







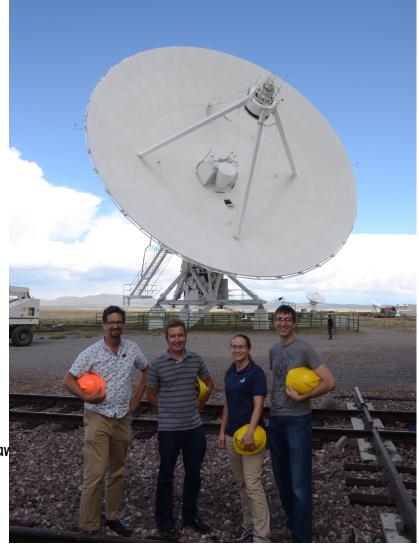








- Geoff Bower (ASIAA)
- Sarah Burke-Spolaor (WVU)
- Bryan Butler (NRAO; NRAO lead)
- Paul Demorest (NRAÓ)
- Shakeh Khudikyan (JPL)
- Casey Law (UC Berkeley; Principal Investigator; clav
- Joe Lazio (JPL)
- Martin Pokorny (NRAO)
- James Robnett (NRAO)
- Michael Rupen (DRAO)



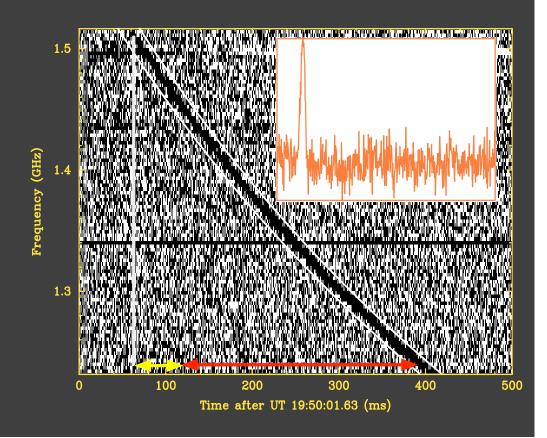
Fast Radio Bursts

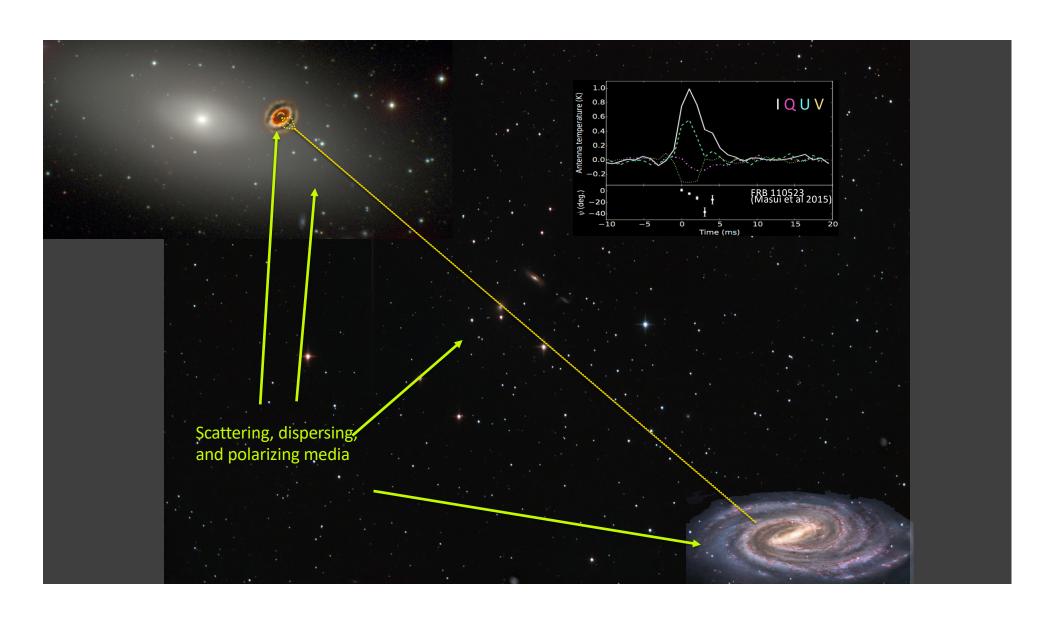
- Millisecond bursts of radio waves.
- "Dispersed" –
 earlier at higher frequencies,
 later at lower.
- Excess dispersion
 → origin outside our Galaxy.
- One-off events.

