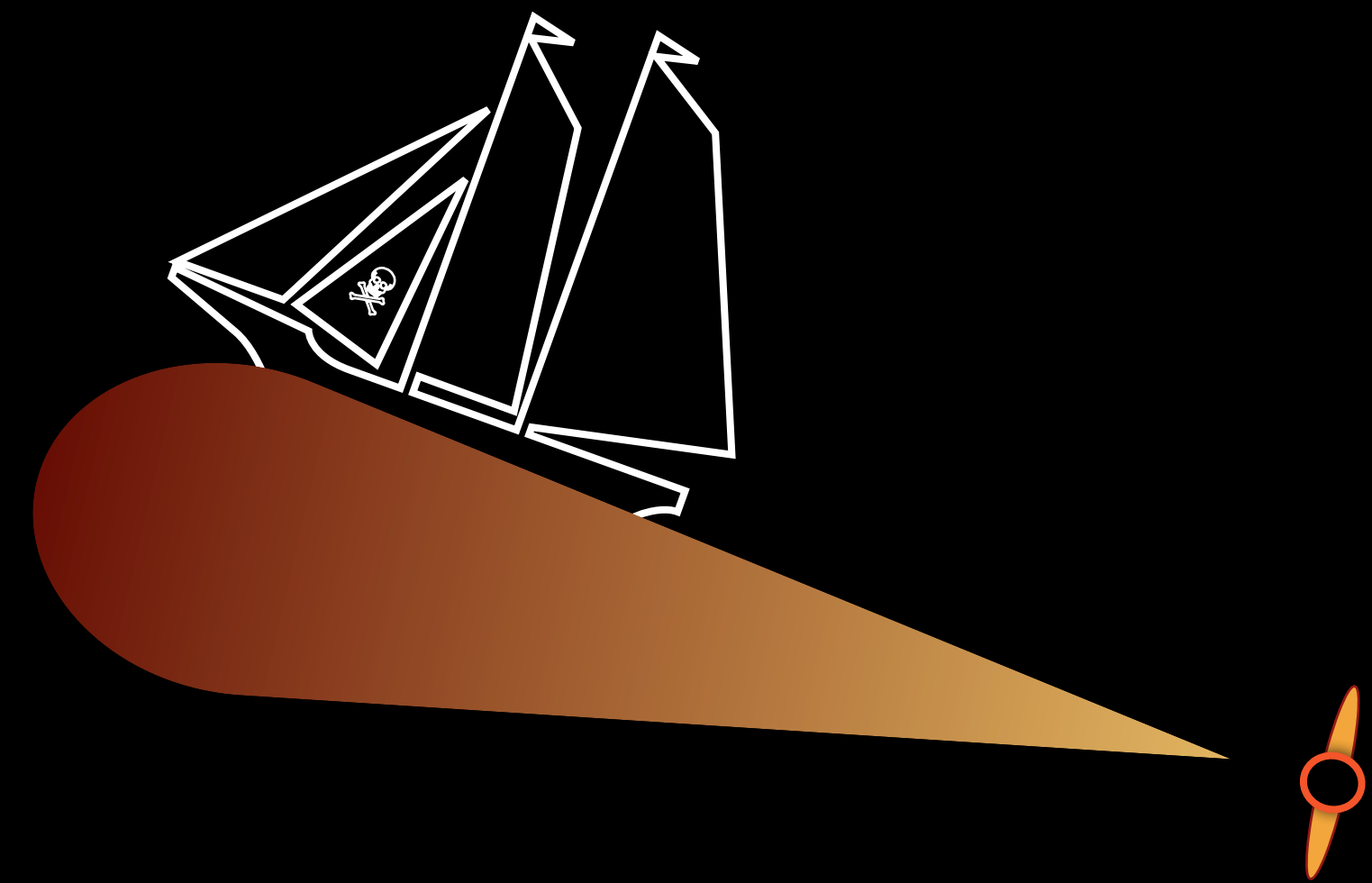


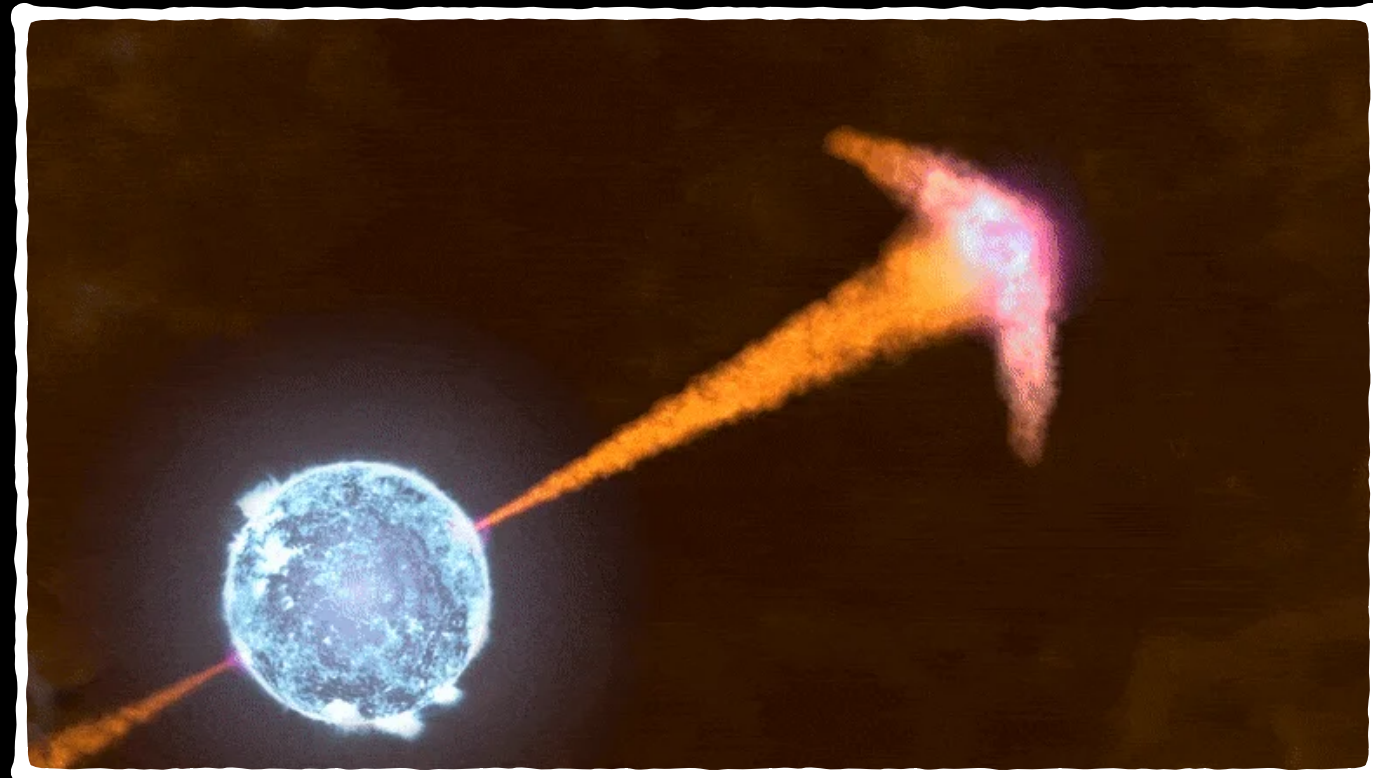
VLBI *science cases*

Gamma-Ray Bursts



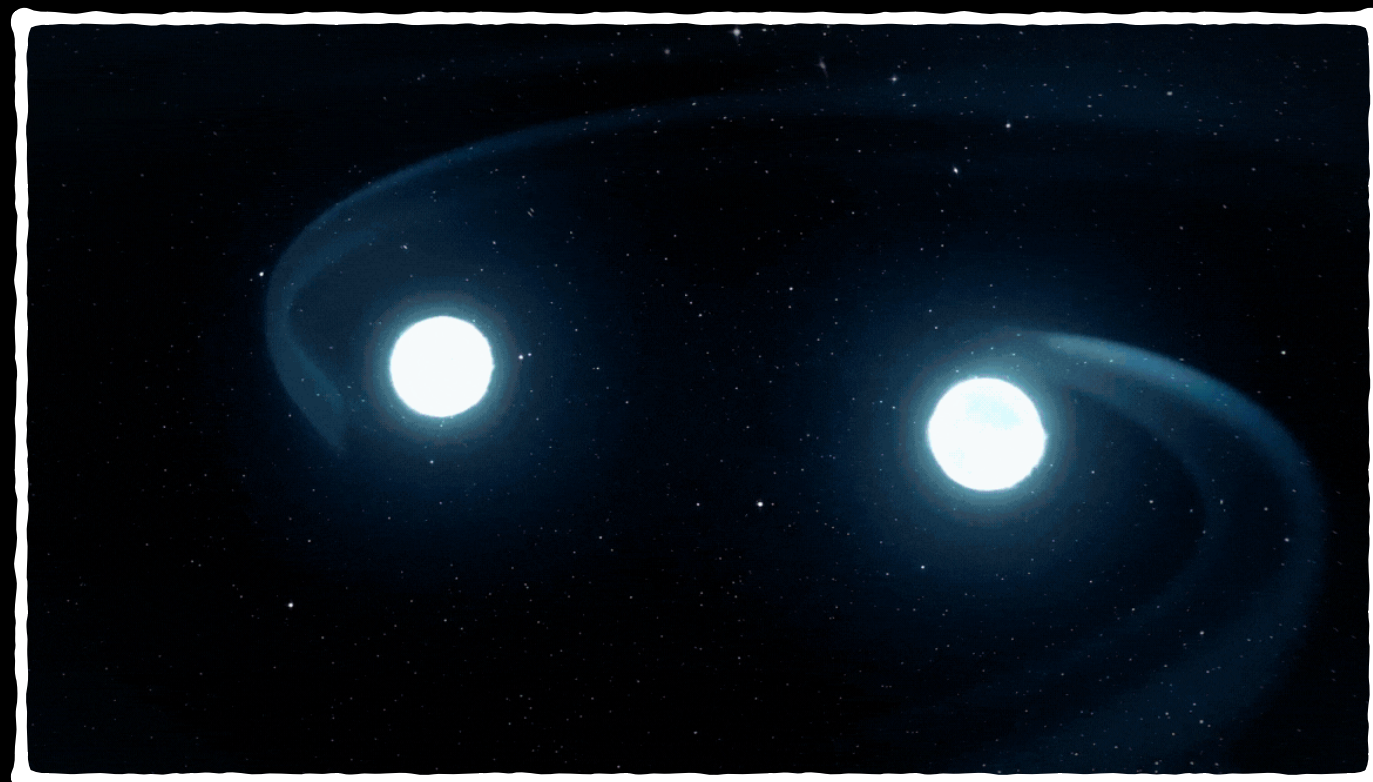
