IAF SYMPOSIUM ON ONGOING AND NEAR FUTURE SPACE ASTRONOMY AND SOLAR-SYSTEM SCIENCE MISSIONS (A7)
Technology Needs for Future Missions, Systems, and Instruments (3)

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SPICA – A SPACE INFRARED TELESCOPE: TECHNICAL CHALLENGES FOR PLATFORM TO SUPPORT HIGH-PERFORMING INFRARED TELESCOPE

Abstract

SPICA (a SPace Infrared telescope for Cosmology and Astrophysics) is a joint European-Japanese candidate mission, which was selected by ESA in 2018 for study of its fifth Medium-class mission (M5) launch opportunity in the Cosmic Vision Programme, together with EnVision and THESEUS.

The objective of this mission is to reveal the physical processes that govern the formation and evolution of galaxies and black holes by observing the lifecycle of gas, ice, and dust within them, aiming at understanding the formation and evolution of habitable systems and the universe itself.

In order to achieve the objective, SPICA features a 2.5m infrared telescope with a cryogenic cooling system, which brings the temperature of the telescope down to as cold as 8K, far lower than that of similar missions such as Herschel (80K) or JWST (45K). The large telescope aperture, together with this extremely low temperature for suppressing thermal background noise, allow the sensitivity to be improved by two orders of magnitude compared to the previous missions.

SPICA would have been planned to be launched in 2032 with H3 Japanese Launch Vehicle from the Tanegashima launch site south of Japan. It would be injected into an orbit around the Second Lagrange Point of the Sun-Earth system (SEL2), 1.5 million km away from the Earth, which is considered to be the best place in Earth's vicinity to make the telescope cool enough to achieve high sensitivity.

Nevertheless, those features of low temperature and large telescope aperture posed several technical challenges to the overall mission and spacecraft development. Thermal control shall be sophisticated both passively (isolation from the platform and the solar illumination) and actively (with several stages of cryogenic cooling system). Pointing shall be accurate in the order of sub-arcsec, with very accurate star sensors placed close to the telescope to avoid TED contribution, as well as a mechanical isolation to suppress microvibration originated from the cryogenic compressors and reaction wheels.

This paper will provide a mission and system overview on the SPICA mission including those technical challenges and their intended solutions, together with consideration on interfaces with instrument and cryogenics payload.