

Burst Chaser: Unveiling the Mysterious Origin of Gamma-Ray Bursts with Citizen Science

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On Behalf of the Burst Chaser team

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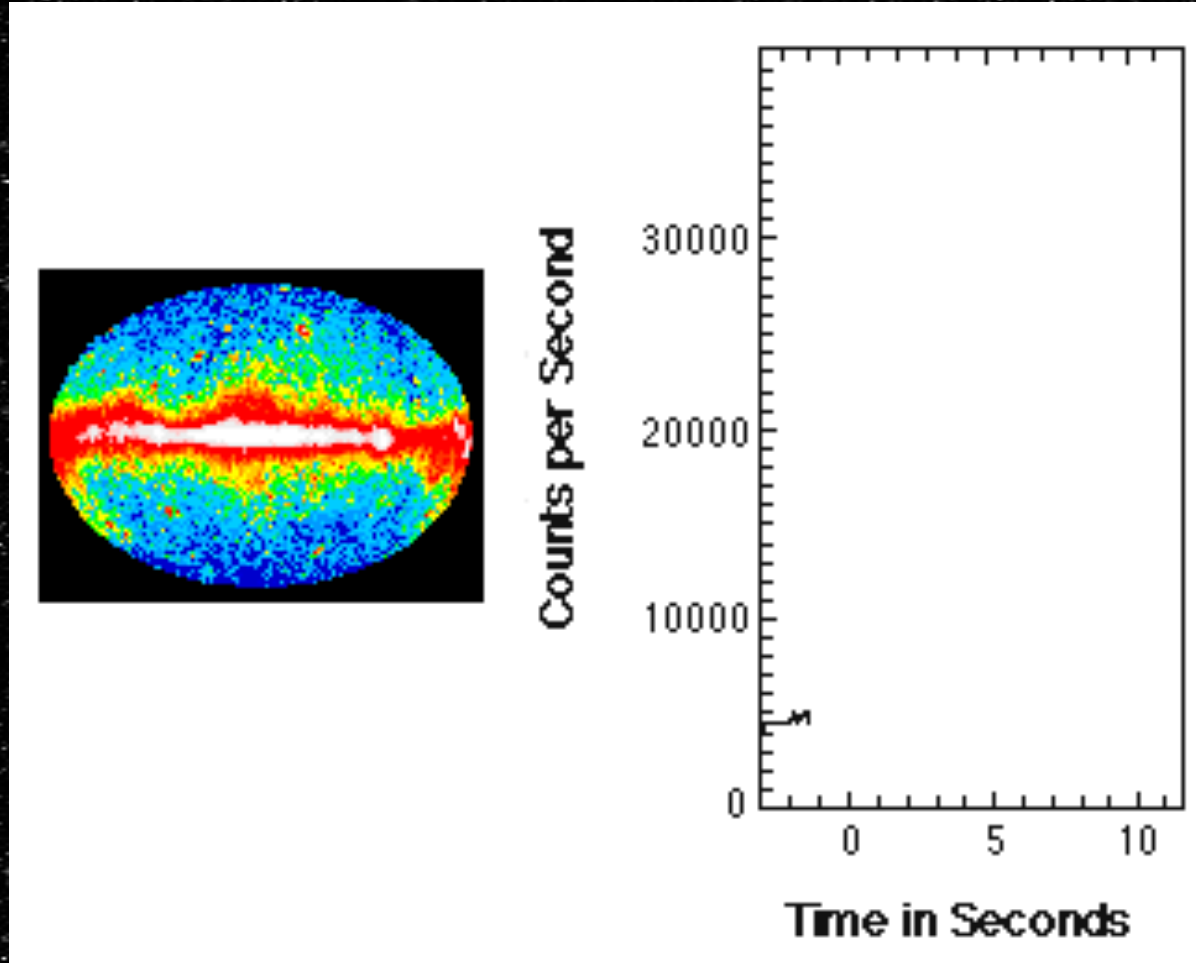
Marc Küchner (NASA/GSFC), Bing Zhang (U of Nevada, Las Vegas), Cliff Johnson (Zooniverse), Michael Moss (NASA/Goddard), Jon Hakkila (U Alabama, Huntsville), Eleonora Troja (U of Rome), Tyler Parsotan (NASA/GSFC), Brad Cenko (NASA/GSFC), Sylvain Guiriec (George Washington U)

NASA Volunteers: Hugo A. Durantini, Danny Roylance, John Yablonsky, John Marco Zaccaria Di Fraia, Sumit Banerjee (Clemson U), Jonathan Holden, Sovan Acharya, Edoardo Antonini, Tom Bickle, Sam Deen, Katherine Doll, Orleo Marinaro, Jorg Schumann, and Samuel Troost