Pictured: FRB 010724 (Lorimer et al. 2007).

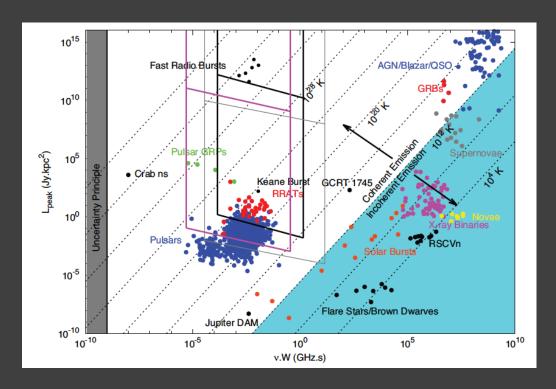
Galactic dispersion; extragalactic dispersion.

$$\label{eq:defDM} \begin{split} \mathsf{DM} &= \int n_e \ dl \\ \mathsf{dt} &= \mathsf{DM} \ \mathsf{f}^{\text{-2}} \end{split}$$



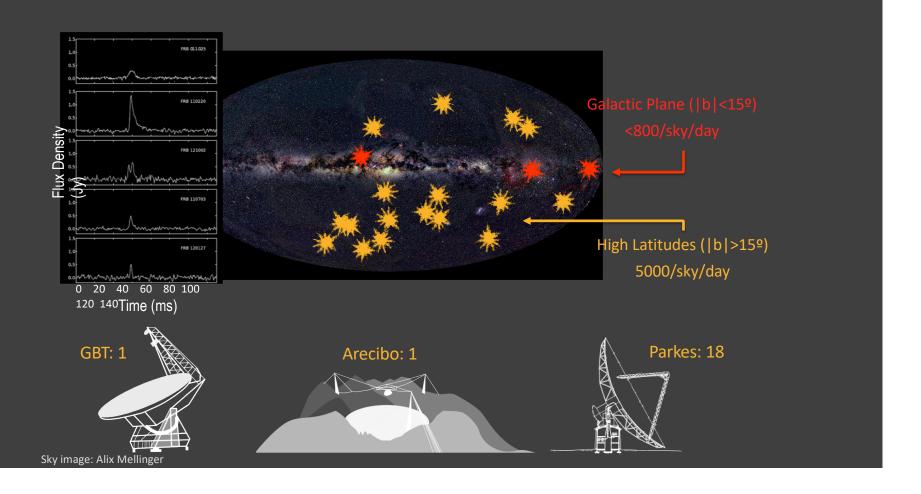


Radio Transient Parameter Space

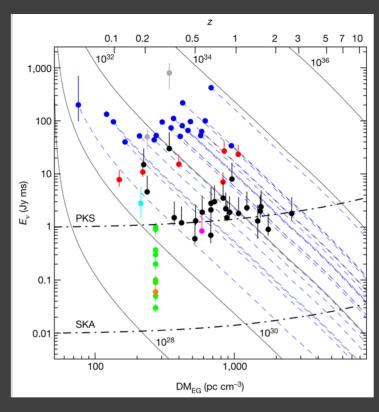


Macquart et al 2015

About 20 FRBs Known



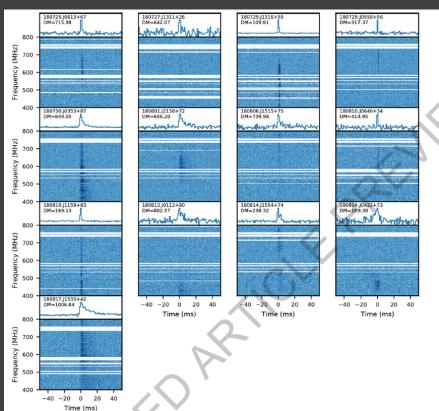
ASKAP FRBs