Gamma-Ray Bursts

Long

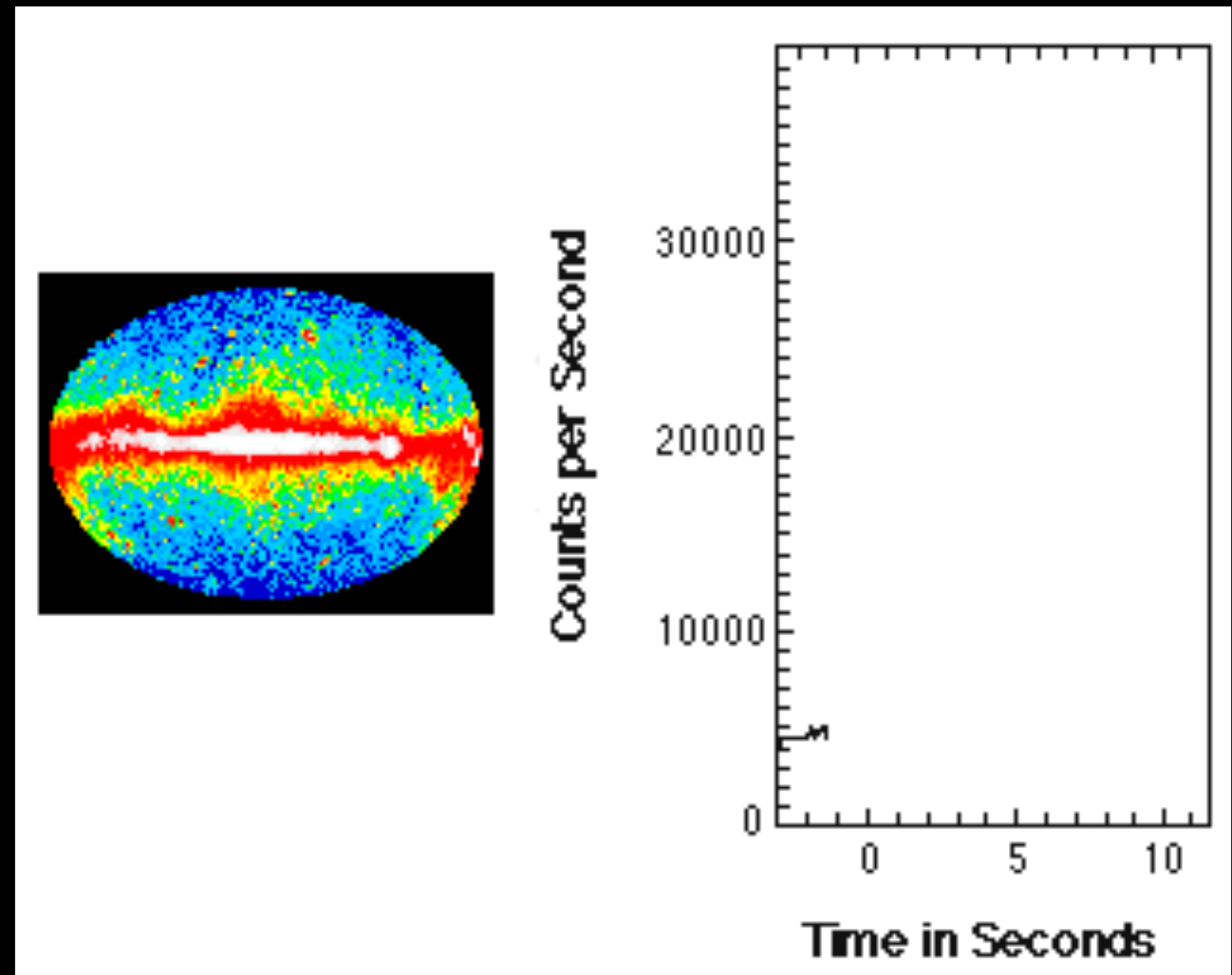


Credits: NASA's Goddard Space
Flight Center

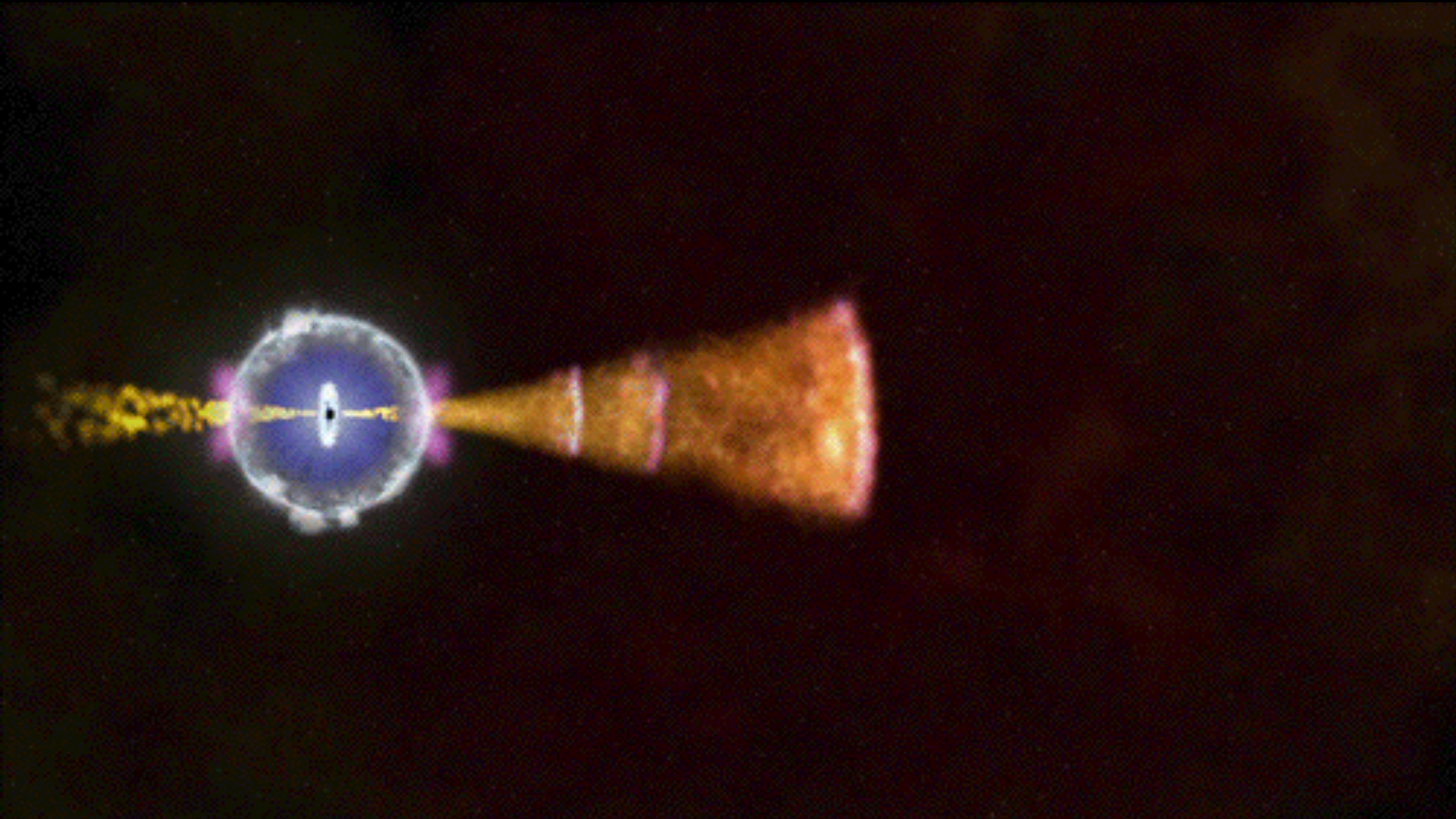
Short



