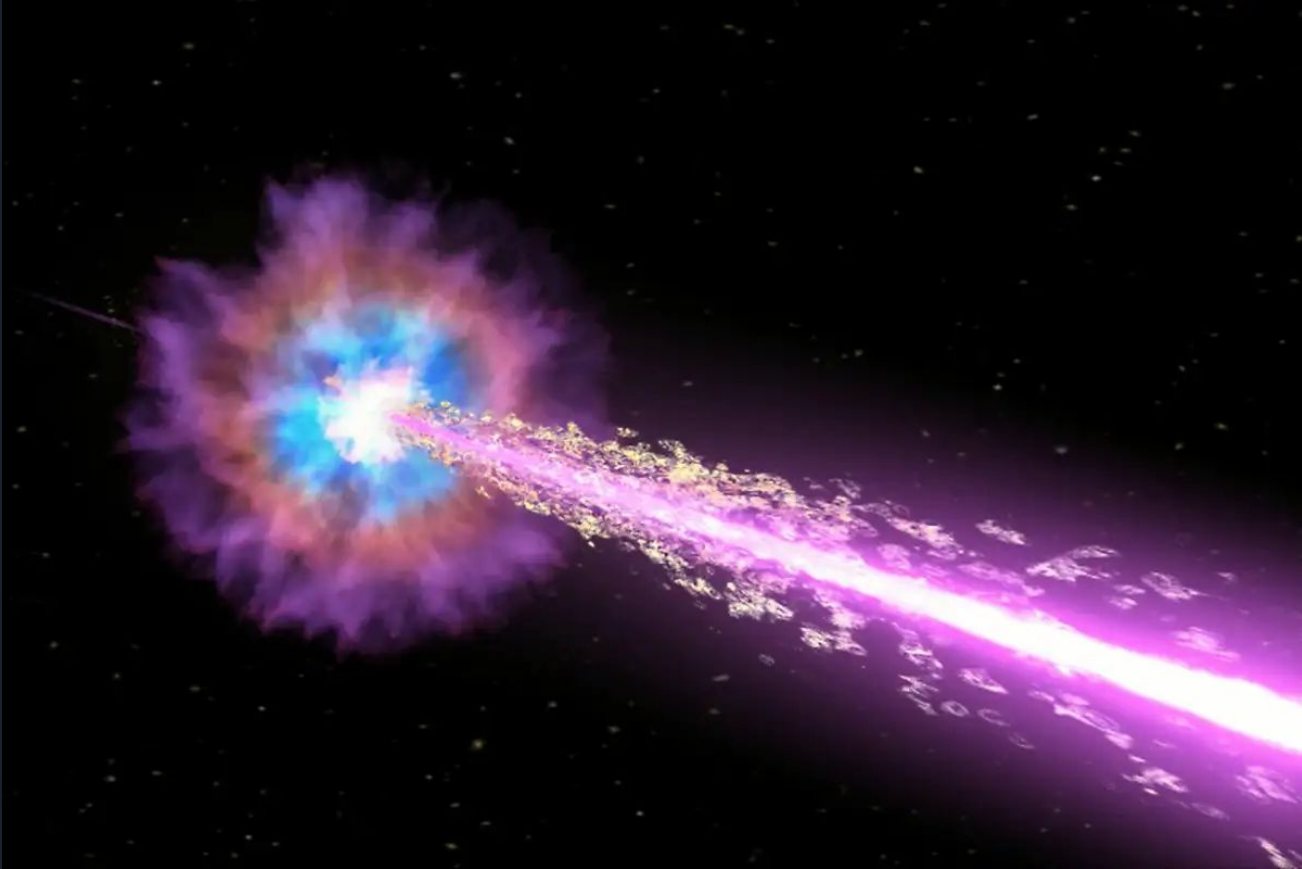


Gamma-ray bursts



Dr. Manisha Shrestha
Postdoctoral Research Assistant
University of Arizona
11/04/2023

