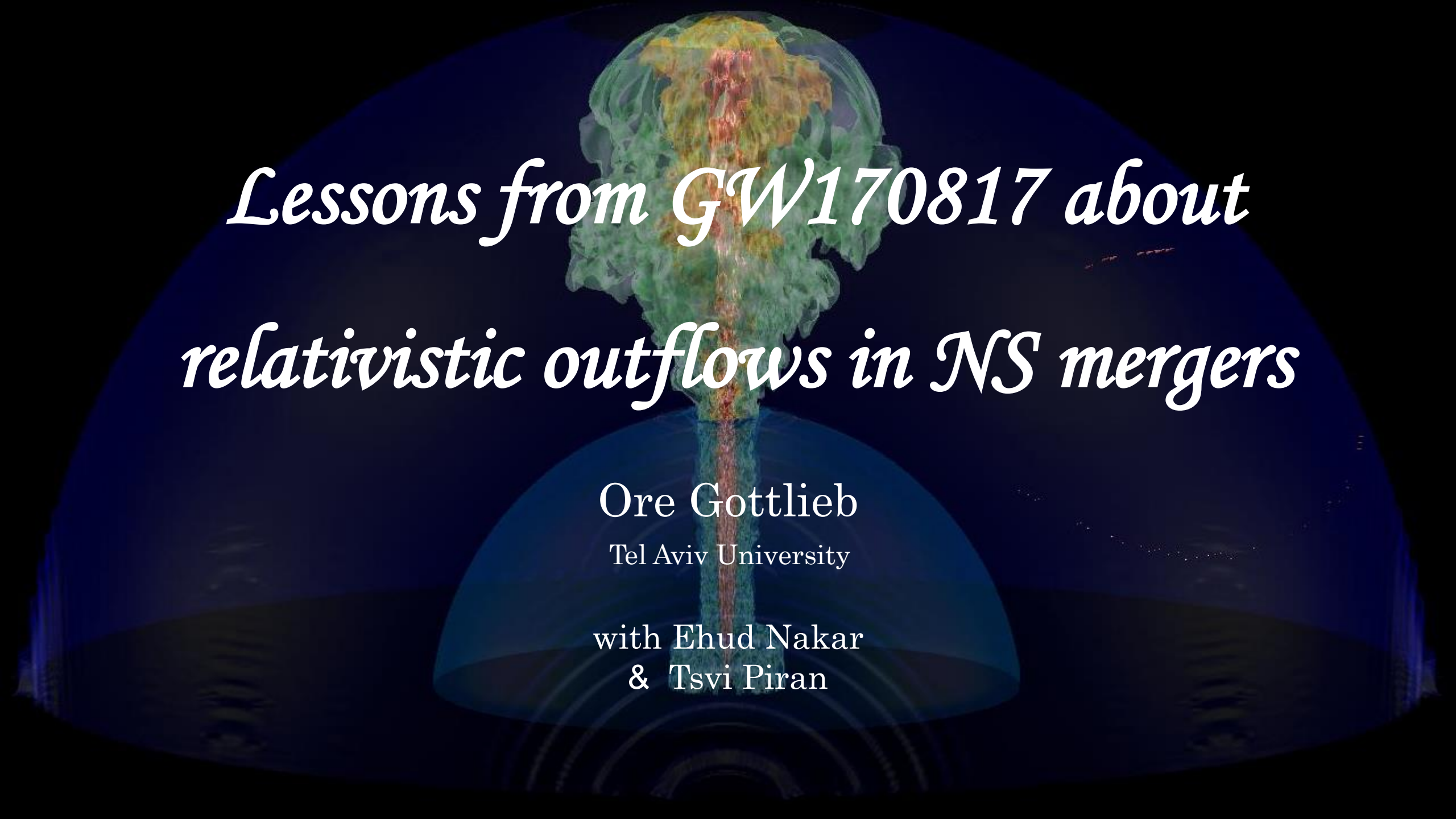

Lessons from GW170817 about relativistic outflows in NS mergers