Credits: NASA's Goddard Space
Flight Center/CI Lab



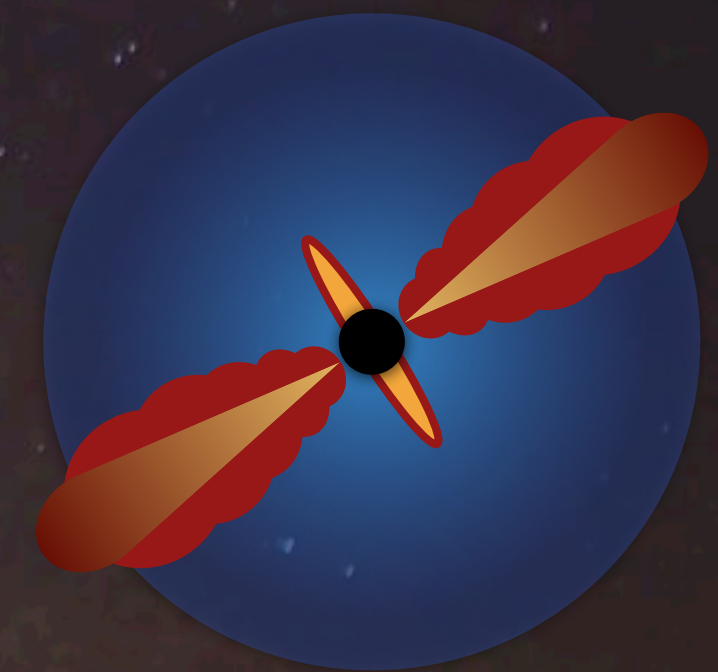
A GRB detected by *BATSE* on-board the Compton
Gamma-Ray Observatory