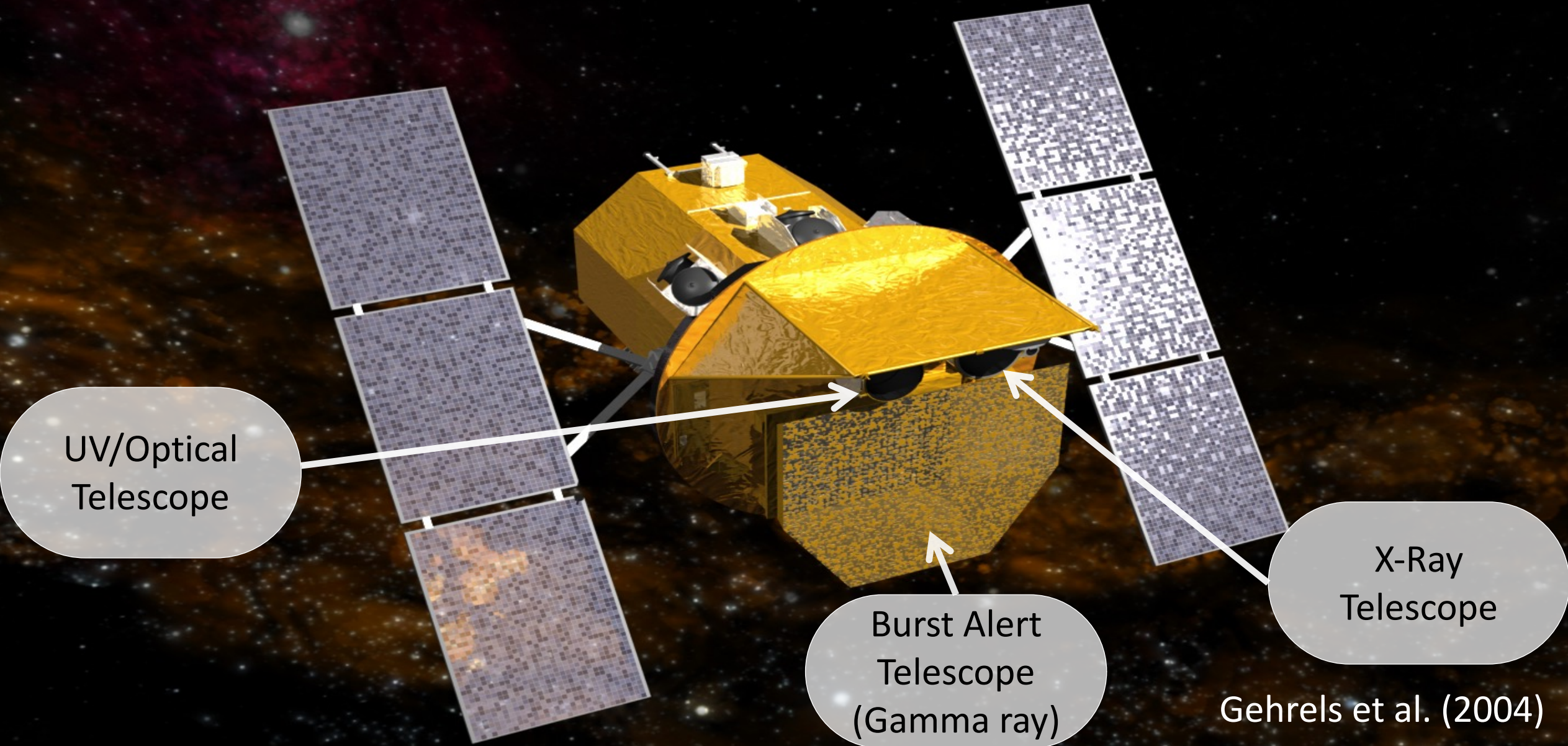
AAS, 2024/01/09



Gamma-ray burst: one of the most energetic explosions in the universe



Neil Gehrels *Swift* Observatory

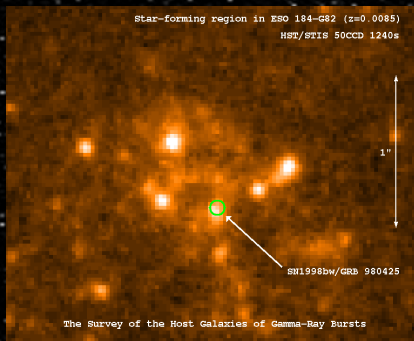


SURFs: a 9 year airborne observatory to observe the distant universe



GRBs act as beacons throughout cosmic time to observe the distant universe

Closest GRB (GRB 980425)

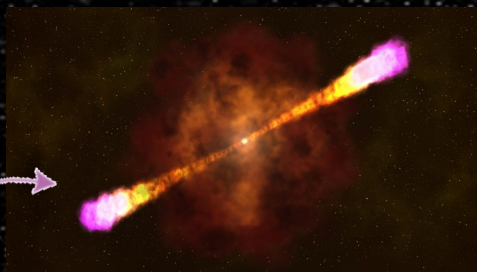


~ 130 million light years
(Light travel time: 130 million years)

GRBs act as beacons throughout cosmic time to observe the distant universe

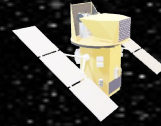


Majority of GRBs



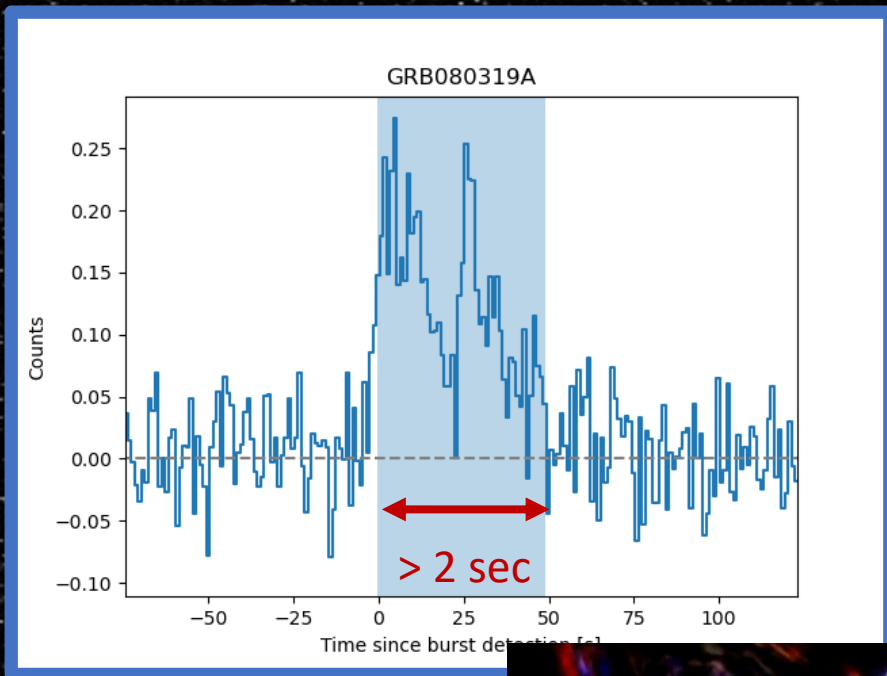
Light travel time: 10.4 billion years
(Peak of star formation)

