

in the dispersion plane. It is redirected in much the same way as with a flat mirror. However, in the sagittal plane light gets redirected in a manner similar to a cylindrical mirror. It exhibits focusing with the focal length only defined by the curvature of the grooves, the incident wavelength, and the grating period.

Because of this, one single diffraction grating can exhibit two dispersal patterns. It disperses light just like a regular flat diffraction grating, while at the same time focusing (or de-focusing) diffracted light onto a perpendicular plane. This focusing generates less aberrations than a mirror would. Non-trivial property of this device is

that its focal length for a fixed wavelength does not depend on the incident angle, even if the angle is extremely non-paraxial.

*This work was done by Dmitri Iazikov, Thomas W. Mossberg, and Christoph M. Greiner of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15680-1*

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## Universal Millimeter-Wave Radar Front End

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A quasi-optical front end allows any arbitrary polarization to be transmitted by controlling the timing, amplitude, and phase of the two input ports. The front end consists of two independent channels — horizontal and vertical. Each channel has two ports — transmit and receive. The transmit signal is linearly polarized so as to pass through a periodic wire grid. It is then propagated through a ferrite Faraday rotator, which rotates the polarization state 45°. The received signal is propagated through the Faraday rotator in the opposite di-

rection, undergoing a further 45° of polarization rotation due to the non-reciprocal action of the ferrite under magnetic bias. The received signal is now polarized at 90° relative to the transmit signal. This signal is now reflected from the wire grid and propagated to the receive port.

The horizontal and vertical channels are propagated through, or reflected from, another wire grid. This design is an improvement on the state of the art in that any transmit signal polarization can be chosen in whatever sequence de-

sired. Prior systems require switching of the transmit signal from the amplifier, either mechanically or by using high-power millimeter-wave switches. This design can have higher reliability, lower mass, and more flexibility than mechanical switching systems, as well as higher reliability and lower losses than systems using high-power millimeter-wave switches.

*This work was done by Raul M. Perez of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact [iaoffice@jpl.nasa.gov](mailto:iaoffice@jpl.nasa.gov). NPO-46654*

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## Mode Selection for a Single-Frequency Fiber Laser

*NASA's Goddard Space Flight Center, Greenbelt, Maryland*

A superstructured fiber-grating-based mode selection filter for a single-frequency fiber laser eliminates all free-space components, and makes the laser truly all-fiber. A ring cavity provides for stable operations in both frequency and power. There is no alignment or realignment required. After the fibers and components are spliced together and packaged, there is no need for specially trained technicians for operation or maintenance. It can be integrated with

other modules, such as telescope systems, without extra optical alignment due to the flexibility of the optical fiber.

The filter features a narrow line width of 1 kHz and side mode suppression ratio of 65 dB. It provides a high-quality laser for lidar in terms of coherence length and signal-to-noise ratio, which is 20 dB higher than solid-state or microchip lasers.

This concept is useful in material processing, medical equipment, biomedical

instrumentation, and optical communications. The pulse-shaping fiber laser can be directly used in space, airborne, and satellite applications including lidar, remote sensing, illuminators, and phase-array antenna systems.

*This work was done by Jian Liu of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15600-1*

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## Qualification and Selection of Flight Diode Lasers for Space Applications

*NASA's Jet Propulsion Laboratory, Pasadena, California*

The reliability and lifetime of laser diodes is critical to space missions. The Nuclear Spectroscopic Telescope Array (NuSTAR) mission includes a metrology system that is based upon laser diodes. An operational test facility has

been developed to qualify and select, by mission standards, laser diodes that will survive the intended space environment and mission lifetime. The facility is situated in an electrostatic discharge (ESD) certified cleanroom and consist of an

enclosed temperature-controlled stage that can accommodate up to 20 laser diodes. The facility is designed to characterize a single laser diode, in addition to conducting laser lifetime testing on up to 20 laser diodes simultaneously.