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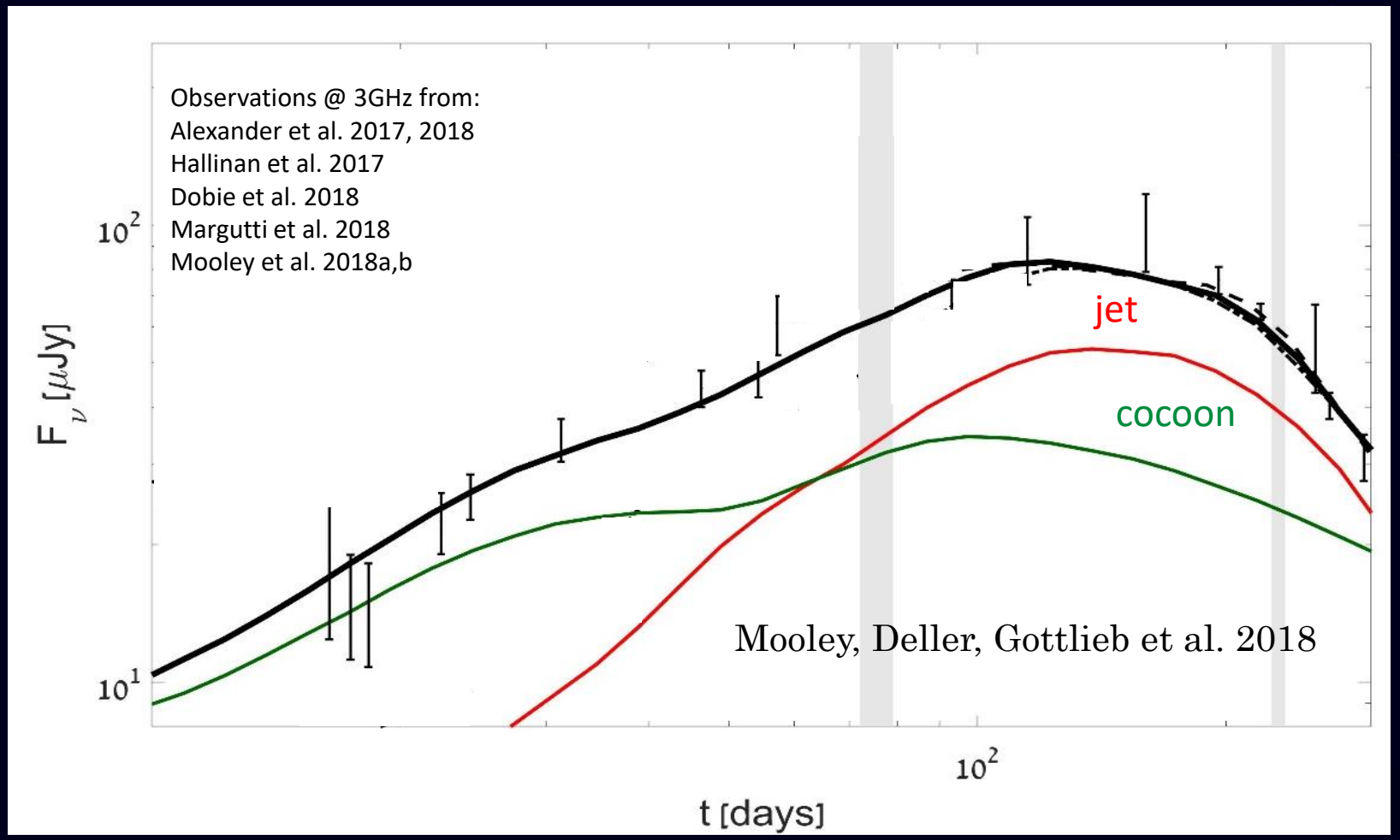