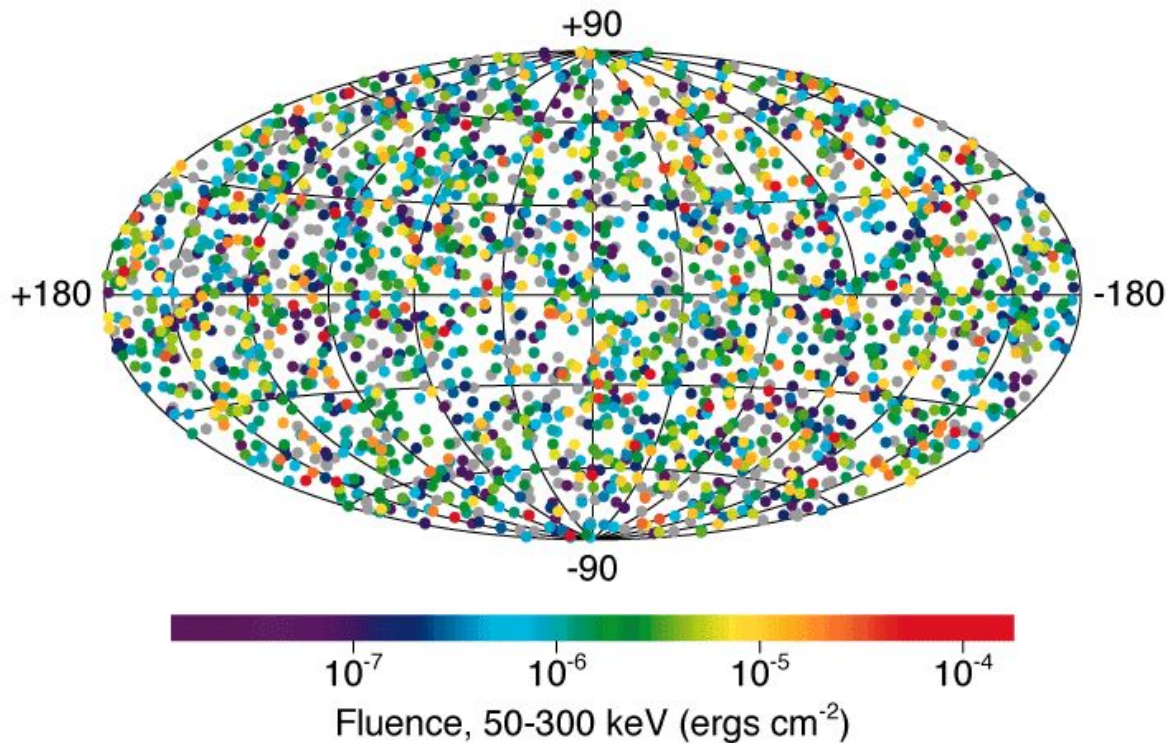
Gamma-ray bursts are very energetic



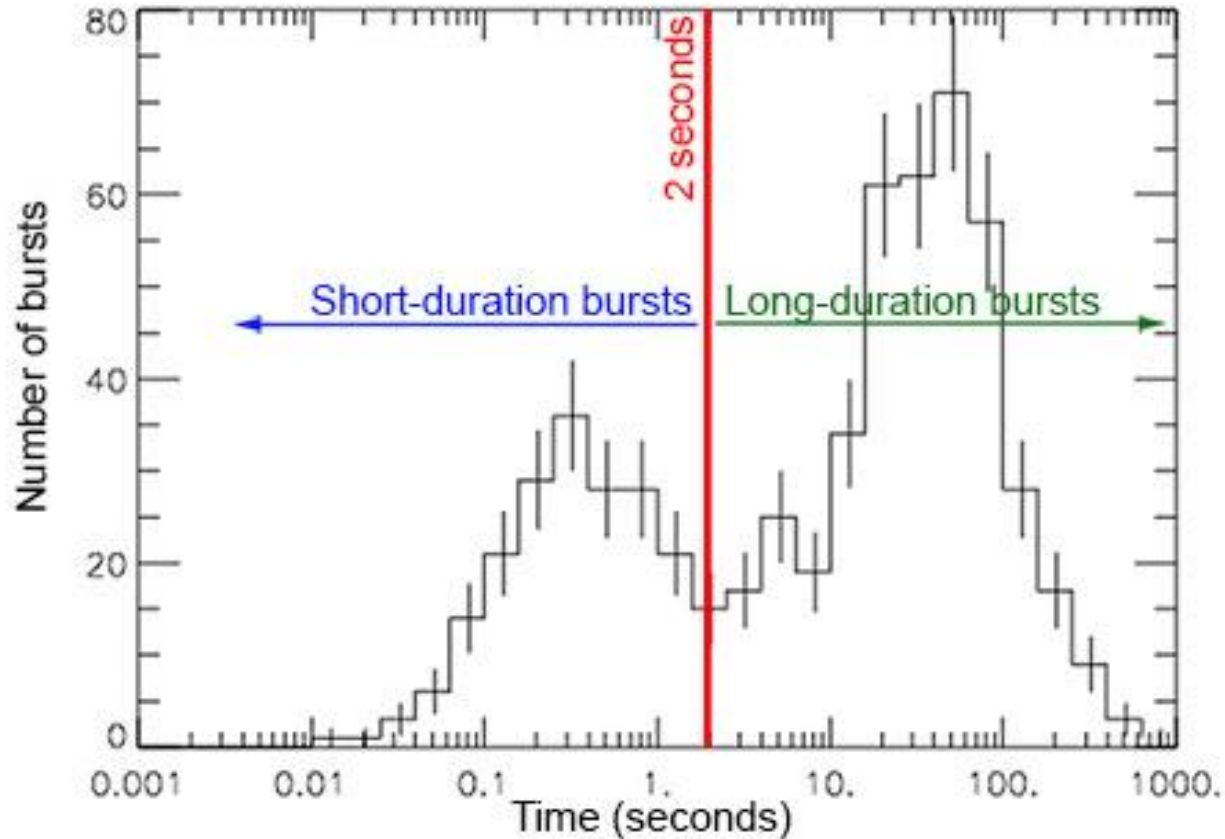
Gamma-ray bursts

Distant origin

2512 BATSE Gamma-Ray Bursts



Types of Gamma Ray Bursts



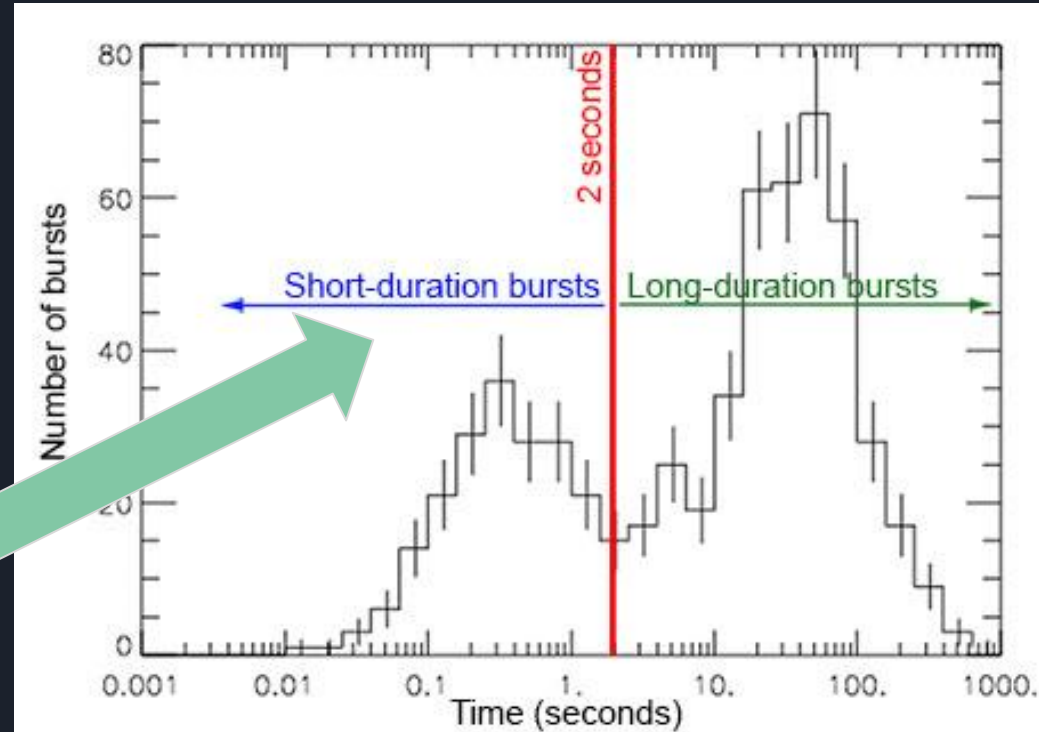
Progenitors of Short GRBS

