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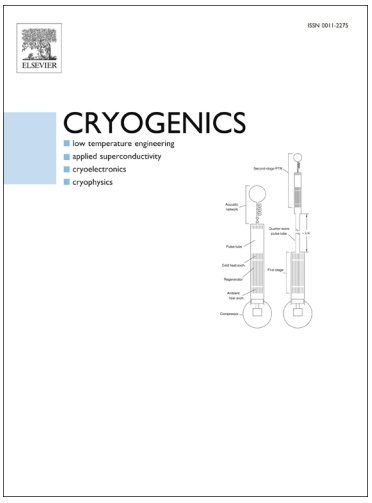

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In-orbit performance of a helium Dewar for the soft X-ray spectrometer onboard ASTRO-H

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Abstract

ASTRO-H was an X-ray astronomy satellite that the Japan Aerospace Exploration Agency (JAXA) developed to study the evolution of the universe and physical phenomena yet to be discovered. The primary scientific instrument of ASTRO-H was the Soft X-ray Spectrometer (SXS). Its detectors were to be cooled to 50 mK using a complex cryogenic system with a multistage adiabatic demagnetization refrigerator (ADR) developed by the National Aeronautics and Space Administration (NASA), and a cryogenic system developed by Sumitomo Heavy Industries, Ltd. (SHI). SHI's cryogenic system was required to cool the ADR's heatsink to 1.3 K or less in orbit for three years or longer. To meet these requirements, SHI developed a hybrid cryogenic system consisting of a liquid helium tank, a 4K Joule-Thomson cooler, and two two-stage Stirling coolers.

ASTRO-H was launched from Tanegashima Space Center on February 17, 2016. The initial operation of the SXS cryogenic system in orbit was completed successfully. The cooling performance was as expected and could have exceeded the lifetime requirement of three years.

This paper describes results of ground tests, results of top-off filling of superfluid liquid helium just before launch, and cooling performance in orbit.

Keywords: Space cryogenics, Cooling system, Joule-Thomson cooler, Stirling Cooler, ASTRO-H