

# Gamma-ray burst afterglows and wysqy: compact binary merger or collapsar?

Tomás Ahumada  
and many, many others



Global Relay of Observatories Watching Transients Happen



UNIVERSITY OF  
MARYLAND



ZTF20abwysqy

# Gamma-ray burst afterglows and wysqy: compact binary merger or collapsar?

Tomás Ahumada  
and many, many others



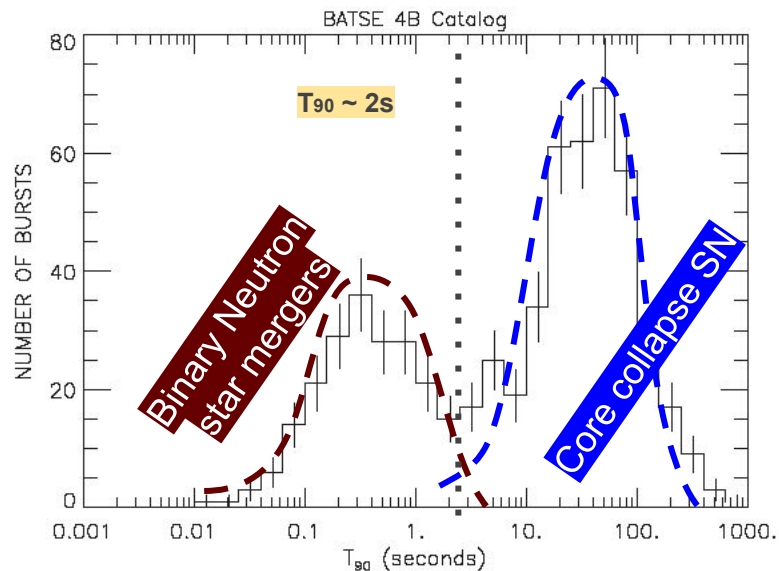
Global Relay of Observatories Watching Transients Happen