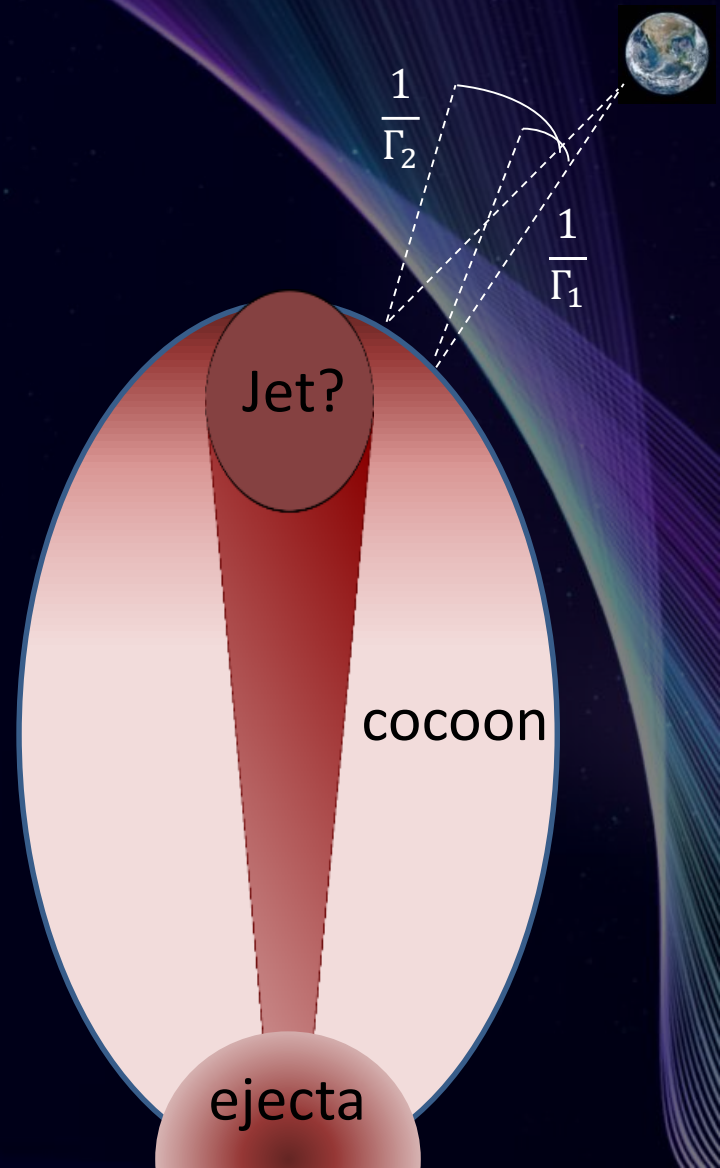
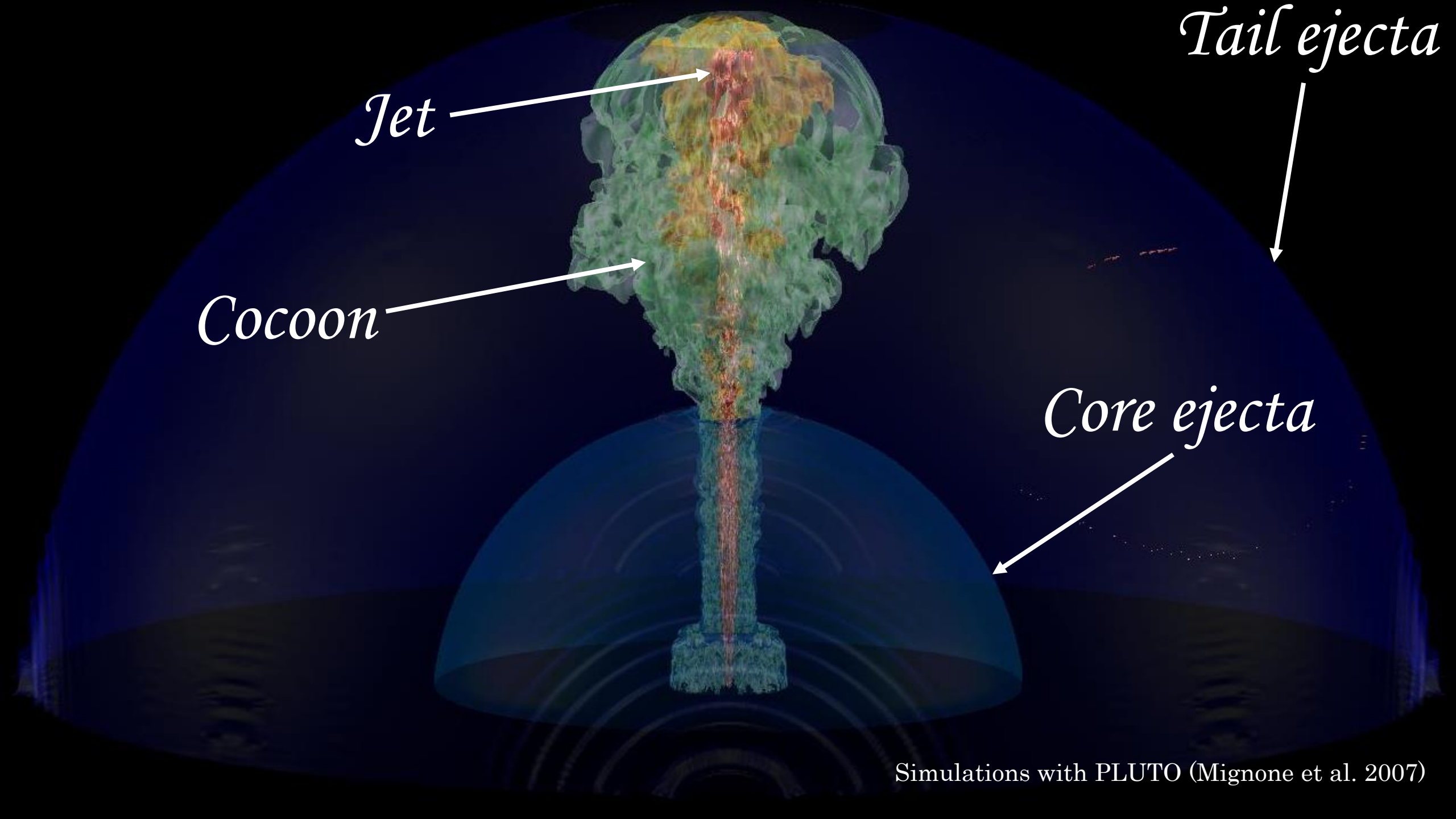
with Ehud Nakar
& Tsvi Piran

