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Two-Arm Flexible Thermal Strap

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Airborne and space infrared cameras require highly flexible direct cooling of mechanically-sensitive focal planes. A thermal electric cooler is often used together with a thermal strap as a means to transport the thermal energy removed from the infrared detector. While effective, traditional thermal straps are only truly flexible in one direction. In this scenario, a cooling solution must be highly conductive, lightweight, able to operate within a vacuum, and highly flexible in all axes to accommodate adjustment of the focal plane while transmitting minimal force.

A two-armed thermal strap using three end pieces and a twisted section offers enhanced elastic movement, significantly beyond the motion permitted by existing thermal straps. This design innovation allows for large elastic displacements in two planes and moderate elasticity in the third plane. By contrast, a more conventional strap of the same conductance offers less flexibility and asymmetrical elasticity.

The two-arm configuration reduces the bending moment of inertia for a given conductance by creating the same cross-sectional area for thermal conduction, but with only half the thickness. This reduction in the thickness has a significant effect on the flexibility since there is a cubic relationship between the thickness and the rigidity or bending moment of inertia.

The novelty of the technology lies in the mechanical design and manufacturing of the thermal strap. The enhanced flexibility will facilitate cooling of mechanically sensitive components (example: optical focal planes).

This development is a significant contribution to the thermal cooling of optics. It is known to be especially important in the thermal control of optical focal planes due to their highly sensitive alignment requirements and mechanical sensitivity; however, many other applications exist including the cooling of gimbal-mounted components.

This work was done by Eugenio Urquiza, Cristal Vasquez, Jose I. Rodriguez, Robert S. Leland, and Byron E. Van Gorp of NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. *NPO-47744*