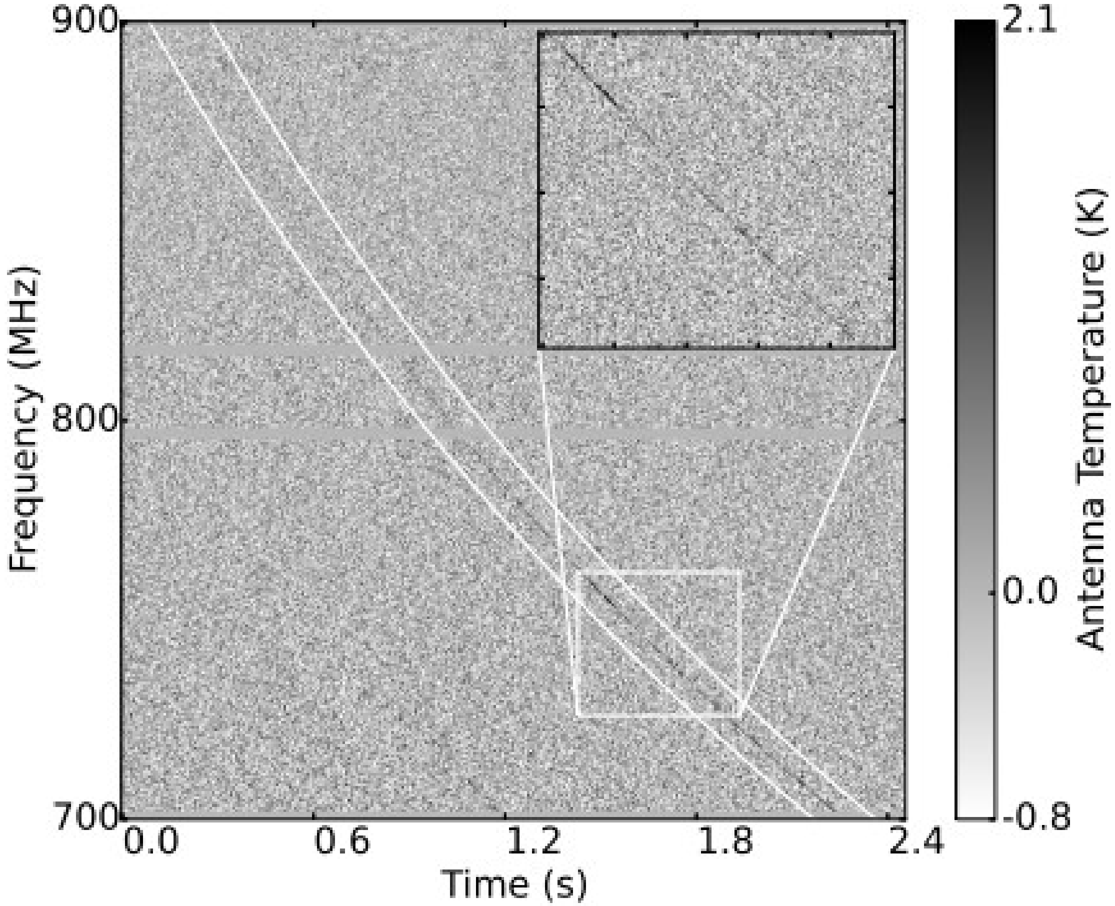
# FRB Rate for TianLai Survey

FRB110523 was discovered from GBT off line data. It was found near 800MHz,and remains the only FRB not found in 1.4GHz.



According to this FRB event, Liam Connor etc. estimated the FRB rate of GBT and extrapolate a universal formula for other telescope survey estimate. [MNRAS 460, 1054–1058 (2016)]

$$N_{\Sigma} = \frac{1}{27.5}\left(\frac{G_{\Sigma}}{G_{\mathrm{GBT}}}\frac{\langle T^{\mathrm{sys}}_{\mathrm{GBT}}\rangle}{\langle T^{\mathrm{sys}}_{\Sigma}\rangle}\sqrt{\frac{B_{\Sigma}}{B_{\mathrm{GBT}}}}\right)^{\gamma}\left(\frac{\Omega_{\Sigma}}{\Omega_{\mathrm{GBT}}}\right)\ \mathrm{d}^{-1}$$

Where as $N_{\Sigma}$ stand for the number of FRB That survey $\sum$ could observed.
G is the gain depends on the effective aperture and the receive area. $T^{sys}$ is system temperature. B is the observed bandwidth. $\Omega$ is the beam size and $\gamma$ is depend what universe is. Here We assume $\gamma = 1.5$ which stand for a Euclidean Universe. More details in Connor's paper above.

# TianLai parameter calculate

$G_{TL}$:

The radius of GBT is 50m. With a 75% aperture effective, The equal receive area is 5890 $m^2$.

We use actual $12 \times 11.4 = 136.8\ m^2$, and 2/3 aperture effective for one TianLai cylinder. So that the equal receive area is 91.2 $m^2$.

As $G_{GBT} = 2$ K / Jy ,

So the $G_{TL}$ = 2 K/Jy * 91.2 / 5890 $\backsimeq$ 0.031 K /Jy

# TianLai parameter calculate

$\Omega_{TL}$:

TianLai telescope is cylinder, of which The N-S beam $\varphi$ could reach120 degree. And according to $\lambda$*1.22 / D,
W-E beam $\theta$ is 1.86 degree.