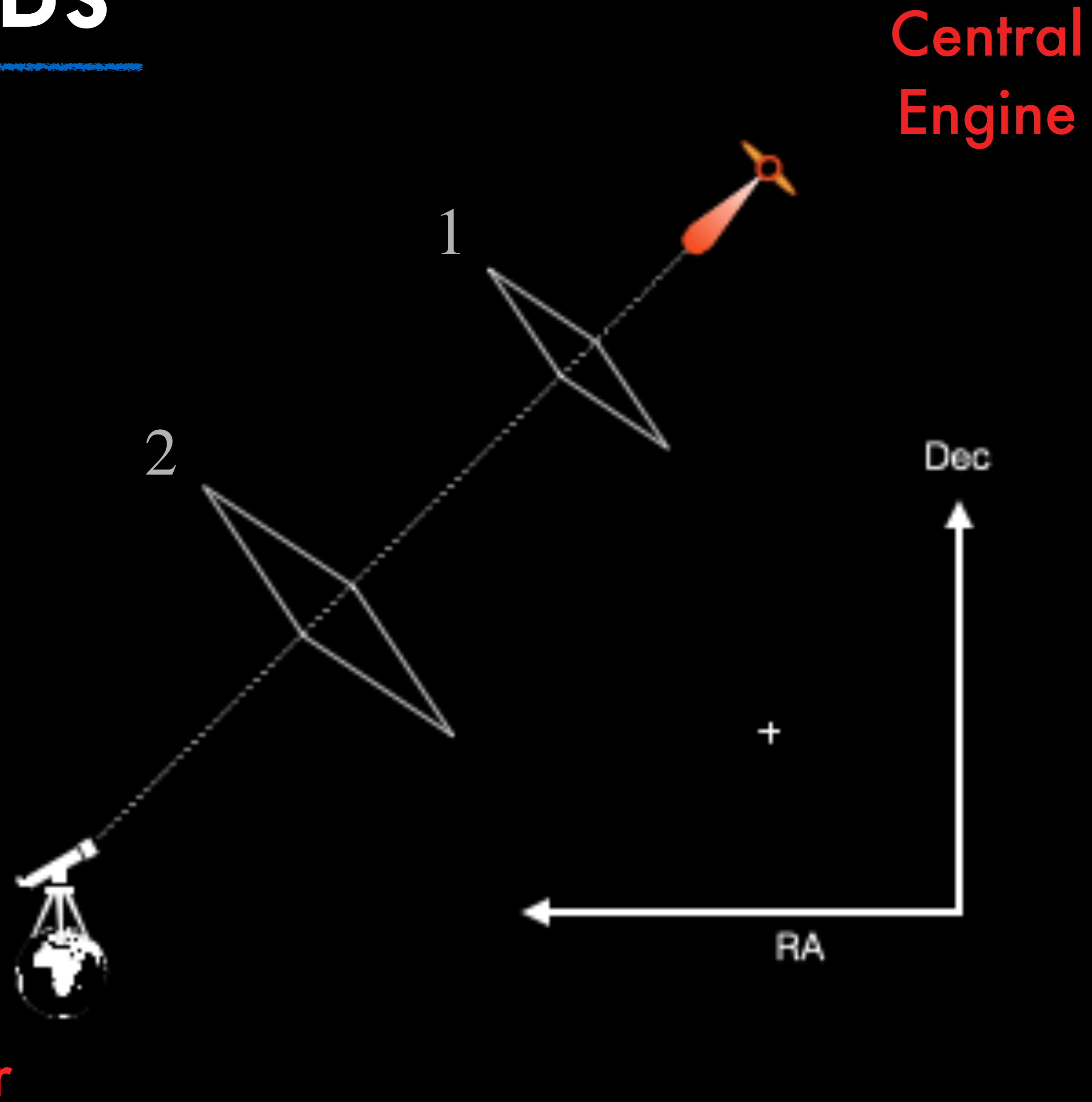
VLBI for GRBs

Geometry

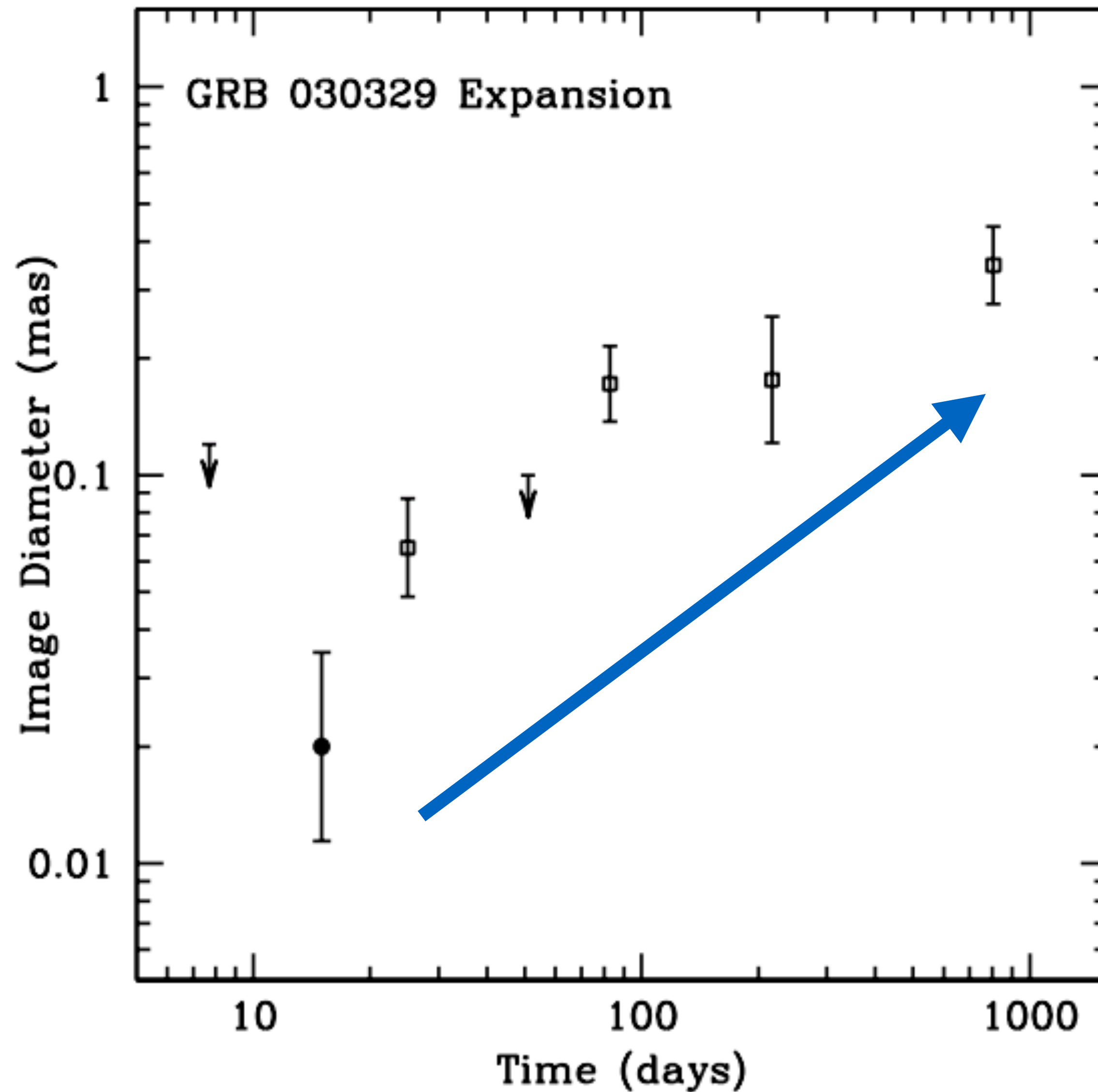
Viewing angle
Collimation angle
Size and structure



