summer season. This test satisfies the required 3 times the design margin that is a total of 2,010 thermal cycles (670 × 3). This development test included functional optical transmission tests during the course of the test. Transmission of the fiber optic cables was performed prior to and after 1,288 thermal cycles and 2,010 thermal cycles. No significant changes in transmission were observed on either of the two representative fiber cables subject through the 3X MSL mission life that is 2,010 thermal cycles.

This work was done by Rajeshuni Ramesham, Christian A. Lindensmith, William T. Roberts, and Richard A. Rainen of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-48055

Solid-State Spectral Light Source System

Goddard Space Flight Center, Greenbelt, Maryland

A solid-state light source combines an array of light-emitting diodes (LEDs) with advanced electronic control and stabilization over both the spectrum and overall level of the light output. The use of LEDs provides efficient operation over a wide range of wavelengths and power levels, while electronic control permits extremely stable output and dynamic control over the output.

In this innovation, LEDs are used instead of incandescent bulbs. Optical feedback and digital control are used to monitor and regulate the output of each LED. Because individual LEDs generate light within narrower ranges of wavelengths than incandescent bulbs, multiple LEDs are combined to provide a broad, continuous spectrum, or to produce light within discrete wavebands that are suitable for specific radiometric sensors.

This work was done by Robert Maffione and David Dana of Hydro-Optics, Biology & Instrumentation Laboratories, Inc. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15851-1

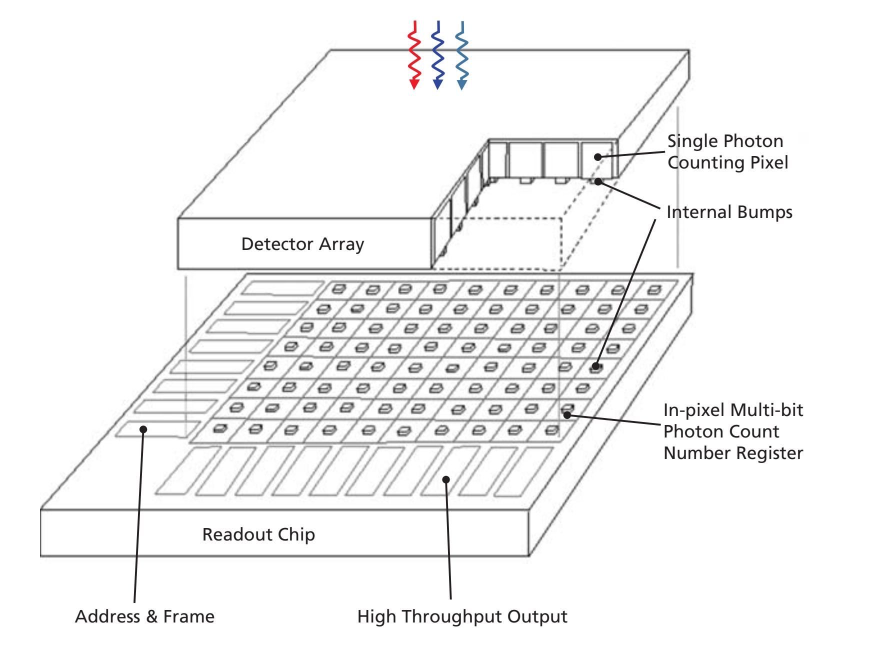
Multiple-Event, Single-Photon Counting Imaging Sensor

This sensor has applications in high-energy physics and medical and biological imaging systems.

NASA's Jet Propulsion Laboratory, Pasadena, California

The single-photon counting imaging sensor is typically an array of silicon Geiger-mode avalanche photodiodes that are monolithically integrated with CMOS (complementary metal oxide semiconductor) readout, signal processing, and addressing circuits located in each pixel and the peripheral area of the chip. The major problem is its "single-event" method for photon count number registration. A single-event single-photon counting imaging array only allows registration of up to one photon count in each of its pixels during a frame time, i.e., the interval between two successive pixel reset operations. Since the frame time can't be too short, this will lead to very low dynamic range and make the sensor merely useful for very low flux environments. The second problem of the prior technique is a limited fill factor resulting from consumption of chip area by the monolithically integrated CMOS readout in pixels. The resulting low photon collection efficiency will substantially ruin any benefit gained from the very sensitive single-photon counting detection.

The single-photon counting imaging sensor developed in this work has a novel "multiple-event" architecture, which allows each of its pixels to register as more than one million (or more) photon-counting events during a frame time. Because of a consequently boosted dynamic range, the imaging array of the invention is capable of performing single-photon counting under ultra-low light through high-flux environments. On the other hand, since the multiple-event architecture is implemented in a hybrid structure, back-illumination and



Structure of a multiple-event **Single-Photon Counting Imaging Sensor** implemented using flip-chip bump bonding technique.