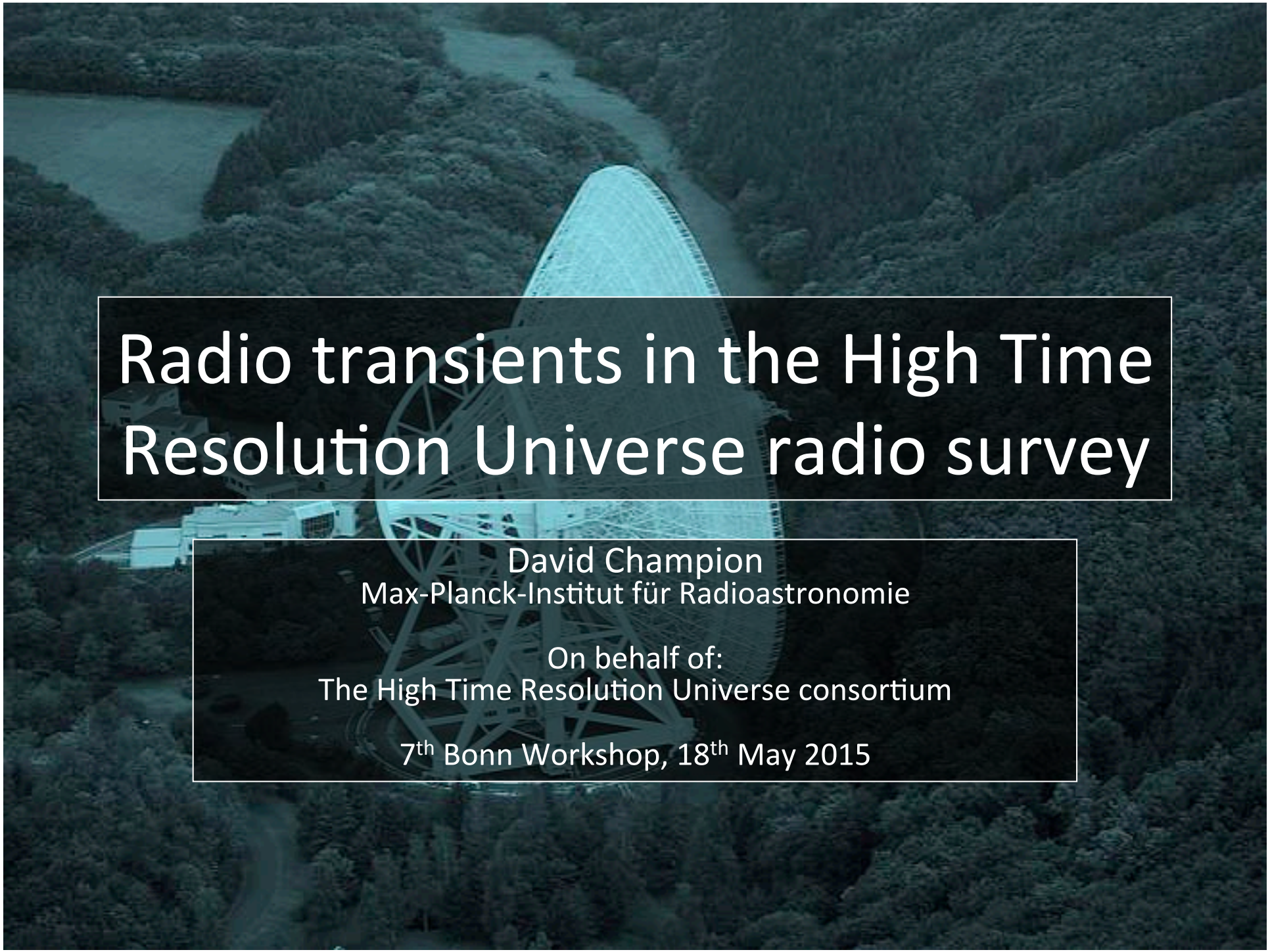


Radio transients in the High Time Resolution Universe radio survey

David Champion
Max-Planck-Institut für Radioastronomie

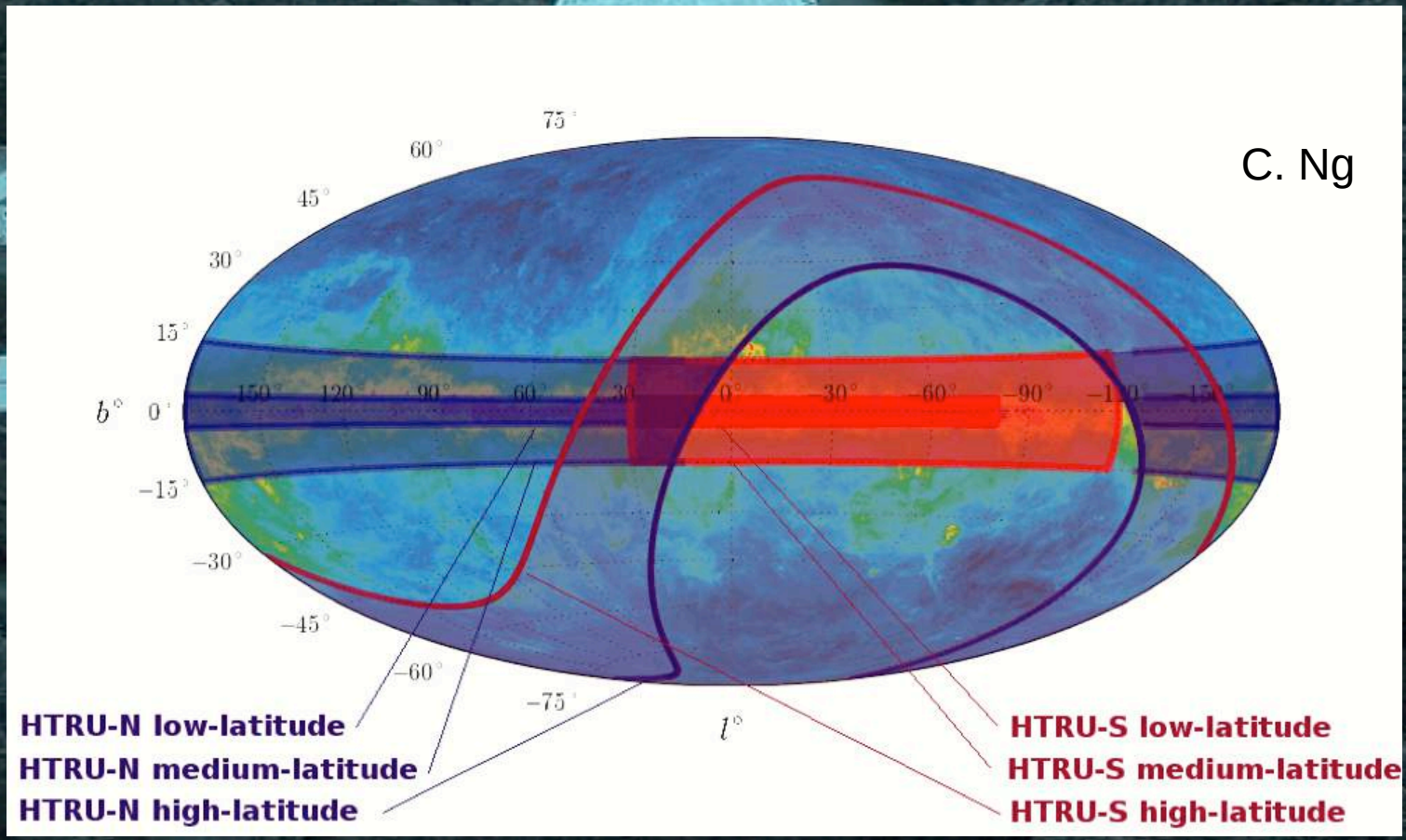
On behalf of:
The High Time Resolution Universe consortium

7th Bonn Workshop, 18th May 2015

HTRU comparison with PMPS

	PMPS	HTRU-N	HTRU-S
Start date:	1997 - 2003	Summer 2010	Early 2008
Telescope:	Parkes-64m	Effelsberg-100m	Parkes-64m
Sky coverage:	$\delta < +10^{\circ}$	$\delta > 0^{\circ}$	$\delta < +10^{\circ}$
Integration time:	2100 s	Low-lat: 1500 s Mid-lat: 180 s High-lat: 90 s	Low-lat: 4300 s Mid-lat: 540 s High-lat: 270 s