Physical origins of GRBs

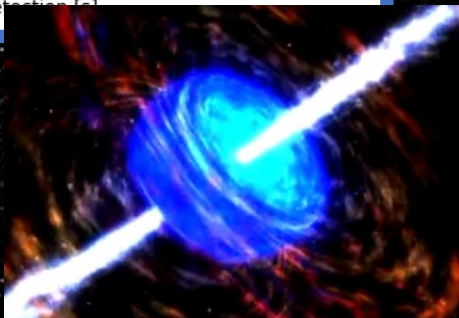


Long GRBs

(duration larger than ~ 2 second)

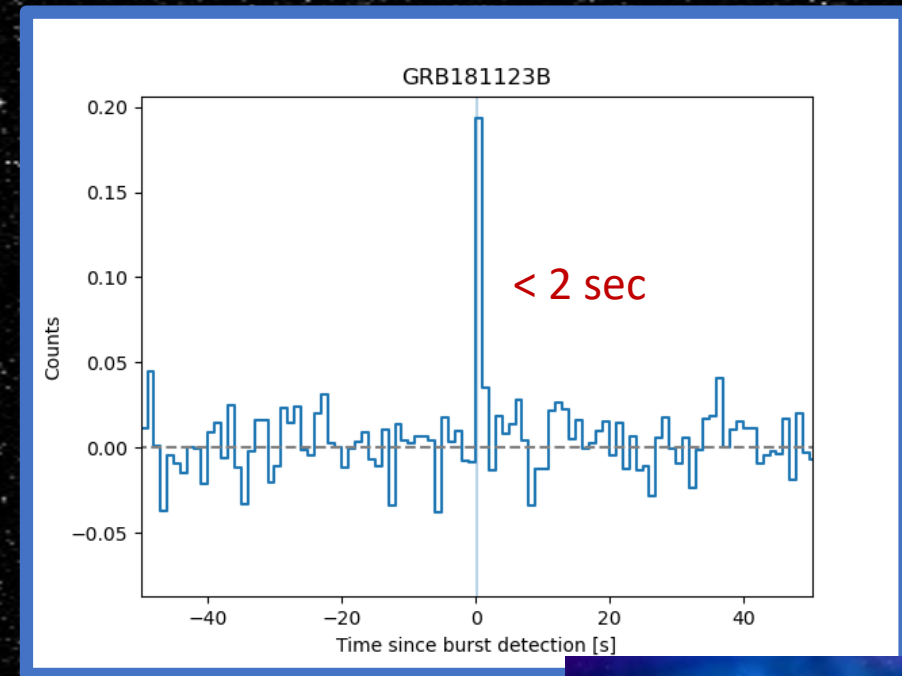


- Supernovae



Short GRBs