On-axis GRBs



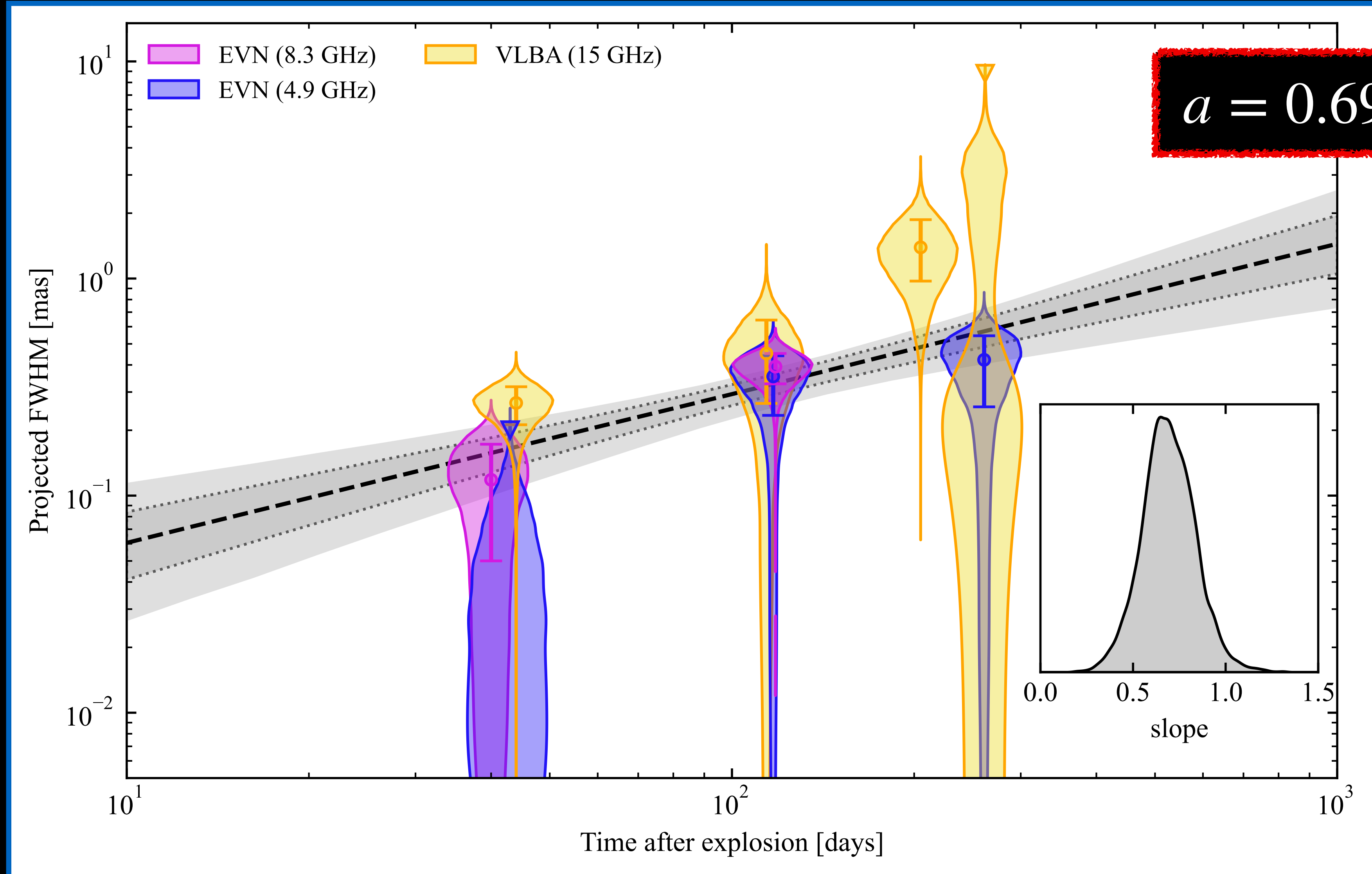
GRB 030329



First direct proof of
(apparent)
superluminal
expansion

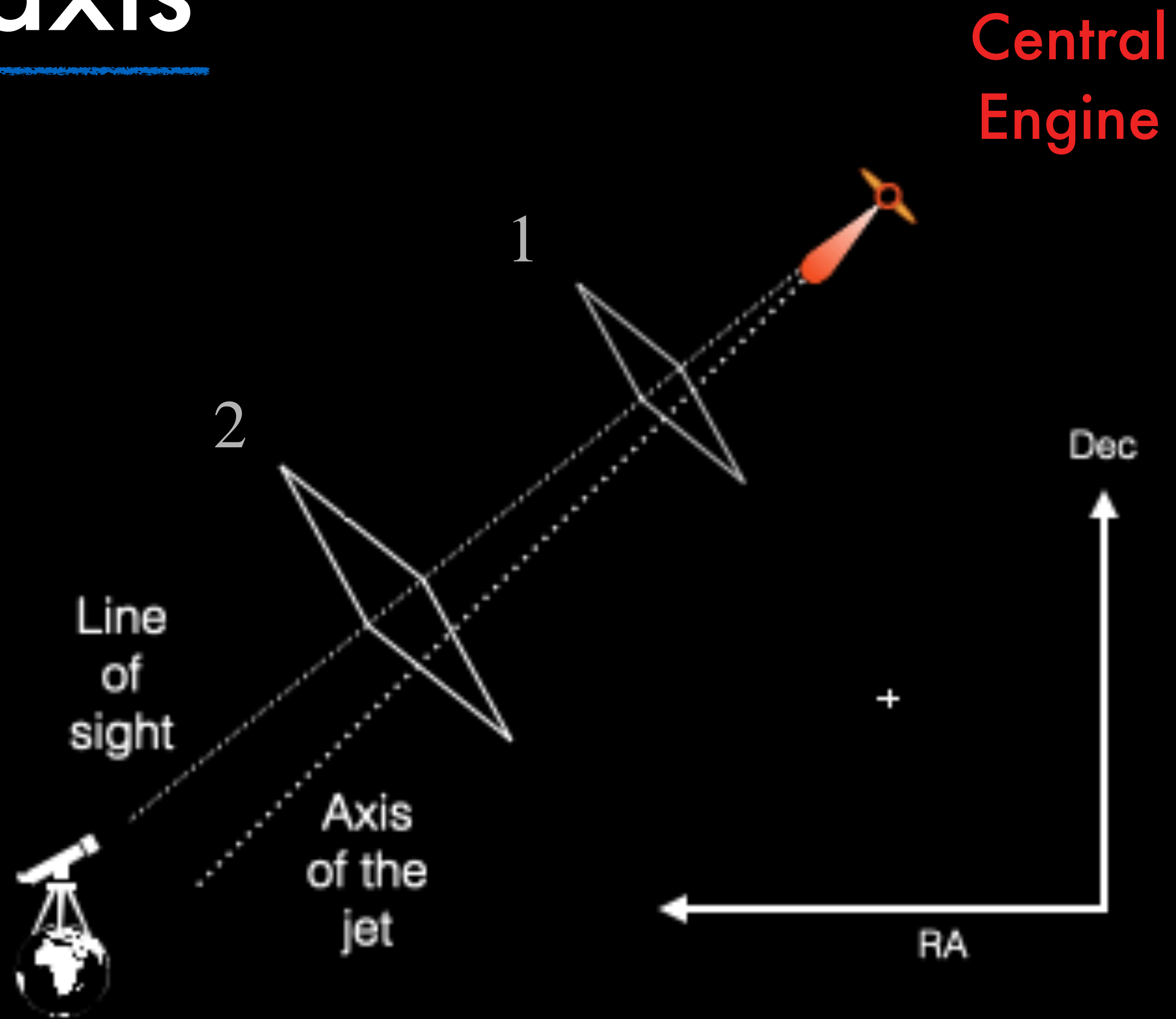
From *Pihlström et al. (2007)*

GRB 221009A



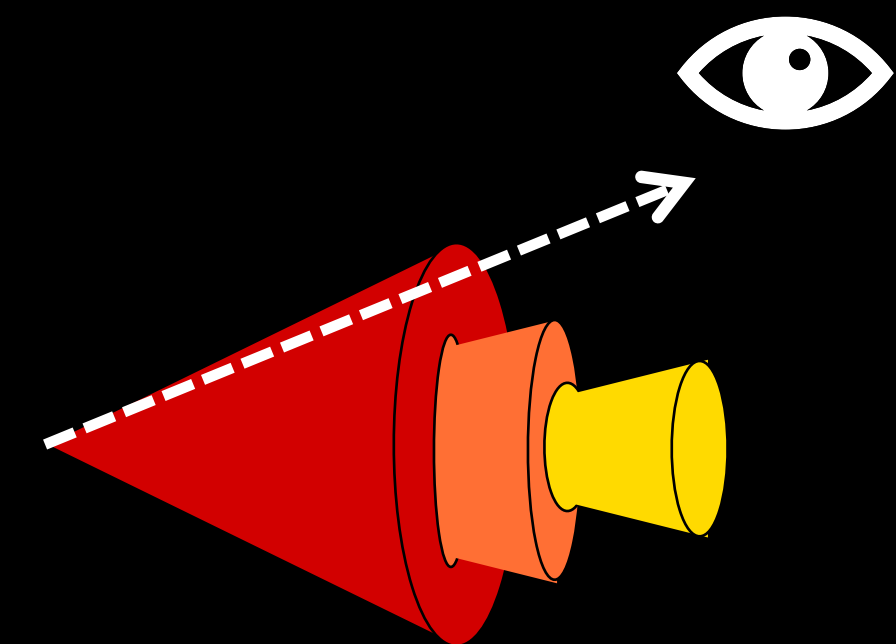
Apparent size evolution.
From *Giarratana et al. (2024)*

