

# Deep Space Exploration Society Science Meeting



July 27, 2020

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Autotracking ushers in new  
era for DSES!

# Information

- 9 ft Dish – Down because hard drive crashed
- SuperSID – Down because of hard drive crash
- Radio Jupiter – still need to get a new receiver and setup at site
- Pulsar – Last observation trip Saturday – no pulsars
  - Used the new autotracking system – worked GREAT!!!!
  - Lots of lightning – may have contributed to obscuring the pulsars in the data
  - Need to arrive earlier to observe +54 to verify the system works
- SARA East Conference – recommend everyone virtually attend: August 1-2 [www.radio-astronomy.org](http://www.radio-astronomy.org)
- Recommended to do Fast Radio Bursts – can utilize the pulsar equipment without modifications – just large data collection requirements

# Observation Run 7-25-20

- Observers: Rich Ray, Bob and Glenn
- Arrived around 5pm left at midnight
- Replaced cable in feed
- New DSES record for combined age on tower! (160+)
- Tested auto tracking – worked great!
- Conducted 4 observation runs (3 on B1749-28 and 1 on B1642-03)
- No luck on them! Possibly because of lightning storm.



# Antenna Feed Plan

(needs to be coordinated by Engineering Meeting)

- Moon Bounce – 1296 MHz TX/RX
- SETI Observations 1420 MHz RX
- Pulsar Observations 1420 MHz RX
- HI Observations 1420 MHz RX
- Pulsar / FRB Observations 408 MHz RX

# 2020 Observation/ Feed Schedule

- July – Antenna down for maintenance
  - Week 4 1420 MHz – Antenna radio source pointing calibration observations
- August
  - Week 1-4: 1420 MHz Feed
    - Skip's Project (TBD)
    - HI Measurements – SpectraCyber
    - Pulsar Measurements
- September
  - Week 1-4 408 MHz Feed
  - Pulsar Measurements
- October
  - Week 1-3: 1296 MHz
  - Oct 10-11 Moonbounce (1296 MHz): <http://www.arrl.org/contest-calendar>
  - Week 4: 1420 MHz – Skips Project
- November
  - Week 1-3: 408 MHz – Pulsar Observations
  - Week 4: Moonbounce (1296 MHz)
  - Nov 28-29 Moonbounce (1296 MHz): <http://www.arrl.org/contest-calendar>
- December
  - Week 1-4 408 MHz Pulsar/FRB

# SARA Virtual Eastern Conference

## [www.radio-astronomy.org](http://www.radio-astronomy.org)

**Saturday and Sunday!**



### Society of Amateur Radio Astronomers

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#### Society of Amateur Radio Astronomers (SARA) Mission Statement



2019 SARA Group Photo



2019 Western Conference



2018 SARA group photo

#### 2020 SARA Conference Keynote Speaker



For all the curious minds in the world, Paul M. Sutter is a new, fresh voice in science communication. Everywhere from his hit podcast Ask a Spaceman! to his role on TV's How the Universe Works, Paul strives to bring science to new audiences.

[Read more](#)

#### The SARA Eastern Conference has gone 100% Virtual!

We are sorry that we will not be able to see each other at Green Bank this year but we are planning to restart the physical conferences next year at the VLA for the Western Conference and Green Bank for the Eastern Conference. The virtual conference will be held on Saturday and Sunday to allow for peoples work. The new dates are 1-2 August 2020. The schedule will include sessions all day Saturday and half of the day Sunday afternoon to accommodate peoples worship services in the morning.

#### Join SARA!

##### SARA Annual Conference

- Live streaming
- Conference info
- Conference Schedule
- Keynote Speaker
- Paper Abstracts
- Conference registration



#### Find Astronomy Events & Clubs (USA)

City:

State:

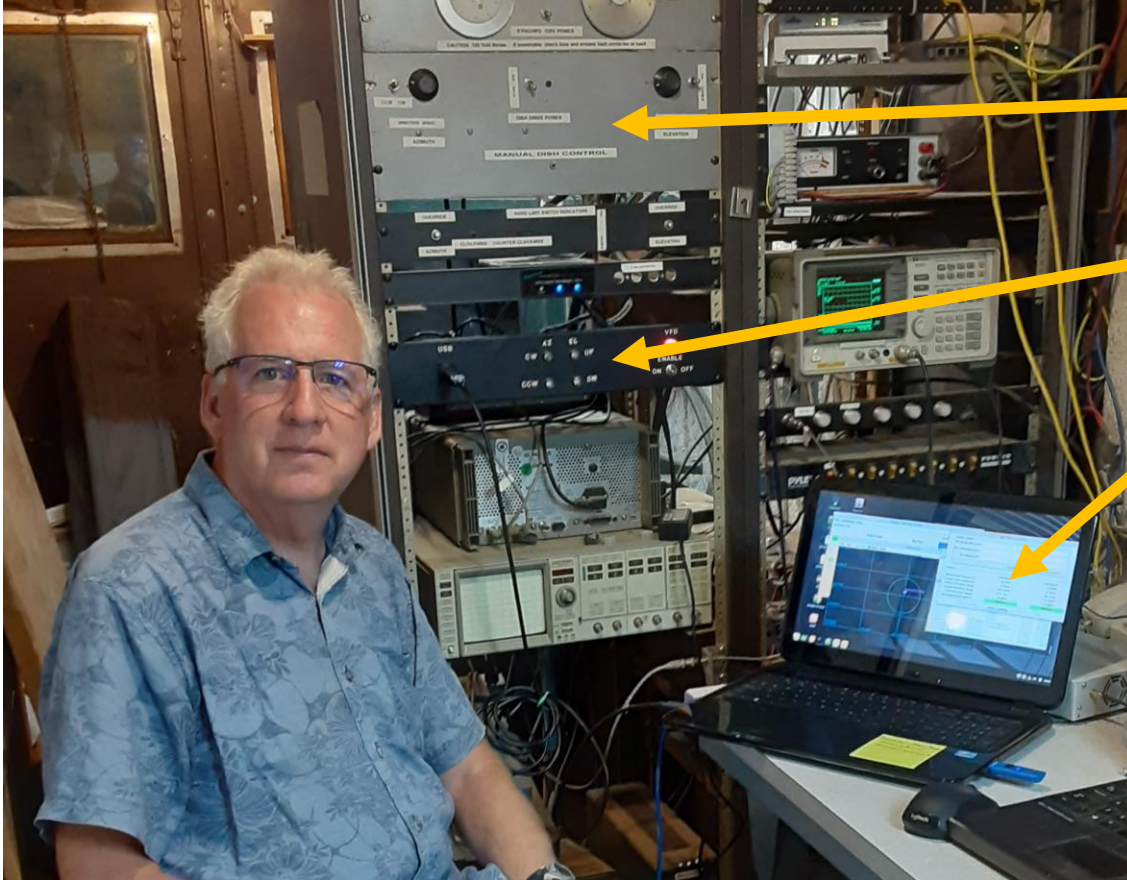
Zip:

☒ Clubs  
☐ Events





# Autotracking!



Manual-tracking Interface Box

Auto-tracking Interface Box

System 1 Laptop

New “Autotracking” software selection

## Tracking

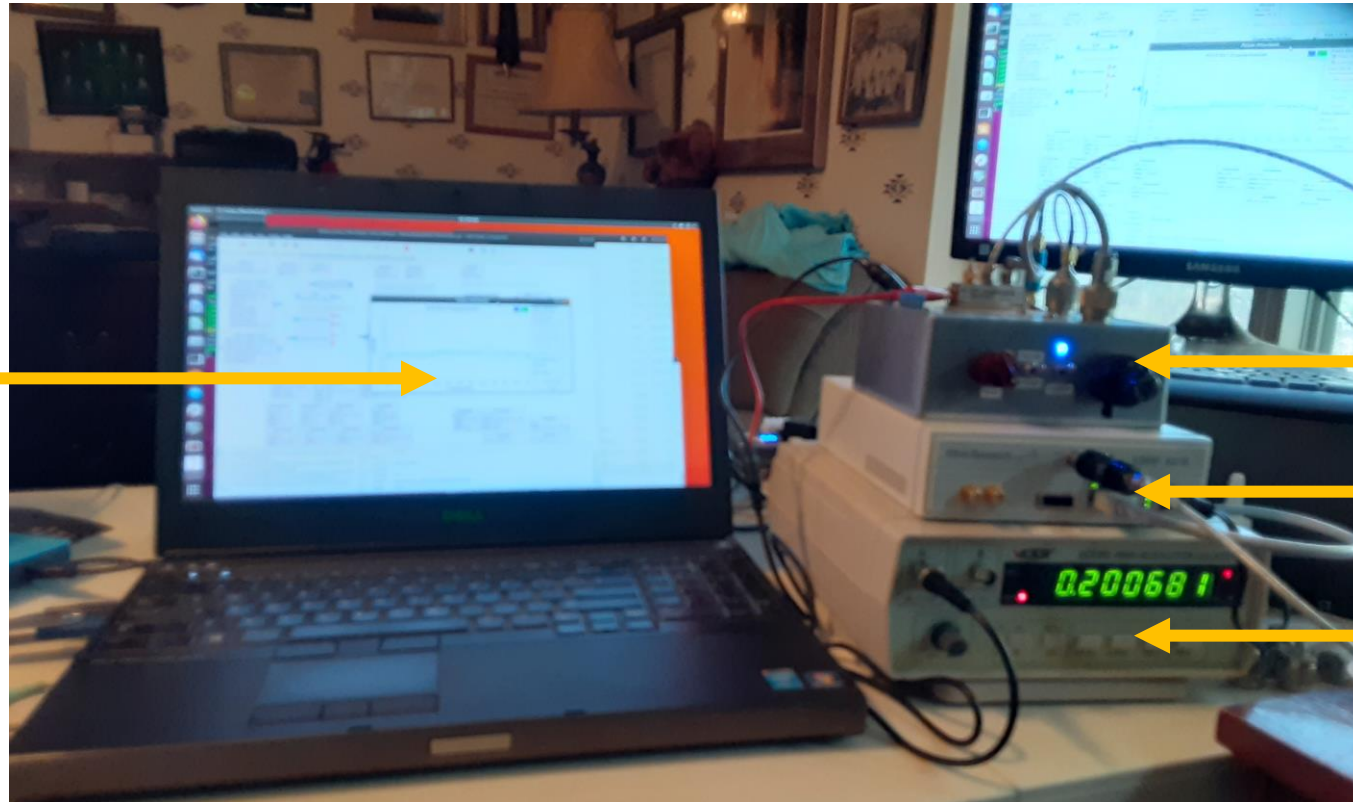
- 1) Jones plug is in manual tracking box (allows antenna operation without the computer)
- 2) For auto-tracking
  - 1) Move Jones plug to auto-tracking interface box
  - 2) Attach USB plug from interface box to computer
  - 3) At computer - start auto-tracking ICON
  - 4) Power up interface box
  - 5) Operate Autotracking per menu
  - 6) On shutdown – move Jones plug back to manual tracking interface box