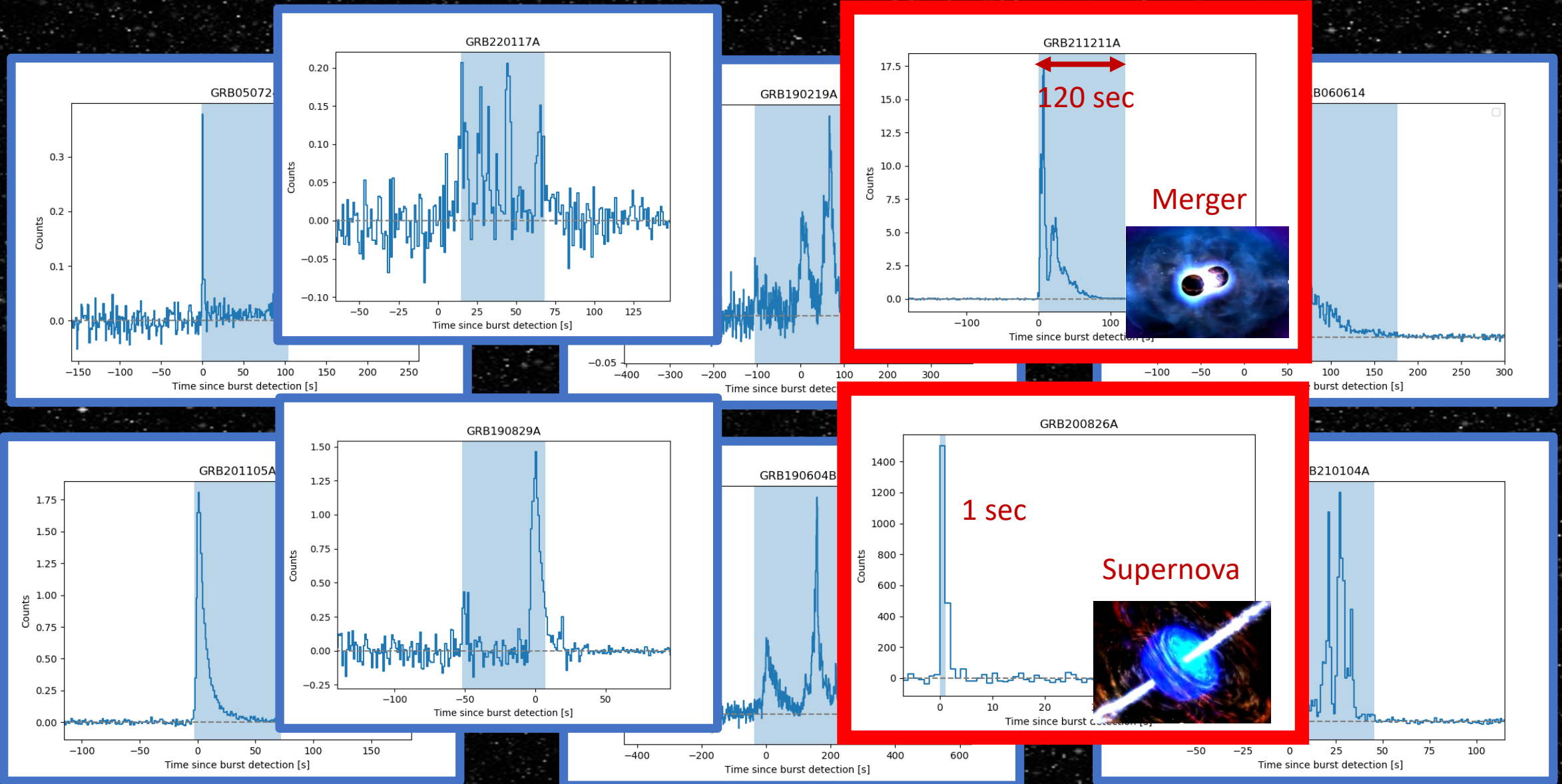
(duration shorter than ~ 2 second)

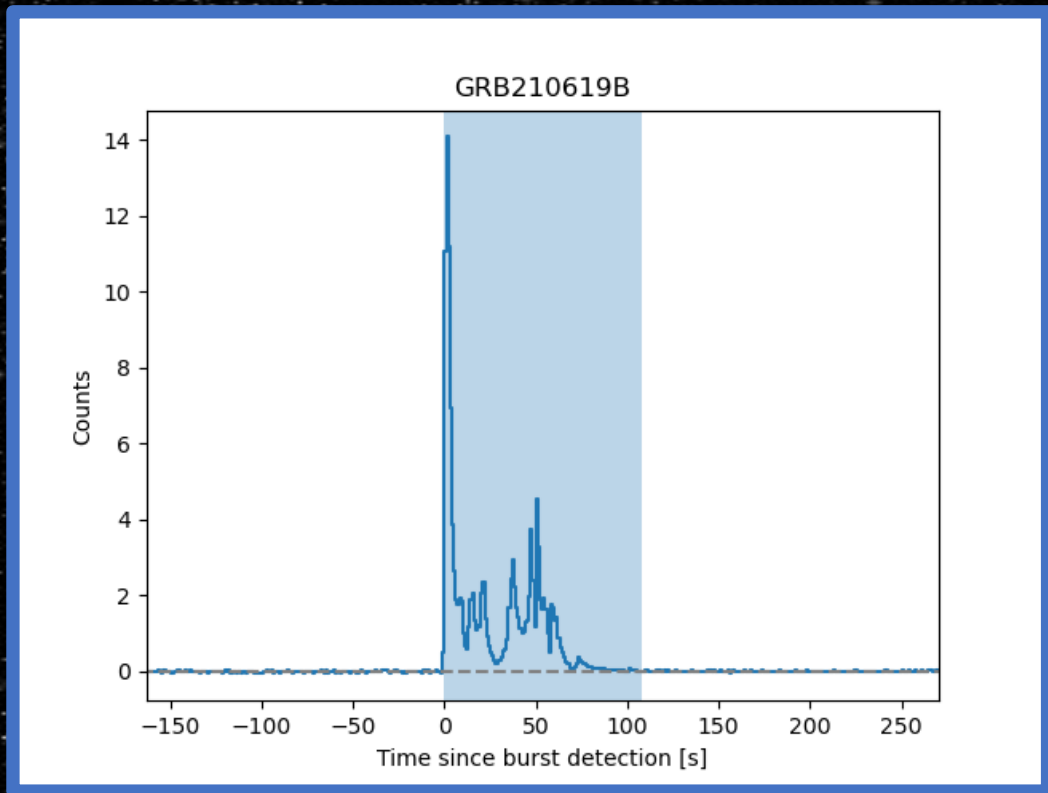


- Merging of neutron stars and black holes



Life is more complicated....