(slightly) Off-axis



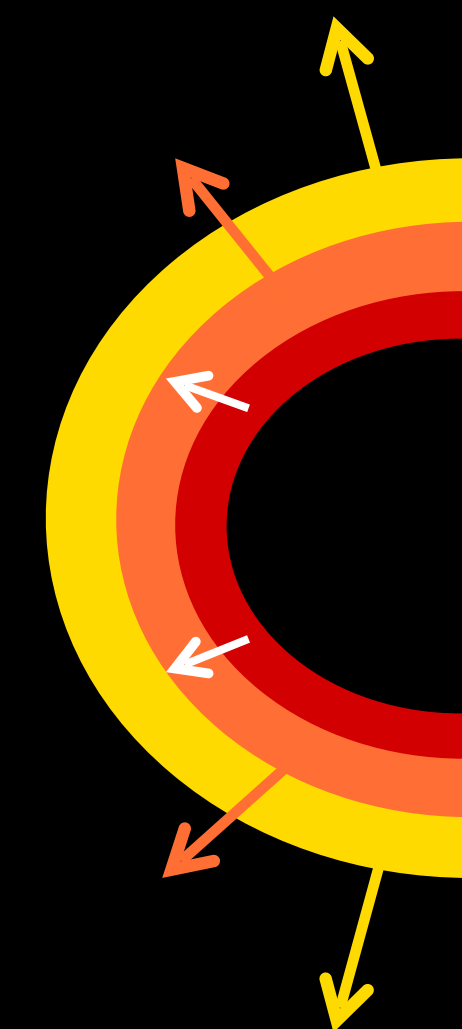
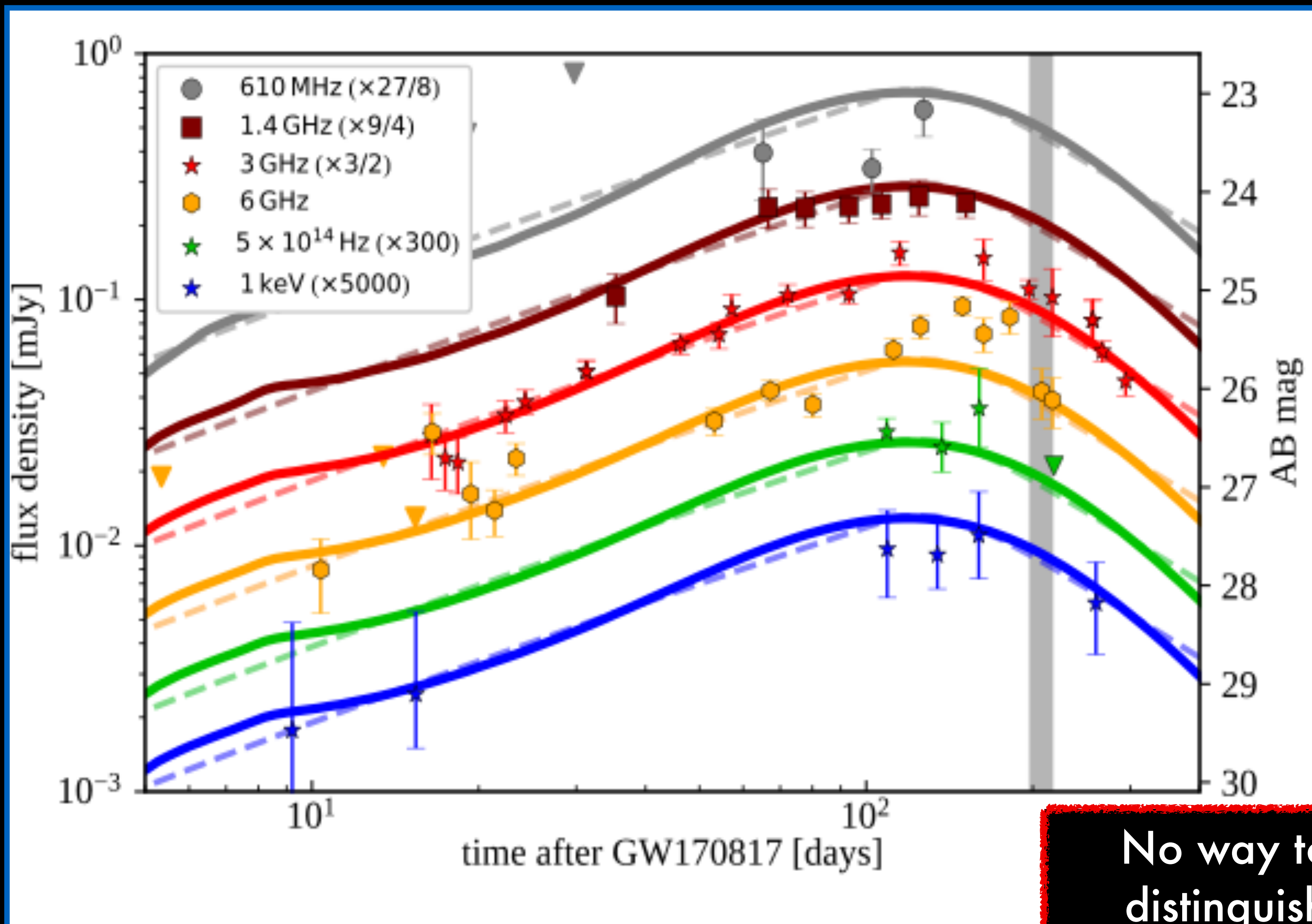
Observer

GRB 170817A



$$\Gamma_1 < \Gamma_2 < \Gamma_3$$

$$E_1 < E_2 < E_3$$



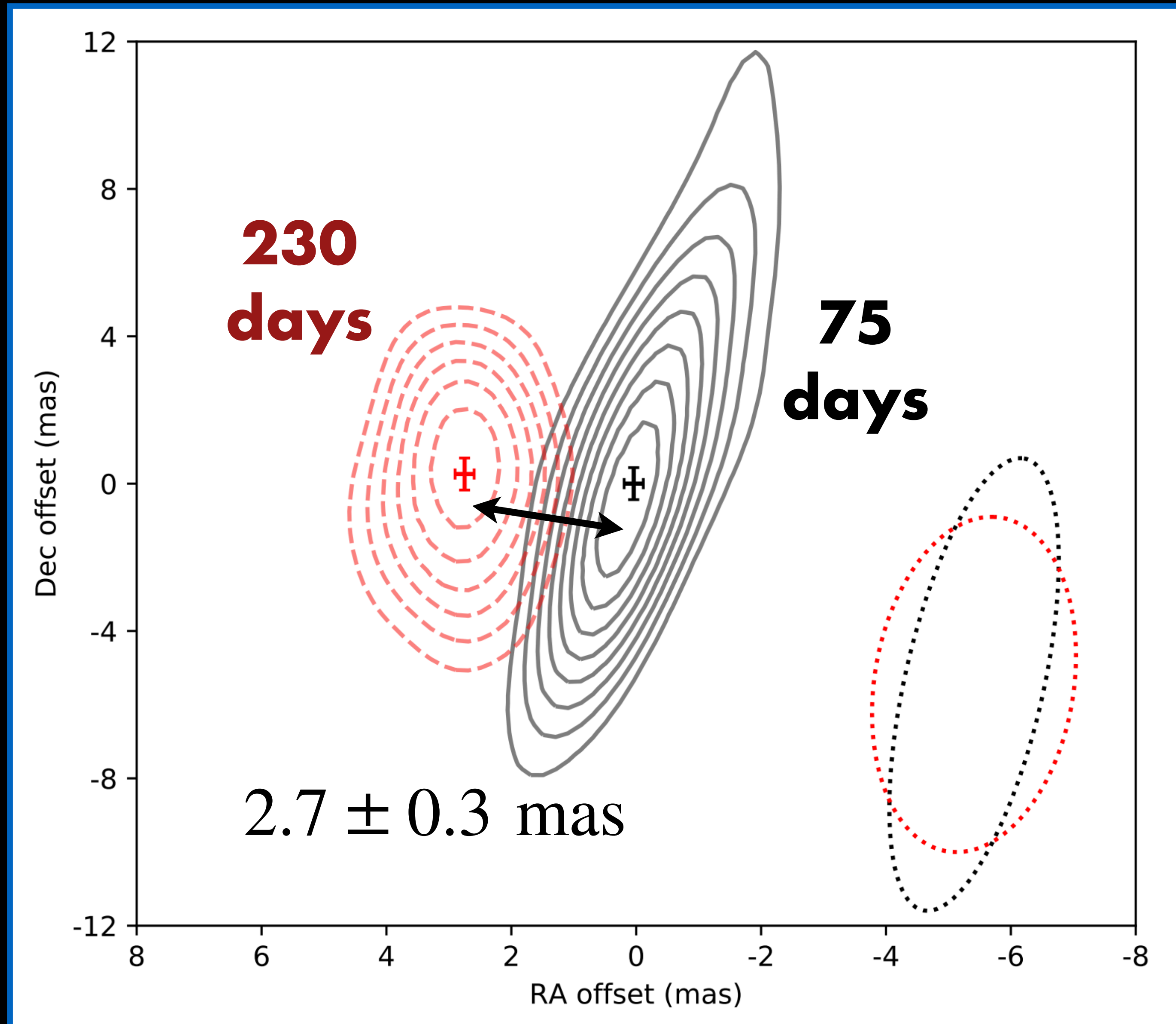
$$\Gamma_1 < \Gamma_2 < \Gamma_3$$

$$E_1 > E_2 > E_3$$

No way to
distinguish
between models!