https://www.youtube.com/watch?v=x_Akn8fUBeQ

Neutron star + Neutron star GW170817

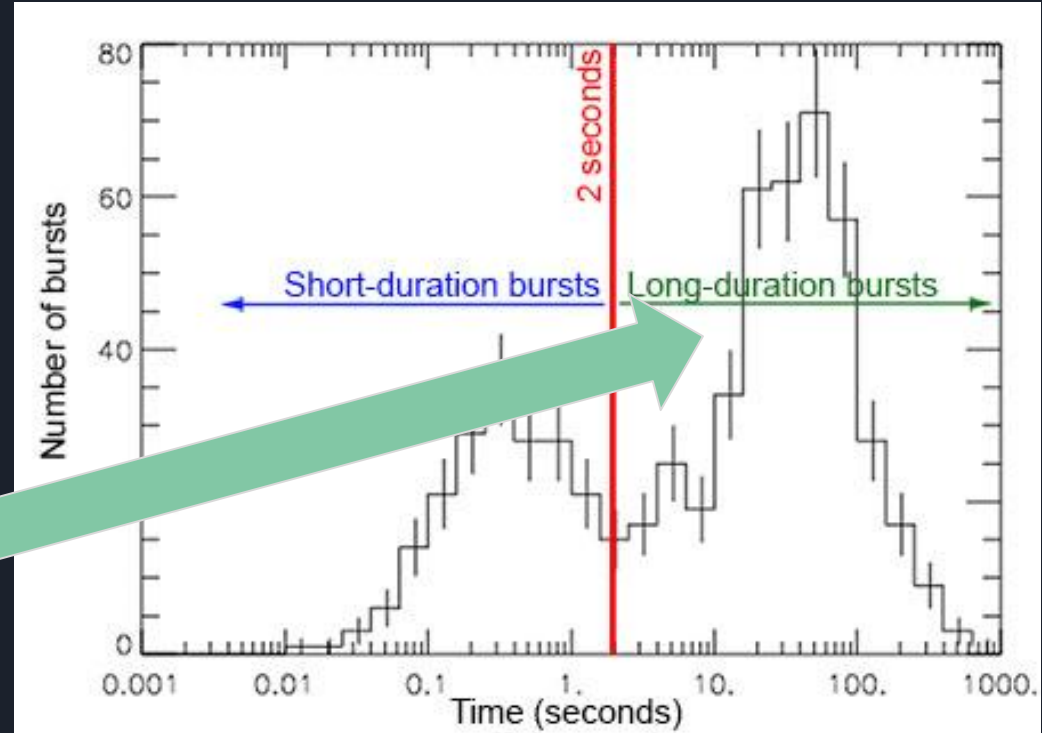


National Science Foundation/LIGO/Sonoma State University/A. Simonnet



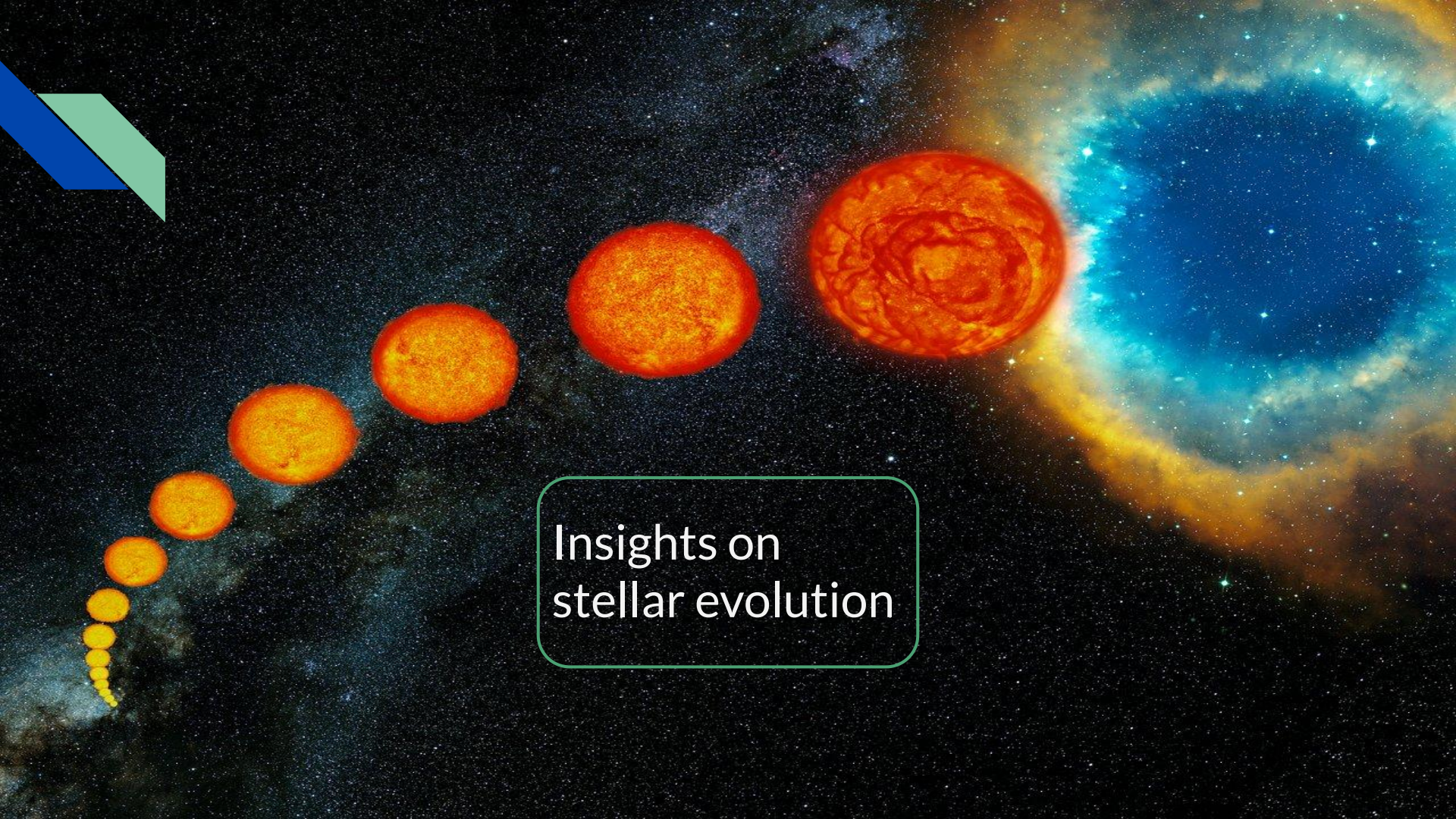
Progenitors of Long GRBS

Death of massive stars (Supernovae)



Why do we care?