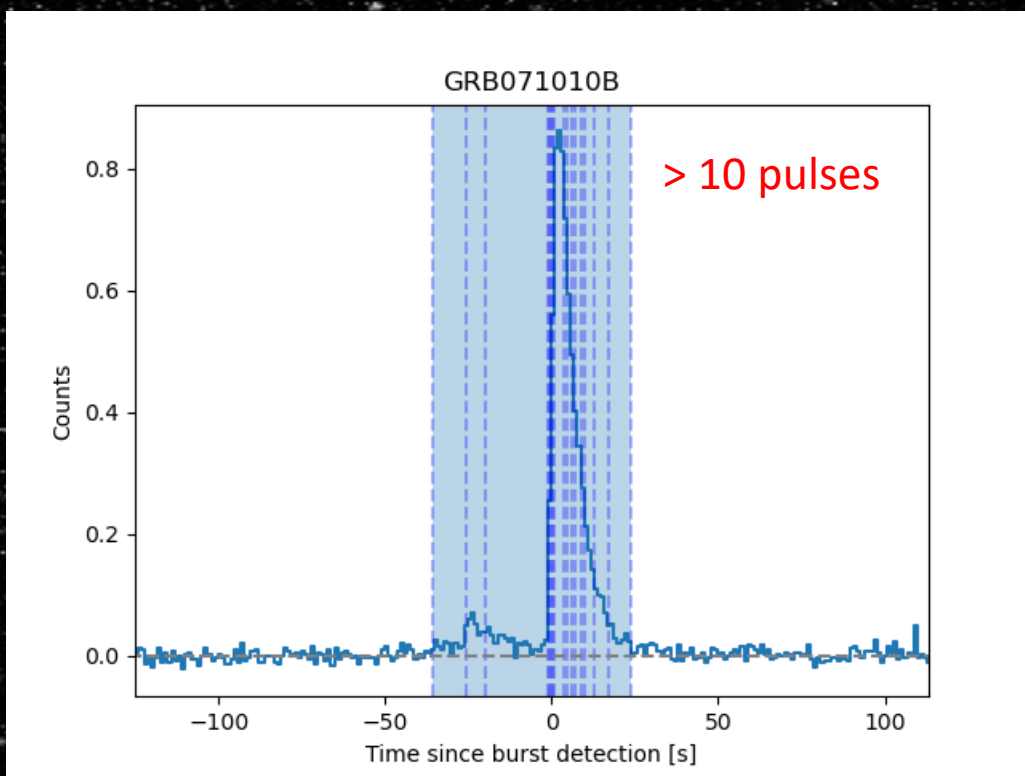




The first pulse shape catalog

Humans are better at recognizing complex pattern than computer

Pulses selected by computer



Pulse shapes selected by humans

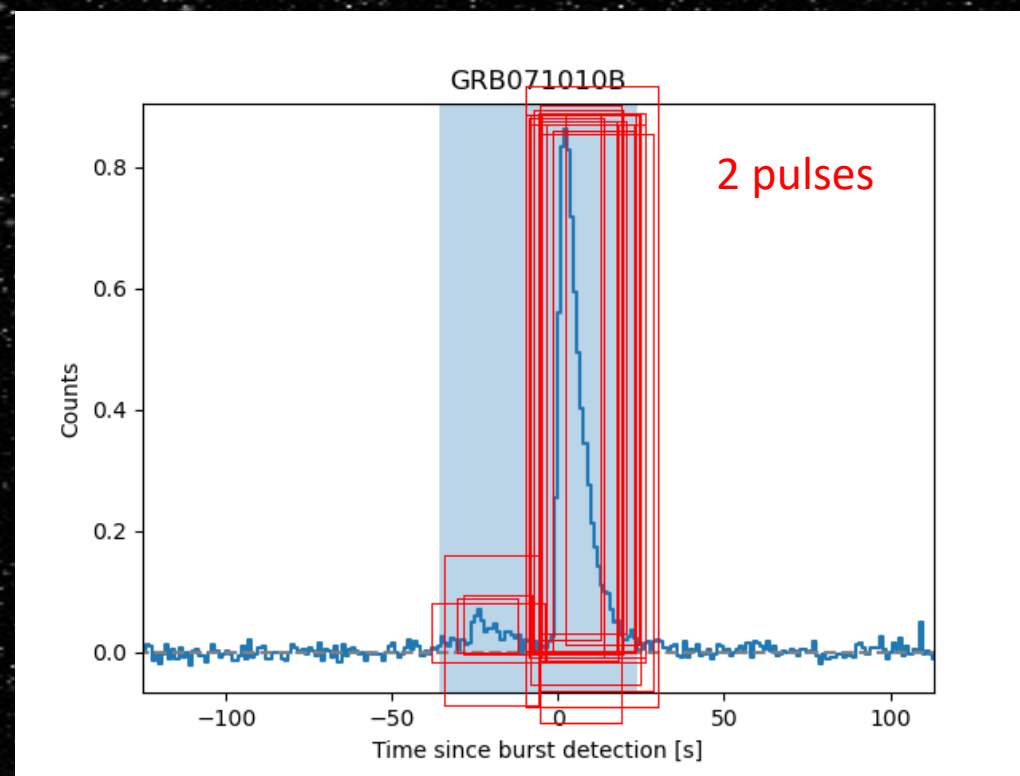


Figure credit: Carter Murawski (U Tampa)

