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

Author: Mr. Pierre-Olivier MINE
Air Liquide, France, pierre-olivier.mine@airliquide.com

HIPTC A DUAL STAGE CRYOCOOLER FOR 10K-40K COOLING OF SCIENCE PAYLOADS

Abstract

Air Liquide Advanced Technologies, in cooperation with CEA and with the support of ESA, has developed a dual-stage pulse tube cooler for space science missions. It is named HiPTC, standing for Heat intercepted Pulse Tube Cooler. I is built with compressors by Thales Cryogenics and a cold finger developed with CEA. A first Bread Board model was tested to validate the achievement of the 15K targeted cryogenic performance and securing TRL4. This model showed that temperatures below 9K were achievable. An engineering model was built to check consistency of the performance, further explore the operating domain and raise the TRL. An extensive test campaign was performed on this model, with coupling of the mechanical cooler with a development electronics and validation of the operational scheme, including:

- Cryogenic characterization over a wide temperature range of 10K – 40K
- Characterization of exported vibrations and validation of vibration reduction loop
- Operational schemes for a science payload Design maturity and test results confirm the suitability of this cryocooler for science payloads, either for directly cooling the instrument or the optics, or as part of a cryogenic chain. One single cooler can provide cooling power at two staged temperatures, between 70K and 100K on the middle stage, and between 10K and 40K on the cold stage. This versatility facilitates the thermal optimization of cryogenic chains. HiPTC is part of the baseline cryogenic cooling chain of ATHENA X-IFU payload. This cooler is also considered for the first levels of cooling in the LITEBIRD and MILLIMETRON missions. For MILLIMETRON, Air Liquide has performed a preliminary study in cooperation with Lebedev Institute of Physics, demonstrating the adequacy of this cooler with the needs of this ambitious mission. The presentation will display cooler characteristics, integration studies on several payloads, as well as recent test results and will discuss potential applications.