**Congratulate Glenn Davis, Phil Gage,  
and Lewis Putnam!**

# Pulsar Simulator

Designed and Built by Ray Uberecken

Collecting pulse data  
From simulator



Pulsar Simulator

N210 Receiver

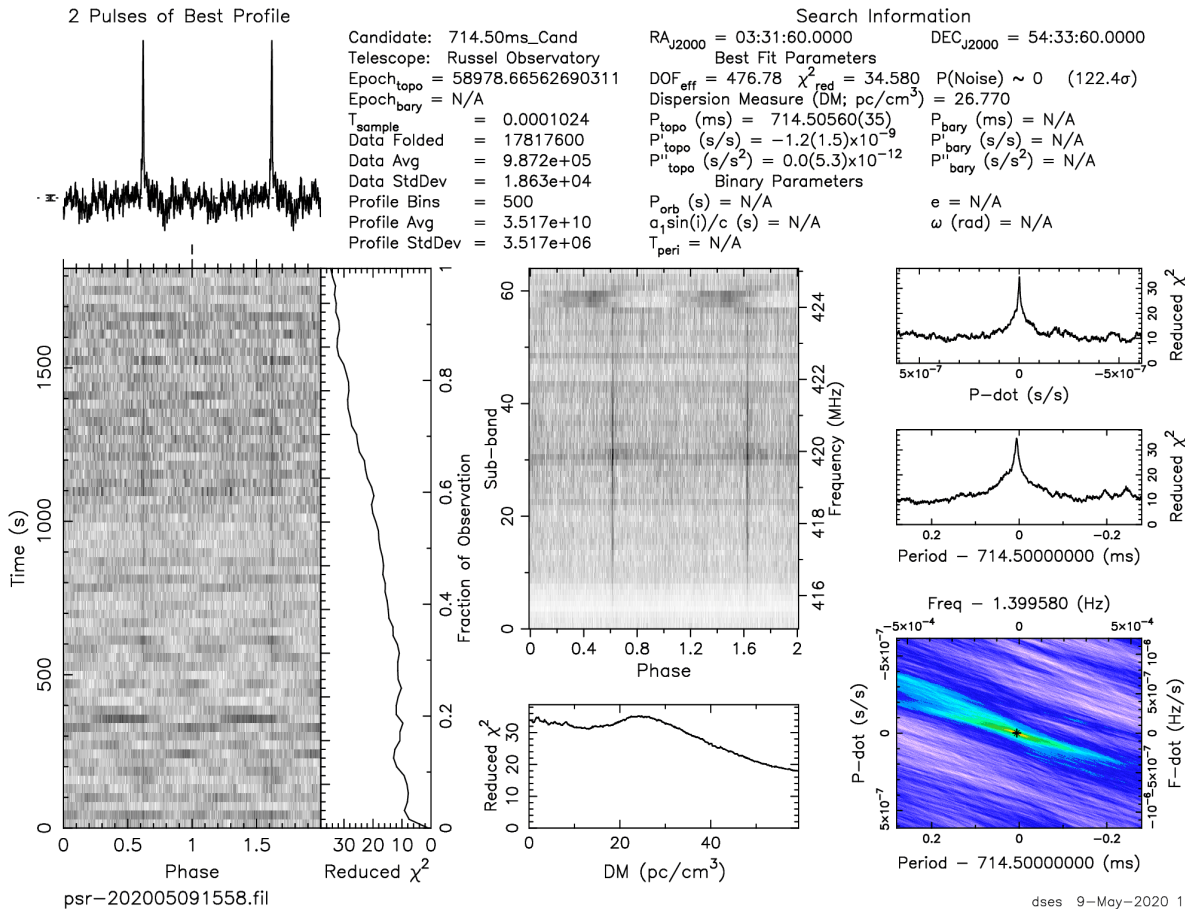
Frequency Counter



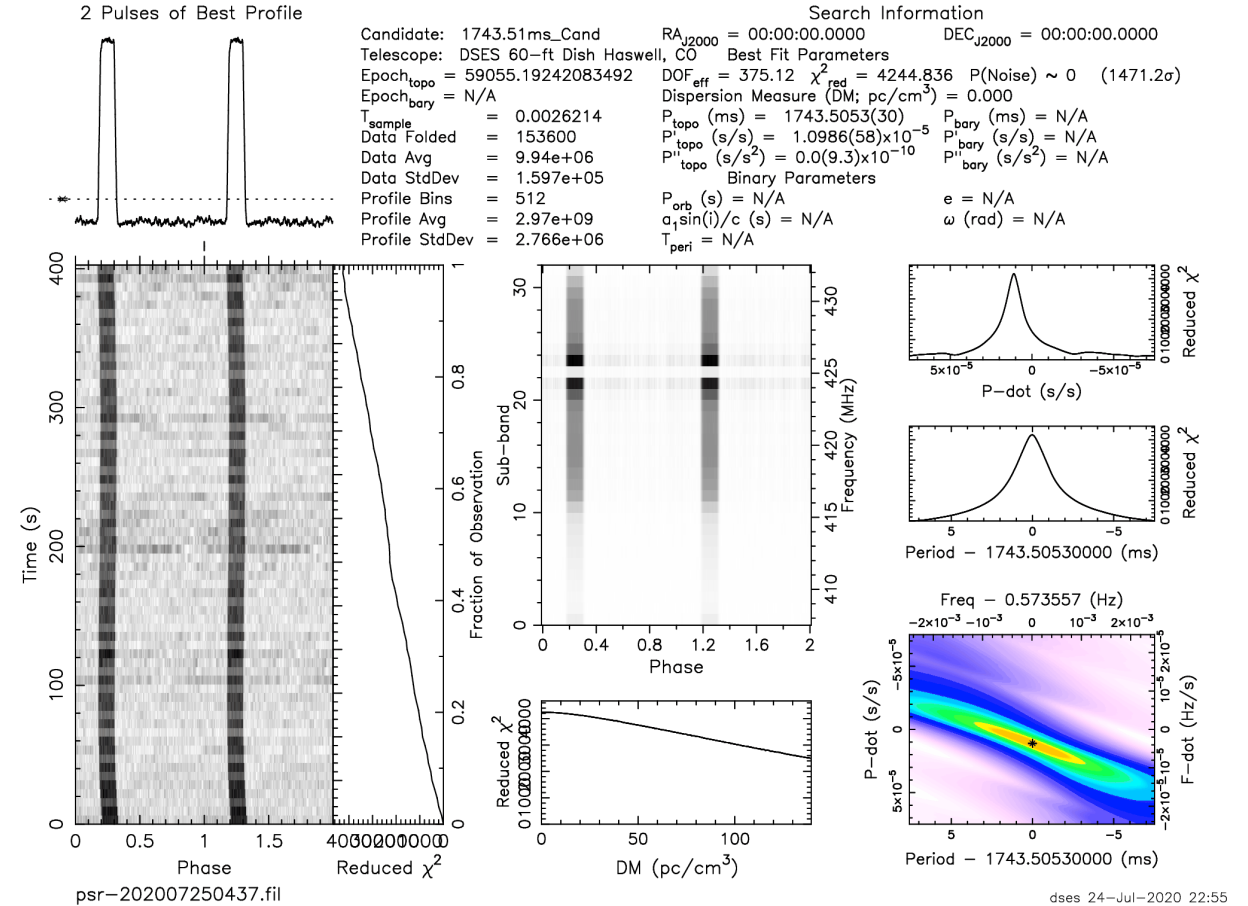
# Pulsar Simulator Output

Pulse Period: 0.2 to 1.3 Seconds

Pulse Width: Narrow to wide (haven't measured yet)