From *Ghirlanda et al. (2019)*

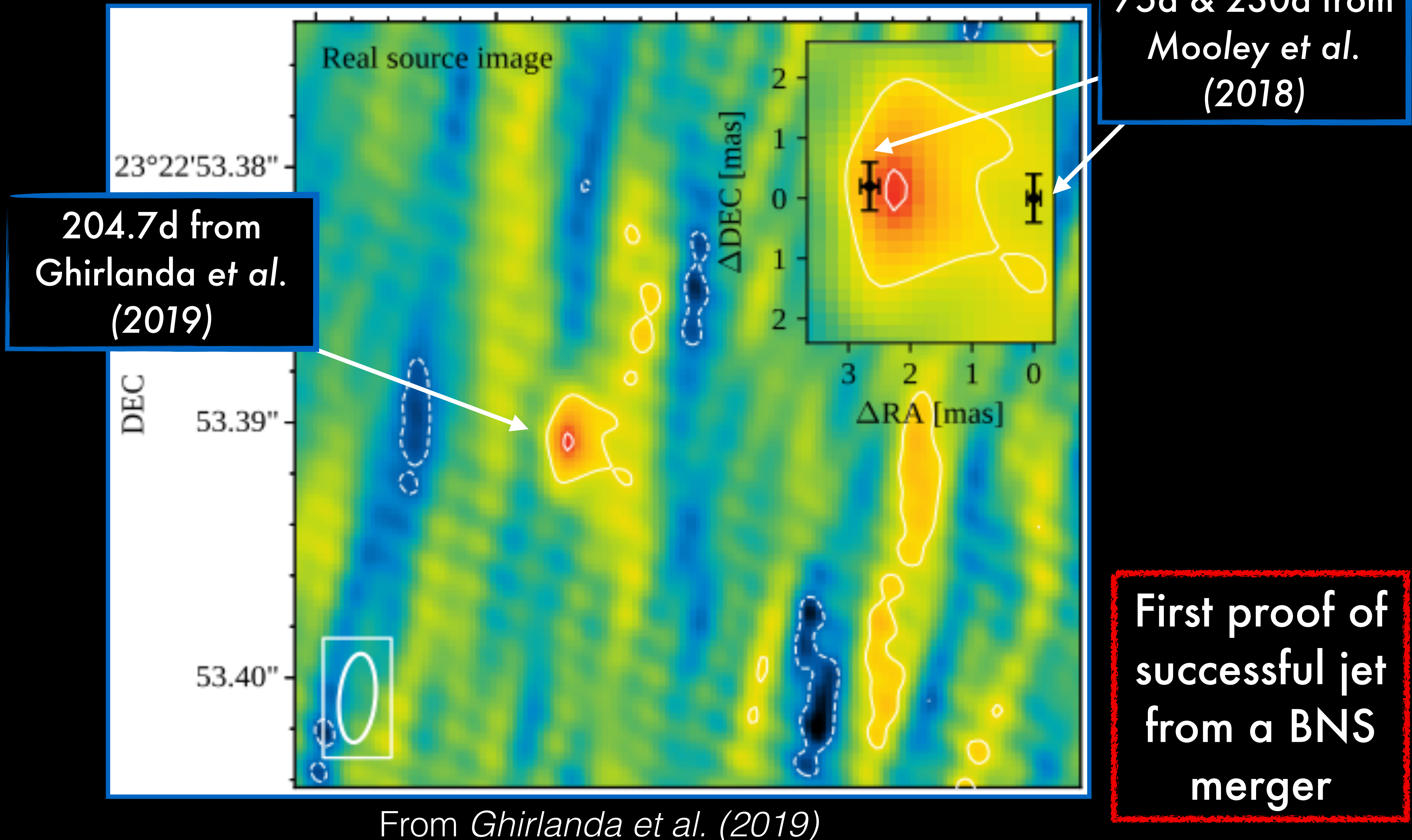
GRB 170817A



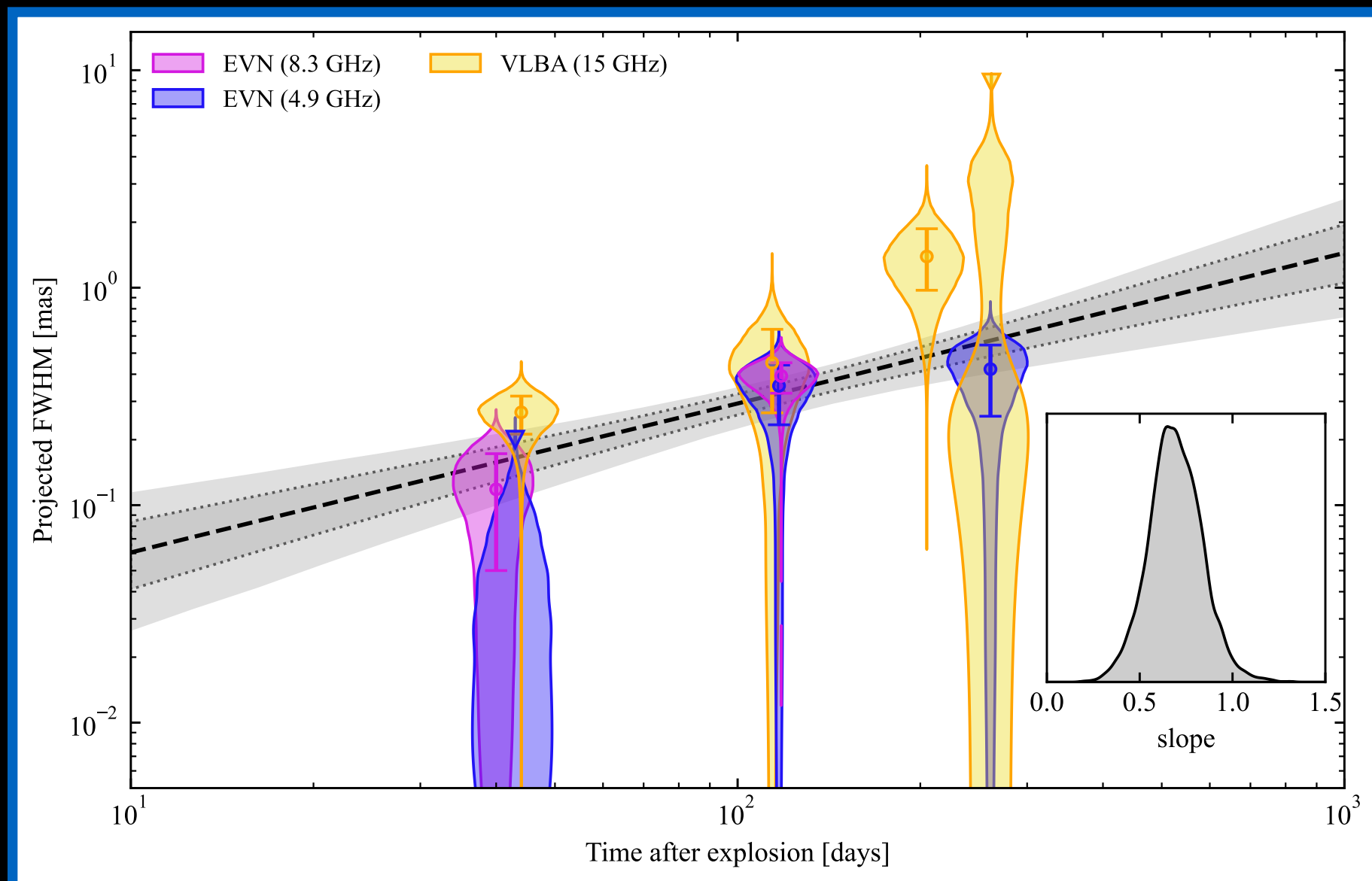
A (slightly)
off-axis GRB

From *Mooley et al. (2018)*