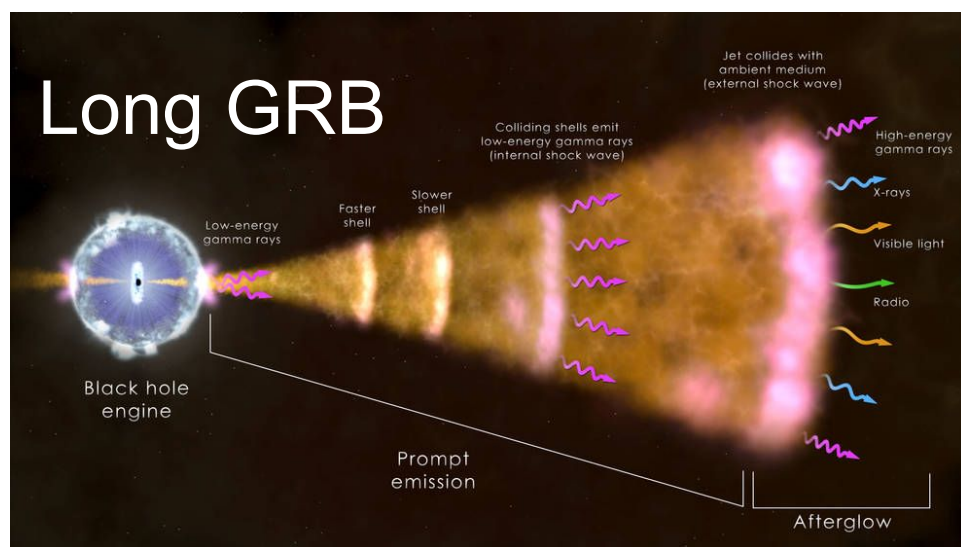
UNIVERSITY OF  
MARYLAND



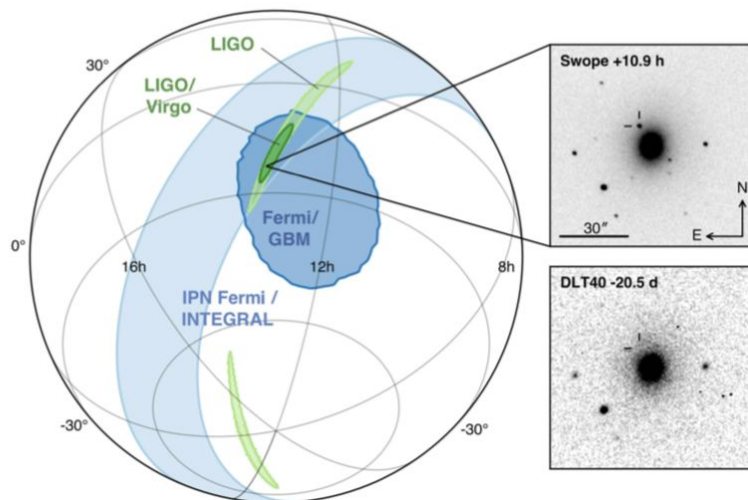
# Gamma-ray Bursts



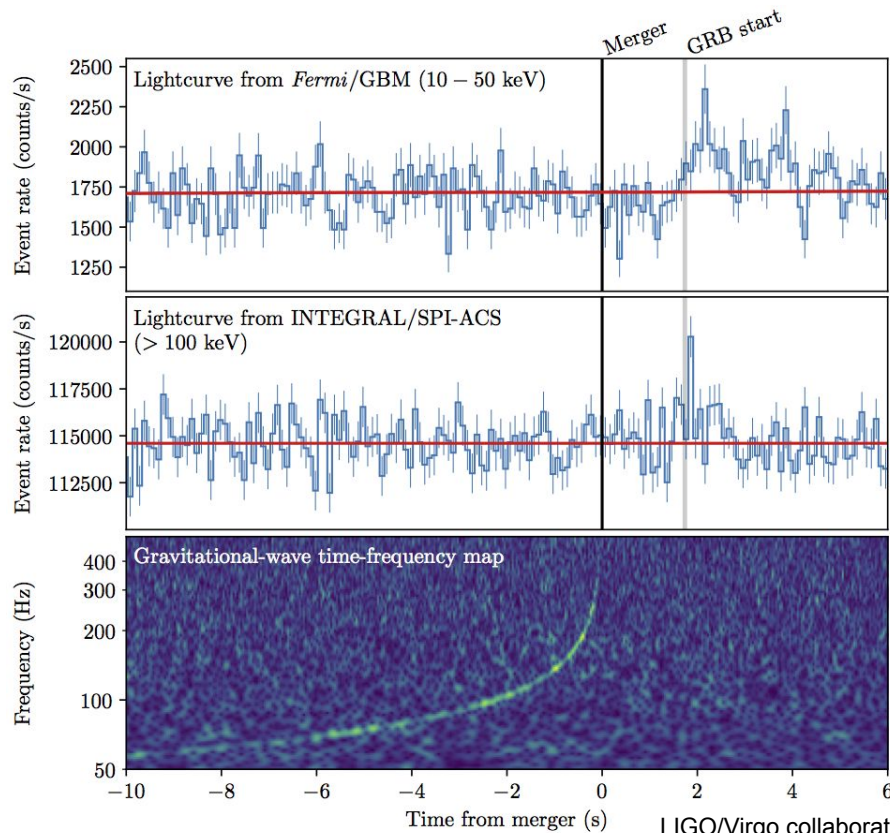
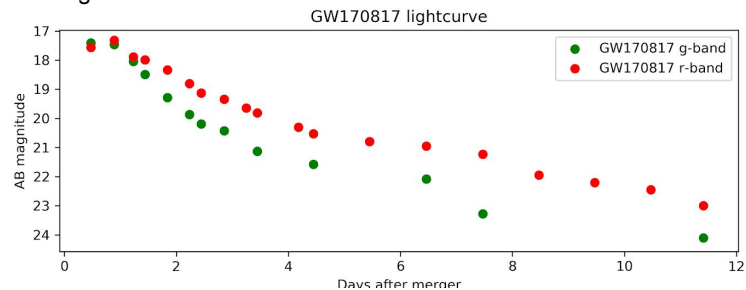
BATSE GRB historical detections (BATSE 2001)



# Gamma-ray Bursts and Gravitational Waves



LIGO/Virgo collaboration 2017



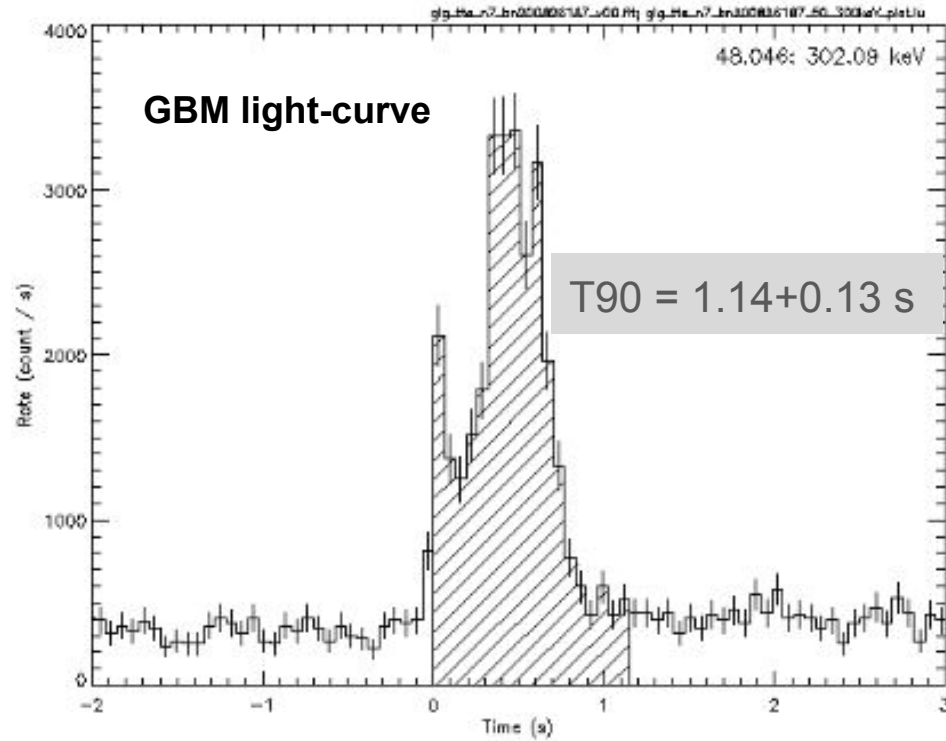
LIGO/Virgo collaboration 2017

# Fermi Gamma-ray Burst Monitor (GBM)

- Wide FOV (all-sky not occulted by Earth)
- Detected GRB170817 1.6 sec after the GW
- More sensitive to higher energies
- **40 SGRB per year**
- **Poor localizations**



