Deep Space Optical Communications (DSOC)

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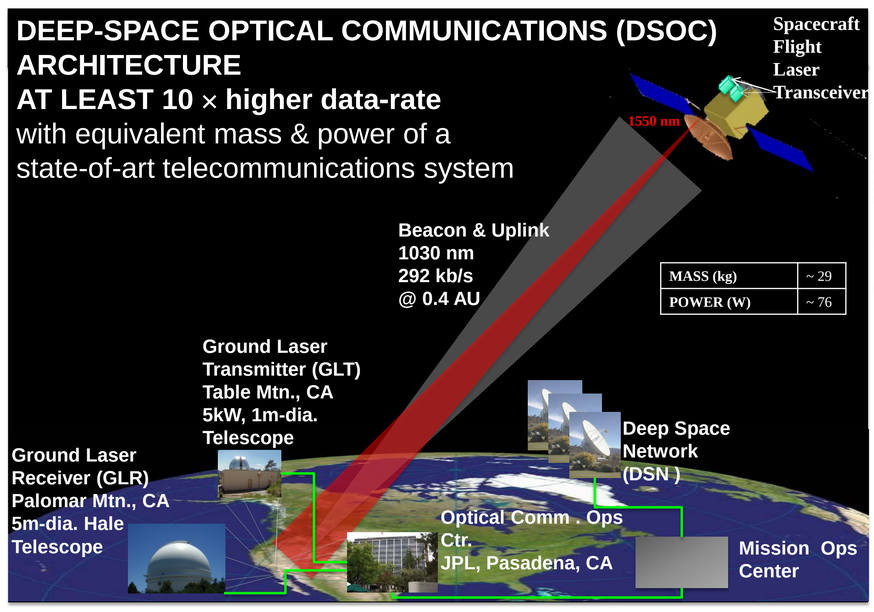
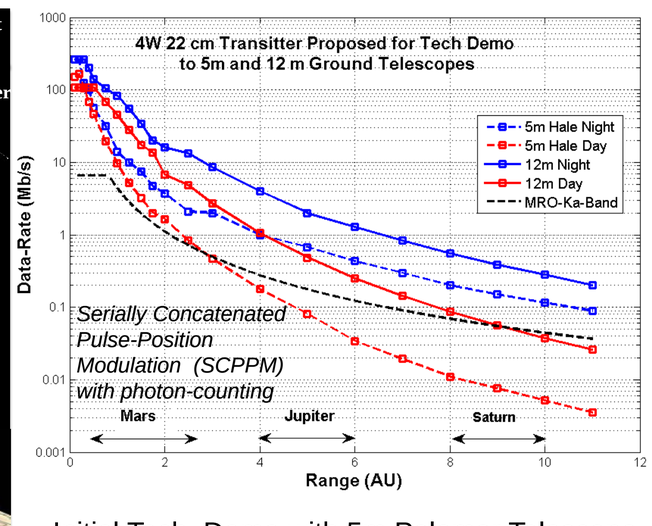
DSOC Project Objectives:

- **Develop technologies for optical communications from deep-space**
- **Perform a Technology Demonstration to retire the risk of implementing an operational capability for future NASA missions throughout solar system**
- **Demonstrate at least a 10× enhanced data-return capacity relative to state of the art deep-space telecommunication systems with equivalent mass and power**
- **Pave the way toward novel light science applications**





- Initial Tech. Demo with 5m Palomar Telescope
- Future ground network with 10-12m telescopes

- **Future Outer Planet Missions can achieve 10 Mb/s from Saturn and 250 kb/s from Neptune by scaling Flight Transceiver to 40cm and 20W**
- **Challenge for distances beyond Saturn : acquire and track link <u>without</u> a laser beacon from Earth**

Benefits to NASA (or significance of results):

- Enable streaming of high-definition video from deep-space
- Support human exploration of deep-space
- Enable use of high data rate science instruments
- Facilitate novel light science applications
  - High precision ranging
  - Laser probing of atmospheres and plasmas

Key flight and ground technologies for DSOC

<u>FLIGHT LASER TRANSCEIVER (FLT)</u>

- Spacecraft Disturbance Isolation Assembly
- Photon-Counting Camera/Uplink Receiver Assembly
- High peak-to-average power Laser Transmitter Assembly