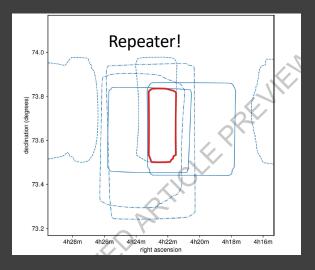


Shannon et al 2018

CHIME FRBs



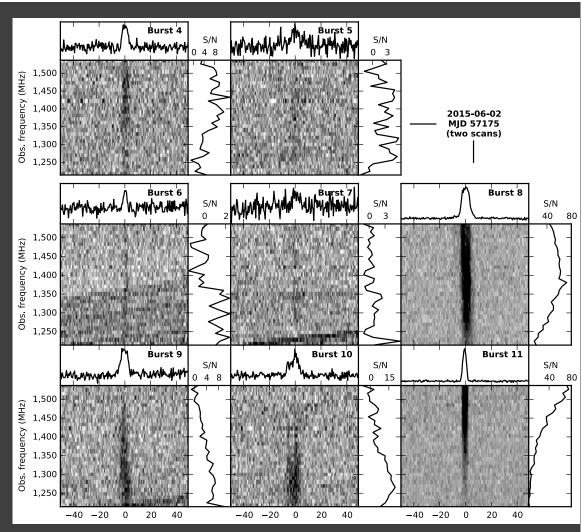




FRB 121102: It repeats!

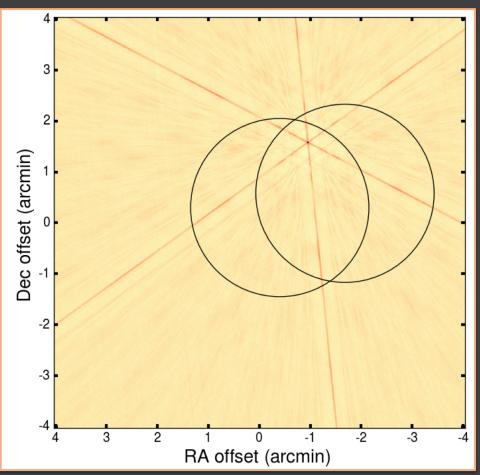
(Spitler et al. 2016)



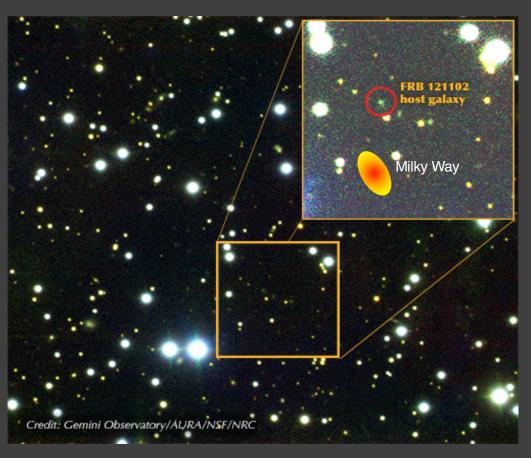


Finally, on 23 August 2016...





Host Galaxy



What we know



WHAT are they?

HOW can we use them?

Extreme physical conditions!

Cosmic ionization history

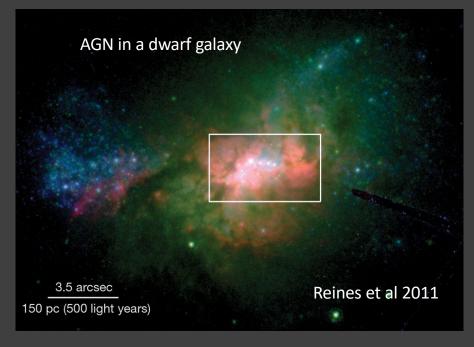
Thousands in the sky per day!