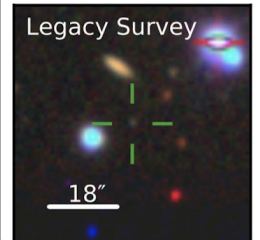
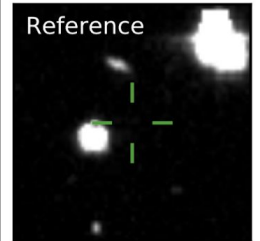
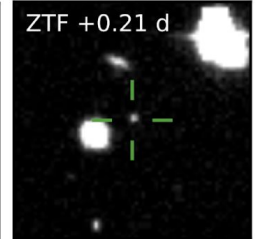
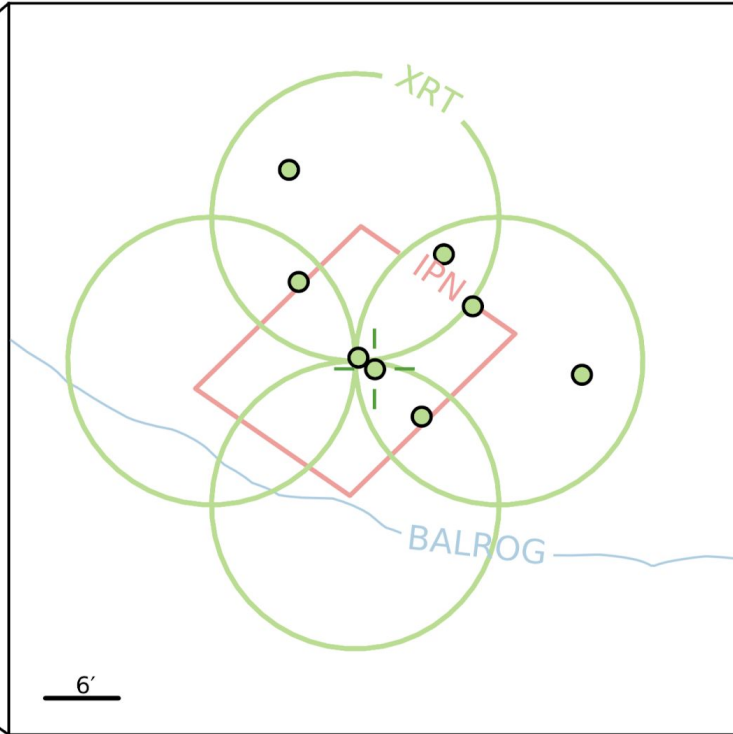
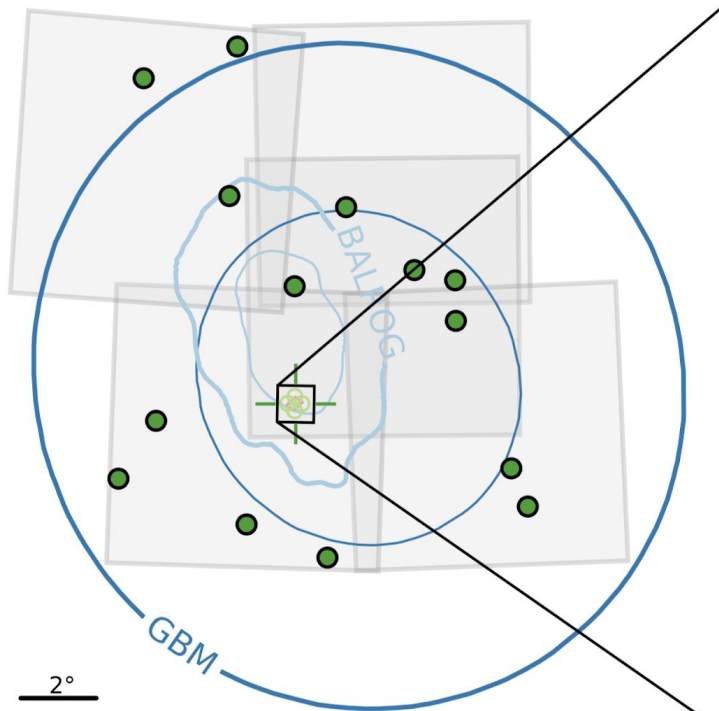
# GRB200826A