dses 9-May-2020 1



dses 24-Jul-2020 22:55

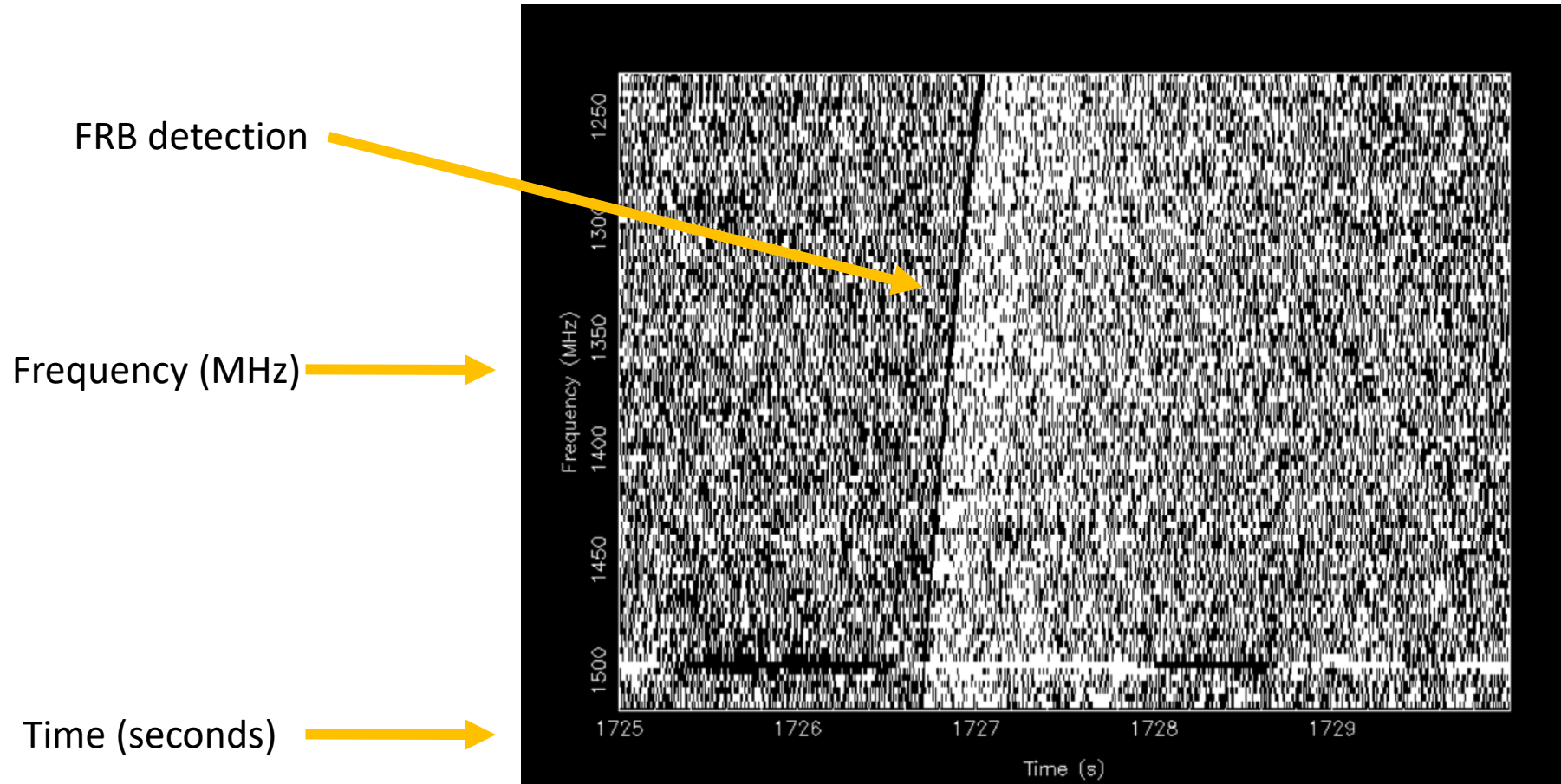
# Science Training

## Fast Radio Bursts

- [https://en.wikipedia.org/wiki/Fast\\_radio\\_burst](https://en.wikipedia.org/wiki/Fast_radio_burst)
- Fast transients (ms level)
- First identified FRB was the Lorimer Burst
- Most FRBs are 1 time events
- Some FRBs repeat – we would use these to test system
- Recommended by Wolfgang Hermann (Astropeiler group) for DSES to take FRB observations with 60 ft antenna
  - Drift scan
  - Uses pulsar system
  - May require large storage to collect days of data
  - Data would be analyzed by us and/or the Astropeiler group to look for FRBs

# FRBs

## Lorimer Burst



[https://en.wikipedia.org/wiki/Fast\\_radio\\_burst#/media/File:Frb\\_1.png](https://en.wikipedia.org/wiki/Fast_radio_burst#/media/File:Frb_1.png)