Receiver:	13-beam 1.35-GHz receiver	7-beam 1.4-GHz receiver	13-beam 1.35-GHz receiver
Backend:	Analogue filterbank (AFB)	Pulsar Fast Fourier Transform Spectrometer (PFFTS)	Berkeley-Parkes-Swinburne Recorder (BPSR)
Bandwidth:	288MHz	300MHz	340MHz
No. of channels:	96	512	1024
Freq resolution:	3MHz	0.58MHz	0.39MHz
Time resolution:	250 μs	54 μs	64 μs
No. sky pointings:	~ 3,200	~ 180,000	~ 43,000
Data sizes:	~ 4 terabytes	~ 5 petabytes	~ 1 petabyte

HTRU search areas



FRB discoveries

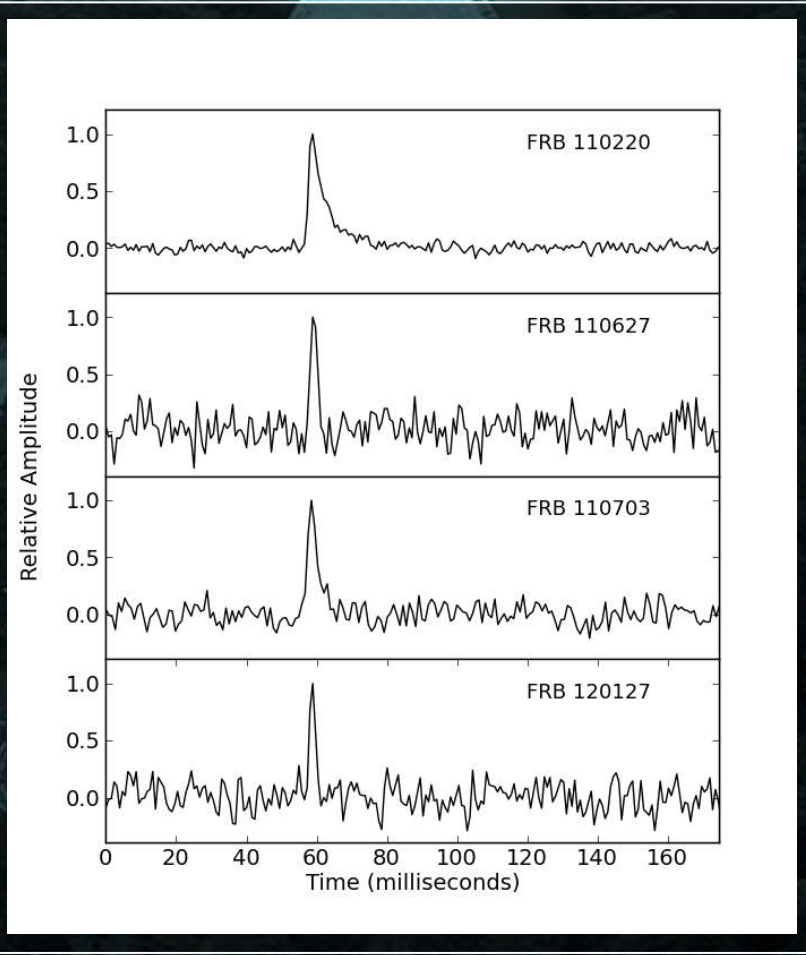
Title: Discovery of a fast radio burst population at cosmological distances