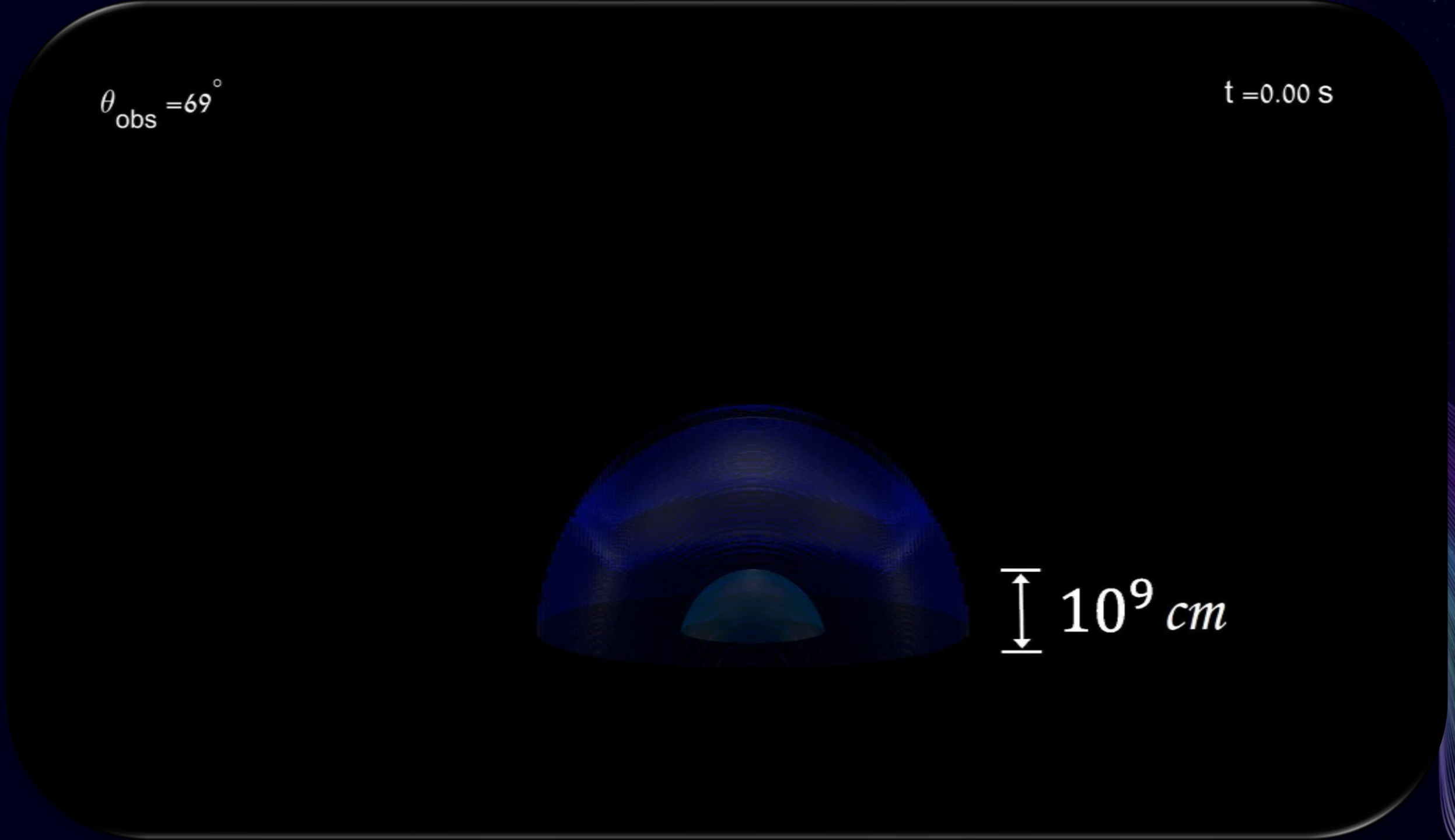
GW170817 radio afterglow







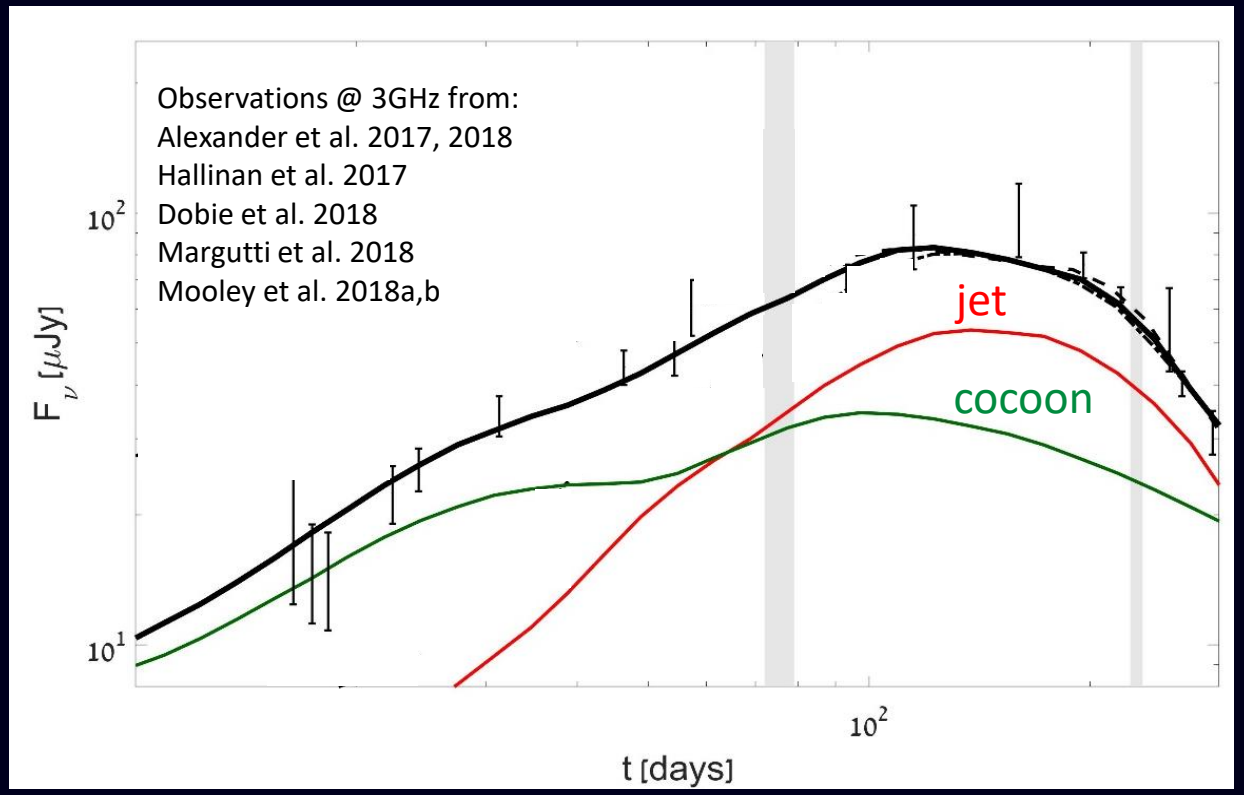
Simulations with PLUTO (Mignone et al. 2007)