# GRB200826A

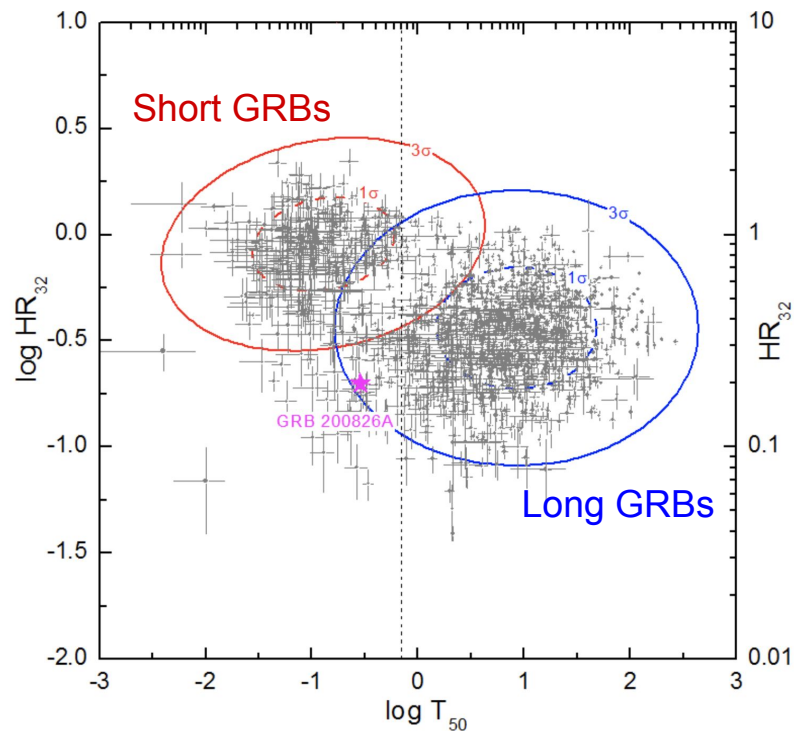
ZTF20abwysq



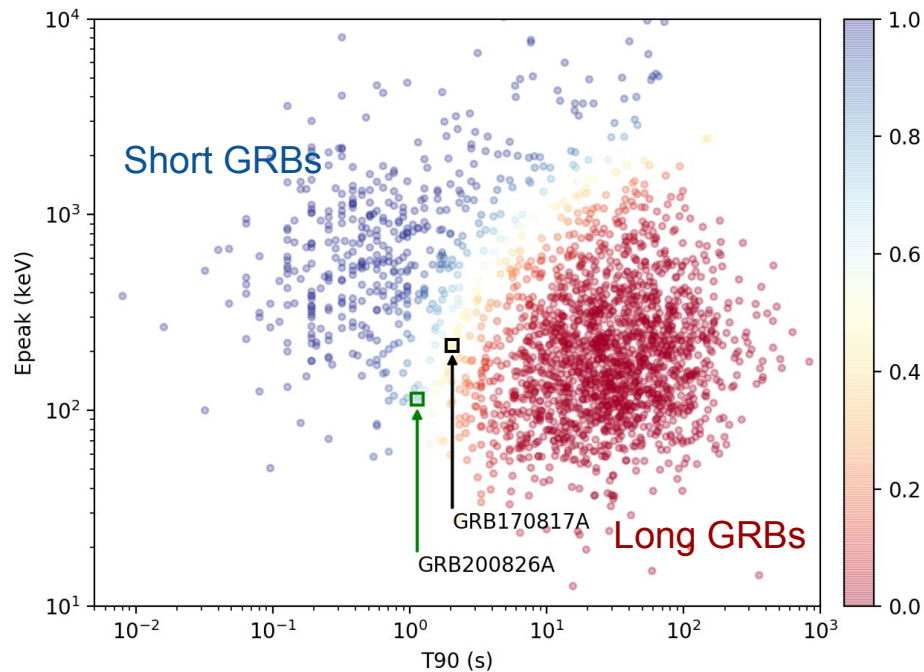
GRB200826A 90% ~250 sq. degrees

# GRB200826A

## Konus-Wind analysis



## Fermi-GBM analysis





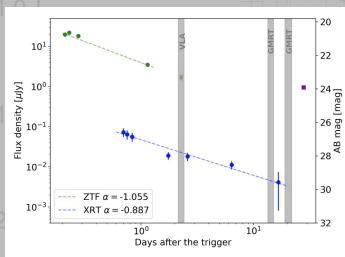
Falls outside the SGRB population

~ *potentially a collapsar*

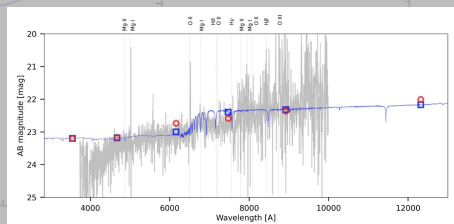
74% short GRB

**~ potentially a compact binary merger**

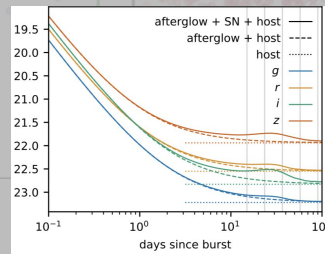
## Afterglow modeling



## Host galaxy properties

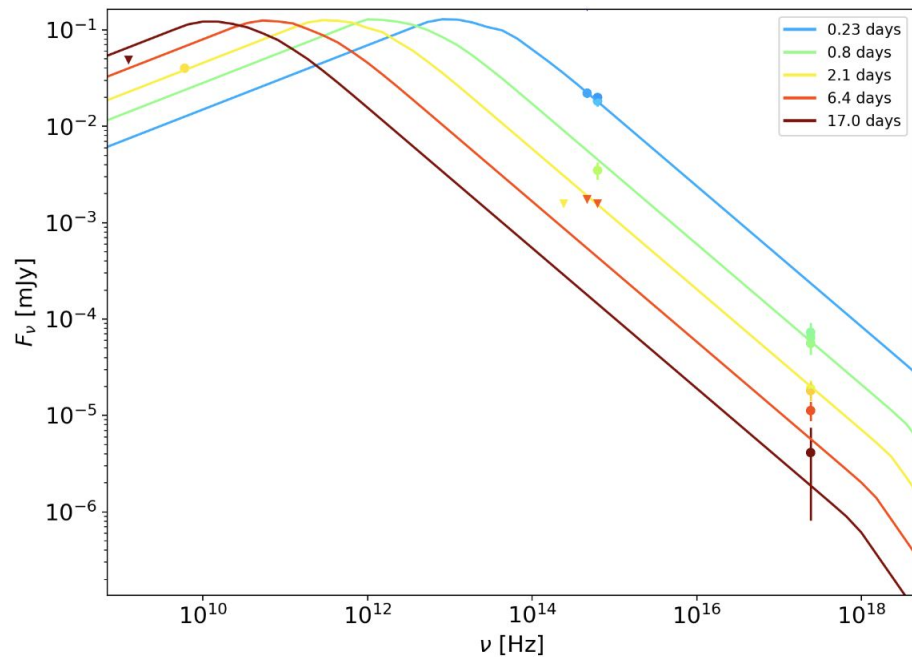
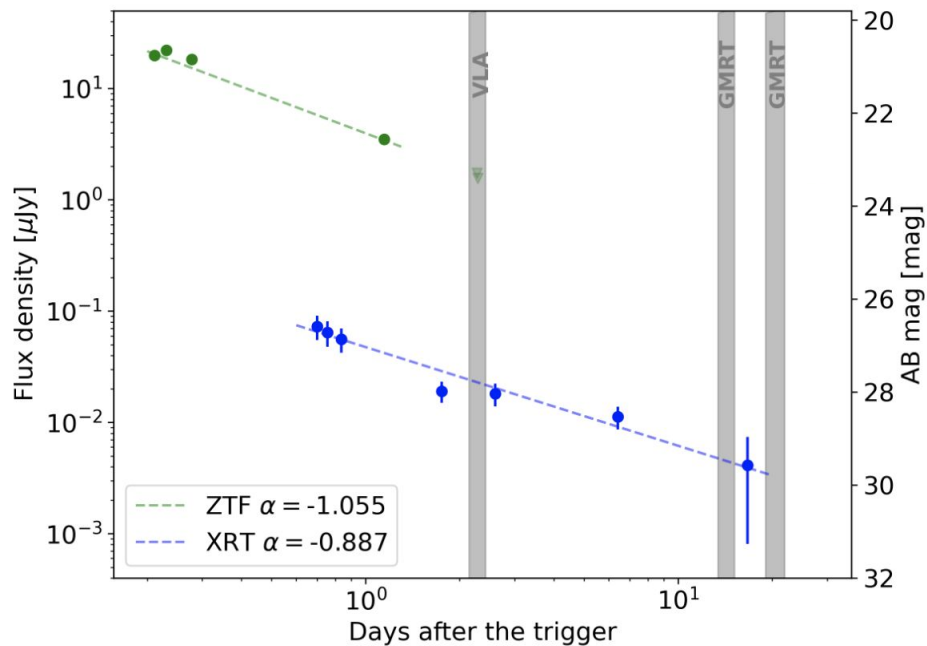
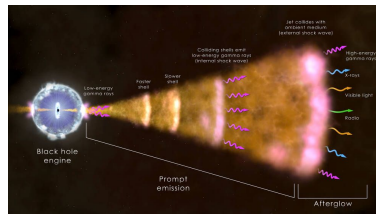