Authors: D. Thornton[1], B.Stappers[1], M. Bailes[2,3], B. Barsdell[2], S. Bates[4], N. D. R. Bhat[2,3,5], M. Burgay[6], S. Burke-Spolaor[7], D. Champion[8], P. Coster[2], N. D'Amico[6], A. Jameson[2], S. Johnston[2,9], M. Keith[9], M. Kramer[1,8], L. Levin[2], S. Milia[6], C. Ng[8], A. Possenti[6], W. van Straten[2,3]

FRB: Fast Radio Burst, 4 detections

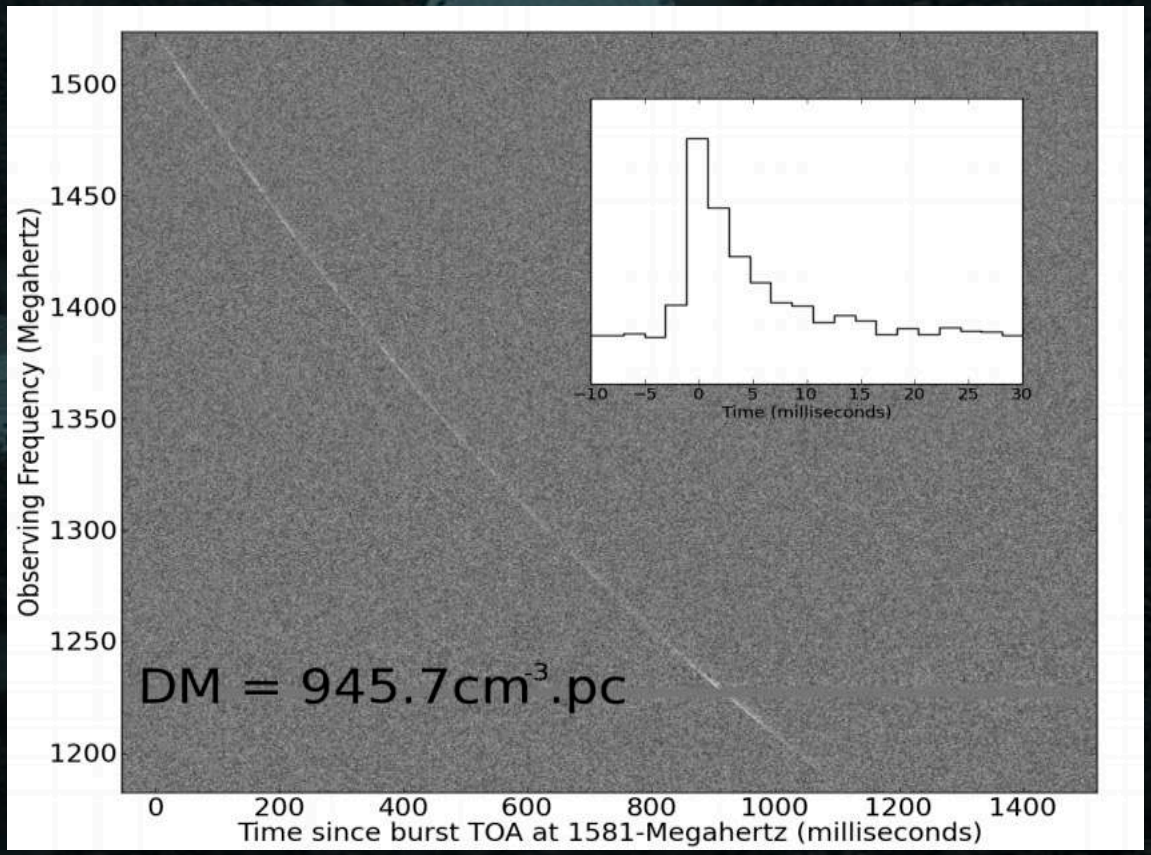
Thornton et al. 2013

4 FRBs



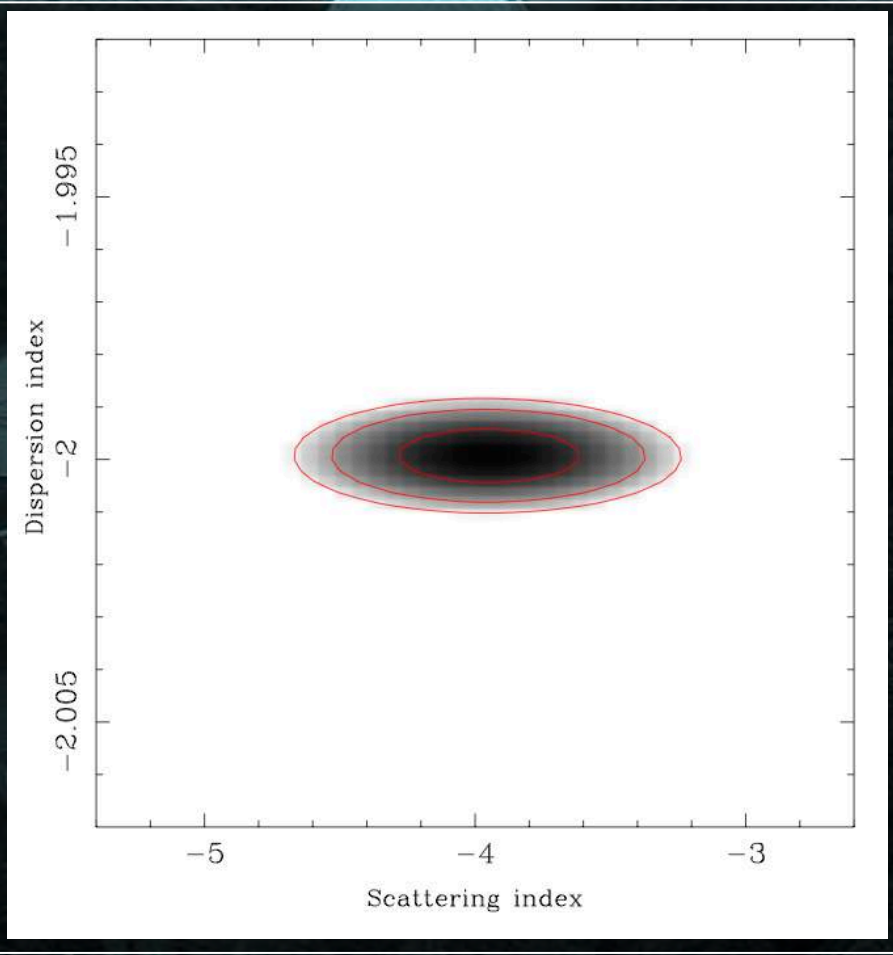
Thornton et al. 2013

FRB 110220



Thornton et al. 2013

DM and Scattering for FRB 110220



M. Kramer

Preliminary

5 more…