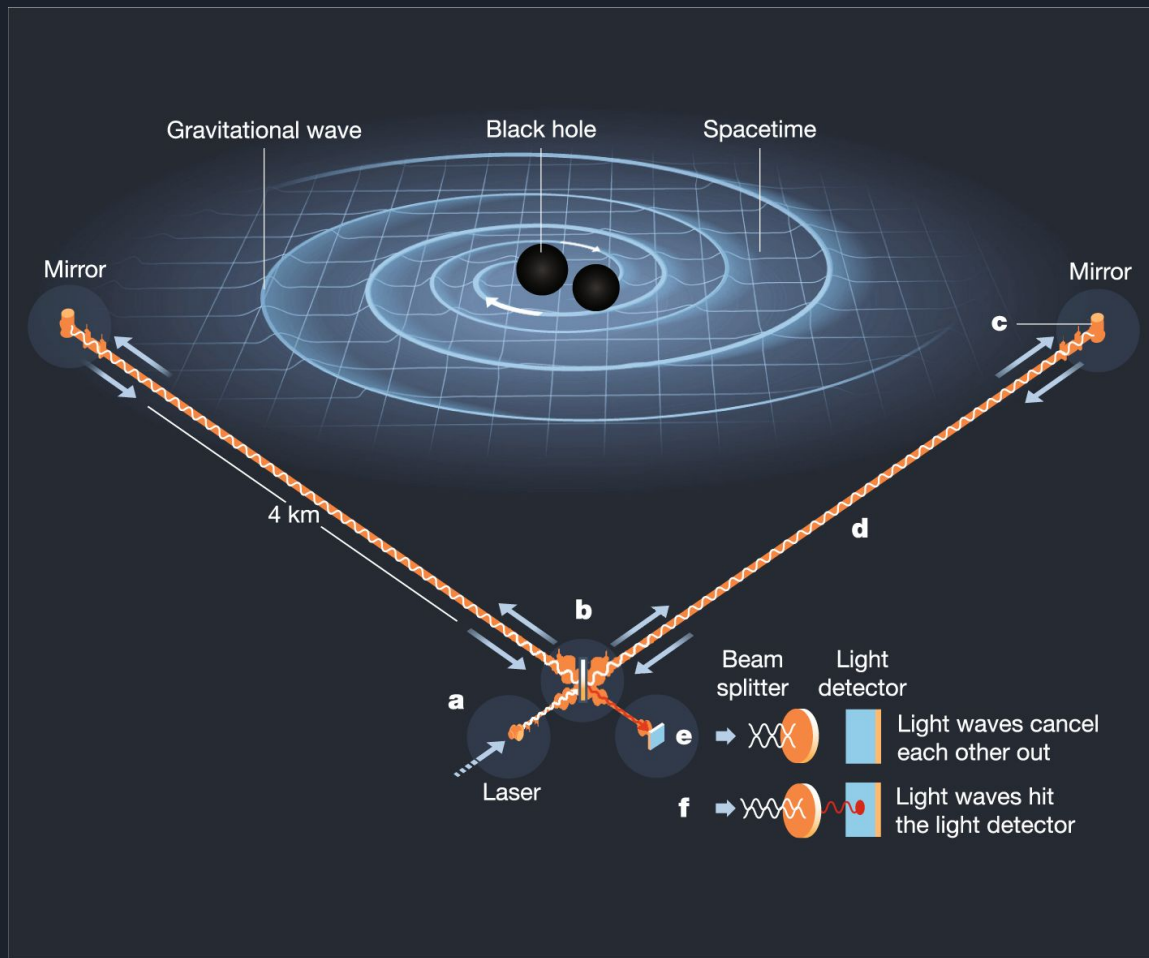





The background of the slide is a deep space image featuring a sequence of stars in various stages of evolution, arranged diagonally from the bottom left to the top right. The stars start as a small, faint protostar and grow progressively larger and more luminous. The final star on the right is a massive blue supergiant with a bright blue core and a surrounding yellowish-orange nebula. In the top left corner, there is a decorative graphic consisting of two overlapping parallelograms, one blue and one light green. A green rounded rectangle is positioned in the lower center, containing the text 'Insights on stellar evolution'.

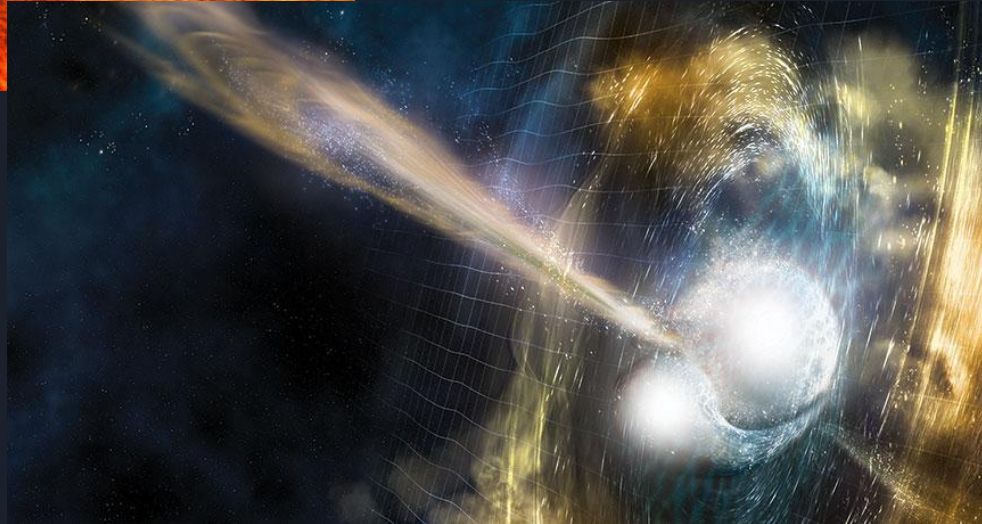
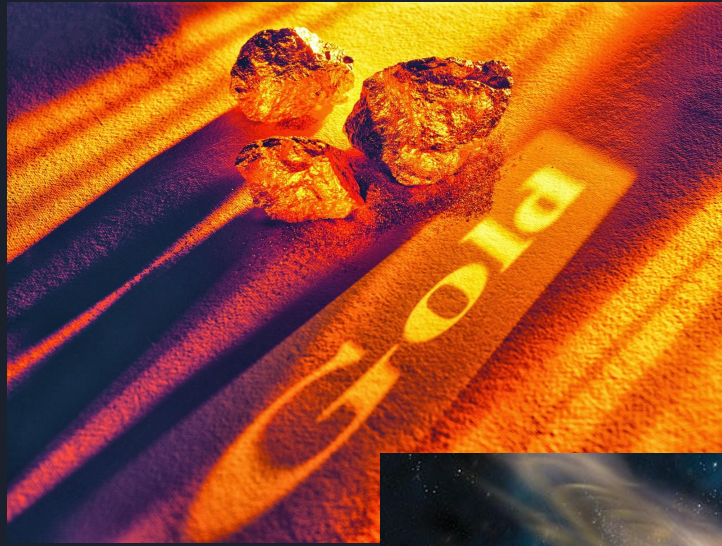
Insights on stellar evolution

