



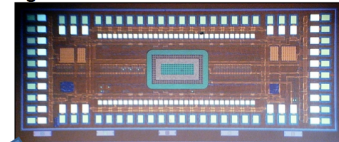
# HgCdTe Infrared Avalanche Photodiode Single Photon Detector Array Applicable to LIST and Other Decadal Missions

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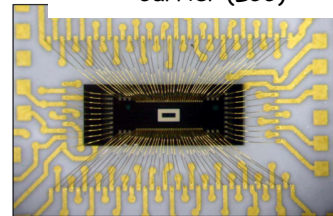
## Objective

- Develop a HgCdTe avalanche photodiode (APD) SWIR/MWIR linear mode photon counting (LMPC) array detector system in support of the LIdar Surface Topography (LIST) measurement concept
- Provide a new type of SWIR/IR focal plane array with near zero read-out noise and fast frame rate for IR spectrometers and cameras for other Earth science decadal missions and scientific and commercial applications

HgCdTe APD FPA Mounted on Silicon ROIC



FPA Mounted on Custom Ceramic Leadless Chip Carrier (LCC)



Mounted in Liquid N<sub>2</sub> Dewar for Operation at 77 K



The FPA/LCC/Dewar System was Designed to Maintain High Bandwidth Analog and Digital Output Signal Integrity

2x8 HgCdTe APD linear mode photon counting detector by DRS for SWIR/IR lidar and spectrometers

## Accomplishments

- Developed a new batch of LMPC HgCdTe e-APD arrays with built-in read-out integrated circuit (ROIC) at DRS with single photon sensitivity from short- to mid-wave IR
- Improved device performance, yield, and ease of use from the 2010 prototype
  - Achieved photon detection efficiency > 65%; dark count rate < 200 kHz at 12.9 volt e-APD bias
  - Met all the performance goals except for timing jitter
- Identified the causes for the larger than expected timing jitter and method of improvement
  - Measured timing jitter 1.1 - 2.0 ns RMS vs. <1.0 ns (specification), due to ROIC parasitics and electron diffusion length
- Verified LMPC HgCdTe e-APD performance at GSFC labs
- Demonstrated laser ranging to natural targets in the field using the new detector in linear mode single photon detection at near infrared wavelength

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TRL<sub>in</sub> = 2

TRL<sub>out</sub> = 4