Name	Position (J2000)	DM (pc cm^{-3})	DM_{Gal} (pc cm^{-3})	Width (ms)	Scattering (ms)
FRB090625	03:07:47-29:55:36	897	32	<1.95	<0.98
FRB121002	18:14:47-85:11:53	1629	74	1.3 (5), 2.8 (5), [3.3 (5)]	0.3 (1)
FRB130626	16:27:06-07:27:48	952	67	0.73 (12)	1.09 (11)
FRB130628	09:03:02+03:26:16	469	53	0.39 (5)	0.17 (2)
FRB130729	13:41:21-05:59:43	860	31	<2.93	<1.5

- All data (including Thornton) processed using Heimdall
- All previously known FRBs redetected
- No FRBs missed in old data

$$S/N \geqslant 10$$

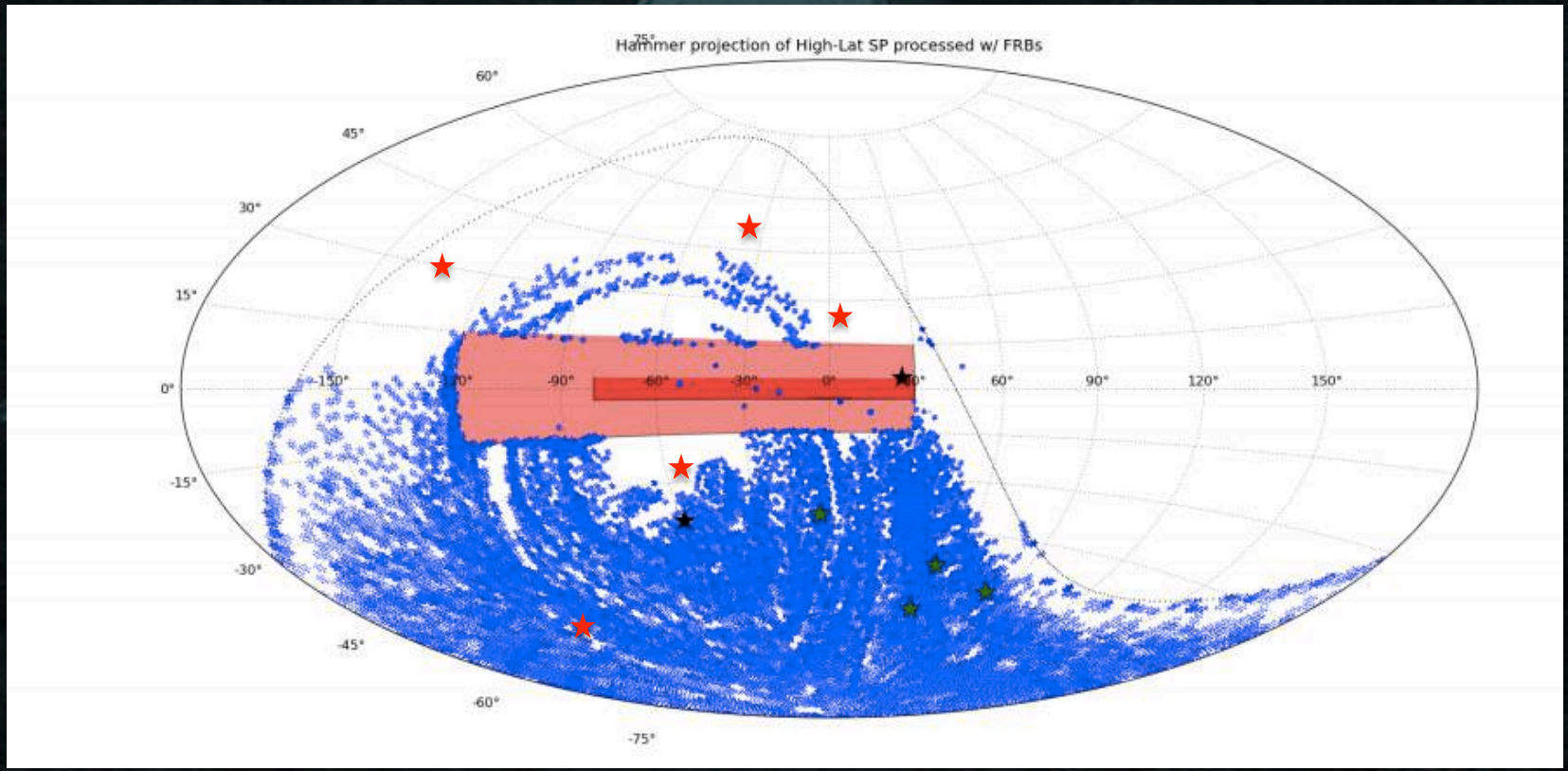
$$\Delta t \leqslant 2^8 \times 64\ \mu s = 16.3\ ms$$