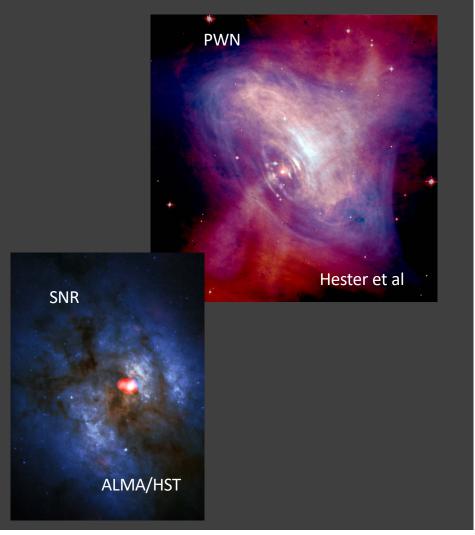
Intergalactic medium turbulence and magnetism

Theoretical and observational mystery!

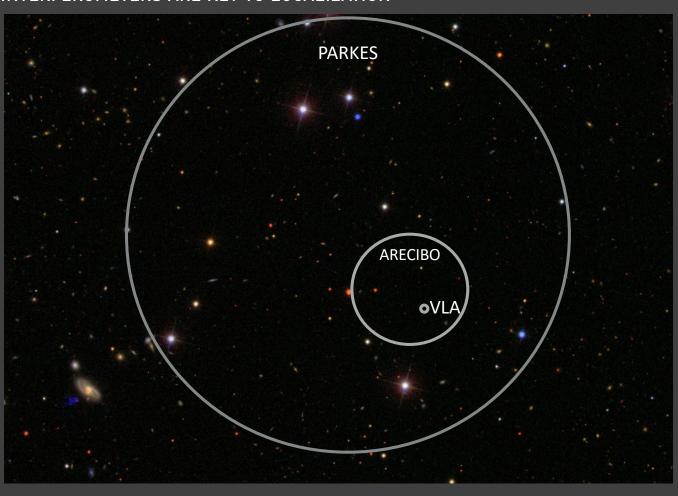
Probe of Galactic halo

What Are FRBs?