<u>GROUND LASER RECEIVER (GLR)</u>

- Superconducting Nanowire Single Photon-counting Detector (SNSPD) Arrays

1m GLT Beacon Source

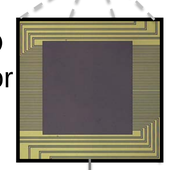
Laser Transmitter

Uplink Modulator

5m GLR Signal Collector

Cryostat

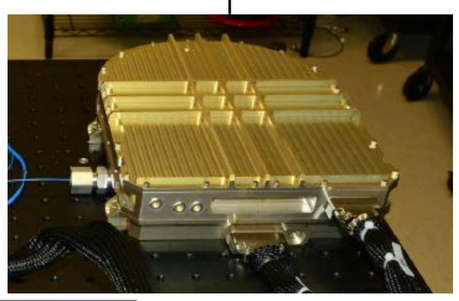
SNSPD Detector Array



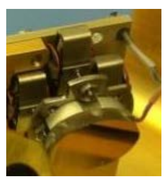
Receiver/Decoder

Channel Combiner

DSOC Ground

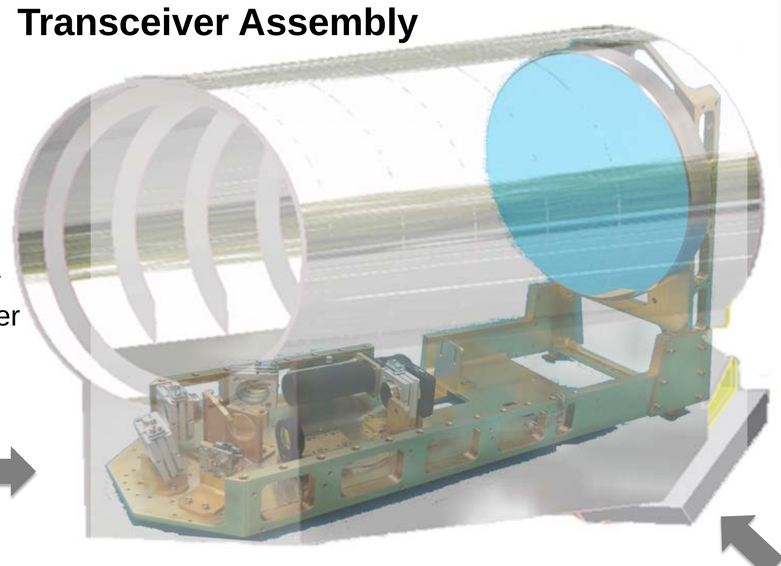


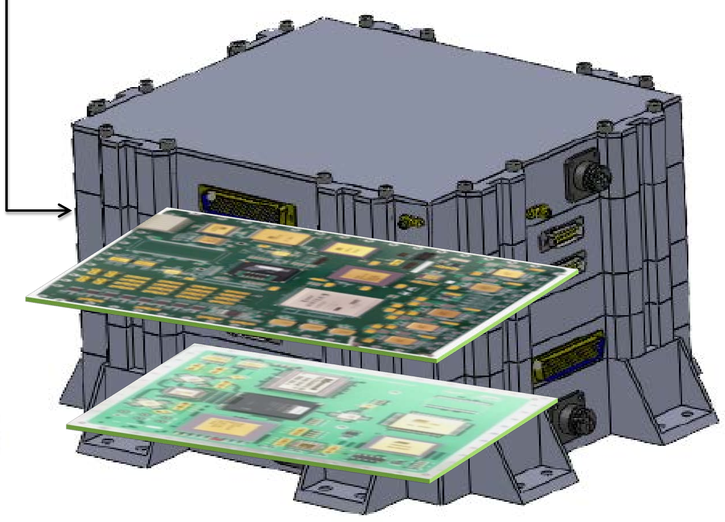
Laser Transmitter Assembly
- High peak-to-average power



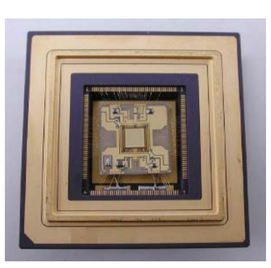
Point-Ahead Mirror
- Supports laser pointing control
- Includes ability to point-ahead

Lightweight Optical Transceiver Assembly

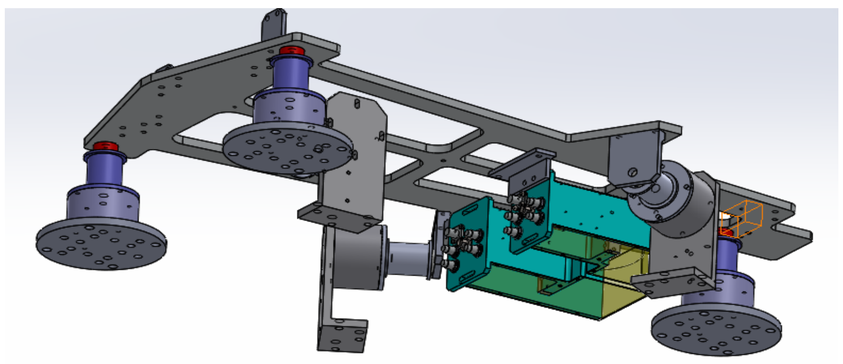




Electronics Assembly
- Processing & Control
- Frequency Standard
- Power Conditioning



Novel space grade photon-counting Detector Array
- High detection efficiency
- One detector for acquisition, tracking, and uplink data
- 1030 – 1080 nm uplink wavelength matched to kW-class Earth beacon lasers
- > 5 year lifetime in deep space



Hybrid active/passive Spacecraft Disturbance Isolation Assembly
- Low mass and power solution
  - Enables optical link acquisition and tracking with dim beacon received at deep-space ranges
  - 50 dB disturbance rejection for typical spacecraft disturbance power spectral density

DSOC Flight Laser Transceiver