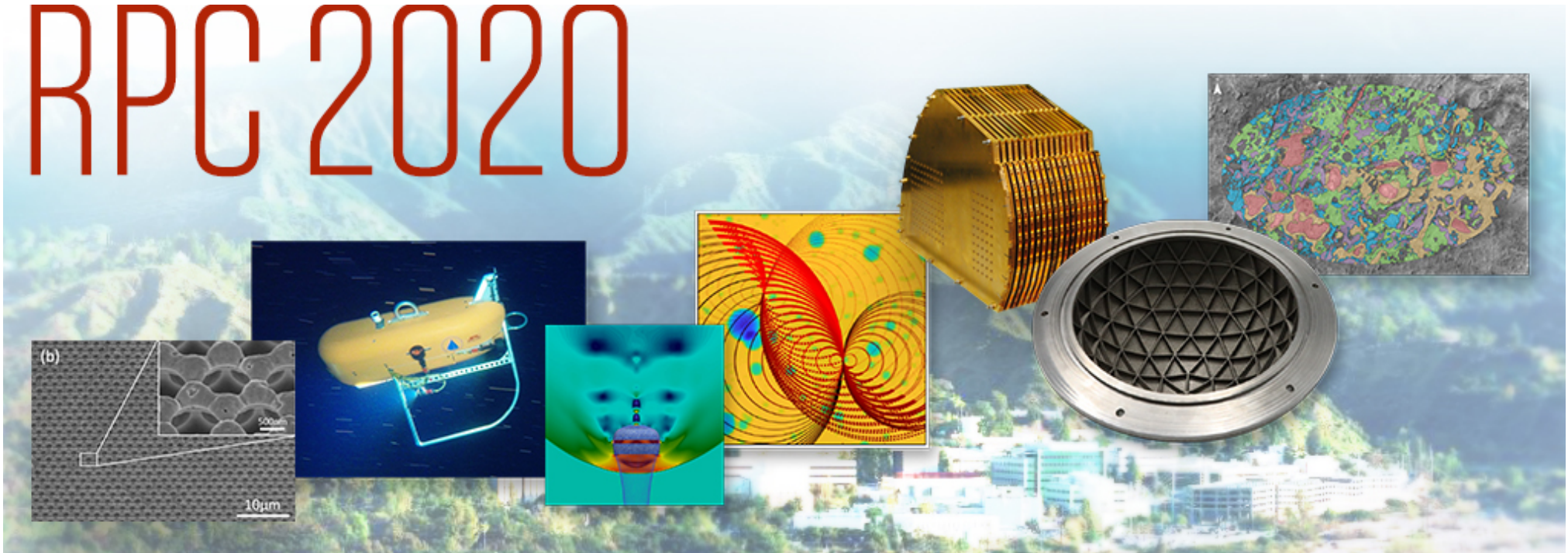


# RPC 2020



## Virtual Research Presentation Conference

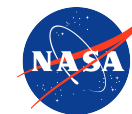
Ultra-High Time Resolution Observations of Fast Radio Bursts