Helps from a few dozen NASA volunteers and students



Hugo Durantini Luca

Danny Roylance

Jonathan Holden

Sovan Acharya

Vikrant Kurmude



John Yablonsky

Katherine Kurilov

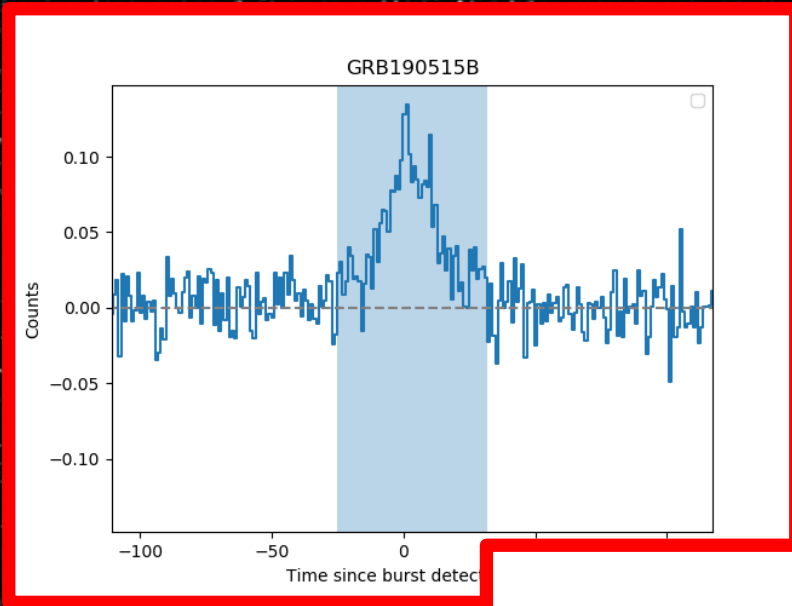
Carter Murawski

Sebastian Reisch

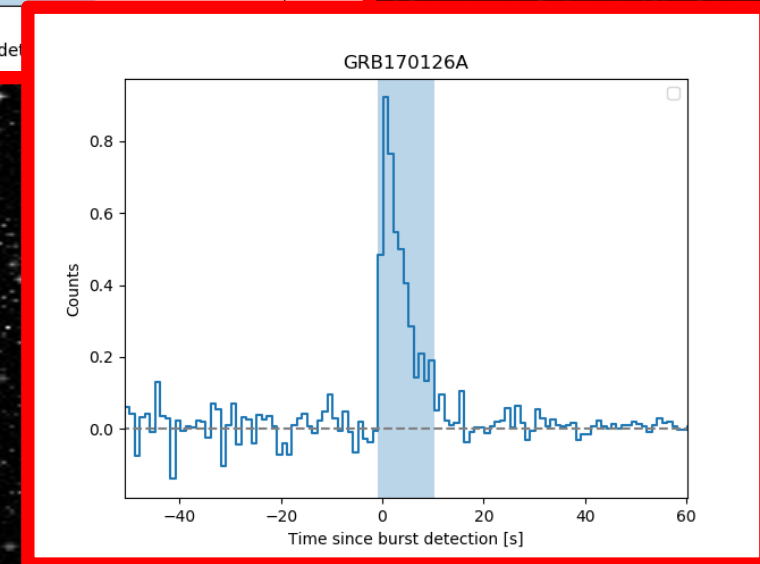
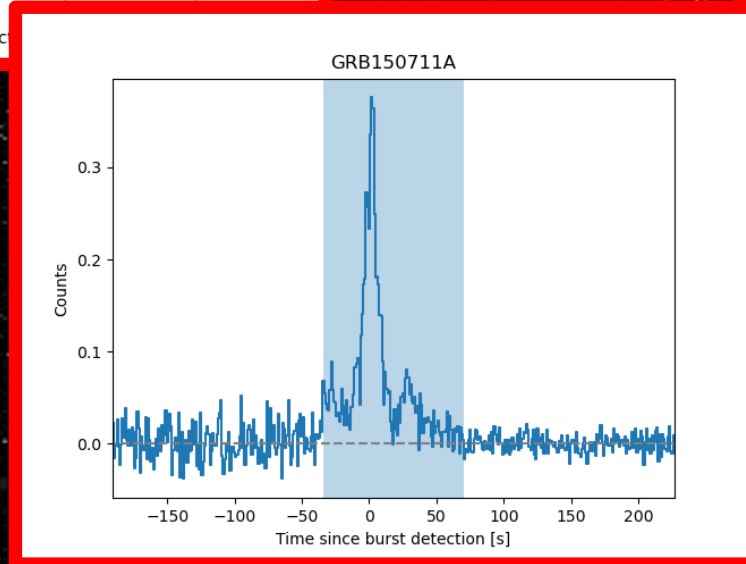
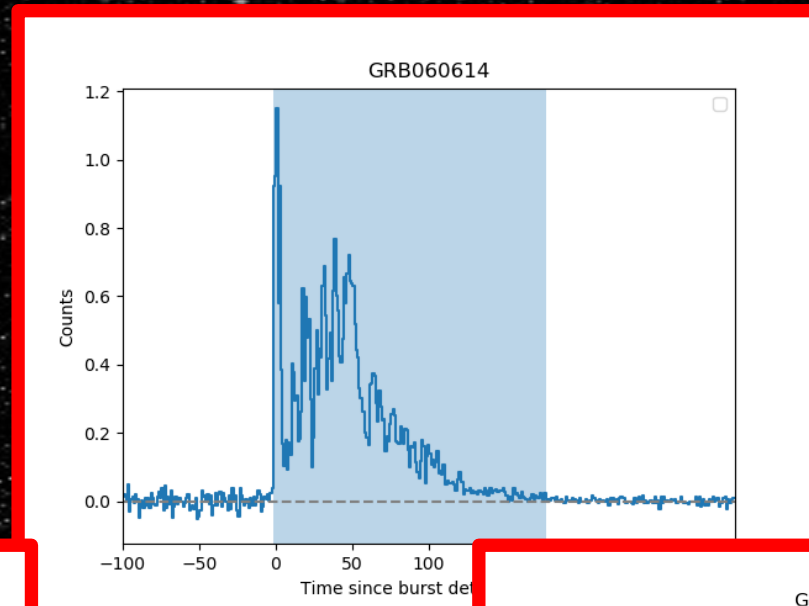
Marco Zaccaria
Di Fraia,
Sumit Banerjee,
Eduardo Antonini,
Orleo Marinaro,
And many more...