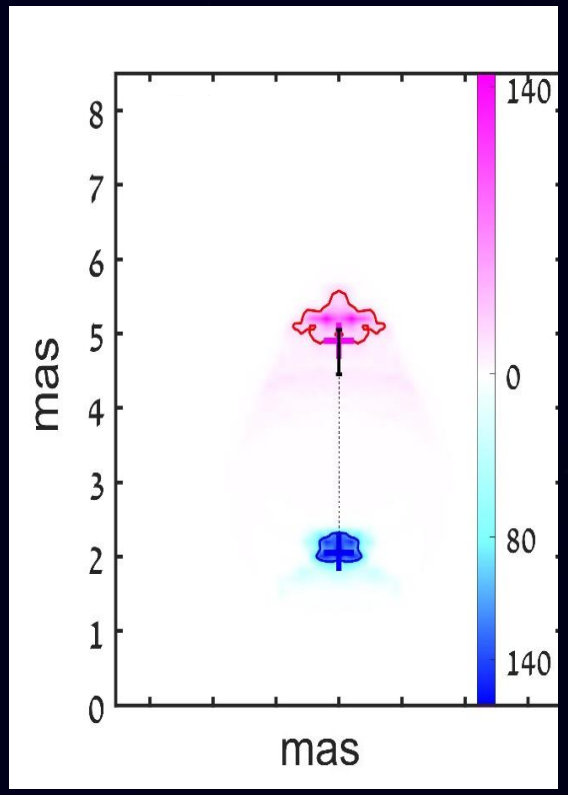

$\theta_{obs} = 69^{\circ}$
t =0.00 s
$10^9\ cm$

Fitting GW170817 Afterglow

- Reproducing the light curve and images centroid movement with

$\theta_j = 4°$, $\theta_{obs} = 20°$, $E_{iso} = 3 \times 10^{52}$ erg and $n = 10^{-3}$ cm^{-3} (best GRB estimates to date).

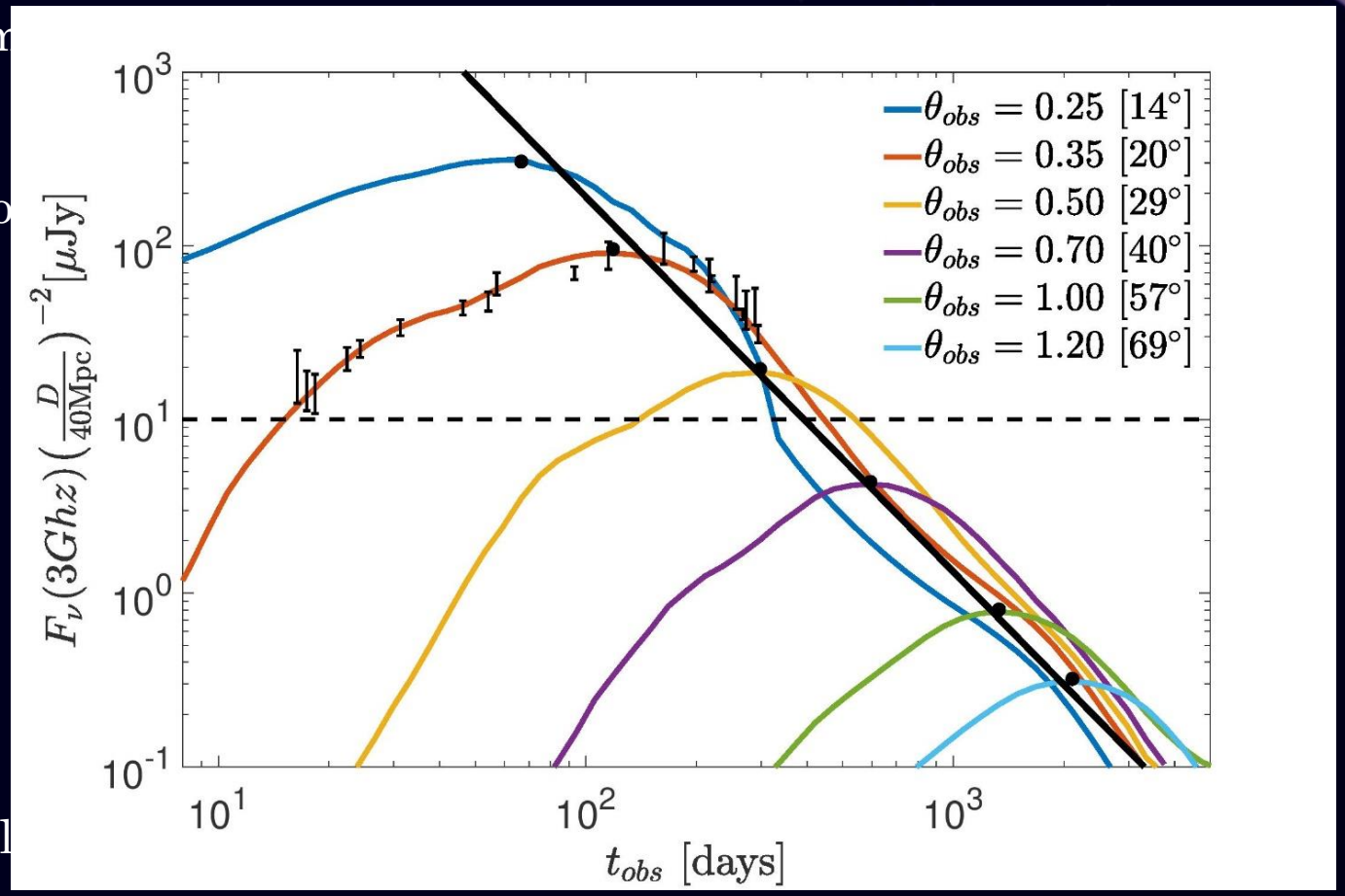




Mooley, Deller, Gottlieb et al. 2018

Peak relations

- Condition: Jet core dom
- Result: Behaves as a to
- Relations (Nakar et al.
- $F_p \propto 120 \left(\frac{\theta_{obs}}{20^\circ}\right)^{-4.32} \mu Jy$
- $t_p \propto 130 \left(\frac{\theta_{obs}}{15^\circ}\right)^{2} days$
- Generic and apply to al
- → GW170817 was detectable up to 33°.