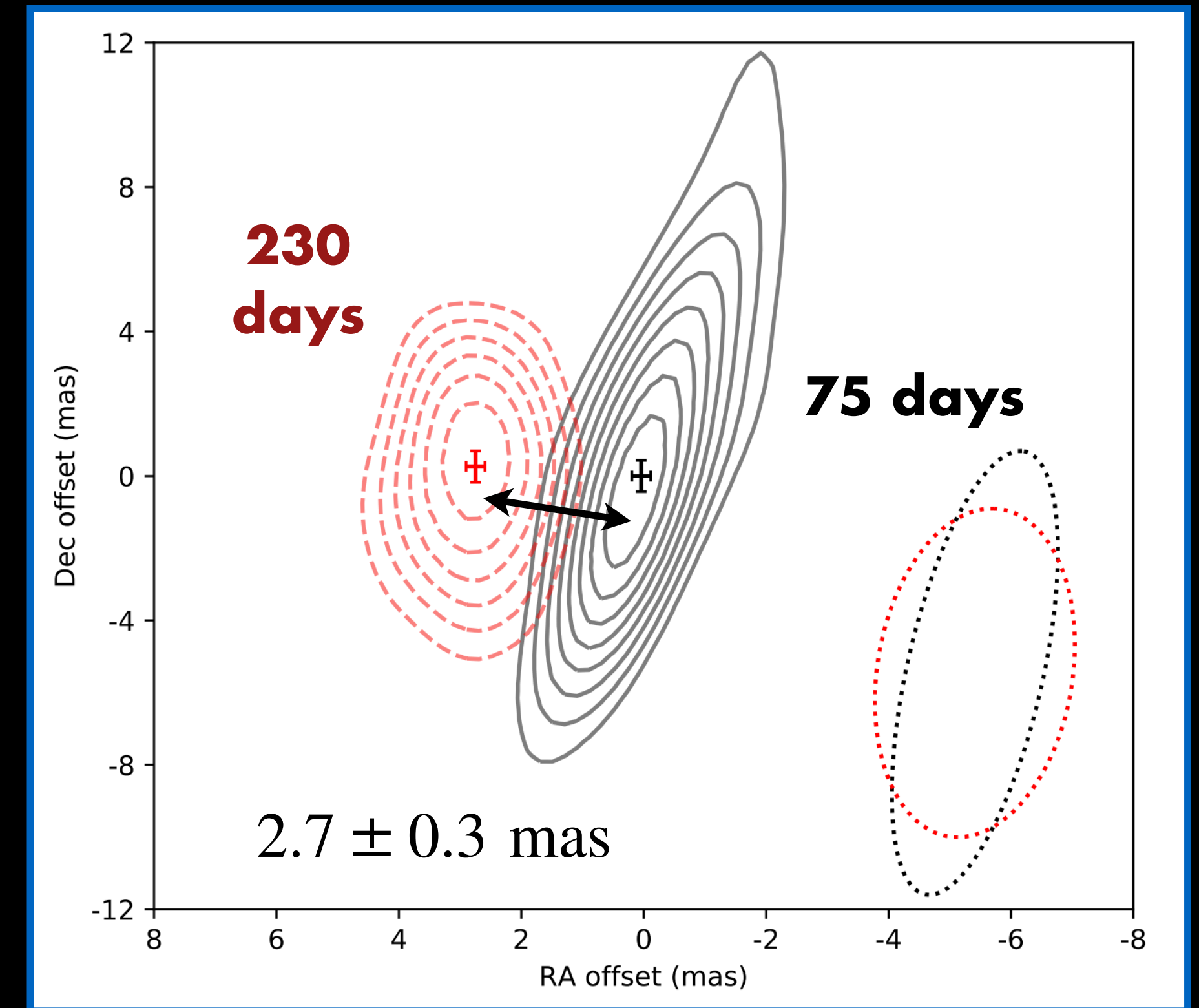
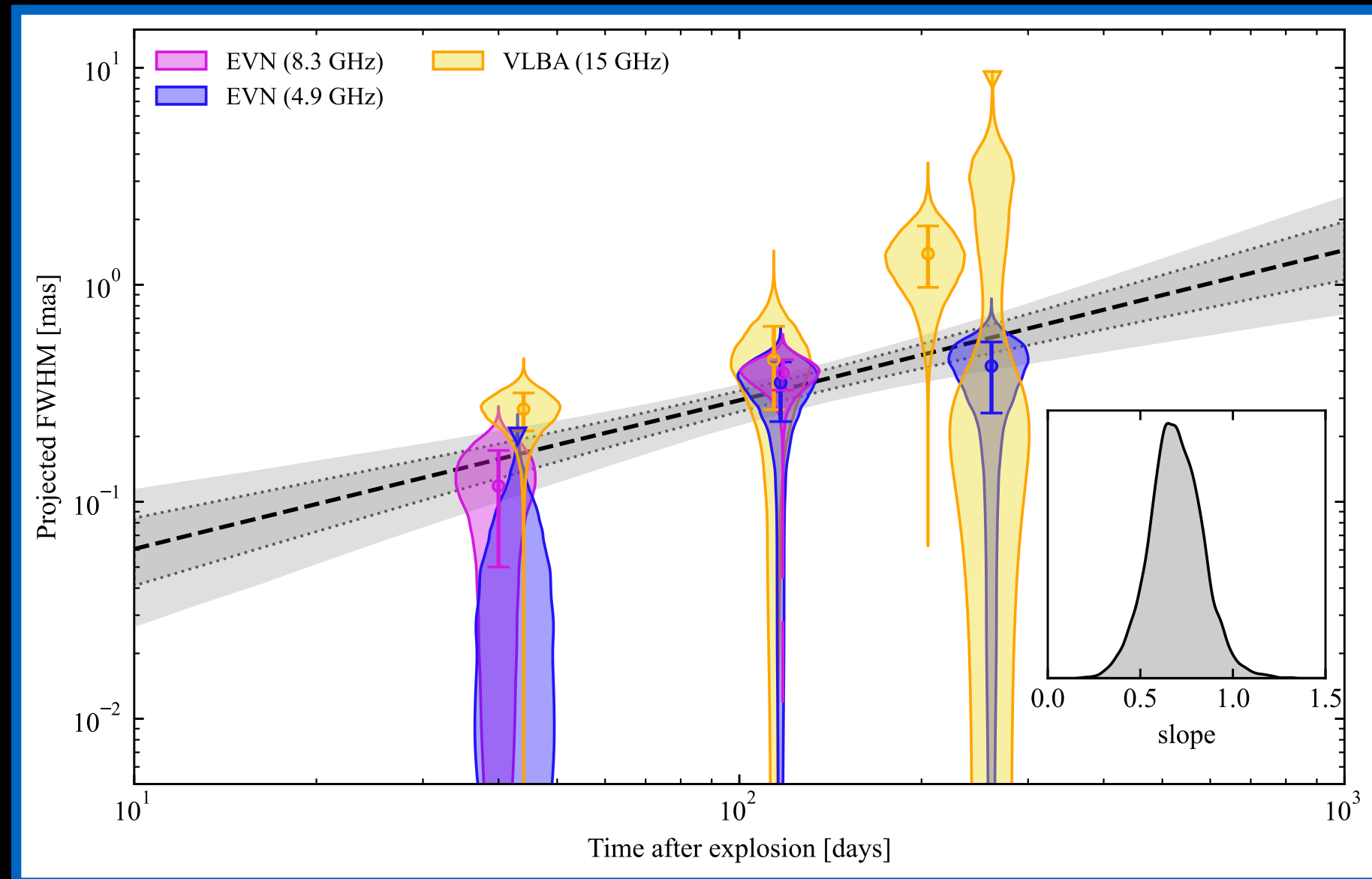
GRB 170817A



(some) Conclusions



(some) Conclusions



(some) Conclusions

