A CubeSat Flight Demonstration of a Photon-counting Infrared Detector (LMPC CubeSat)

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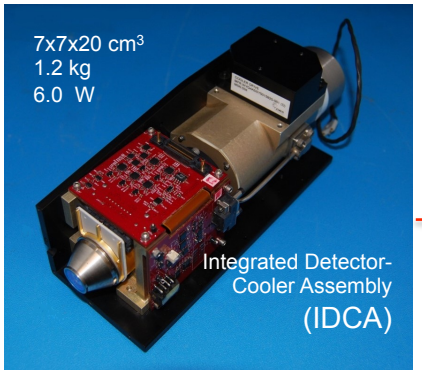
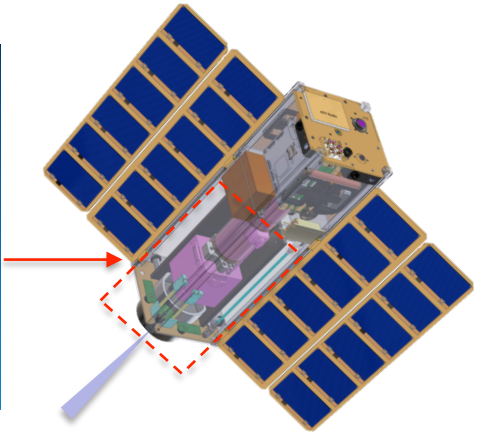
Objective

- Demonstrate that a highly sensitive detector for lidar with >90% quantum efficiency from 0.9 to 4.3 μm and linear mode photon counting (LMPC) response can be achieved in an Earth observing orbital environment
- Demonstrate an integrated detector-cooler assembly (IDCA) and fit within a 3U CubeSat
- Adapt the Aerospace Aerocube™ CubeSat design to accommodate the IDCA and planned science experiments
- Assess the detector's sensitivity to space radiation and its annealing behavior
- Determine suitability of detector for future Earth science missions



2x8 pixel linear mode photon counting HgCdTe avalanche photodiode detector with microlens array in a mini-Stirling (tactical) cooler



3U CubeSat Bus, > 12 W orbit average power, 3-axis stabilized to <0.1 deg pointing uncertainty

Accomplishments

- Although never demonstrated in space, the task developed two flight integrated detector cooler assemblies for space use
- Demonstrated 2x8 pixel HgCdTe avalanche photodiode microlensed arrays with >10x higher sensitivity than existing photon counting detectors over the range of 0.9 to 1.7 um
  - Developed Mini-Stirling cooler and support electronics in a <2U volume and 6 W total electrical power at room temperature
- Successfully completed environmental testing per Goddard Environmental Verification Standard that includes vibration, thermal cycling, and thermal-vacuum
- Performed radiation testing (55 MeV protons to 10 krad(Si)) of detector chips with no measurable degradation after annealing
- Completed 3U CubeSat design and prototyped key components to accommodate payload and perform science experiments
  - Electrical power for payload to operate at 100% duty cycle, filter wheel for detecting laser signals at 1.06, 1.57, or 2.05 μm wavelength, 0.1 deg pointing uncertainty, and the electronics for onboard data acquisition & processing

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TRL_{in} = 5 **TRL_{out} = 6**