**Principal Investigator:** Thomas Prince (120, Caltech, PMA)

**Co-Is:** Walid Majid (335D)

**Program:** Spontaneous

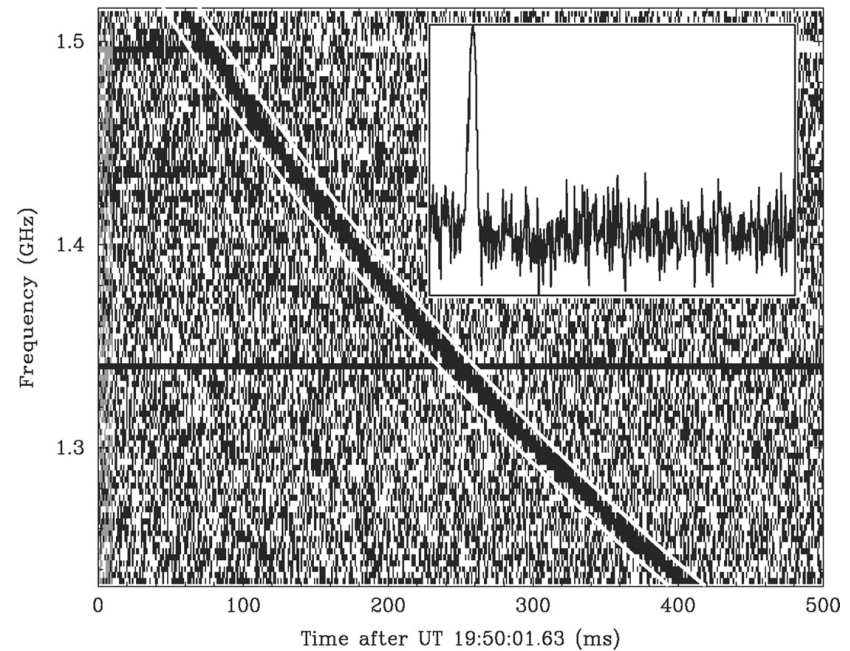
Assigned Presentation # RPC-31



**Jet Propulsion Laboratory**  
California Institute of Technology

## Tutorial Introduction

- Bright millisecond duration radio bursts with flux densities in the range of few mJy – MJy
- Large dispersion measures well in excess of expected values from the Milky Way
- ~10,000 events per sky per day
- Energy densities 10 Billion times larger than from Galactic pulsars



Lorimer+2008

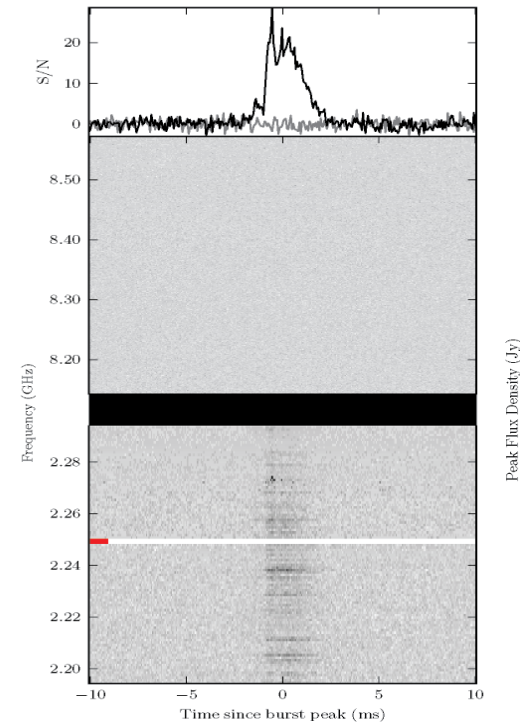
## Program Description

- a) Observe a sample of repeating fast radio bursts simultaneously at multiple radio wavelengths
- b) Make use of the sensitive Deep Space Network dishes with multiple receivers
- c) Carry out observations with high time and high frequency resolution
- d) Constrain the emission mechanism of FRBs through detailed studies of burst spectra
- e) Study propagation effects due to interstellar medium



## Results

- Multi-frequency observation of FRB121102, first repeating FRB
  - Simultaneous observations at S and X-bands
  - Narrow emission bandwidth: Detection of six bursts at S-band and absence of emission at X-band
  - Propagation effects not responsible for narrow-banded emission
  - Paper has been published in ApJL (Majid+2020)
- Coordinated observation of FRB 180916.J0158+65 with Chandra X-ray telescope
  - Constrain energetics of FRBs at high energies
  - Paper submitted to ApJ (Scholz+2020)
- Long term monitoring of FRB 180916.J0158+65 at S and X-bands
  - FRB has been localized using the EVN
  - DSN observations using DSS-14 & DSS-63 at S, X, and L-bands
  - Paper in prep (Pearlman+2020)



Majid et al. 2020

## Significance and Next Steps

### Significance

- Broadband observation of FRBs provide an excellent means to study the emission processes responsible for this puzzling phenomenon.
- Our work has led to several publications, highlighting the unique capabilities of the DSN large dishes for FRB studies. The unique capabilities at the DSN has allowed us to for the first time constrain the broadband nature of FRBs.
- Our early results from FRB121102 was also recently highlighted by the AAS NOVA team as a significant contribution to the study of FRBs.

### Next steps

- Research effort in collaboration with the DSA instrument on Campus is continued through support from a PRPDF program

The screenshot displays the AAS NOVA website, which provides research highlights from the journals of the American Astronomical Society. The page features a navigation bar with links for HOME, HIGHLIGHTS, and JOURNALS DIGEST, along with social media icons and a search bar. The main content area is divided into two columns: HIGHLIGHTS and JOURNALS DIGEST. The HIGHLIGHTS section lists several articles with dates, categories, and brief descriptions. The JOURNALS DIGEST section lists articles from various journals, including Citlalmittl, Planet, and ApJ.