The actual beam shape is a ellipse, We could regard it as a rectangular to make a rough estimate.

So the Total beam $\Omega_{TL} = \theta * \varphi = 1.86 * 120 = 223.2 \text{ deg}^2$

# Compare

| | GBT | TianLai |
|---|---|---|
| G ( k/Jy) | 2 | 0.031 |
| $T^{sys}$ (K) | 26.5 | 80 |
| B (MHz) | 200 | 100 |
| Ω ($deg^2$) | 0.055 | 223.2 |

With the formula developed by Liam Connor, The TianLai survey might observe 0.032 $day^{-1}$ FRB event or 1 burst a month.

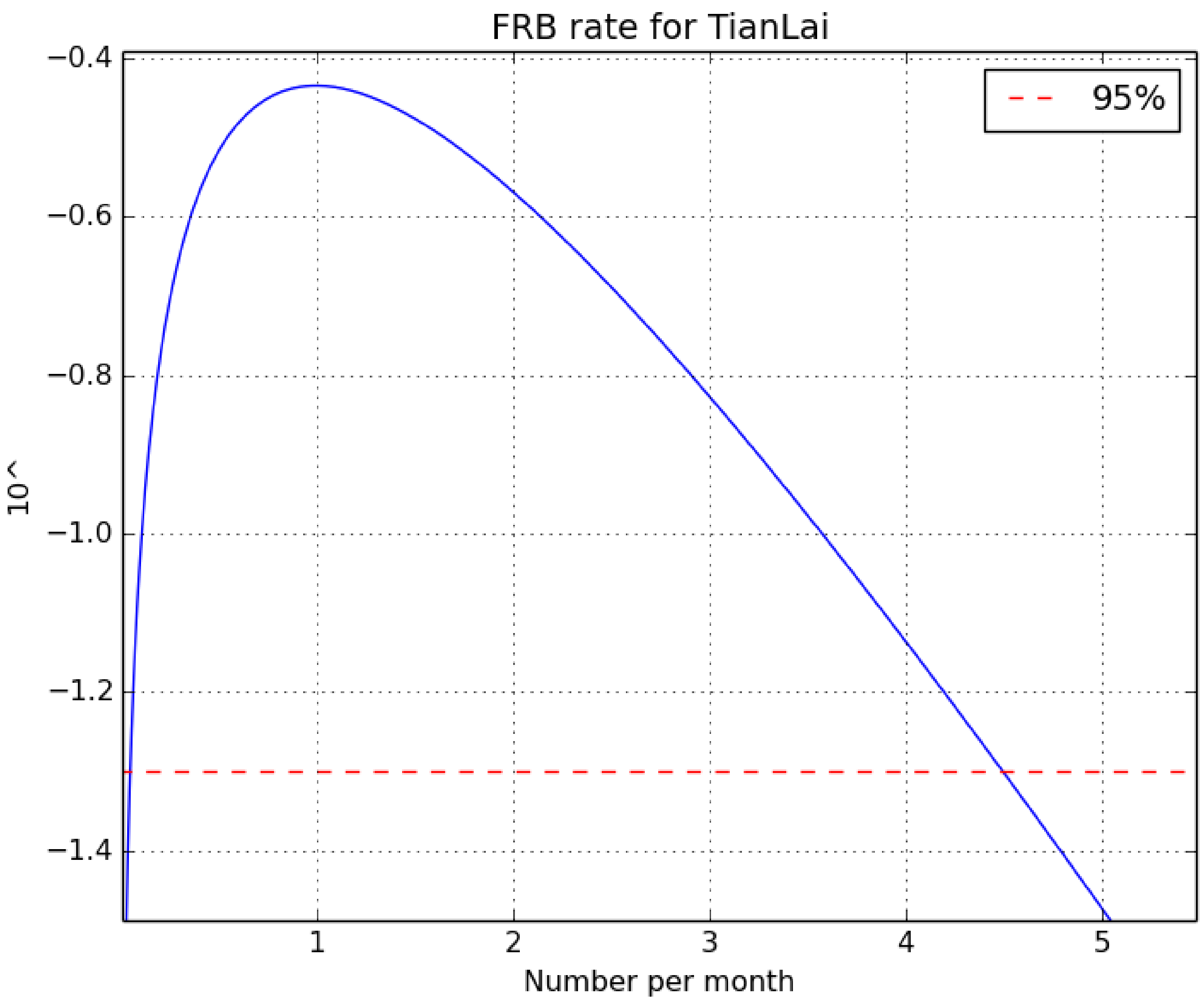
# Rate estimate

Assume the FRB contribute a Poissonian distribution.

$$P(M_{tot}) = \frac{M_{S_{min}}^{M_{tot}} e^{-M_{s_{min}}}}{M_{tot}!}$$

$M_{S_{min}}$ is the number of bursts that we expect above the threshold $S_{min}$. Thus we could get the possibility of observing $M_{tot}$ bursts above threshold.

# Rate estimate




If we plot the possibility, we could found that: above 95% , One TianLai cylinder might observe 0.05 ~4.5 bursts per month.