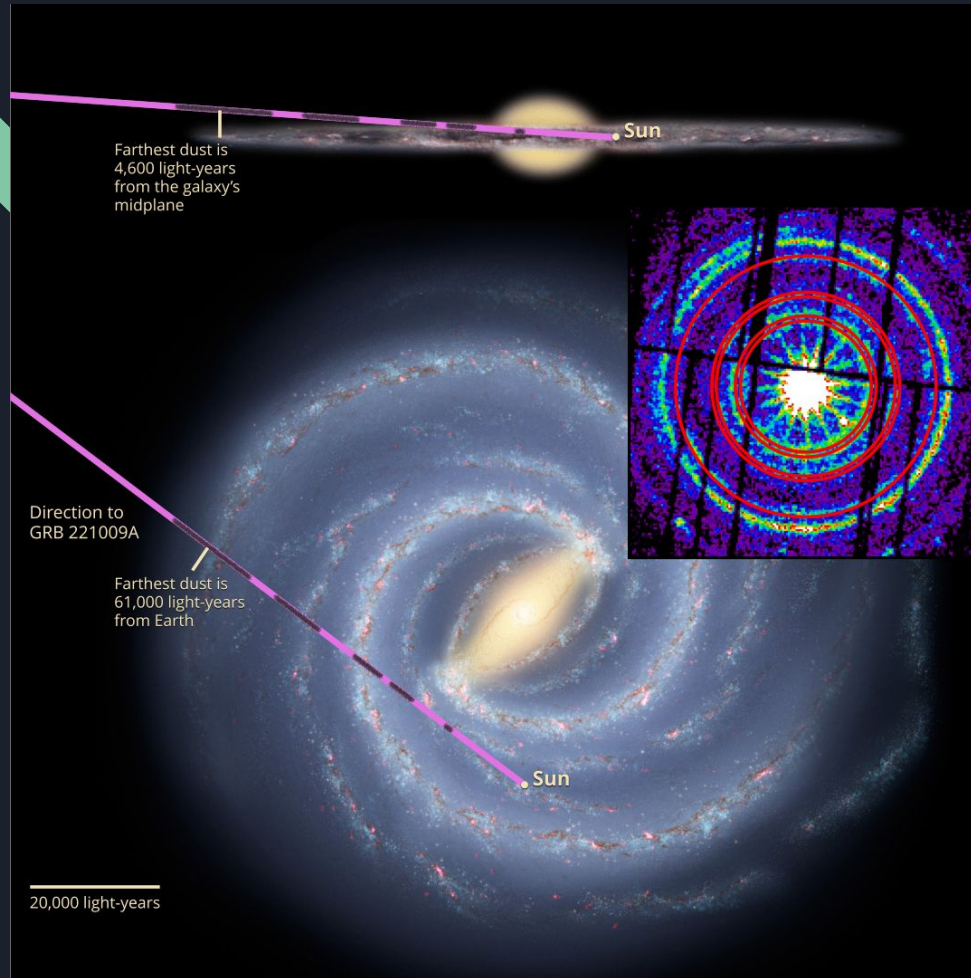
Sources of Gravitational Wave





Origin of heavy elements like Gold





Can map distant
Universe

What do we know?



Merger scenario

Neutron stars

Black hole

Disk

Central engine

Massive star

Hypernova scenario

Faster blob

Slower blob

Blobs collide (internal shock wave)

Gamma rays

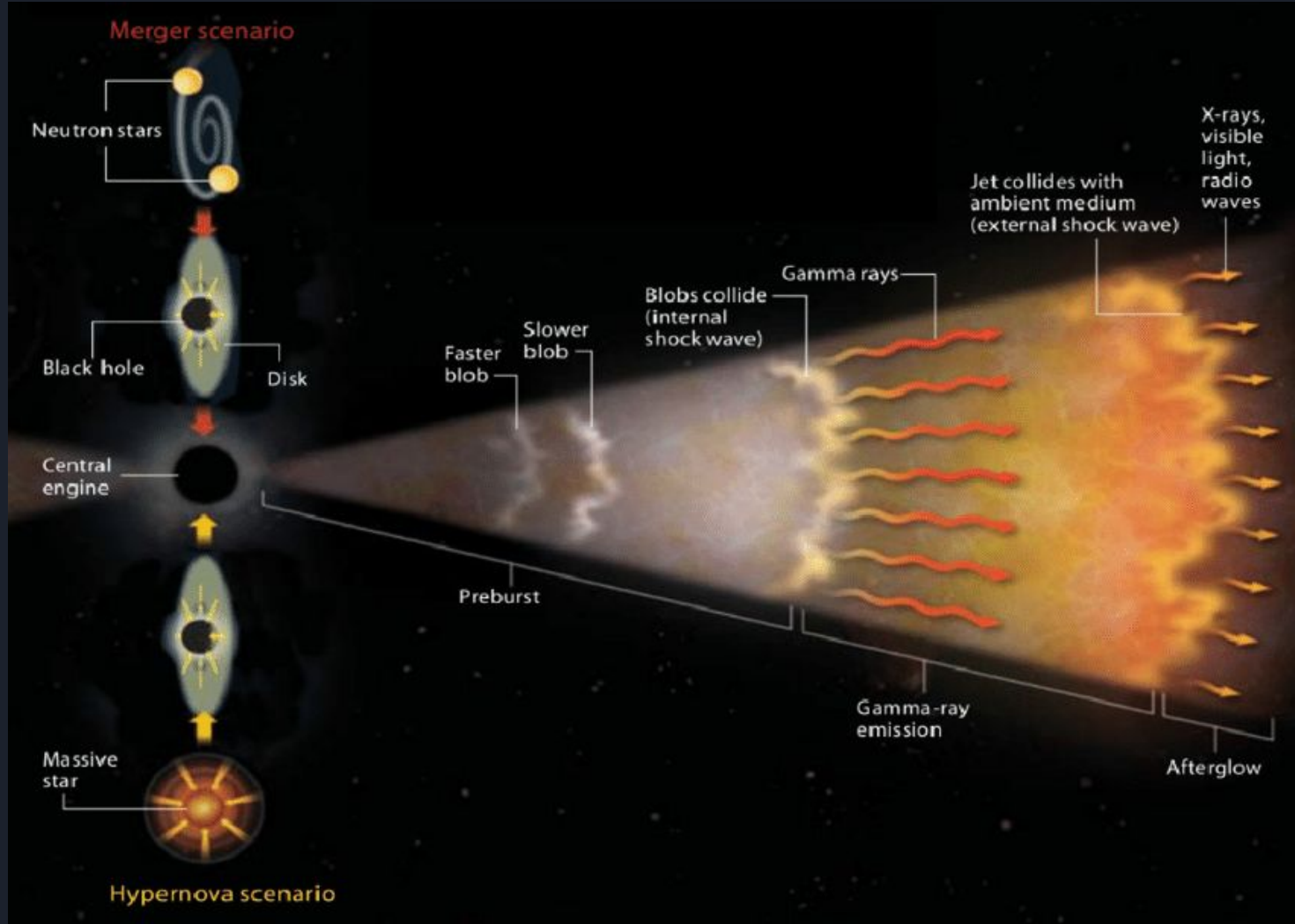
Jet collides with ambient medium (external shock wave)