$$DM/DM_{Galaxy} > 0.9$$

$$N_{beams} \leqslant 4$$

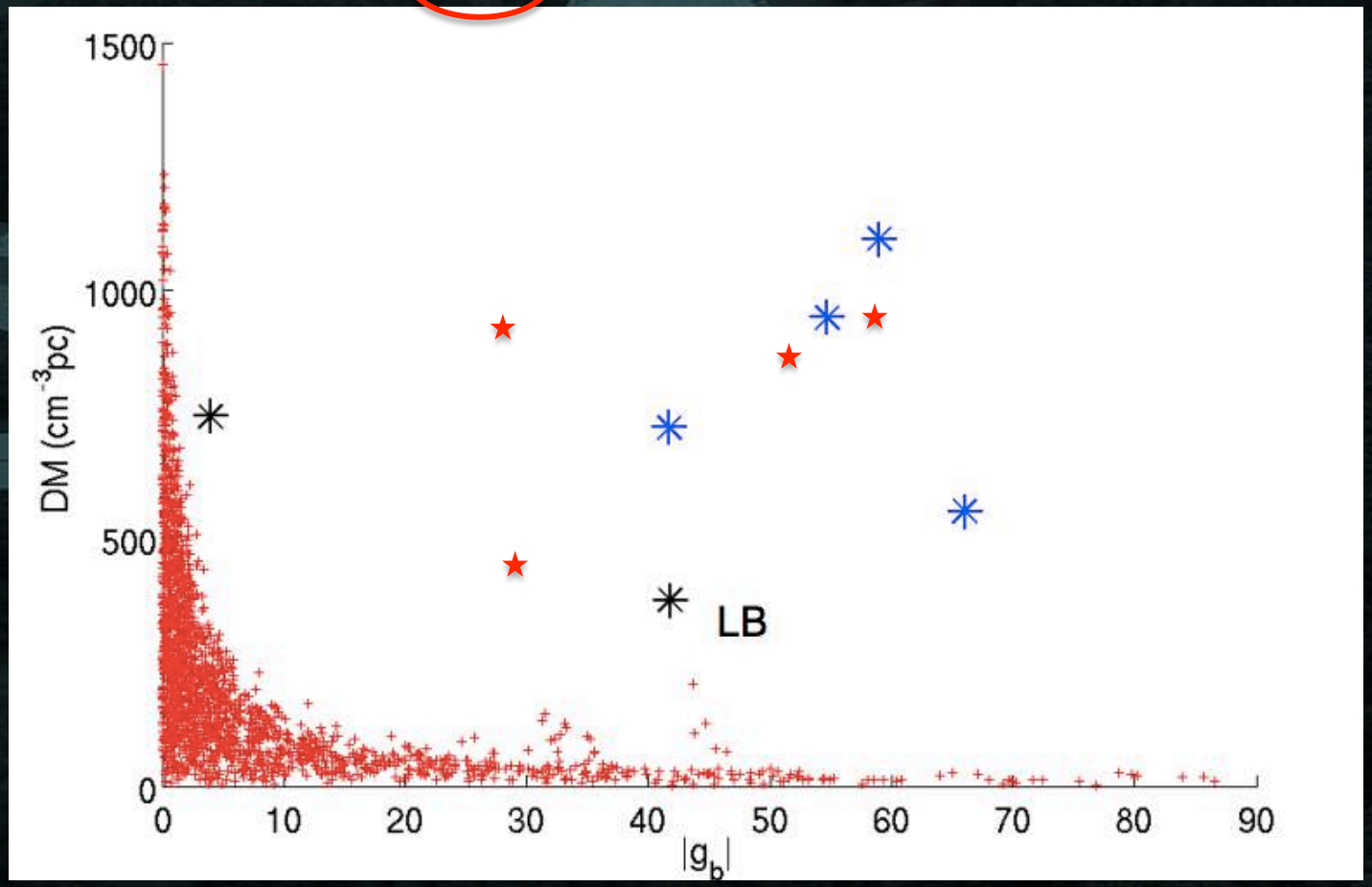
Champion et al in prep.

