

SPICA FAR-IR SPECTROMETER SAFARI Yasuo Doi¹, Peter R. Roelfsema², and SAFARI consortium³

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Abstract

The primary goal of the SPICA mission is to reveal the main drivers of galaxy evolution from the early universe to the present. SAFARI (SpicA FAR-infrared Instrument) is a powerful spectrum mapping machine that covers 34–210 μ m, where we can observe many important gas diagnostic lines, with a high sensitivity of $< 5 \times 10^{-20}$ [W m⁻²] by combining medium resolution (R~ 300) grating spectrometers and a sensitive TES detector system (NEP $< 2 \times 10^{-19}$ [W Hz^{-0.5}]). SAFARI is also efficient to observe spatially extended sources (e.g., nearby galaxies) by having a beam-steering mirror to map $2' \times 2'$ with a fixed satellite attitude. A higher spectral resolution (R~ 3000) is achieved by inserting a Fabry-Perot into the optical path for observations of protoplanetary discs and so on.

SAFARI grating spectrometer

Galaxy evolution at $z \sim 1 - 3$ to the present

- High-sensitivity FIR line diagnosis of the distant galaxies over their evolutional history, mineralogy of protoplanetary and planetaly discs
- Wavelength coverage: $34\mu m 210\mu m$ with a targeted extension for $230\mu m$
- $-230\mu \mathrm{m} \leftrightarrow \mathrm{[NII]} 57\mu \mathrm{m} @ \mathrm{z=}3$
- Sensitivity: $4 7 \times 10^{-20} [W m^{-2}]$
- $-cf. \text{ expected intensity of [ON] 25.9}\mu\text{m}$ $\sim 1 2 \times 10^{-20} \text{ [W m}^{-2]}$ $(L \sim 10^{11.5} 10^{12}L_{\odot} @ \text{z=3})$



- High-sensitivity R=300 Spectral Resolution mode (grating), High-resolution R=3000 mode (grating + Fabry-Perot)
- -optimised key science cases
- –spectroscopy of external galaxies: require $R\sim 150-500$
- -AGN outflow: require $R\sim 1500$
- ~ $2' \times 2'$ mapping capability with BSM
- Spatial Resolution: 3'' 21''

One of the key scientific objectives of the SPICA mission is to reveal the whole process of the galaxy evolution. SAFARI will detect key diagnostic lines and reveal physical conditions of distant galaxies at $z \sim 1 - 3$, where the star formation activities were of their peak, as well as nearby galaxies to reveal the variety of physical conditions at the present epoch.







Key technology items

Highly reliable system configuration utilising ISO and Herschel heritages is under consideration. High sensitivity TES detector system is under development and is reaching its goal performance.





Three detector bands cover the whole wavelength range simultaneously for the grating spectroscopy mode with $R \sim 300$ (1a/1b). High resolution spectroscopy mode with $R \sim 3000$ is achieved by inserting Fabry-Perot to the optical paths (2a/2 b).





TES detectors NEP: 2×10^{-19} [W Hz^{-0.5}]

heritages from ISO and Herschel