## SN hunt

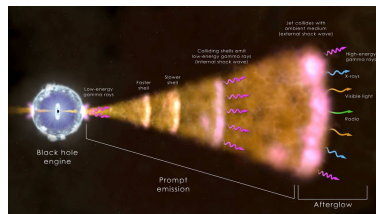


**Spoiler alert: we think it's a collapsar**

# Afterglow modeling

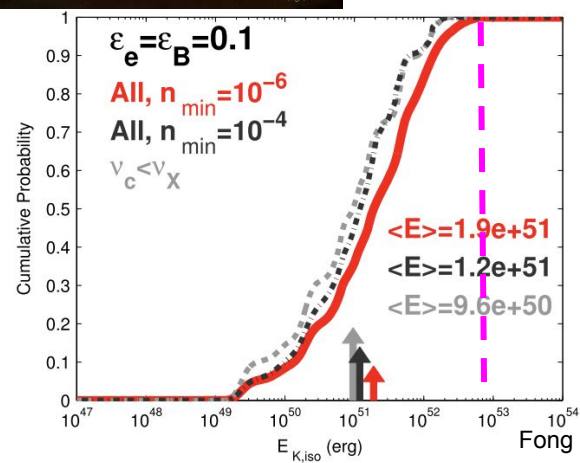
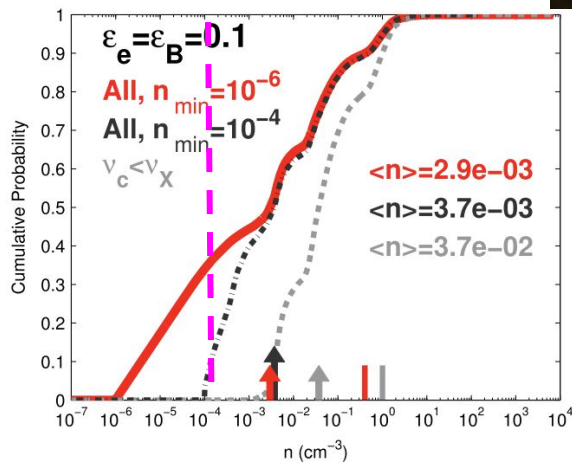


# Afterglow modeling



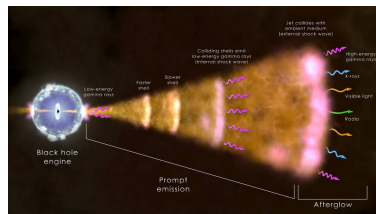
Short GRBs

Time Bins (s)	Model	Amplitude
$\theta_v$	[rad]	0.0001
$E_{K,iso}$	[erg]	$9.94^{+0.67}_{-0.62} \times 10^{52}$
$\theta_c$	[rad]	$> 0.29$
$n$	[cm <sup>-3</sup> ]	$1.01^{+0.16}_{-0.14} \times 10^{-4}$
$p$		$2.45^{+0.03}_{-0.03}$
$\epsilon_e$		0.1
$\epsilon_B$		0.01

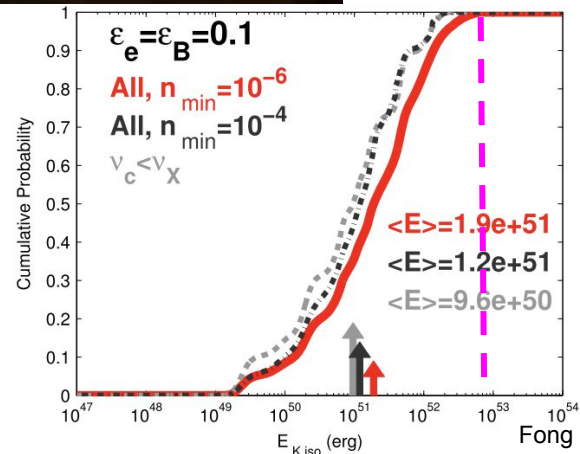
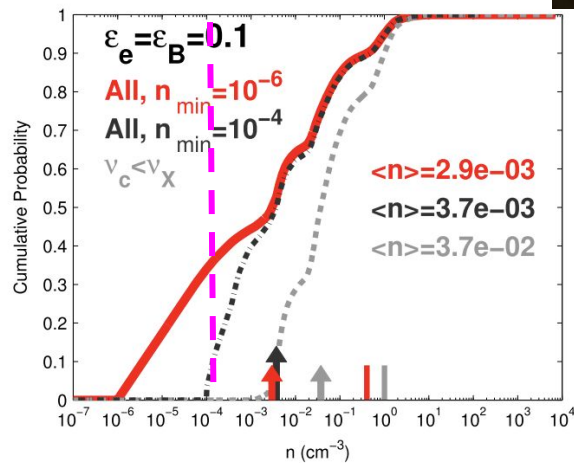


Fong + 2015

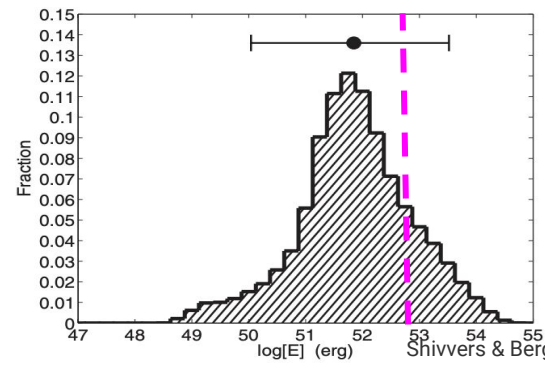
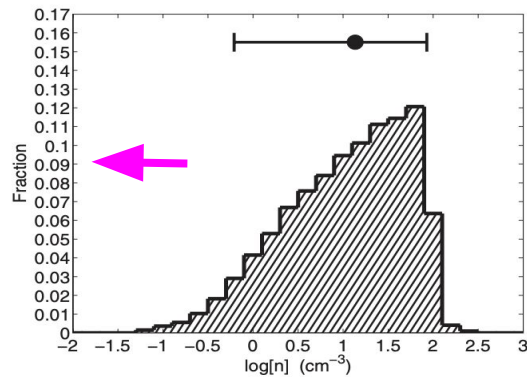
# Afterglow modeling