Locations of the bursts



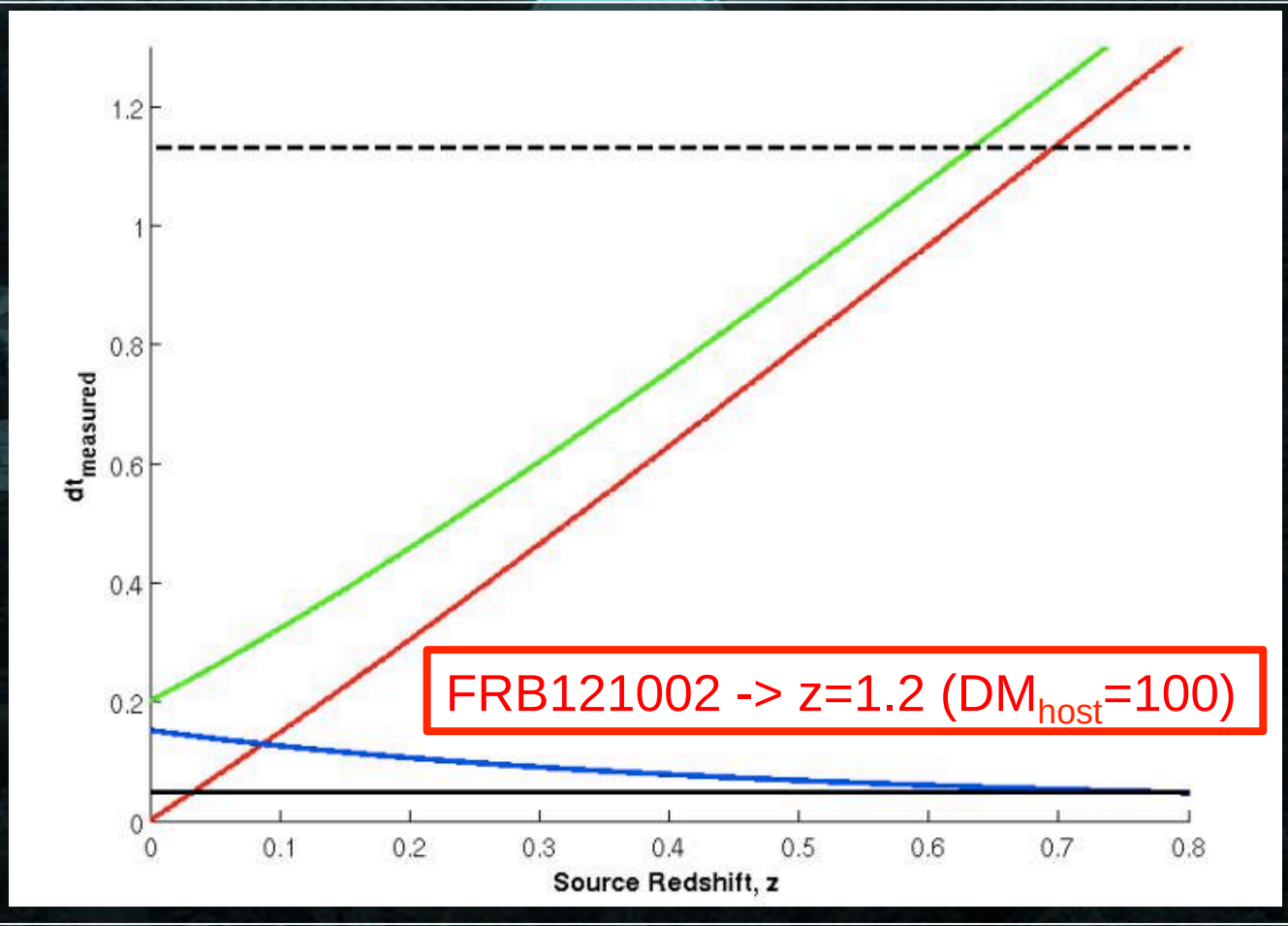
Thornton

DMs of the bursts



Thornton

DM and redshift



Thornton

Preliminary

Rate of FRBs

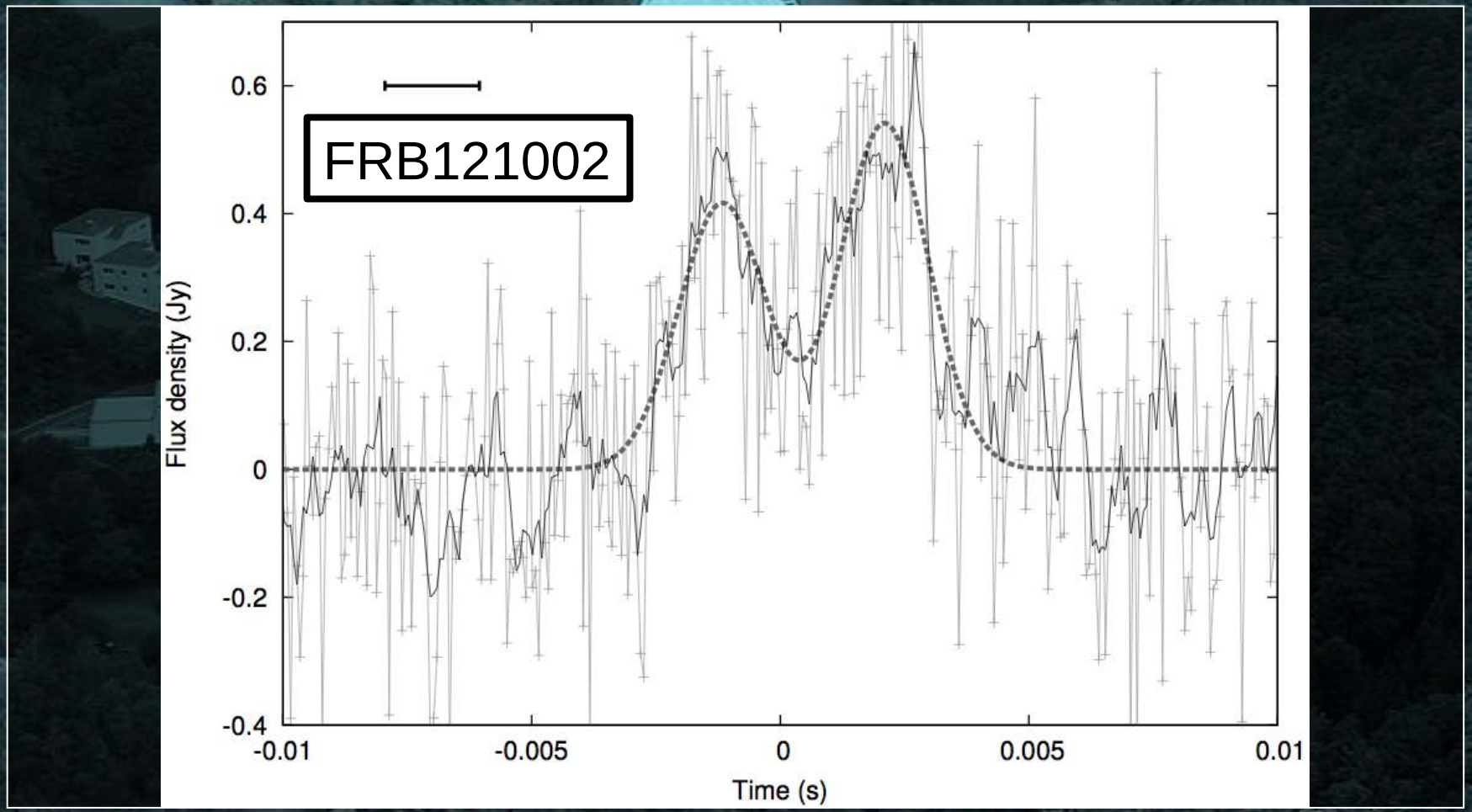
- 100% of HTRU-S high-lat checked:
  33,500 pointings x 13 beams x 270 sec = 1549 deg^2hrs

$$9\ \mathrm{FRBs} \times \frac{24\ \mathrm{hrs/day} \times 41253\ \mathrm{deg^2/sky}}{1549\ \mathrm{deg^2\ hrs}}.$$

- R_{FRB}(>0.6Jy ms) ~ $5.7 \times 10^{3\ +4.2}_{\ -2.7}$ sky^{-1} day^{-1}
- At lower end but consistent with Thornton et al 2013
- Consistent with Spitler et al. 2014
- 97% inconsistent with MedLat rate (Petroff et al 2014)

