National Aeronautics and Space Administration

Next-Generation Deep Space Optical Communication Ground Systems

Principal Investigator: Matthew Shaw (389); Co-Investigators: Abhijit Biswas (337), Andrew Beyer (389), Boris Korzh (389), Emma Wollman (389), Bruce Bumble (389), Erik Alerstam (337), Ryan Rogalin (332), Meera Srinivasan (337), Malcolm Wright (337)

Program: FY21 R&TD Strategic Initiative **Strategic Focus Area: Optimizing Deep Space Optical Communication Ground Systems Awareness**

Ground Technology for Deep Space Optical Communication

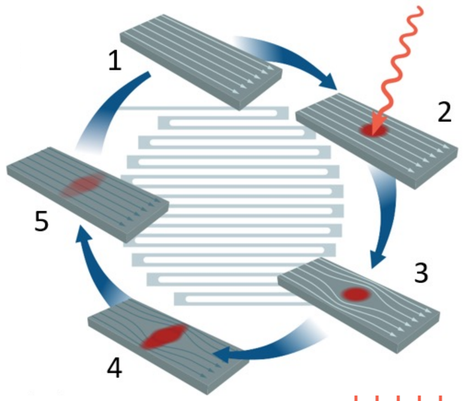
- Performed basic research and technology development to improve superconducting nanowire single photon detectors (SNSPDs) and high-rate receiver electronics to support a future optical DSN
- Targeting a photon counting detector and receiver system capable of processing 6 Gcps with an active area of 3 mm^2
- Represents 6x improvement in speed and 30x improvement in area, simultaneously in the same device

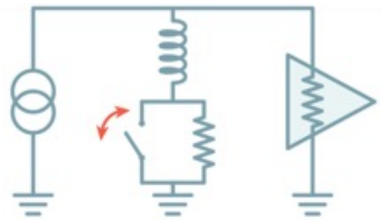
Superconducting Detector Fabrication Process Development

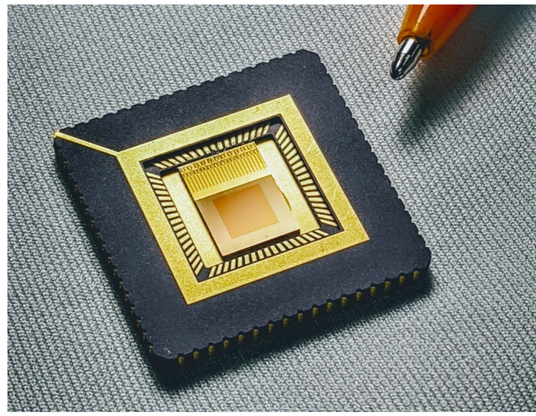
- Performed materials development for Si-rich WSi and small-crystal NbTiN nanowires, which have significant technical advantages over conventional WSi and NbN technologies
- Successfully developed a fabrication process for superconducting "microwires" up to 4 μm wide to obtain larger active areas
- Performed basic fabrication process development implementing Self-Aligned Double Patterning (SADP), an advanced technique to fabricate narrow nanowires using photolithography
- Developed fabrication process for SNSPDs with Distributed Bragg Reflector (DBR) mirrors for higher detection efficiency in Near-IR

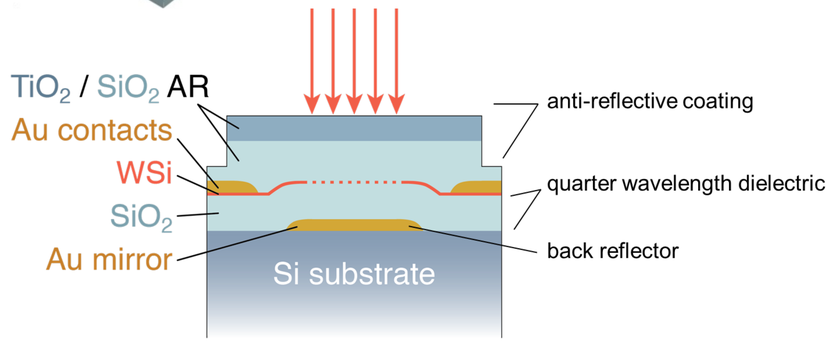
High-Rate Receiver Electronics

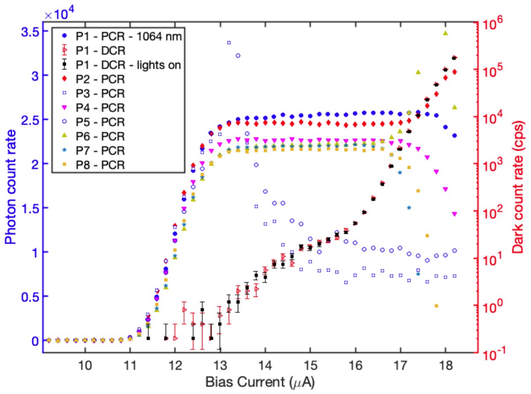
- Demonstrated high-rate time-to-digital converter capable of streaming 6 x 10^9 events per second over PCIexpress (100 Gbps data pipeline) through collaboration with outside contractor (Dotfast Consulting)

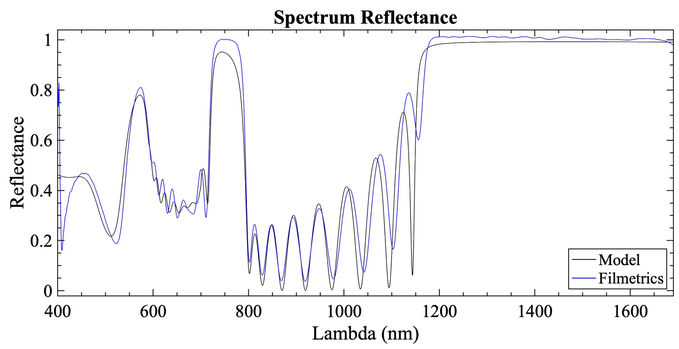


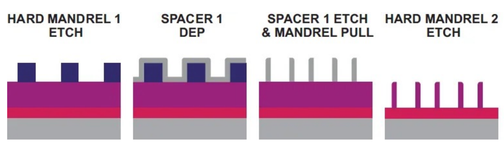












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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

PI/Task Mgr Contact
Email: Matthew.D.Shaw@jpl.nasa.gov

www.nasa.gov

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