X-rays, visible light, radio waves

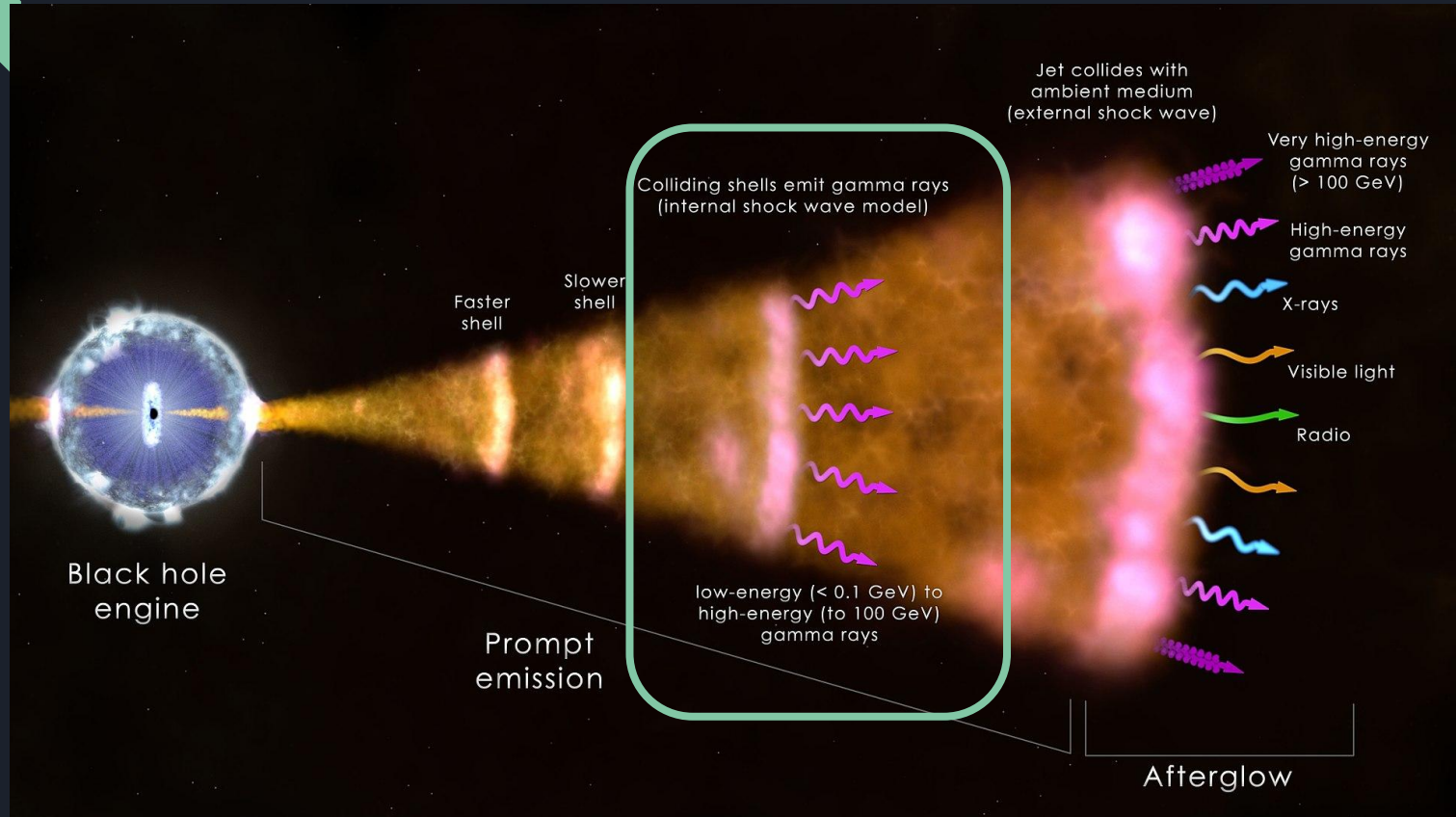
Preburst

Gamma-ray emission

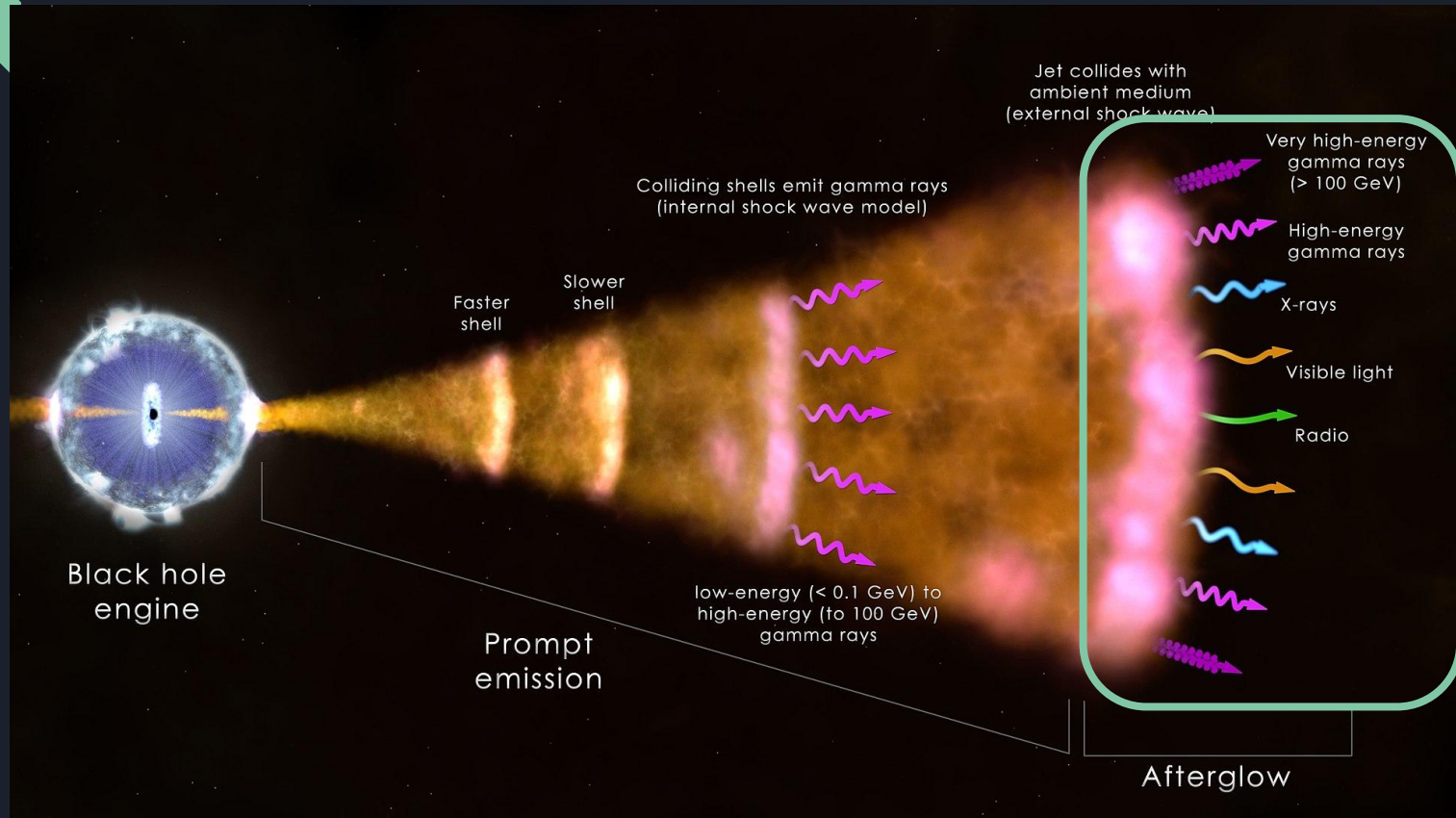
Afterglow



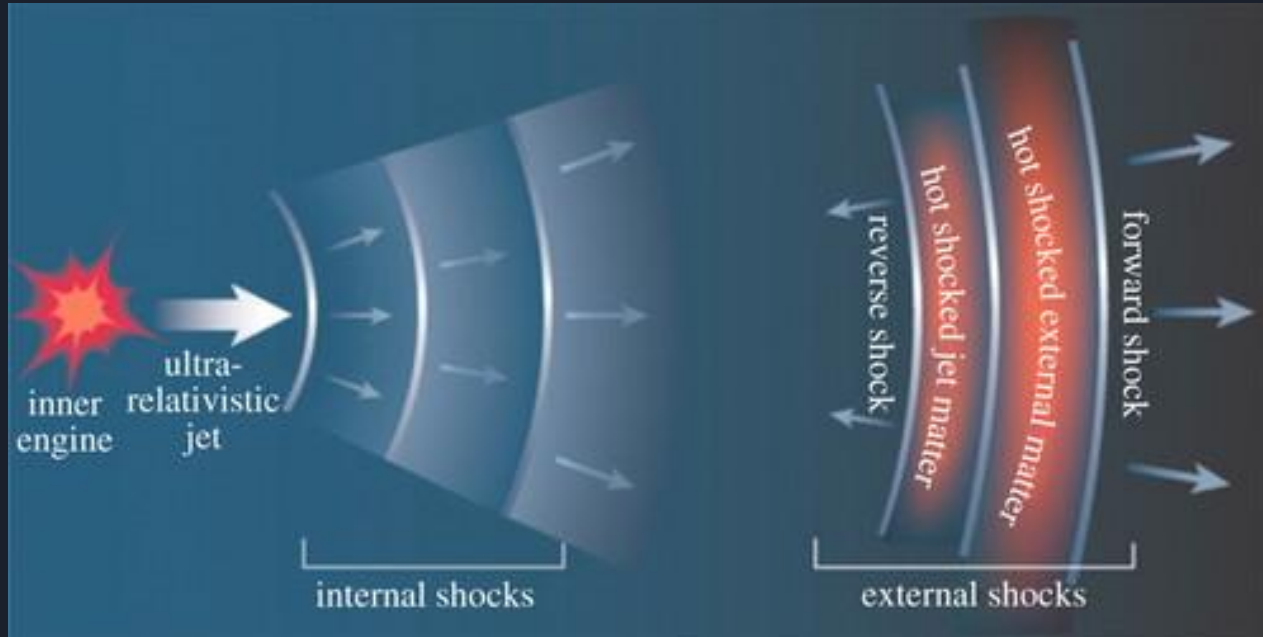
Gamma ray emission mechanism