# Current Observed FRBs

Name	Date and time (UTC) for 1581.804688 MHz	RA (J2000)	Decl. (J2000)	DM (pc·cm <sup>-3</sup> )	Width (ms)	Peak flux (Jy)	Notes
FRB 010621 <sup>[137]</sup>	2001-06-21 13:02:10.795	18 <sup>h</sup> 52 <sup>m</sup>	−08° 29′	746	7.8	0.4	
FRB 010724 <sup>[32]</sup>	2001-07-24 19:50:01.63	01 <sup>h</sup> 18 <sup>m</sup>	−75° 12′	375	4.6	30	"Lorimer Burst"
FRB 011025 <sup>[138]</sup>	2001-10-25 00:29:13.23	19 <sup>h</sup> 07 <sup>m</sup>	−40° 37′	790	9.4	0.3	
FRB 090625 <sup>[122]</sup>	2009-06-25 21:53:52.85	03 <sup>h</sup> 07 <sup>m</sup>	−29° 55′	899.6	<1.9	>2.2	
FRB 110220 <sup>[63]</sup>	2011-02-20 01:55:48.957	22 <sup>h</sup> 34 <sup>m</sup>	−12° 24′	944.38	5.6	1.3	
FRB 110523 <sup>[40][35]</sup>	2011-05-23	21 <sup>h</sup> 45 <sup>m</sup>	−00° 12′	623.30	1.73	0.6	700–900 MHz at <a href="#">Green Bank</a> radio telescope, detection of both circular and linear polarization.
FRB 110627 <sup>[63]</sup>	2011-06-27 21:33:17.474	21 <sup>h</sup> 03 <sup>m</sup>	−44° 44′	723.0	<1.4	0.4	
FRB 110703 <sup>[63]</sup>	2011-07-03 18:59:40.591	23 <sup>h</sup> 30 <sup>m</sup>	−02° 52′	1103.6	<4.3	0.5	
FRB 120127 <sup>[63]</sup>	2012-01-27 08:11:21.723	23 <sup>h</sup> 15 <sup>m</sup>	−18° 25′	553.3	<1.1	0.5	
FRB 121002 <sup>[139]</sup>	2012-10-02 13:09:18.402	18 <sup>h</sup> 14 <sup>m</sup>	−85° 11′	1628.76	2.1; 3.7	0.35	double pulse 5.1 ms apart

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FRB 121002 <sup>[122]</sup>	2012-10-02 13:09:18.50	18 <sup>h</sup> 14 <sup>m</sup>	−85° 11′	1629.18	<0.3	>2.3	
FRB 121102 <sup>[140]</sup>	2012-11-02 06:35:53.244	05 <sup>h</sup> 32 <sup>m</sup>	+33° 05′	557	3.0	0.4	by <a href="#">Arecibo</a> radio telescope Repeating bursts, <sup>[4][5][48][16]</sup> very polarized.
FRB 130626 <sup>[122]</sup>	2013-06-26 14:56:00.06	16 <sup>h</sup> 27 <sup>m</sup>	−07° 27′	952.4	<0.12	>1.5	
FRB 130628 <sup>[122]</sup>	2013-06-28 03:58:00.02	09 <sup>h</sup> 03 <sup>m</sup>	+03° 26′	469.88	<0.05	>1.2	
FRB 130729 <sup>[122]</sup>	2013-07-29 09:01:52.64	13 <sup>h</sup> 41 <sup>m</sup>	−05° 59′	861	<4	>3.5	
FRB 131104 <sup>[141]</sup>	2013-11-04 18:04:01.2	06 <sup>h</sup> 44 <sup>m</sup>	−51° 17′	779.0	<0.64	1.12	'near' <a href="#">Carina Dwarf Spheroidal Galaxy</a>
FRB 140514 <sup>[142]</sup>	2014-05-14 17:14:11.06	22 <sup>h</sup> 34 <sup>m</sup>	−12° 18′	562.7	2.8	0.47	21 ±7 per cent (3σ) circular polarization
FRB 150215 <sup>[143][144]</sup>	2015-02-15 20:41:41.714	18 <sup>h</sup> 17 <sup>m</sup> 27 <sup>s</sup>	−04° 54′ 15″	1105.6	2.8	0.7	43% linear, 3% circular polarized. Low galactic latitude. Low/zero <a href="#">rotation measure</a> . Detected in real time. Not detected in follow up observations of gamma rays, X-rays, neutrinos, IR etc. <sup>[143]</sup>
FRB 150418	2015-04-18 04:29	07 <sup>h</sup> 16 <sup>m</sup>	−19° 00′	776.2	0.8	2.4	Detection of linear polarization. The origin of the burst is disputed. <sup>[69][70][71][72]</sup>
unnamed	2015-05-17 2015-06-02	05 <sup>h</sup> 31 <sup>m</sup> 58 <sup>s</sup> (average)	+33° 08′ 04″ (average)	559 (average)	0.02–0.31	2.8–8.7	10 repeat bursts at FRB 121102 location: 2 bursts on May 17 and 8 bursts on June 2 <sup>[44][45]</sup> and 1 on 13 Nov 2015, 4 on 19 Nov 2015, and 1 on 8