Short GRBs



Fong + 2015

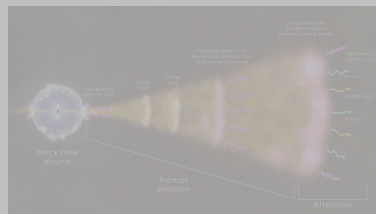


Shivvers & Berger 2011

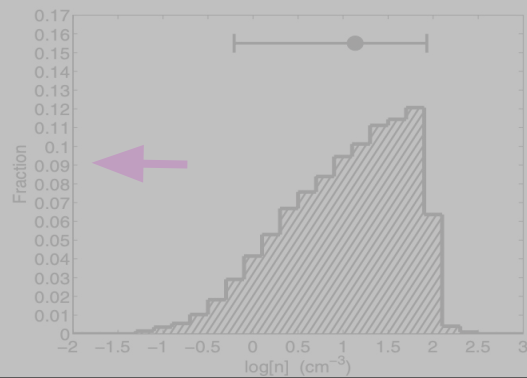
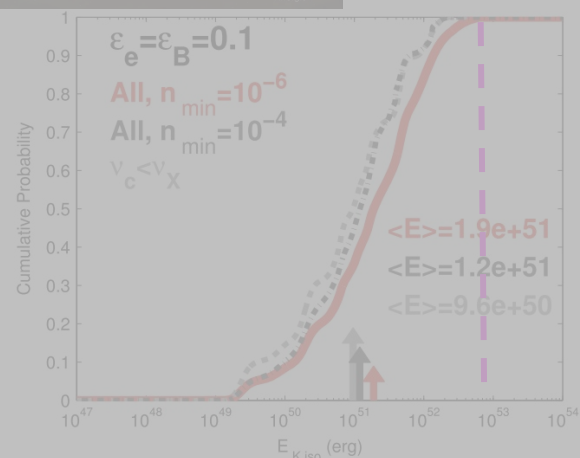
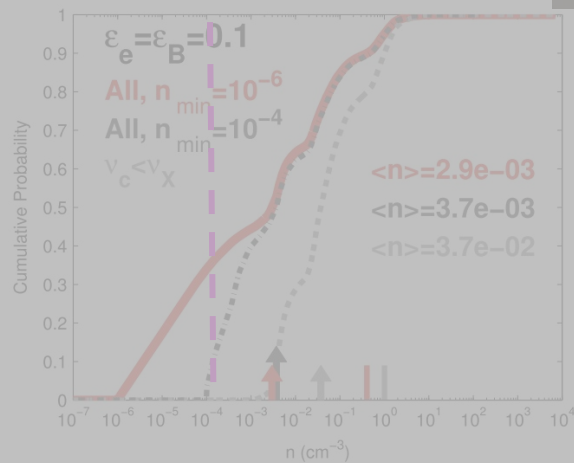
Time Bins (s)	Model	Amplitude
$\theta_v$	[rad]	0.0001
$E_{K,iso}$	[erg]	$9.94^{+0.67}_{-0.62} \times 10^{52}$
$\theta_c$	[rad]	$> 0.29$
$n$	[cm <sup>-3</sup> ]	$1.01^{+0.16}_{-0.14} \times 10^{-4}$
$p$		$2.45^{+0.03}_{-0.03}$
$\epsilon_e$		0.1
$\epsilon_B$		0.01

Long GRBs

# Afterglow modeling



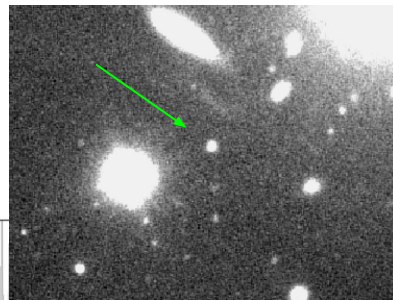
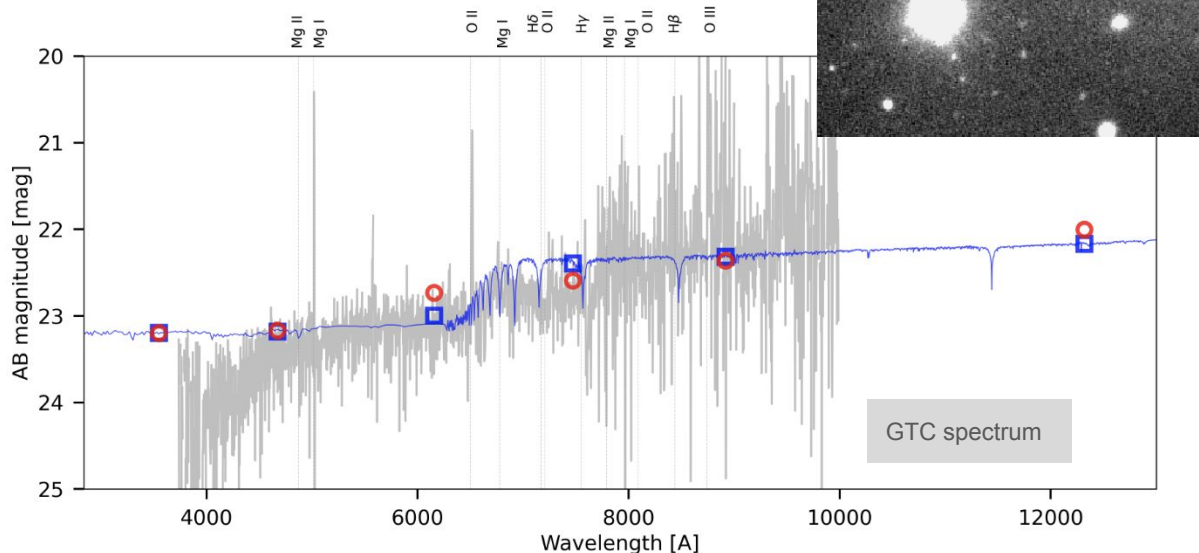
Time Bins (s)	Model	Amplitude
$\theta_v$	[rad]	0.0001
$E_{K,iso}$	[erg]	$9.94^{+0.67}_{-0.62} \times 10^{52}$
$\theta_c$	[rad]	$> 0.29$
$n$	[cm <sup>-3</sup> ]	$1.01^{+0.16}_{-0.14} \times 10^{-4}$
$p$		$2.45^{+0.03}_{-0.03}$
$\epsilon_e$		0.1
$\epsilon_B$		0.01