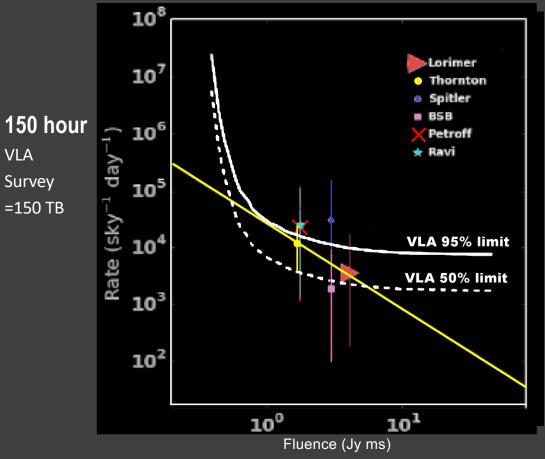




INTERFEROMETERS ARE KEY TO LOCALIZATION

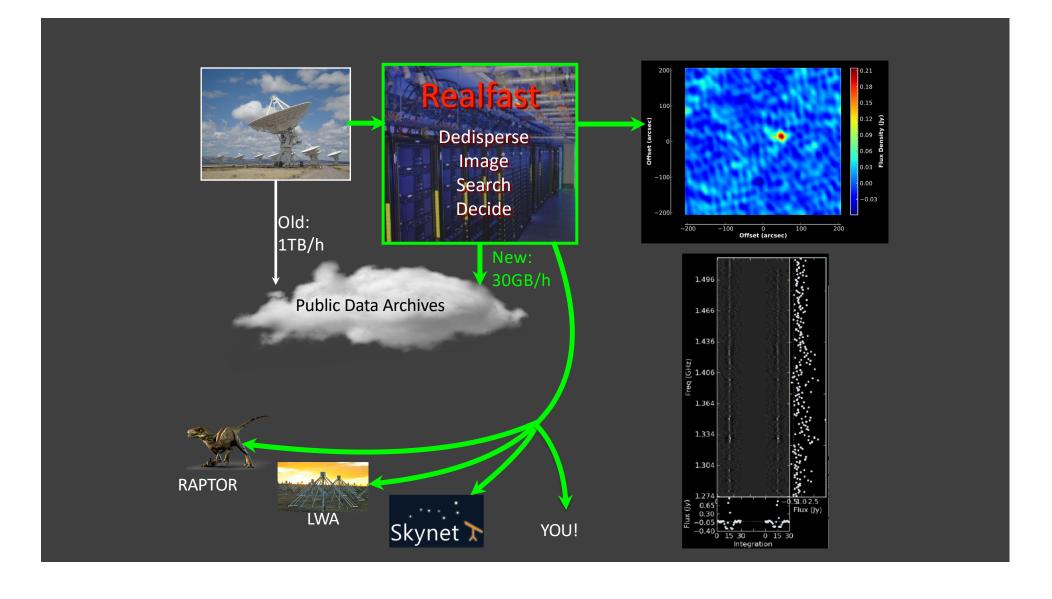


Present: VLA Fast Radio Bursts



"It's only a matter of time!"

Law et al. (2015)

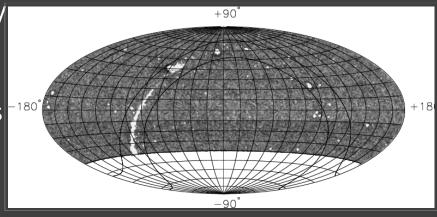


Commensal with VLASS

**5000 hours on sky has huge discovery potential.

#10s of FRBs/year

**50 ms integrations would have sensitivity to find all known FRBs



NVSS SOURCE COUNT DENSITY

Realfast Design Specifications

Table 2. Number of Systems Required for Real-Time Transient Searches

	CPU-based ^a			GPU-based ^b				
Ant. configuration	D	\mathbf{C}	В	A	D	\mathbf{C}	В	A
Milliseconds/image	1	1.7	14	140	0.4	0.5	1.4	14
20 ms int, FRB-like ^c	2	2	16	154	1	1	2	16
5 ms int, FRB-like	18	30	250	249	8	9	25	250
3 ms int, FRB-like	50	84	691	690	20	25	70	690
1 ms int, FRB-like	445	757	6230	62300	178	226	623	6230
20 ms int, Galactic ^c	1	1	5	49	1	1	1	5
5 ms int, Galactic	6	10	76	760	3	3	8	16
3 ms int, Galactic	15	26	210	2100	6	8	21	210
1 ms int, Galactic	135	230	1890	18900	54	68	189	1890

Standard Mode

- 5 msec sampling
- 256 MHz/256 channels
- Dual polarization
- 1 TB/hour

Table 3: Fastest REALFAST Observing Modes and L-Band Sensitivity

Config	Img size	θ_b	$\min t_{int}$	Thresh.	$S_{ m lim}$
	(pixels)	(")	(ms)	$(1 \text{ false } \text{hr}^{-1})$	$(\mathrm{mJy}/t_{\mathrm{int}})$
A	5832^{2}	1.3	20	7.9σ	48
В	1728^{2}	4.3	5	7.7σ	94
C	512^{2}	14	3	7.5σ	119
D	192^{2}	46	3	7.2σ	114

