 arcmin². All four bands are available. Scan pattern: two round-trip scans with a cross-scan shift. Scan speed is either 8 arcsec/sec or 15 arcsec/sec.
- **FIS02**: Mapping of large areas (~1 deg x 8). All four bands are available. Scan pattern: one round-trip scan with fixed speed of 15 arcsec/sec. No cross-scan shift is operated during a pointed observation to maximize the scan length.

### Sky Confusion Estimates:
Very likely, FIS observations will be affected by galactic cirrus noise and background source confusion. Users are encouraged to take confusion into account when planning observations, it may save significant amount of observing time. The sky confusion noise due to galactic diffuse emission (cirrus) is a function of Galactic Latitude with a dependence given by the figure.

**Sky confusion tool**: http://www.ir.isas.jaxa.jp/ASTRO-F/Observation/Confusion/

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The Far Infrared Surveyor (FIS) instrument will carry out an All Sky Survey and deep scans in pointed mode in 4 far infrared bands from 50-180 µm and is also equipped with a Fourier Transform Spectrometer.
The Infrared Camera (IRC) instrument will carry out an All-Sky Survey at 9 and 20 \( \mu \)m and will perform pointed observations in 9 photometric bands and 6 spectroscopic elements in the 2 – 26 \( \mu \)m range.

**Basic IRC Capabilities:** The IRC consists of three cameras: NIR, MIR-S & MIR-L. Each camera is equipped with three filters and two dispersion elements. The filters can be chosen from a limited number of pre-determined combinations defined in each AOT. Only NIR and MIR-S share the same FoV. This means that at least two pointed observations in different revolutions are needed to observe a particular position with all three cameras. An IRC pointed observation consists of an \( n \) times repeated exposure cycle and various operations between them (micro-scan and filter changes). One exposure cycle takes 65.45 s in the current design, during which NIR carries out one short (2.3 s) and one long (51 s) exposures, and MIR cameras carry out one short (0.6 s) and three long (19 s) exposures.

**IRC Imaging:** 5\( \sigma \) detection and saturation limits for a pointed observation in imaging mode (IRC 00-02-03 and 11), computed at the ecliptic pole and at the ecliptic plane. IRC11 values correspond to different scan speeds (in arcsec/sec).

Point source detection limits are given in \( \mu \)Jy and extended source detection limits in MJy/sr.

**IRC Spectroscopy:** The MIR-S and MIR-L cameras always observe with two dispersion elements (GRISM) to cover their full wavelength range, while only one of the NIR dispersion elements (NP; PRISM; NG; GRISM) can be selected at a time.

A short exposure image will be taken for pointing alignment. A slit is provided in each camera in order to observe diffuse radiation. The NIR camera has also an entrance aperture (slit) for point source confusion-less spectroscopy.

**SPECTROSCOPIC AOT & DISPERSION ELEMENT SELECTION**

**IMAGING AOTS & FILTER SELECTION**

**GRAPHICAL INFORMATION**

- **CONT. DETECTION LIMIT (mJy/\( \lambda \))**
- **LINE DETECTION LIMIT (10 \( \lambda \) \( \mu \)m)**

5\( \sigma \) detection limits for a pointed observation, in the ecliptic pole and the ecliptic plane. Line detection limits are given for integrated line fluxes. Continuum detection limits are given per pixel. Integrating over the area of the resolution bin and over the image size can improve the detection.