Identifying structures

A simple pulse



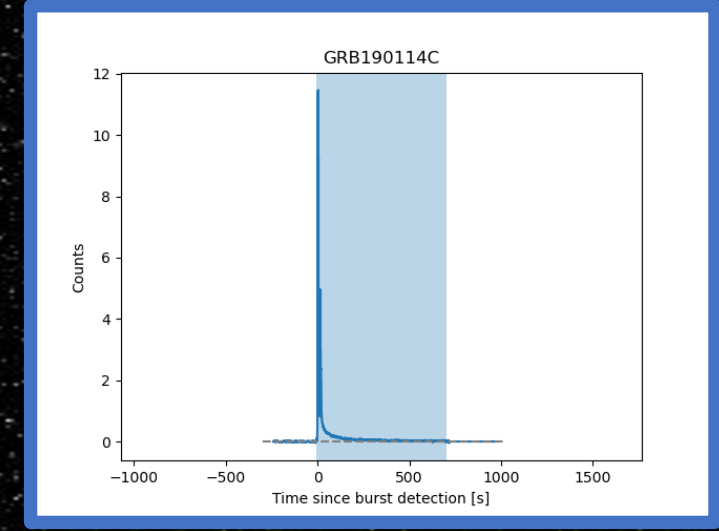
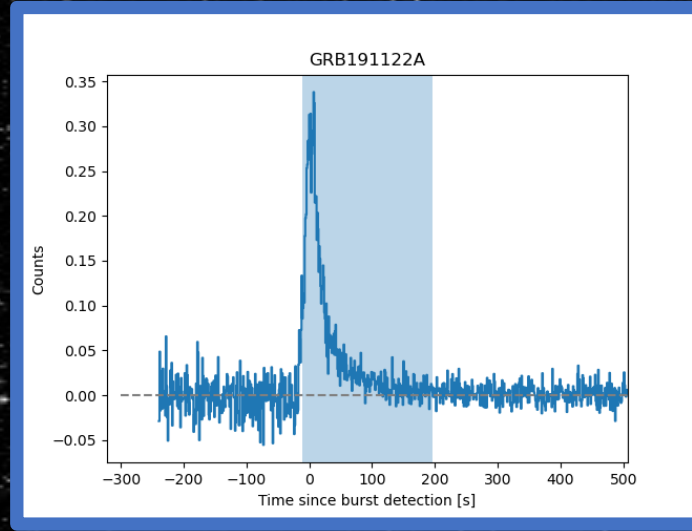
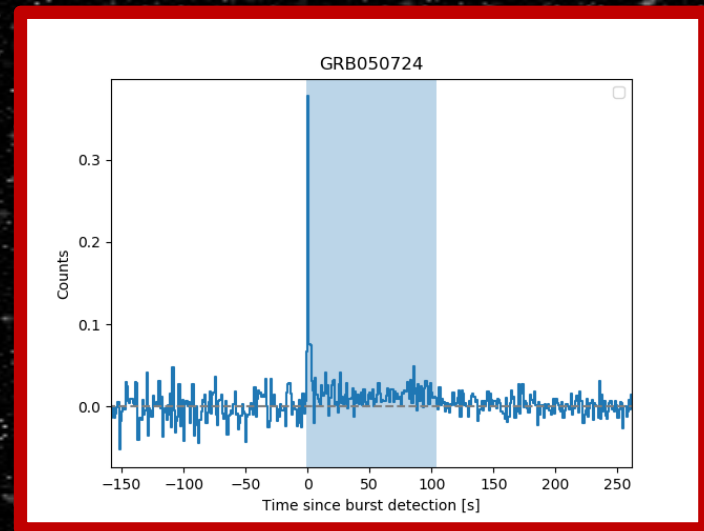
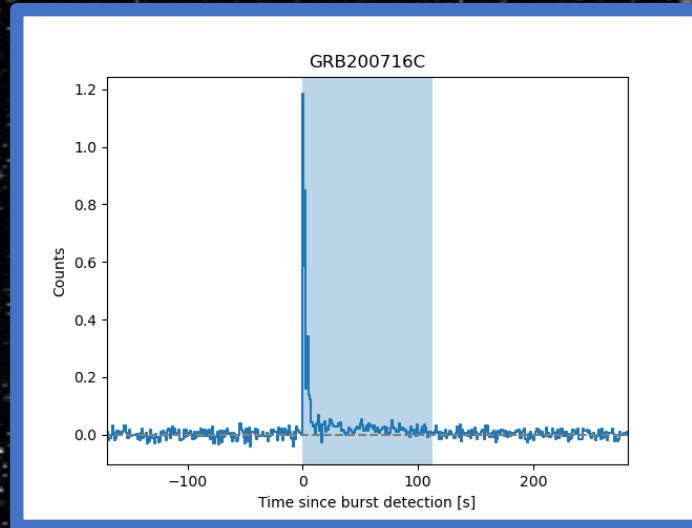
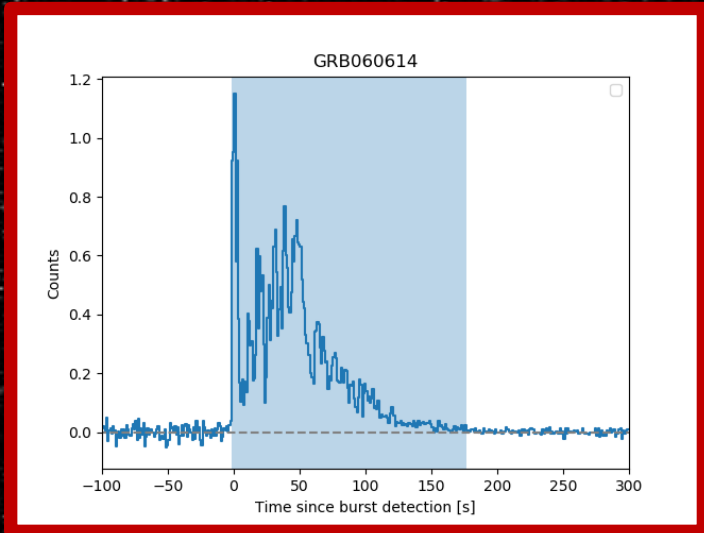
A pulse followed by extended emission