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FRB 170827 <sup>[146]</sup>	2017-08-27 16:20:18	00 <sup>h</sup> 49 <sup>m</sup> 18.66 <sup>s</sup>	−65° 33′ 02.3″	176.4	0.395		low DM
FRB 170922 <sup>[147]</sup>	2017-09-22 11:23:33.4	21 <sup>h</sup> 29 <sup>m</sup> 50.61 <sup>s</sup>	−07° 59′ 40.49″	1111	26		extreme scattering (long pulse)
FRB 171020	2017-10-20 10:27:58.598	22:15	− 19:40	114.1±0.2	3.2		ASKAP s/n=19.5 G-Long'=29.3 G-lat'=-51.3 Lowest DM so far. <sup>[148]</sup>
FRB 171209 <sup>[149]</sup>	2017-12-09 20:34:23.5	15 <sup>h</sup> 50 <sup>m</sup> 25 <sup>s</sup>	−46° 10′ 20″	1458	2.5	2.3	Seems to be in the same location as GRB 110715A <sup>[21]</sup>
FRB 180301 <sup>[150]</sup>	2018-03-01 07:34:19.76	06 <sup>h</sup> 12 <sup>m</sup> 43.4 <sup>s</sup>	+04° 33′ 44.8″	520	3	0.5	positive spectrum, from Breakthrough Listen
FRB 180309 <sup>[151]</sup>	2018-03-09 02:49:32.99	21 <sup>h</sup> 24 <sup>m</sup> 43.8 <sup>s</sup>	−33° 58′ 44.5″	263.47	0.576	12	
FRB 180311 <sup>[152]</sup>	2018-03-11 04:11:54.80	21 <sup>h</sup> 31 <sup>m</sup> 33.42 <sup>s</sup>	−57° 44′ 26.7″	1575.6	12	2.4	
FRB 180725A <sup>[81][153]</sup>	2018-07-25 17:59:43.115	06 <sup>h</sup> 13 <sup>m</sup> 54.7 <sup>s</sup>	+67° 04′ 00.1″	716.6	2		first detection of an FRB at radio frequencies below 700 MHz Realtime detection by CHIME.
FRB 180814 <sup>[7]</sup>							Detected by CHIME. Second repeating FRB to be discovered and first since 2012.
FRB 180916	2018-09-16 10:15:19.803	01 <sup>h</sup> 58 <sup>m</sup> 00.75 <sup>s</sup>	+65° 43′ 00.5″	349.2 ± 0.4	1.4 ± 0.07	1.4 ± 0.6	repeating FRB localized to a nearby (450 million lyr) spiral galaxy. 16.35 day periodicity. <sup>[154]</sup>
FRB 180924 <sup>[98]</sup>	2018-09-24 16:23:12.6265	21 <sup>h</sup> 44 <sup>m</sup> 25.26 <sup>s</sup>	−40° 54′ 0.1″	361.42	1.3	16	first non-repeating FRB whose source has been localized; a galaxy 3.6 billion light-years away

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FRB 180924 <sup>[98]</sup>	2018-09-24 16:23:12.6265	21 <sup>h</sup> 44 <sup>m</sup> 25.26 <sup>s</sup>	-40° 54' 0.1"	361.42	1.3	16	first non-repeating FRB whose source has been localized; a galaxy 3.6 billion light-years away
FRB 190523							A non-repeating FRB – localised to a galaxy at nearly 8 billion lyr
FRB 200428	2020-04-28	19 <sup>h</sup> 35 <sup>m</sup>	+21° 54'	332.8	—	—	first ever detected FRB inside the <a href="#">Milky Way</a> about 30,000 lyr; first ever linked to a known source: the <a href="#">magnetar SGR 1935+2154</a>

# FRB Plan

- Collect data on the Crab pulsar – the large pulses are similar to an FRB and test the detection software
- Buy 2<sup>nd</sup> pulsar system (get donations)
  - High End multi-core LINUX Computer (load with GNU, PRESTO, etc...)
  - SDR (use the N210, B210 or even X310 SDRs)
  - Determine large storage requirements – maybe a RAID device
    - Use the pulsar simulator to take days of data to estimate storage requirements
- Conduct Drift Scans
- Process data locally and/or ship to Wolfgang for analysis

# Pictures by Glenn Davis



Questions?