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LASER CRYOCOOLER DEVELOPMENT FOR SPACE APPLICATIONS

Abstract

Laser coolers are an innovative class of coolers capable of reaching cryogenics temperatures in a miniaturized, contact-less and entirely vibration free technology. They are based on optical refrigeration in solids: upon illumination at the appropriate wavelength, rare-earth doped cooling crystals possess the property to extract heat out of their crystalline lattice, re-emitting more light than they have absorbed. This promising effect, known as anti-Stokes cooling, has seen major improvements over the last decade.

We report on our progress with the development and demonstration of the first fiber-coupled Laser Cryocooler prototype aimed at space applications, in a partnership led by Air Liquide Advanced Technologies. On top of a design suitable for easy integration onboard a satellite, our results show that our prototype reaches cryogenics temperatures with reduced parasitic thermal loads, thanks to the small dimensions of cooling crystals and the optical, contact-less power supply method.

This newcoming technology among existing cryocoolers solutions opens the door to active, entry-level cryogenic cooling in a number of applications where size, weight and vibrations are critical, such as in small Earth observation satellites but also in ground applications.