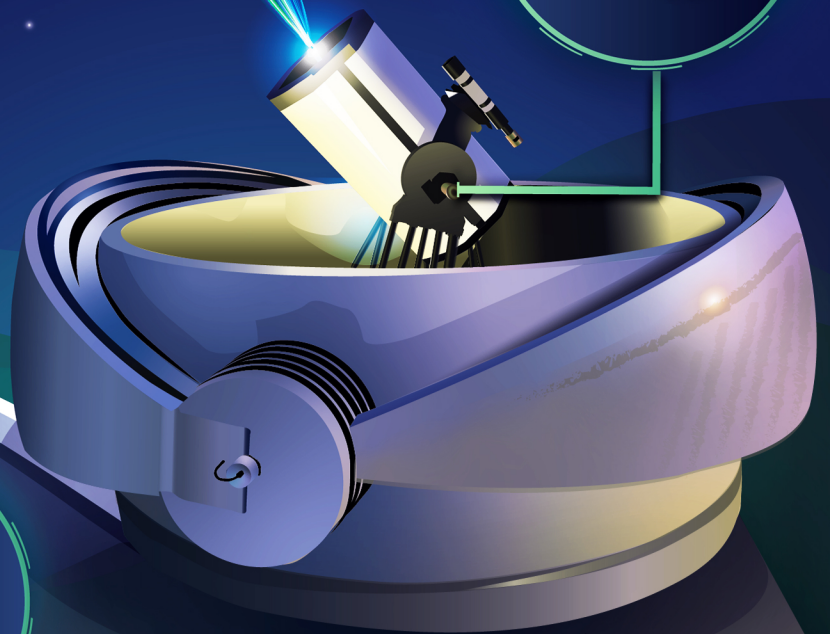
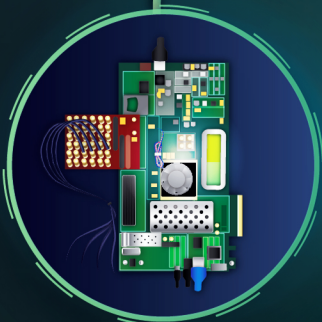
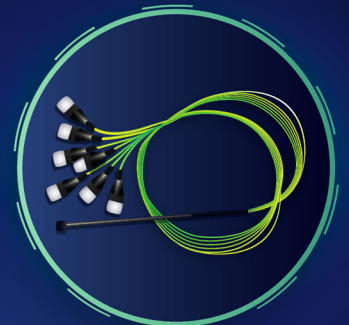




# RealTOR

Real Time Optical Receiver  
Project at NASA's Glenn  
Research Center

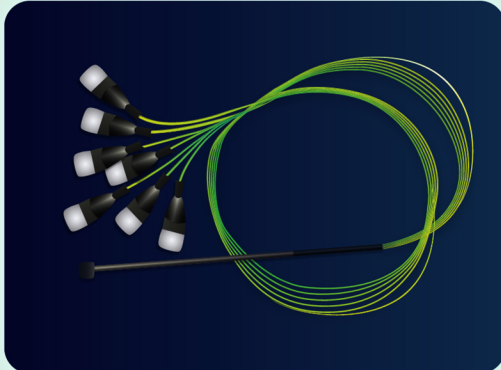
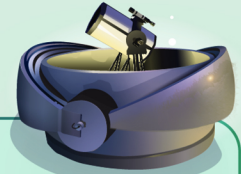


Goddard Geophysical  
and Astronomical Observatory

# ReaTOR Technologies

The Real Time Optical Receiver (ReaTOR) project at NASA's Glenn Research Center is building a portable, scalable, low-cost photon-counting ground receiver. The receiver is compatible with the Consultative Committee for Space Data Systems (CCSDS) High Photon Efficiency (HPE) standard (up to 0.5 ns modes). The receiver is designed with commercial off the shelf parts and the field programmable gate array (FPGA) code will be released internationally for reuse. The architecture of the receiver is designed to scale with data rates. Currently, two fiber/detector architectures are being prototyped and tested in the laboratory. After prototypes are completed, NASA plans to transfer this technology to commercial partners for system integration.

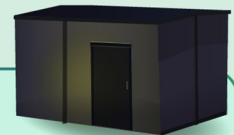
## Low-Cost Optical Terminal



### FREE-SPACE TO FIBER COUPLING

- Prototypes include a few mode fiber or a photonic lantern (one multimode fiber input to multiple FMF outputs)
- Photonics lantern input fiber core size, number of outputs, and output fiber core size scalable to application
- Photonic lantern prototypes have been developed at GRC in partnership with University of Sydney; fabrication process can be transferred to commercial companies with specialized fiber processing capability

## Equipment Shelter



### SINGLE PHOTON DETECTOR

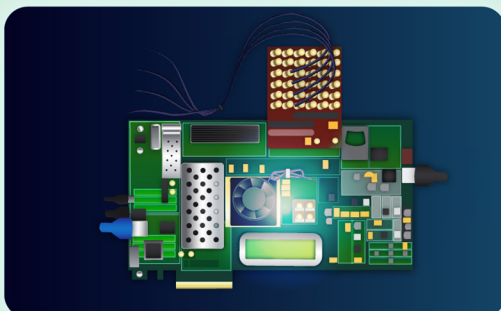
- COTS, portable, rack-mounted, continuous operation, 60-80% efficient
- Prototypes under investigation are FMF coupled single-pixel detectors sharing one cryostat and a single monolithic 16-channel array



### FPGA-BASED RECEIVER

#### FIELD PROGRAMMABLE GATE ARRAY BASED RECEIVER

- COTS FPGA platform used for real time processing
- 1 ADC per detector channel; digital detector channel combining
- Compatible with CCSDS telemetry link optical waveform (high photon efficiency)
- FPGA VHDL receiver code will be released



### FPGA-BASED TRANSMITTER

#### FIELD PROGRAMMABLE GATE ARRAY BASED TRANSMITTER

- Compatible with CCSDS telemetry link optical waveform (high photon efficiency)
- FPGA VHDL code released for international use (<https://software.nasa.gov/software/LEW-20090-1>)