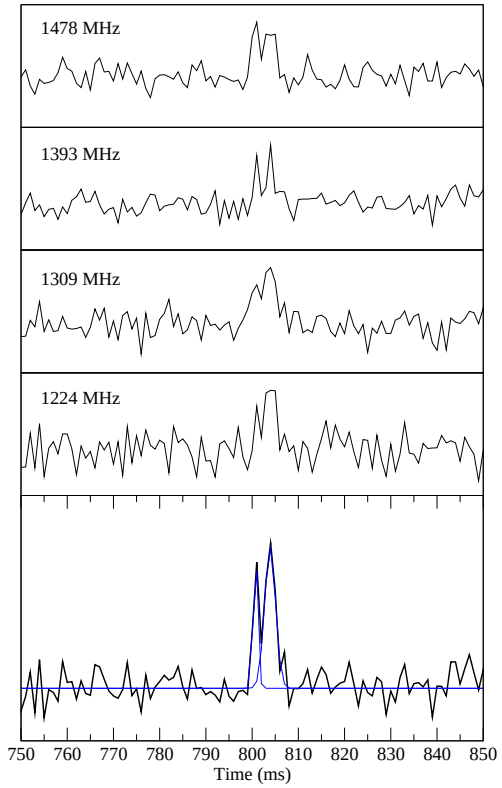
Champion et al. In Prep

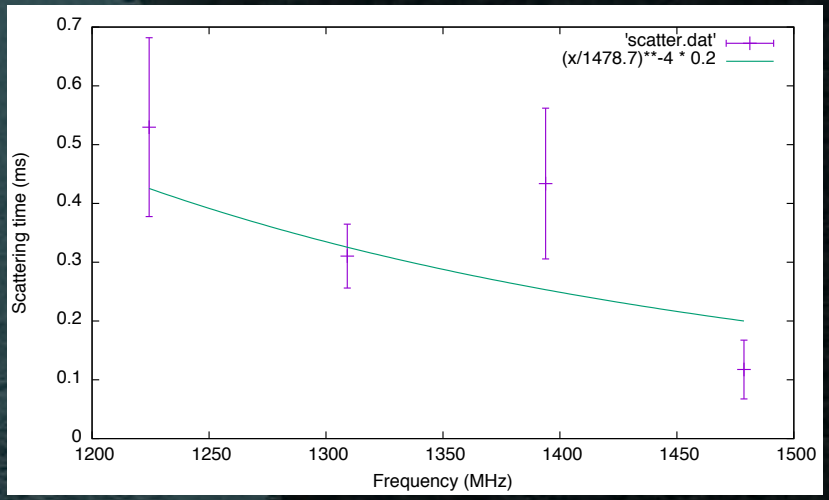
Double component FRB



Keith

Double component FRB





Subbands fitted independently
Highest subband used as template
Fitted for scattering and amplitude
Consistent with global fit

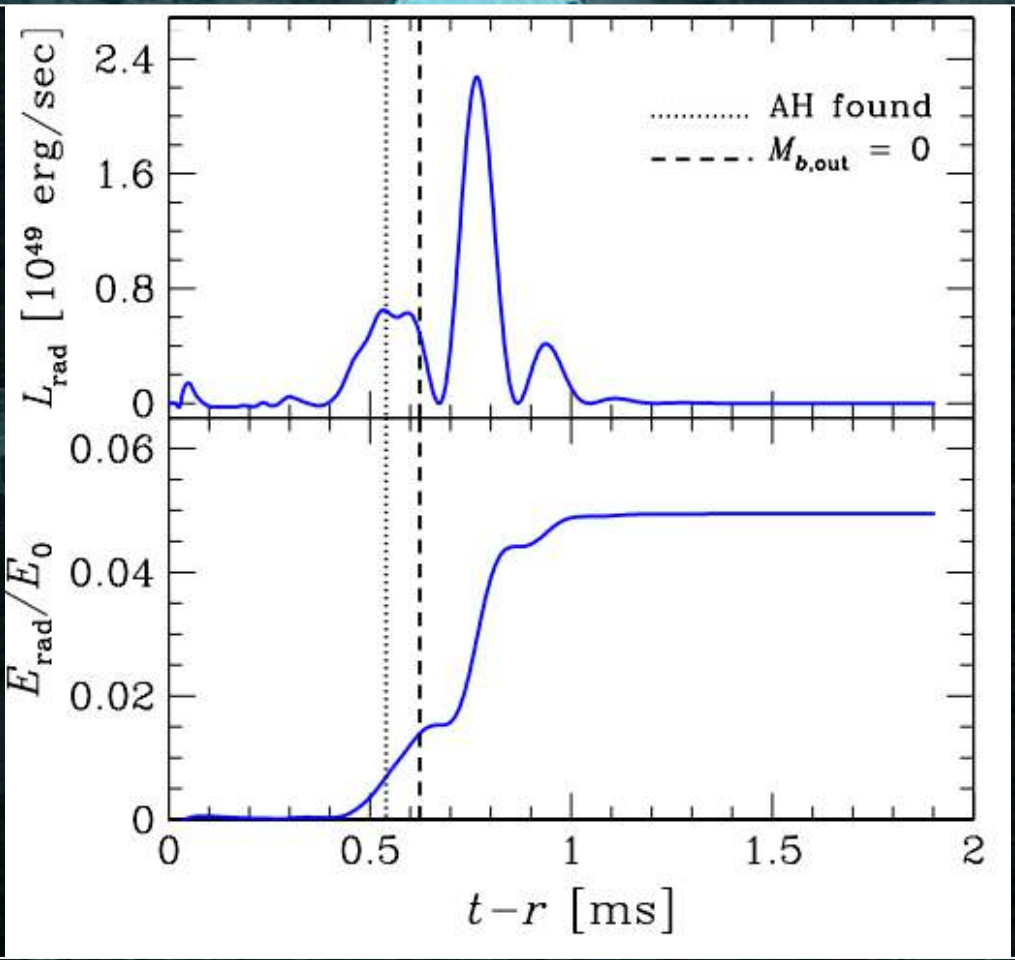
Kramer

Models

- Evaporation of BHs (Rees 1977)
- WD merger (Kashiyama et al 2013)
- NS merger (Hansen & Lyutikov 2001)
- Cosmic string collisions (Cai et al. 2012)

- SGR giant flares (e.g. Thornton et al. 2013)
- SGR hyper flares (Popov & Postnov 2007)
- Super giant pulses (Cordes & Wasserman 2015)
- Collapse of a supra massive BH (Falcke & Rezzolla 2014)

Supra massive BH collapse



Dionysopoulou et al. 2013

Conclusions

- The HTRU surveys are providing a snapshot of the radio sky for pulsars and transients
- We have confirmed a new population of extragalactic radio transients
- The rate is lower than but consistent with the Thornton et al. rate
- First evidence of structure in FRB
- Challenges some origin theories
- NS sources and supra-massive BH model explain this more easily