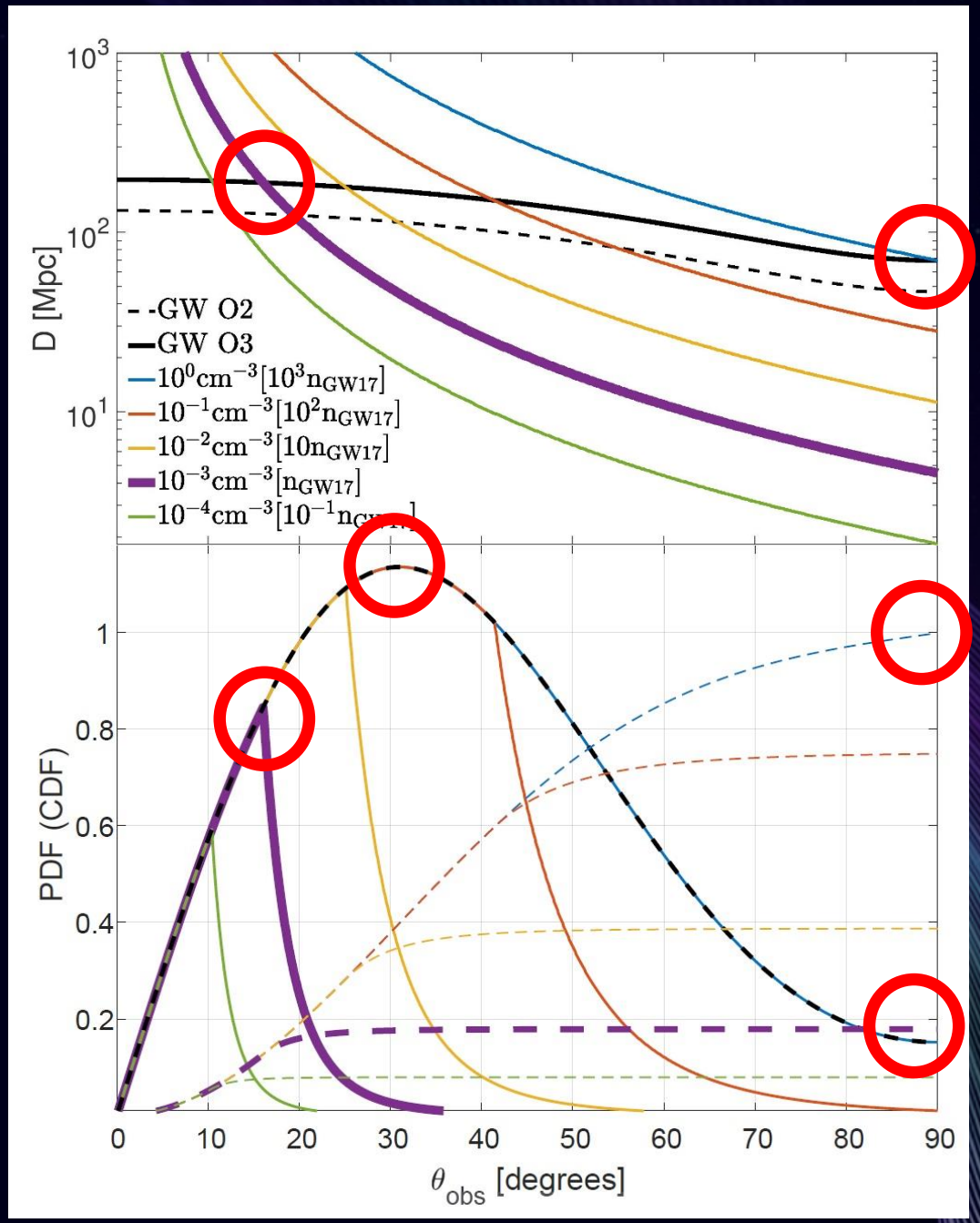
Radio detection horizon

- All GW170817-like events are detectable at $\theta_{obs} < 16^{\circ}$ in O3.
- Only 18% of GW170817-like events are detectable in O3.

  Almost all at $15^{\circ} < \theta_{obs} < 20^{\circ}$.
- At $n \approx 1\ cm^{-3}$ all afterglows are detectable in O3, with the

  majority at $\theta_{obs} \approx 30^{\circ}$.
- Most detections at $n > 5 \times 10^{-2}\ cm^{-3}$ at $\theta_{obs} \approx 30^{\circ}$ (70% of

  these events).