X-ray to radio emissions



Reverse and forward shock



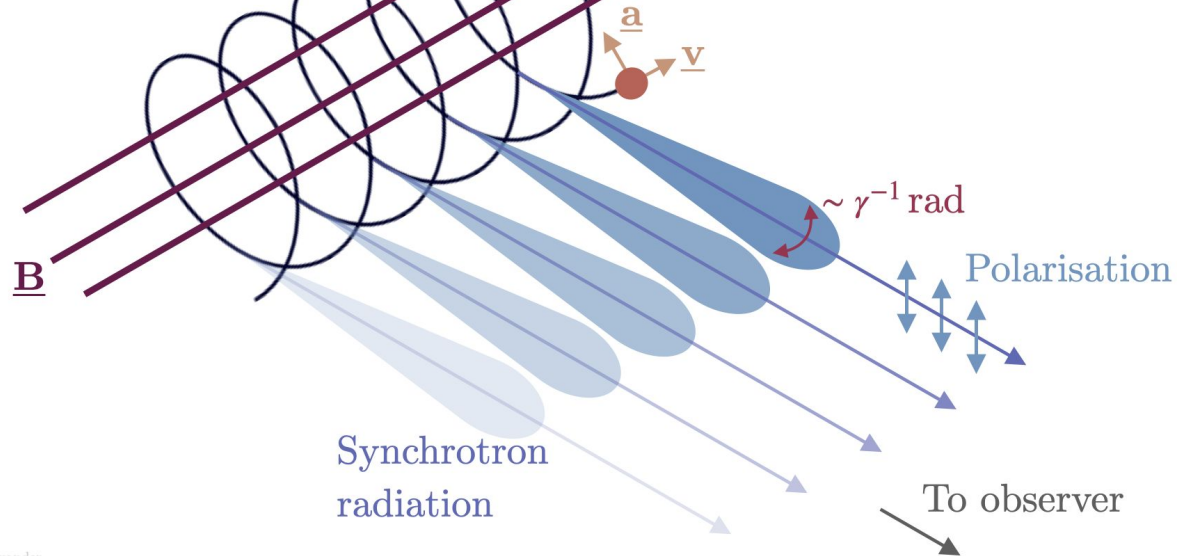


Synchrotron radiation

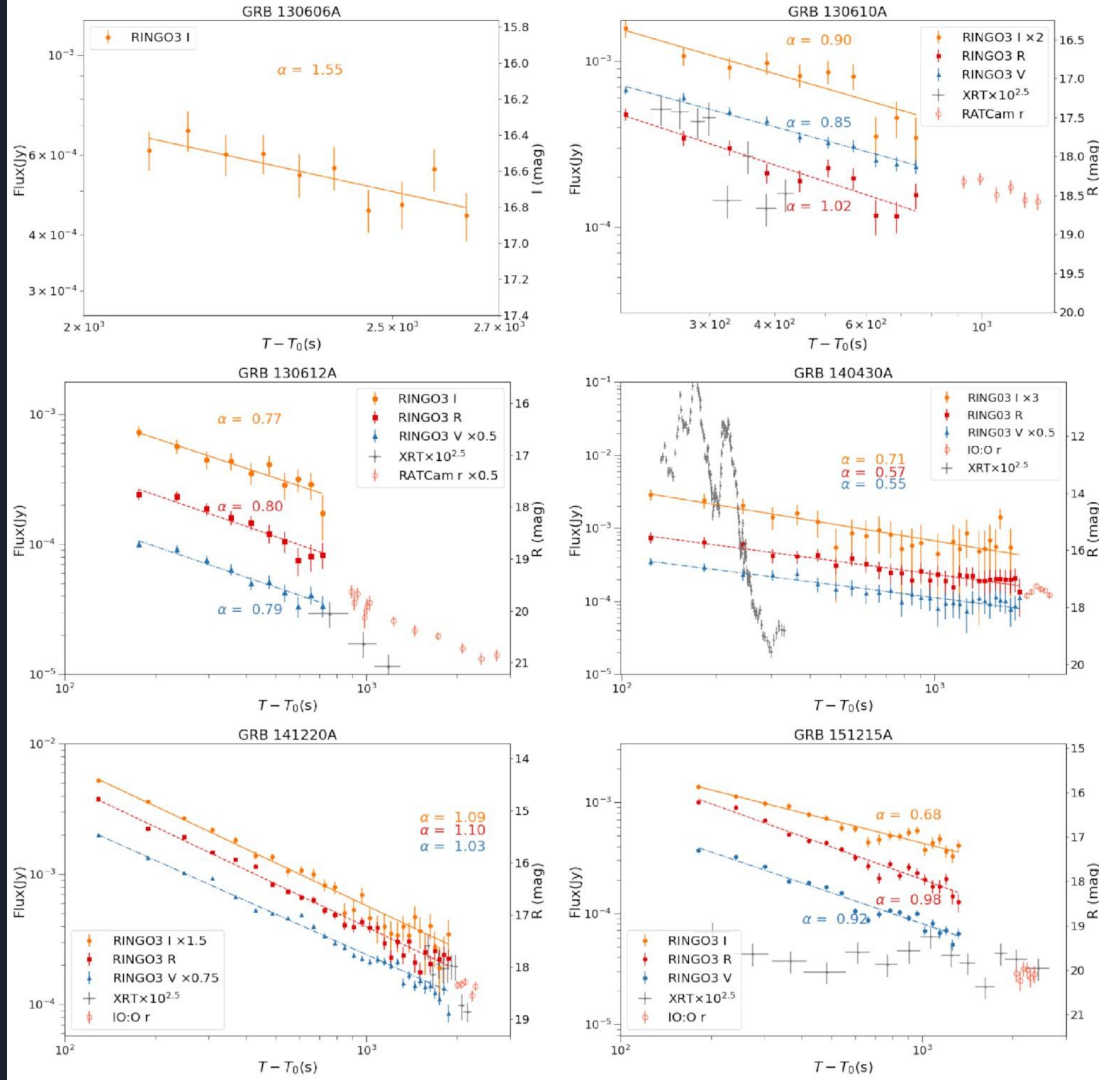
Radiation emitted from
any part of trajectory