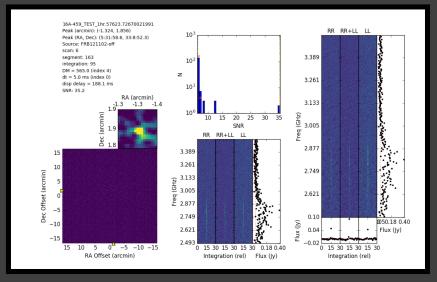
Plus:

- Slow Transient Searching
- Interferometric Pulsar Searching

realfast

- VLA commensal fast transient survey system
 - Fast sampled visibilities
 - Dedicated computing
 - Triggered data recording
- In year 3 of 3 of NSF ATI
- More info at <u>https://arxiv.org/abs/1</u> 802.03084

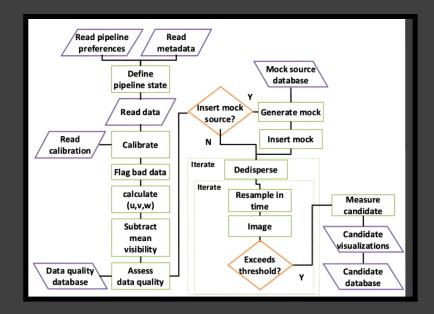
http://realfast.ic



Prototype realfast localization of FRB 121102

Searching realfast

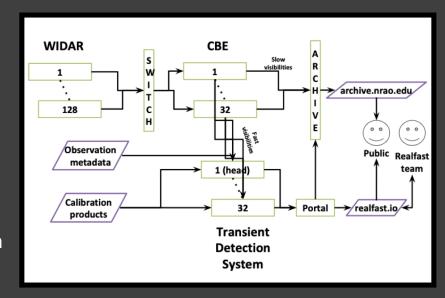
- Software
 - FFT imaging with Python/Cython/CUD
 - <u>fpipe</u> (Law et al 2017)
 - Candidate portal
- Hardware
 - CPU/GPU cluster
 - Integrated with VLA