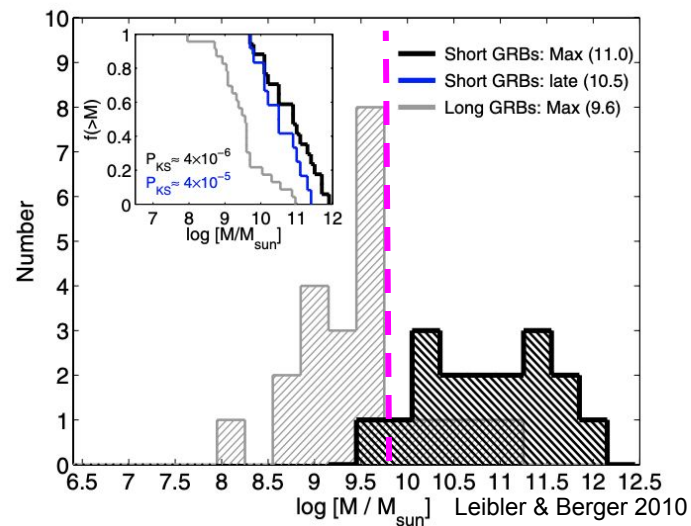
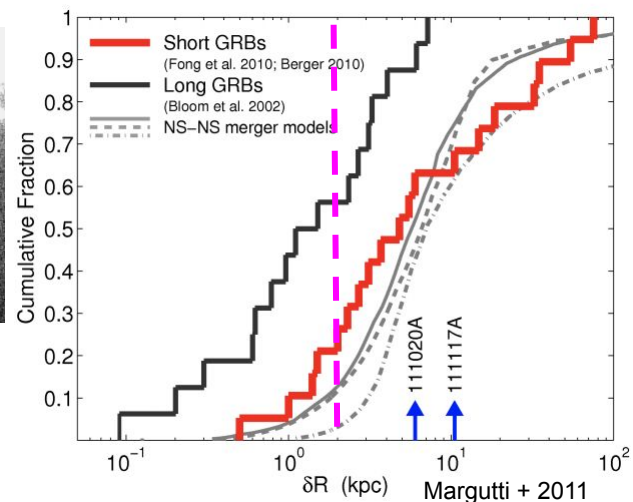
Not conclusive

Spoiler alert: we think it's a collapsar

# Host galaxy

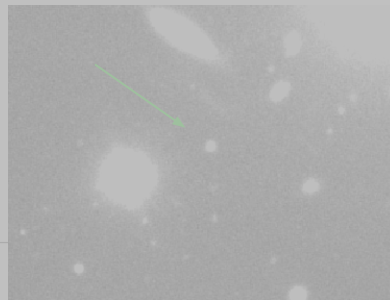
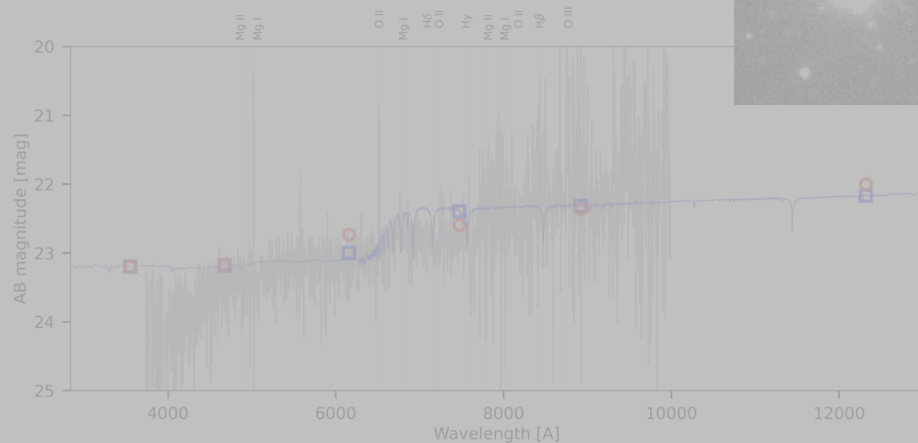


- $z \sim 0.74$
- $\sim 2.5$  kpc from the center of the host galaxy
- Strong OII and OIII features
- $9.8 \times 10^9 M_{\text{sun}}$

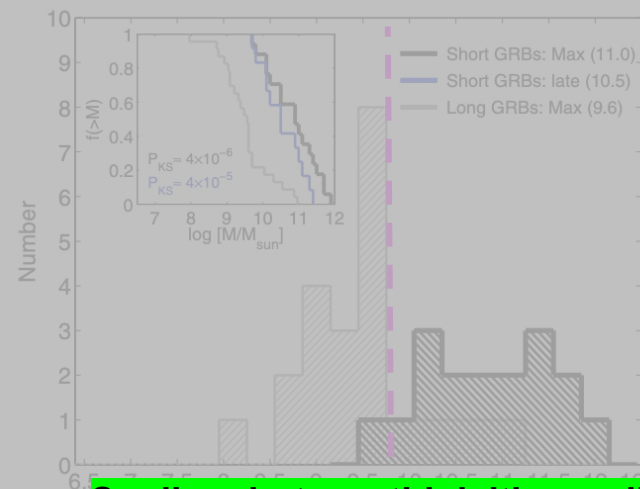
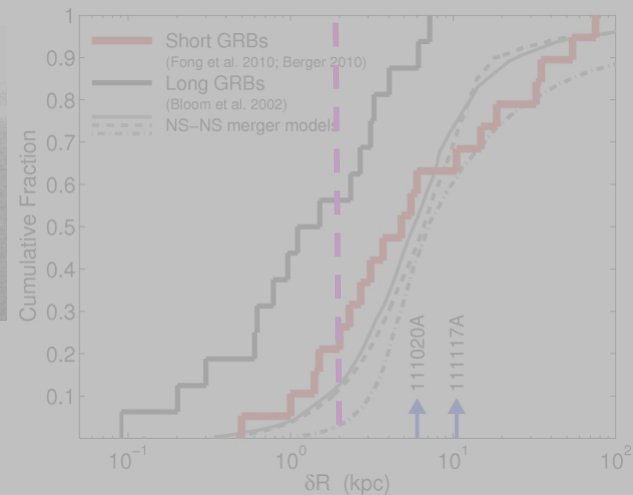