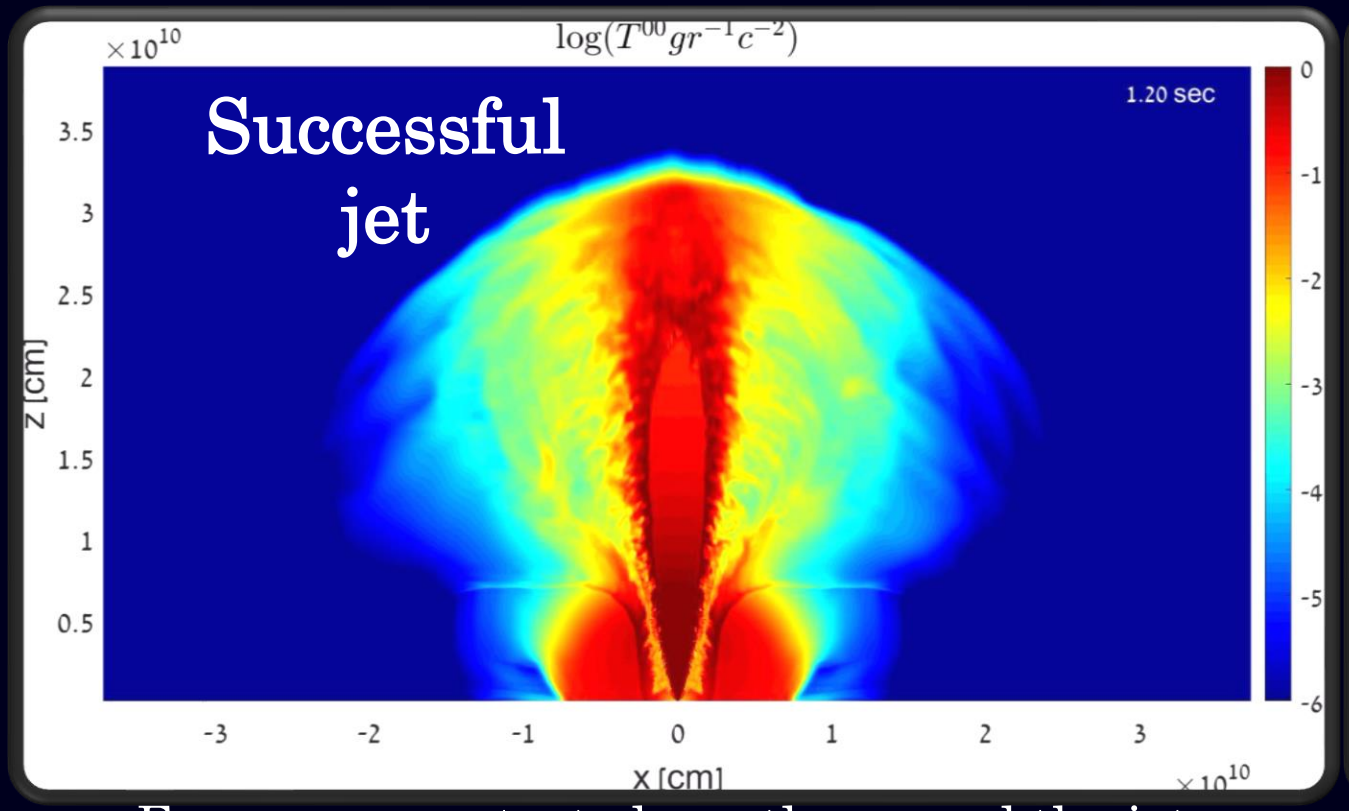
Maximal time for detection

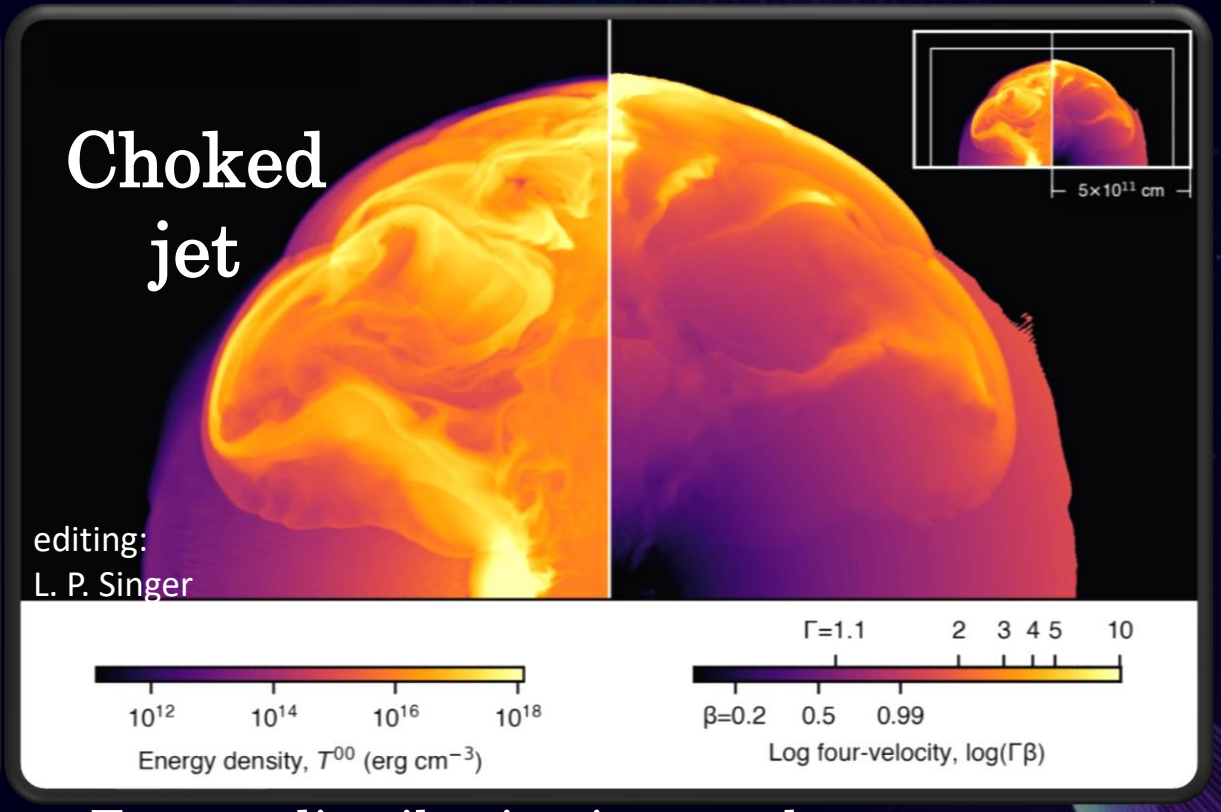
- High density (early strong peak) vs. low density (late faint peak).