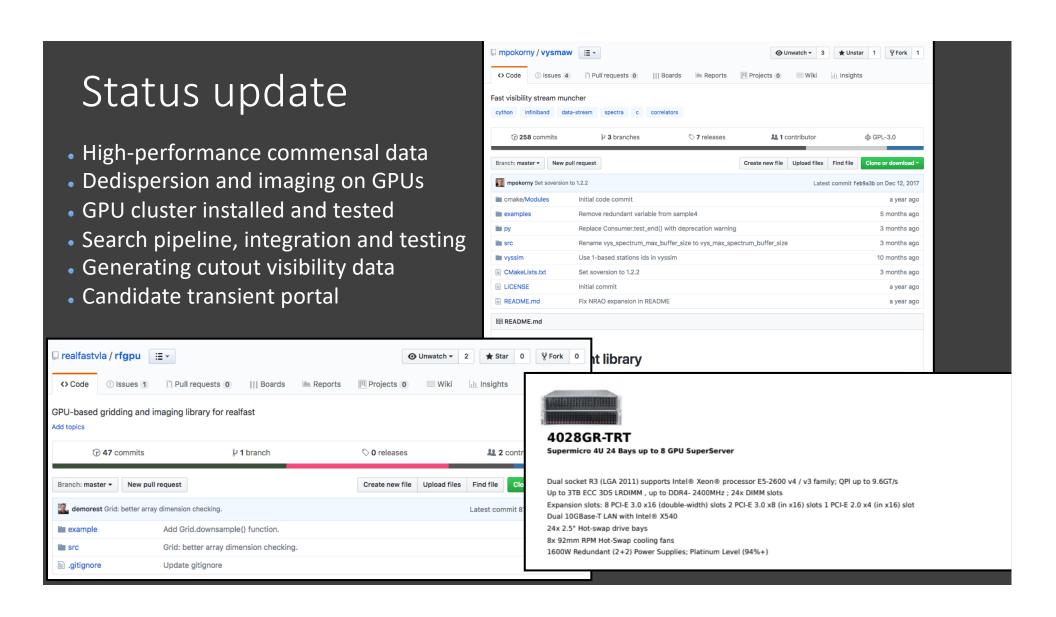


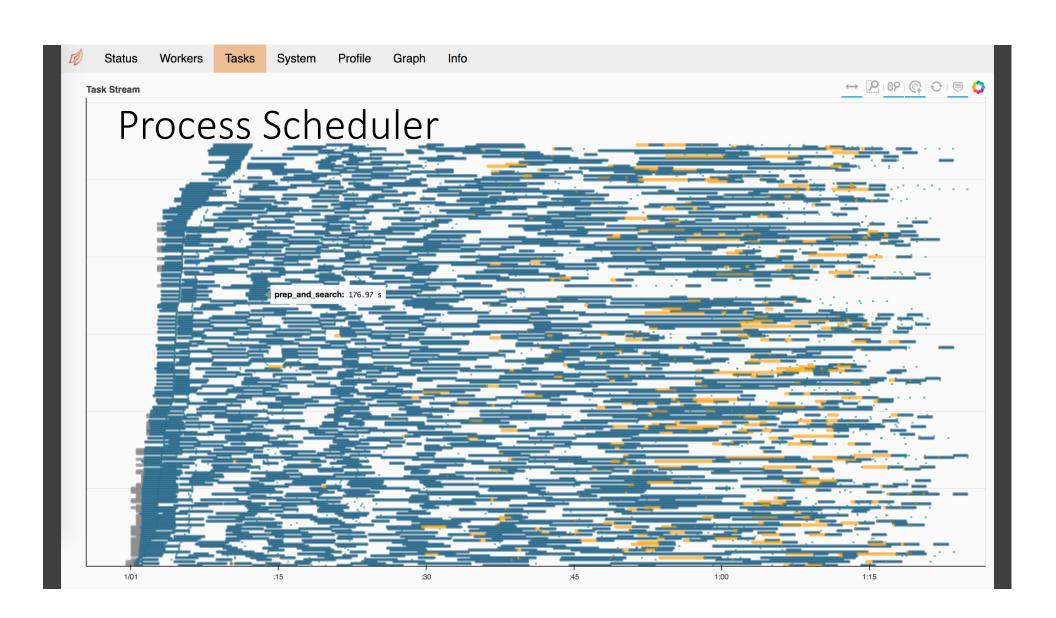
FRB search pipeline

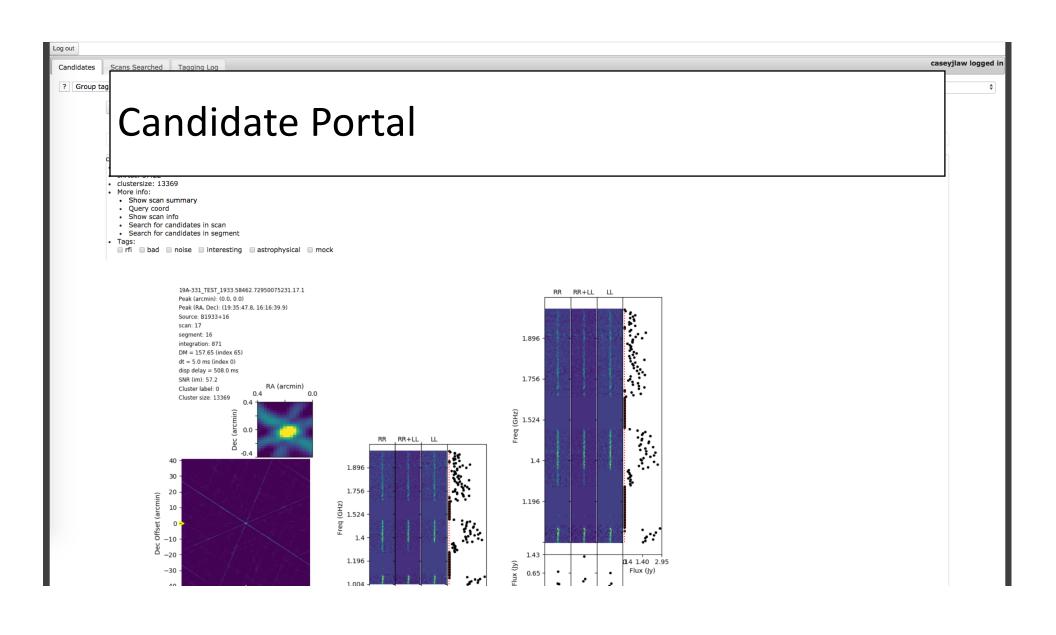
implementing commensal

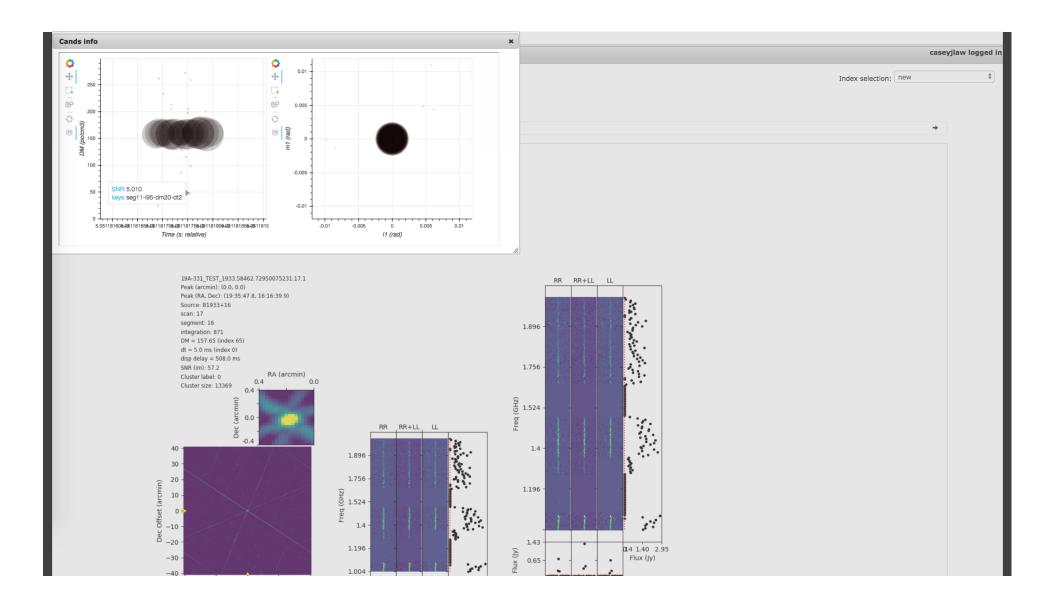
- realfast chooses:
 - internal correlator integration time
 - Deploy correlator mode for general use
- Primary choses:
 - Frequencies somewhere between 1 and 50 GHz
- Fast sampled visibilities are a "new", public data product











realfast summary

- VLA localized FRB 121102 and is pursuing R2
- Blind VLA searches have not made a discovery
- Solution is commensal campaign
- We are commissioning hardware and software for realtime commensal observing
- Potential discovery and localization of 10s of FRBs per year



Source Of Mysterious Space Radio Signals Found

AMERICAN VOICES

January 6, 2017

VOL 53 ISSUE oo Opinion Scientists have determined that a unique series of radio wave bursts detected since 2007 are coming from a dwarf galaxy 3 billion light years away, though the waves are not likely to signal alien activity. What do you think?









"Tell them to knock it off!"

Dean Berry · UNEMPLOYED



"Just to be safe, we should probably blast some radio signals toward them containing Q104.3's Two For Tuesday lineup as a peace offering."

Karl McCluskey • RESOURCE FUNNELER



"It's humbling to learn that nothing is happening billions of light years away."

Krista Moreland . WIRING EXPERT