This work was done by David W. M. Marr, Tieying Gong, John Oakey, Alexander V. Terray, and David T. Wu of the Colorado School of Mines for Johnson Space Center. Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MSC-24160-1/1-1/2-1/3-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

RuO_2 Thermometer for Ultra-Low Temperatures

Goddard Space Flight Center, Greenbelt, Maryland

A small, high-resolution, low-power thermometer has been developed for use in ultra-low temperatures that uses multiple RuO_2 chip resistors. The use of commercially available thick-film RuO_2 chip resistors for measuring cryogenic temperatures is well known due to their low cost, long-term stability, and large resistance change.

To measure the resistance, a small excitation is applied across the sensor and the resistance is measured. At increased currents, a greater output signal is achieved, resulting in better sensitivity. Problems including lowered resolution and sensitivity are found because of self-heating at temperatures below 100 mK when a single chip is used.

A new thermometer design uses multiple RuO_2 chip resistors and off-the-shelf bobbins. The chips would be configured in an array to spread the heat over a greater area during excitation. A technique was developed to connect the chips together, first in a 2×2 array, and finally in a 3×3 array. The 3×3 array configuration of the RuO_2 chips allows better internal heat distribution than a single chip, thereby reducing self-heating. The uniqueness of this design is in the array configuration, which allows greater sensitivity at ultralow temperatures while keeping a small package footprint [about 0.4 in. (10 mm)]. The device uses a standard round bobbin with a #4 screw through-hole.

This work was done by Thomas Hait, Peter J. Shirron, and Michael DiPirro of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15690-1

Ultra-Compact, High-Resolution LADAR System for 3D Imaging

Lyndon B. Johnson Space Center, Houston, Texas

An eye-safe LADAR system weighs under 500 grams and has range resolution of 1 mm at 10 m. This laser uses an adjustable, tiny microelectromechanical system (MEMS) mirror that was made in SiWave to sweep laser frequency. The size of the laser device is small (70×50×13 mm). The LADAR uses all the mature fiber-optic telecommunication technologies in the system, making this innovation an efficient performer. The tiny size and light weight makes the system useful for commercial and industrial applications including surface damage inspections, range measurements, and 3D imaging.

This work was done by Jing Xu and Roman Gutierrez of SiWave, Inc. for NASA's Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MSC-23873-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Dual-Channel Multi-Purpose Telescope

Goddard Space Flight Center, Greenbelt, Maryland

A dual-channel telescope allows for a wide-field telescope design with a good, narrow field channel of fewer surfaces for shorter-wavelength or planet-finding applications. The design starts with a Korsch three-mirror-anastigmat (TMA) telescope that meets the mission criteria for image quality over a wide field of view. The internal image at the Cassegrain focus is typically blurry due to the aberration balancing among the three mirrors. The Cassegrain focus is then re-optimized on the axis of the system where the narrow field channel instrument is picked off by bending the primary mirror. This now makes the wide-field channel blurry (i.e., the TMA image), and it must be re-optimized while holding the fore-optics fixed. This leaves the tertiary mirror as a variable, as well as a fold mirror strategically placed at the image of the primary mirror (i.e., exit pupil of the telescope). This fold mirror can then be used to compensate for the departure in primary mirror figure used to optimize the narrow field channel. As such, only an aspheric term is needed for this final optimization on this "corrector" fold mirror.

This work was done by Joseph M. Howard and David Content of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15574-1