SPICA: The Space Infrared Telescope for Cosmology and Astrophysics

Ciska Kemper

Institute of Astronomy and Astrophysics, Academia Sinica
The SPICA telescope

- Telescope: 3.0 m, 6 K
- Wavelength: 20 – 210 μm
- Instruments:
  - SMI: 20-37 μm
  - SAFARI: 34-210 μm
- Orbit: L2
- Mission life: 3 years (nominal), 5 years (goal)
- Launch: ∼ 2026
### SAFARI Overview
- Three band Fourier transform spectrometer
- Continuous spectroscopic capability from 34-210 μm
- Simultaneous broadband photometry in three bands
- Background limited performance
- Synchronous field of view of 2’x2’ in all three bands

### General

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Waveband</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SW</td>
</tr>
<tr>
<td>Band centre</td>
<td>47 μm</td>
</tr>
<tr>
<td>Wavelength range</td>
<td>34-60 μm</td>
</tr>
<tr>
<td>Band centre beam FWHM</td>
<td>4’</td>
</tr>
<tr>
<td>Number of detectors</td>
<td>43 x 43</td>
</tr>
</tbody>
</table>

### Photometry

<table>
<thead>
<tr>
<th>Parameter</th>
<th>SW band</th>
<th>MW band</th>
<th>LW band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Zodiacal background</td>
<td>8.0 MJysr⁻¹</td>
<td>3.8 MJysr⁻¹</td>
<td>2.1 MJysr⁻¹</td>
</tr>
<tr>
<td>Limiting source flux density (5σ-1-hour)</td>
<td>14 μJy</td>
<td>21 μJy</td>
<td>32 μJy</td>
</tr>
<tr>
<td>Time to reach confusion limit at 5σ</td>
<td>123 s</td>
<td>0.3 s</td>
<td>0.006 s</td>
</tr>
</tbody>
</table>

### Spectroscopy

<table>
<thead>
<tr>
<th>Limiting line flux density 5σ-1-hour*</th>
<th>High Res. (R~2000)</th>
<th>Medium Res. (R~500)</th>
<th>Low Res. (R~50)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW band</td>
<td>11 mJy</td>
<td>2.9 mJy</td>
<td>0.3 mJy</td>
</tr>
<tr>
<td>MW band</td>
<td>19 mJy</td>
<td>4.9 mJy</td>
<td>0.5 mJy</td>
</tr>
<tr>
<td>LW band</td>
<td>31 mJy</td>
<td>7.8 mJy</td>
<td>0.8 mJy</td>
</tr>
</tbody>
</table>

*Values are based on single pixel raw sensitivity estimates

### SPICA Telescope
- Effective mirror diameter: 3.05 m
- Primary mirror temperature: 6 K

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*Change in system performance, as a function of target flux density, relative to the background limited case.
*The decrease in sensitivity is a result of the increased photon noise from the target source*
The SPICA Mid-infrared Instrument (SMI)

- **New instrument:** ISAS/JAXA
- **Imager**
  - $1k \times 1k$ Si:Sb array
  - $R \sim 20$
  - $20 - 37 \, \mu m$
  - FOV: $5' \times 5'$
- **Spectrometer**
  - $1k \times 1k$ (Si:As for MRS-S; Si-Sb for MRS-L)
  - $20 - 37 \, \mu m$
  - $R \sim 1000 - 2000$ (2000 only for point sources)
  - Slit: $150'' \times 3.1''$
- **HRS** $12 - 18 \, \mu m$: $R \sim 20,000 - 30,000 \ ???$
SPICA science

- SPICA will mostly function as a survey instrument, executing a number of large surveys
- PI observations are probably still possible
- Main science goals:
  - The distant universe
  - The ISM in nearby galaxies
  - Planet formation
The distant universe
The nearby universe
The nearby universe

Survey parameter space of local universe
Wide range of type, spatial resolution, Metallicity, star formation, etc...

SFR \[M_{\odot} \text{yr}^{-1}\]

\(<0.01\quad 0.1\quad 0.5\quad 1<\)

- MW
- LMC
- M31
- M33
- M82
- M83
- He2-10
- N625
- N755
- N1569
- N4449
- N4214
- N5253
- N1705
- IC10
- SMC
- N6822
- UGC4483
- M84
- N2366
- VII Zw403
- I Zw18
- SBS1159
- SBS1211
- HS0822
- SBS1415
- SBS1442
- N1369
- N1326
- Haro3
- HS017
- N1140
- Haro2
- SBS1249
- HS1319
- HS1330
- HS1222
- SBS1236
- HS1304
- Mrk1089
- Mrk1450
- Mrk209
- Mrk930
- UM133
- Haro11
- HS2352
- UM311
- UM448
- HS0052
- HS0017
- Tol1214
- HS1319
- SBS0335
- N1236

\(d\)

- 100 kpc
- 1 Mpc
- 10 Mpc
- 100 Mpc

\(<Z>\)

- 0.5 pc
- 5 pc
- 50 pc
- 500 pc
SPICA consortium

- Japan
  - PI country
  - Telescope facility, satellite
  - SMI
- Europe
  - SAFARI (consortium led by SRON)
  - Mirror (ESA)
- Taiwan
- Korea
ESA Cosmic Vison M4

- Budget on Japanese side limited
- Goal: to raise additional funding in Europe
  - M-class proposals in the Cosmic Vision program are suitable to raise up to $\sim 500$ M
- PI: Peter Roelfsema (SAFARI PI, SRON)
- Competition:
  - LOFT: X-ray
  - Millimetron
  - PRISM: CMB
  - Marco Polo: sample return mission
M4 timeline

- Call: May 2014 -> delayed
- M4 proposal deadline: September 2014 -> delayed to Mid October
- First selection: November 2014 -> delayed
- Consolidated instrument proposal: June 2017
- Final selection: November 2017
- Launch: 2026

Updated proposal timeline:
- 1-15 October: last iteration
- 1-15 September: critical reading by select group
- 1 September: Draft V0.9
- 21 May: open science workshop - Leiden
- 1 May: Draft V0.7
- End April: core science judged by select group
Taiwan participation

- Until 2013: MCS instrument (but this instrument no longer exists)
  - Detectors
  - Filters
  - Calibration lamp
- SPICA-Taiwan key members:
  Toshio Matsumoto, Youichi Ohyama, Paul Ho, Shiang-Yu Wang, Hiro Takami, Ciska Kemper
- New role:
  - SMI (similar to MCS)
  - SAFARI
  - Data processing/archiving (IPAC-like)
  - other...?