

Proposed Technical sessions :**ICR0643**

Session 4: New fluids, new systems, and system integration – Energy efficient refrigeration systems
 Session 1: Cryophysics and cryo-engineering – Small scale cryo-coolers and pulse tubes.

Brayton technology for the –80°C Freezer of the International Space Station

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Abstract:

The Minus Eighty degrees Celsius Laboratory Freezer for the International Space Station (ISS), **MELFI**, is the first freezer delivered to NASA as Laboratory Support Equipment by the European Space Agency (ESA). MELFI first flight inside the Space Shuttle is scheduled beginning 2003.

From the beginning, the technology for a –80°C freezer was identified as very critical to develop. The technical specification imposed:

- Very low induced vibrations, to minimize the perturbations on the micro-gravity environment;
- Reduced electrical power consumption, to be compatible with the power available during the ascent phase (550W) and in ISS (900W);
- Accurate temperature control of 4 separate cold volumes at different temperatures (+4°C, -26°C, -80°C);
- Preservation of the scientific samples at the required cold temperatures even during the mission phase when electrical power is not available (up to 8 hours power-off);
- High availability ratio with a mission duration of 2 years in orbit;
- Capability of being launched to the ISS and returned to earth up to 15 times.

Those requirements were not compatible with the solutions previously used in space. The technology selected for the cold power generation is based on the reverse Brayton thermo-dynamical cycle using a high-speed rotating machine with the compressor and the turbine wheels mounted on the same shaft supported by gas bearings. The thermal barriers rely on vacuum insulation for reducing the electrical power consumption.

This paper explains how the reverse Brayton cycle technology has been adapted for space missions, and how the different technical challenges have been overcome through the development of the MELFI to have a freezer compatible with all ISS and Shuttle requirements.

Potential future evolutions of the product and its utilization are also presented, which may answer additional needs already identified by NASA for the scientific research inside the ISS.