# Host galaxy



- $z \sim 0.74$
- $9.8 \times 10^9 M_{\text{sun}}$
- **Not conclusive** and OIII features
- $\sim 2.5$  kpc from the center of the host galaxy

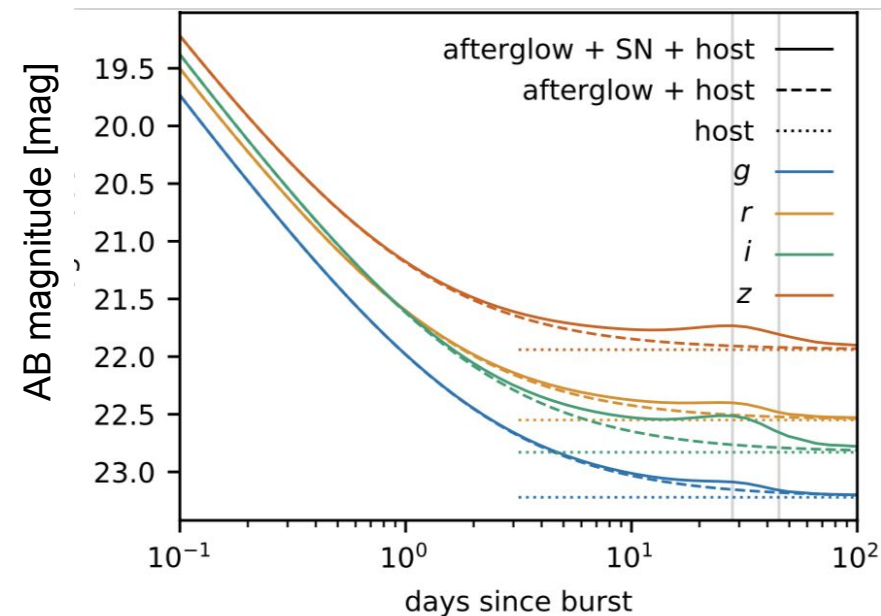


**Spoiler alert: we think it's a collapsar**

# Hunting for the SN

product of a compact binary merger

- At this distance, any **kilonova** would be  $m \sim 30$  mag, therefore undetectable



Science Sept. 23



~28 days after GRB

Reference Oct. 10

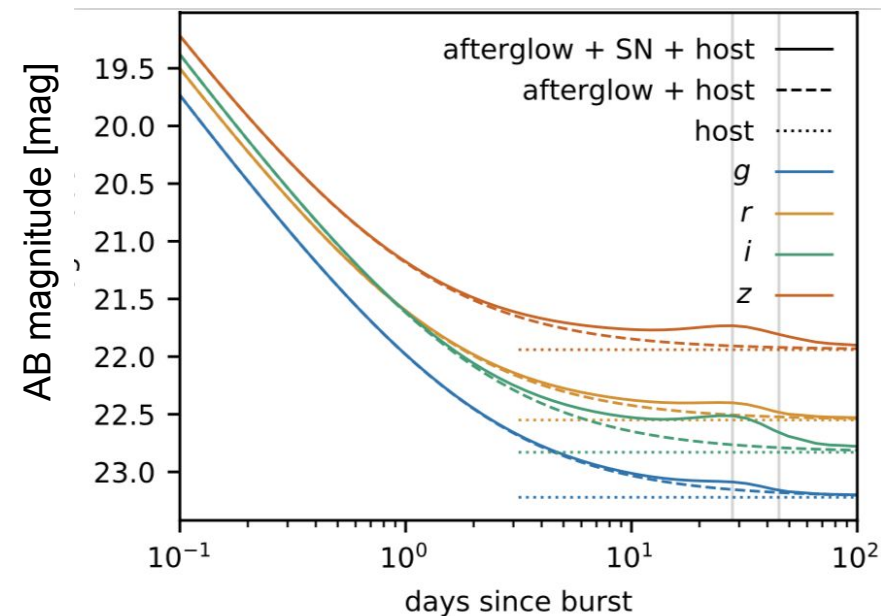


~45 days after GRB

# Hunting for the SN

product of a compact binary merger

- At this distance, any **kilonova** would be **m ~ 30 mag**, therefore undetectable



Science Sept. 23

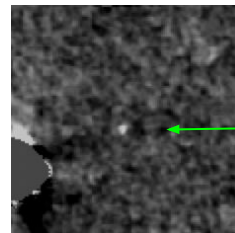


~28 days after GRB

Reference Oct. 10



~45 days after GRB



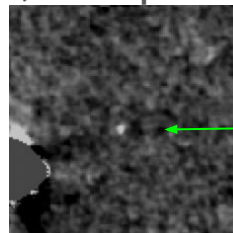
i-band = 23.91 mag

**We found a short (duration) GRB afterglow!!!!!!**

# Summary

**All the above favors a collapsar origin**

- The **Konus-Wind GRB analysis** suggests the progenitor of GRB200826A is a collapsar
- From the **afterglow** analysis, the **kinetic isotropic energy** is unusual for SGRB
- From the **host galaxy analysis**, the Mass of the galaxy and offset from it are in the center of the distribution of the LGRB population, but on the lower tail of the SGRB population.
- We found a **rising source 28 days after the GRB**, interpreted as a **SN**



**i-band = 23.91 mag**