Pulses connected by underlying emission

Fast rise and slow decay

A pulse followed by extended emission people selected



Consistent results from volunteered reviewers

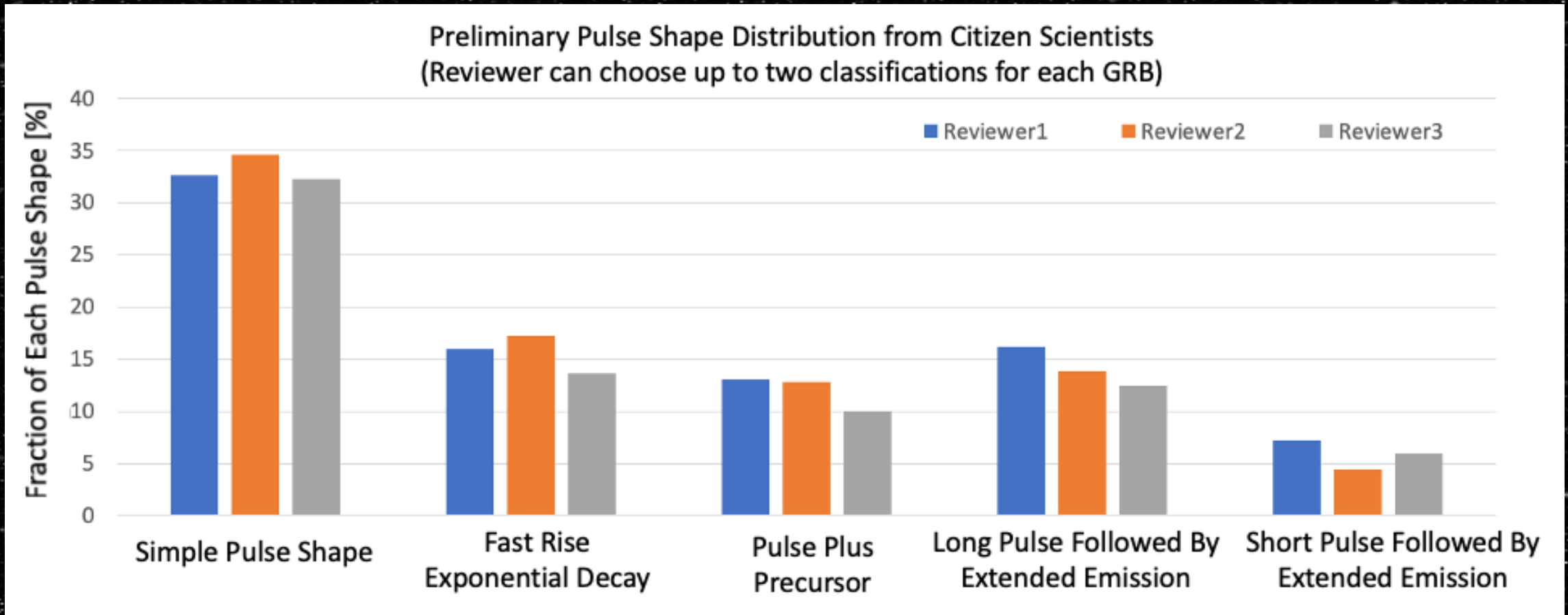
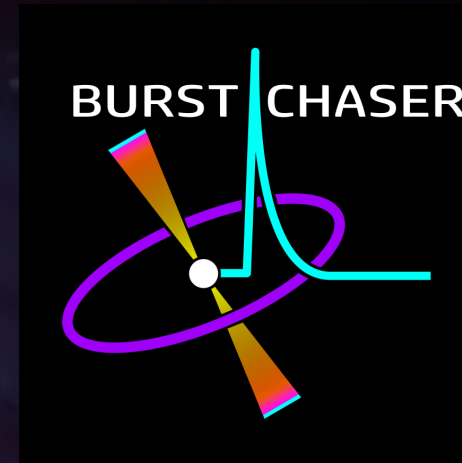


Figure credit: Marco Zaccaria Di Fraia (NASA volunteer)

Burst Chaser on Zooniverse

Unveiling the mysterious origin of
gamma-ray bursts

[Learn more](#)



Join us at <https://www.zooniverse.org/projects/amylien/burst-chaser>

- Expand the sample size and collect more pulse structures
- Invite more volunteers to classify each burst so we can get better statistics
- Build the first pulse structure catalog to unveil the true nature of gamma-ray bursts

Thank you!