→ There is a minimal density for which $F_{\nu,p}$ is above the detection limit.

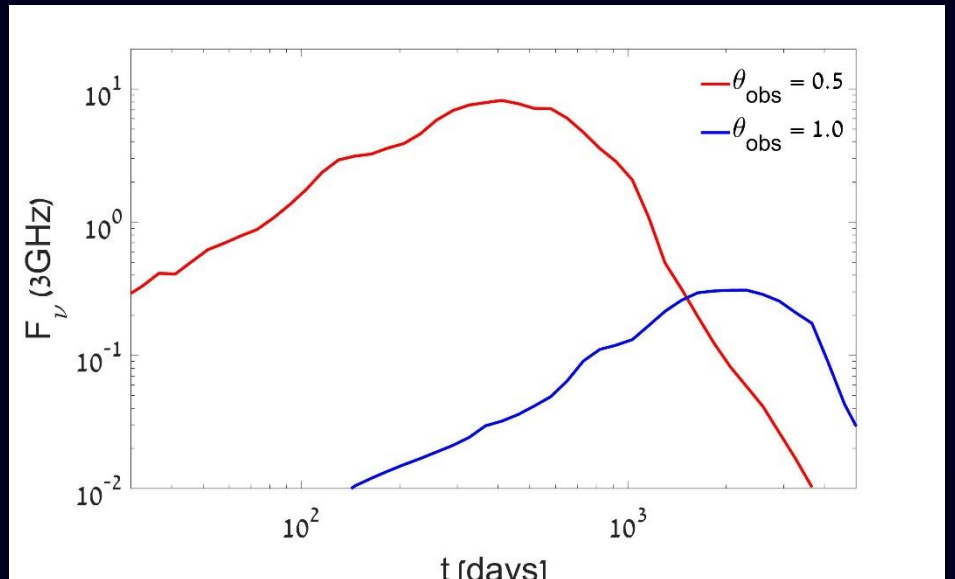
→ Maximal time for detection: $t_{last} = 240 \left(\frac{E}{10^{50} erg}\right)^{0.76} \left(\frac{F_{lim}}{10 \mu Jy}\right)^{-0.42} \left(\frac{D}{150 Mpc}\right)^{-0.84} days.$

- Latest time for detection is typically 200 days.
- Very energetic or very different ϵ_B can yield $t_{last} \approx 2$ years.
- Non-relativistic components can be detected in later times.

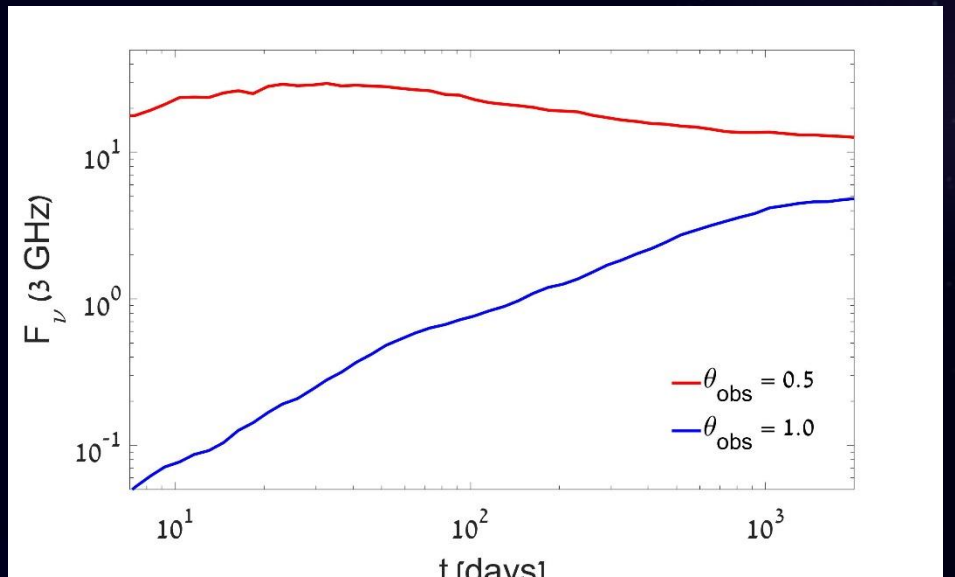




Energy concentrated mostly around the jet



Energy distribution is more homogenous



Future events

- Detectable afterglows of GW170817-like events are unlikely, leaving the MN as the only EM signal.
- Most NS merger afterglows will be detectable at $\theta_{obs} \approx 30^{\circ}$ and $n \approx 0.1\ cm^{-3}$ (70% of such events).
- Choked jets are possibly more common than successful jets and be detectable to larger viewing angles

  both for their afterglow and shock breakout, allowing a joint a GW/$\gamma - ray$/afterglow detection.