National Aeronautics and Space Administration

Breakthrough Science with Hybrid Radio/Optical DSN Tracking Antenna

Principal Investigator: Walid Majid (332); Co-Investigators: Michael Shao (326), Robert Preston (330), Daniel Hoppe (333), Makan Mohageg (332), Charles Naudet (335), Thomas Prince (Caltech), Gregg Hallinan (Caltech), Vikram Ravi (Caltech)

Program: FY22 R&TD Topics
Strategic Focus Area: Gravitational astrophysics and fundamental physics

Objectives:

- Install a low-noise, high-speed camera on the new Radio/Optical hybrid telescope in Goldstone, CA.
- Develop precision timing between radio and optical instruments.
- Develop high-speed photometry capability to enable simultaneous radio and optical observation of fast transients, such as fast radio bursts (FRBs).
- Commission the new instrument and verify synchronous timing between radio and optical wavelengths
- Carry out pilot observations of nearby repeating FRBs.

Background:

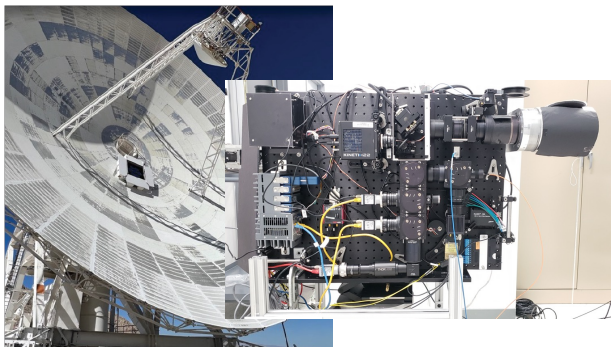
- Fast radio bursts (FRBs) are bright, millisecond duration, radio pulses of unknown origin.
- FRBs are extragalactic phenomenon with enormous energy outputs > 10^{39} erg in the radio band alone.
- As neither the progenitors nor their emission mechanisms are known, simultaneous multi-wavelength studies of repeating FRBs across vastly different wavelengths can constrain emission models.

Technical Approach and Results:

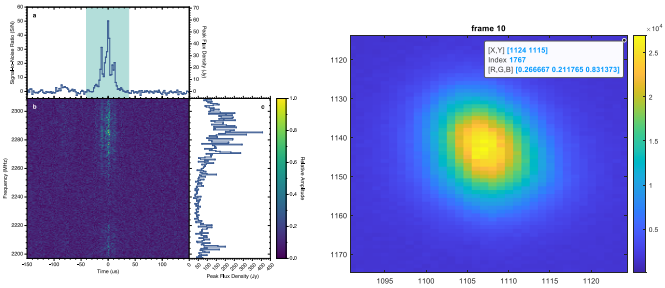
- Procured high-speed, low-noise camera and characterization in lab tests.
- Successful installation and integration in RFO camera box.
- Development of radio trigger.
- Development of high-speed photometric pipelines.
- Begin commissioning observations.

Significance of Results; Benefits to NASA/JPL:

- Unique scientific capabilities: simultaneous radio/optical, high time resolution, large FoV, ease of scheduling, sensitive instruments.
- Excellent sensitivity in both radio and optical, key to new discoveries in an emerging and exciting field in astronomy and astrophysics.

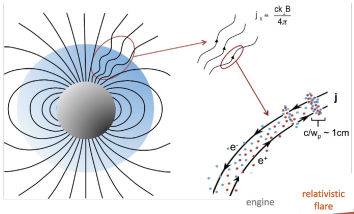


Left panel: RFO's Segmented aperture and camera box installation on DSS-13 at DSN's Goldstone complex in CA. Right panel: RFO camera box.



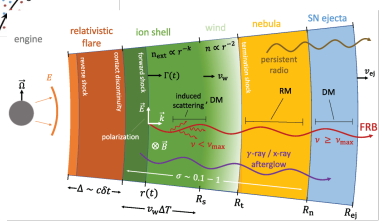
Left panel: FRB dynamic spectrum (Majid 2021 et al.). Right panel: Polaris image obtained from a recent commissioning observations at DSS-13.

Proposed FRB Emission Mechanisms:
Near versus Far



Kumar & Bosnjak 2020

Metzger+ 2019



National Aeronautics and Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

www.nasa.gov

Clearance Number: CL#22-5540
Poster Number: RPC# 22109

PI/Task Mgr. Contact Information:
Email: Walid.A.Majid@jpl.nasa.gov