SPICA

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Published in:
The Space Astrophysics Landscape for the 2020s and Beyond

Publication date:
2019

SPICA: revealing the hearts of galaxies and forming planetary systems; Overview and US contributions.

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Introduction: How did the diversity of galaxies we see in the modern Universe come to be? When and where did stars within them forge the heavy elements that give rise to the complex chemistry of life? How do planetary systems, the Universe's home for life, emerge from dusty interstellar material? These fundamental questions drive much of modern astrophysics.

Mid- and far-infrared wavelengths are powerful tools for study of these fundamental topics. Far-IR continuum measurements with Herschel and Spitzer have shown that most of the energy ever produced in galaxies emerges in the far-IR; this is simply because most star formation and growing black holes are typically obscured by the very material that feeds them: dusty interstellar gas. Similarly, planets assemble from optically-thick disks which cool primarily in the far-IR. The broad-band far-IR measurements with Herschel have set the stage, demonstrating the extent of dust-obscured activity, but fall short at providing insight into the underlying astrophysics and suffer from source confusion. Spectroscopy, a far more powerful tool which will provide quantitative diagnostics to assess astrophysical machinery, and naturally overcomes source confusion. This is a particular focus of SPICA.

Mission: A joint European-Japanese project is proposed to implement the SPace Infrared telescope for Cosmology and Astrophysics, SPICA, an infrared space observatory designed to achieve true background limited performance with a 2.5-meter primary mirror cooled to below 8 K. ESA has selected SPICA as one of the 3 candidates for the Cosmic Visions M5 mission, and JAXA has indicated commitment to their portion of the collaboration. ESA and JAXA have invested in a joint concurrent study, and a collaboration framework has gelled. ESA will provide the silicon-carbide telescope, science instrument assembly, satellite integration and testing, and the spacecraft bus. JAXA will provide the passive and active cooling system (supporting the T<8K telescope), cryogenic payload integration, and launch vehicle. The ESA phase-A study is underway now; the downselect among the three candidates will occur in 2021, and the expected launch is around 2030.

Instruments: SPICA will have 3 instruments. JAXA's SPICA mid-infrared instrument (SMI) will offer imaging and spectroscopy from 12 to 38 microns (see Figure). It is designed to complement JWST MIRI with wide-field mapping (broad-band and spectroscopic), R~30,000 spectroscopy with an immersion grating, and an extension to 38 μm with antimony-doped silicon detector arrays. A far-IR polarimeter from a French-led consortium will provide dual-polarization imaging in 3 far-IR bands. A sensitive far-IR spectrometer SAFARI is being provided by an SRON-led consortium. It will provide full-band instantaneous coverage over the full 35-230 μm band (longer wavelength extension is under study) using four R=300 grating modules (see Figure). A Fourier-transform module which can be engaged in front of the grating modules will offer a boost to the resolving power, up to R=30,00 at 100 microns. As a member of the SAFARI consortium, a US team is working with the European team to contribute the two long-wavelength detector arrays and spectrometer modules for SAFARI (noted as BLISS in the figure) through a NASA Mission of Opportunity.