**AAS NOVA** Research highlights from the journals of the American Astronomical Society

HOME HIGHLIGHTS JOURNALS DIGEST

**HIGHLIGHTS**

- 18 September 2020** **FEATURE**  
**Different Views of a Fast Radio Burst**  
What does a fast radio burst look like at different frequencies? And what can that tell us about them?
- 16 September 2020** **FEATURES**  
**Forecasting Eruptions of Solar Flares**  
A new look at hundreds of past solar flares may help us predict when a solar flare will be accompanied by a potentially hazardous ejection of mass.
- 15 September 2020** **ASTROBITES**  
**A Windy Day in the Milky Way**  
Astrobites reports on how winds in star clusters can drive dramatic turbulence in enormous, expanding superbubbles.
- 14 September 2020** **IMAGES**  
**Featured Image: Simulating the Birth of a Close Binary**  
Ever wondered how stellar binaries form? Check out this numerical simulation, which tracks the process over 400 years.
- 11 September 2020** **FEATURE**  
**A Satellite for Eurybates**  
It turns out that this asteroid – a target for the upcoming Lucy mission, which will visit Jupiter trojans – isn't alone.
- 9 September 2020** **FEATURES**  
**An Update on Fast Radio Bursts: New Discoveries in Our...**  
Have we recently spotted the first equivalent of a fast radio burst located within our own galaxy?
- 8 September 2020** **ASTROBITES**  
**Detecting Non-Uniform Clouds on Hot Jupiters in the Era of...**  
Astrobites reports on how we can find non-uniform cloud cover on exoplanets using the James Webb Space Telescope.
- 4 September 2020** **FEATURES**  
**History as Told by a Merger Background**  
How does the rate of binary black hole mergers change with time? The gravitational waves produced by undistinguished individual mergers might be able to help.
- 2 September 2020** **FEATURES**  
**LIGO/Virgo's Newest Merger Defies Mass Expectations**  
The two black holes that merged in GW190521 are the most massive we've observed yet, and this has major astrophysical implications.

**JOURNALS DIGEST**

- 18 September 2020**  
**Citlalmittl: A Laser-based Device for Meteoritical Sample Fabrication with Arbitrary Thermal Histories**  
Patricia Hernández-Reséndiz et al. 2020 Planet. Sci. J. 1 34  
Citlalmittl is a new experimental device designed and built to simulate high-temperature processes relevant for meteorites, including chondrule formation and atmospheric reentry of micrometeorites.
- 17 September 2020**  
**Does Matter Matter? Using the Mass Distribution to Distinguish Neutron Stars and Black Holes**  
Maya Fishbach et al. 2020 ApJ. 899 L8  
Analysis of the 11 detections from LIGO/Virgo's first gravitational-wave catalog shows that the gravitational-wave data alone suggests that neutron stars and black holes represent two distinct populations of compact objects.
- 16 September 2020**  
**Low-Albedo Surfaces of Lava Worlds**  
Zahra Essack et al. 2020 ApJ. 898 160  
Experimental measurements of molten silicates and quenched glasses – a product of rapidly cooled lava – indicate that hot super-Earth lava planets with solid or liquid surfaces have low albedos.
- 15 September 2020**  
**Challenges in Scientific Data Communication from Low-mass Interstellar Probes**  
David G. Messerschmitt et al. 2020 ApJ. 249 36  
This study explores fundamental physical and statistical communication limitations on the return of scientific data from a fleet of laser-beam-propelled, relativistic interstellar spacecraft.

MORE HIGHLIGHTS

## Publications and References

[A] Majid, W. A., Pearlman, A. B., Prince, T. A., et al., “A Dual-band Radio Observation of FRB 121102 with the Deep Space Network and the Detection of Multiple Bursts”, *The Astrophysical Journal Letters*, 897, L4 (2020).

[B] Scholz, P., Cook, A, Cruces, M., et al., “Simultaneous X-ray and Radio Observations of the Repeating Fast Radio Burst FRB 180916.J0158+65”, Submitted to the *Astrophysical Journal*, arXiv:2004.06082 (2020).

[C] Pearlman, A. B., Majid, W. A, Prince, T. A., et al., “MULTIWAVELENGTH RADIO OBSERVATIONS OF TWO REPEATING FAST RADIO BURST SOURCES: FRB 121102 AND FRB 180916.J0158+65”, To be submitted to *The Astrophysical Journal* (2020).