ID de Contribution: **41** Type: **Oral presentation**

Development of a Closed Cycle Dilution Refrigerator for future astronomical missions

vendredi 28 février 2020 17:45 (15 minutes)

The use of stable sub-Kelvin coolers is a key technology in order to reach the highest sensitivity that astrophysical space missions can offer. Historically, few instruments (e.g. Planck HFI or Hitomi SXS) required temperature down to 100 mK. Currently, two technologies can provide such temperatures in a space environment: ADR (Adiabatic Demagnetization Refrigerator) and OCDR (Open Cycled Dilution Refrigerator). For CMB observations, the next generation of satellites (e.g. LiteBIRD) will require the highest stability and continuous temperature operation. For now, only the OCDR can reach such requirements but with a limited lifetime as this cooler is making use of a limited quantity of He3 and He4 isotopes which mixture is then wasted in space. Planck-HFI observations were then limited to 2.5 years.
I am working on the design and development of a new dilution system (CCDR - Closed Cycle Dilution refrigerator) for which the He3-He4 mixture will be recycled and separated in order to avoid large quantities of helium to be embarked and to extend the sub-K cooler lifetime.

Field

Instrumentation

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Classification de Session: Talk

Classification de thématique: Astrophysics