Electron with acceleration
 \underline{a} (\perp to \underline{B}), velocity \underline{v} ,
pitch angle α (not shown)

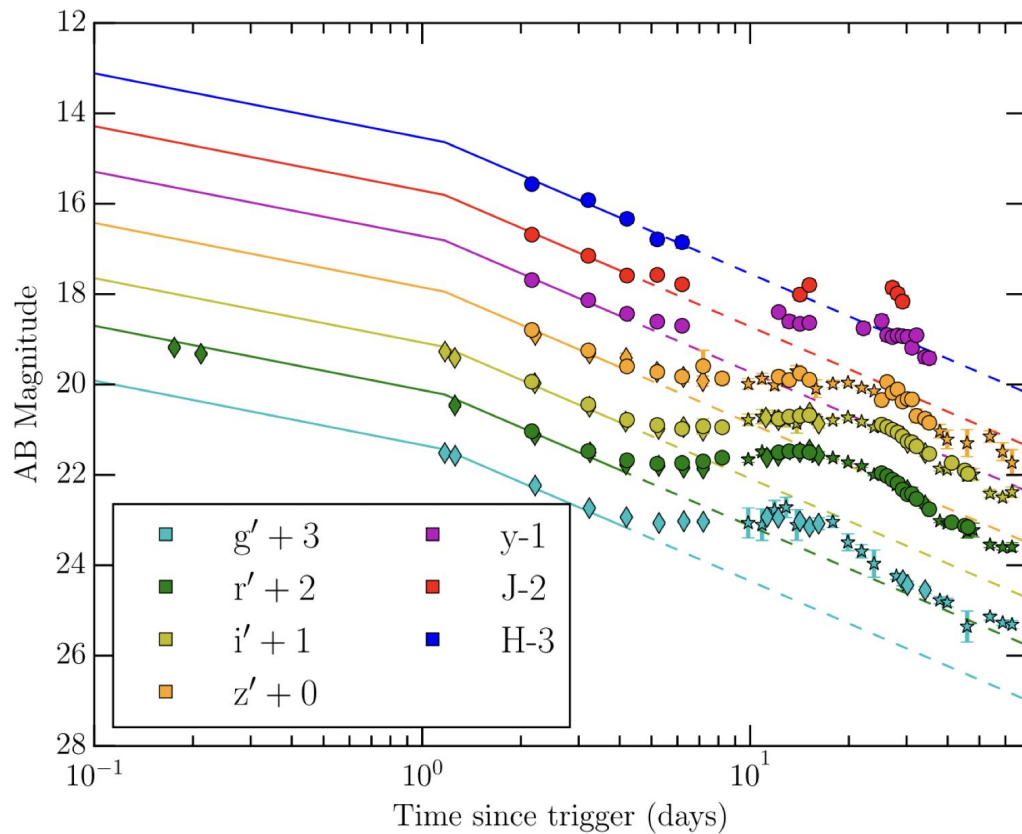
⊗



GRB afterglow

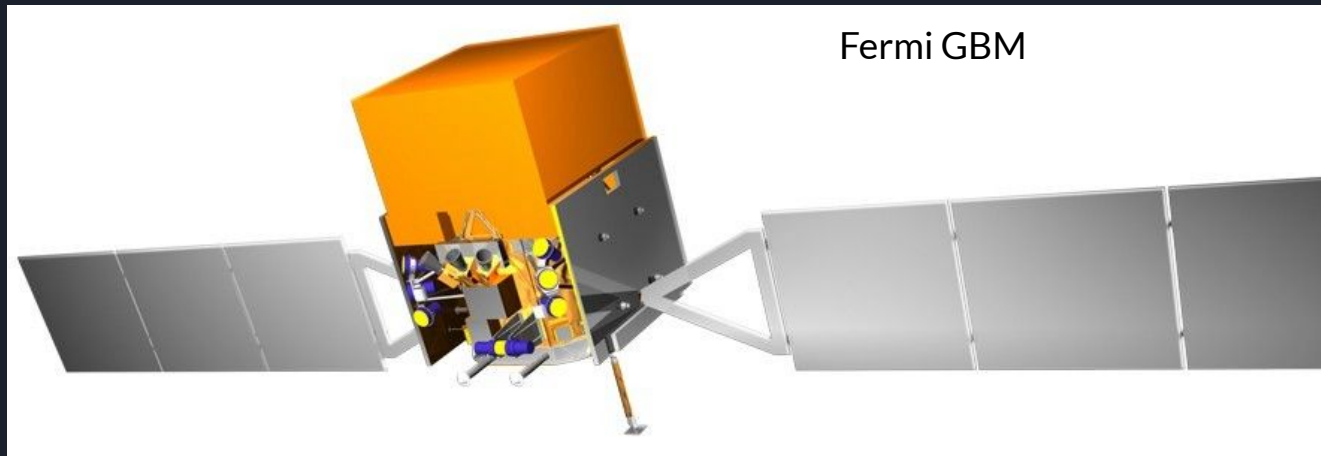


Supernova bump

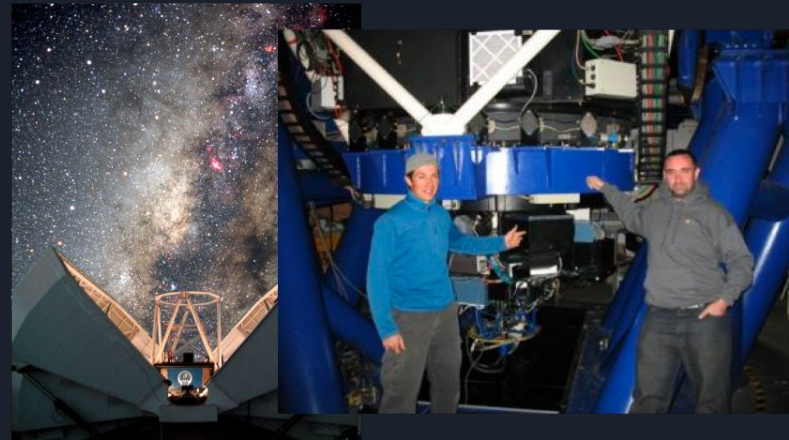


Toy et al. 2016

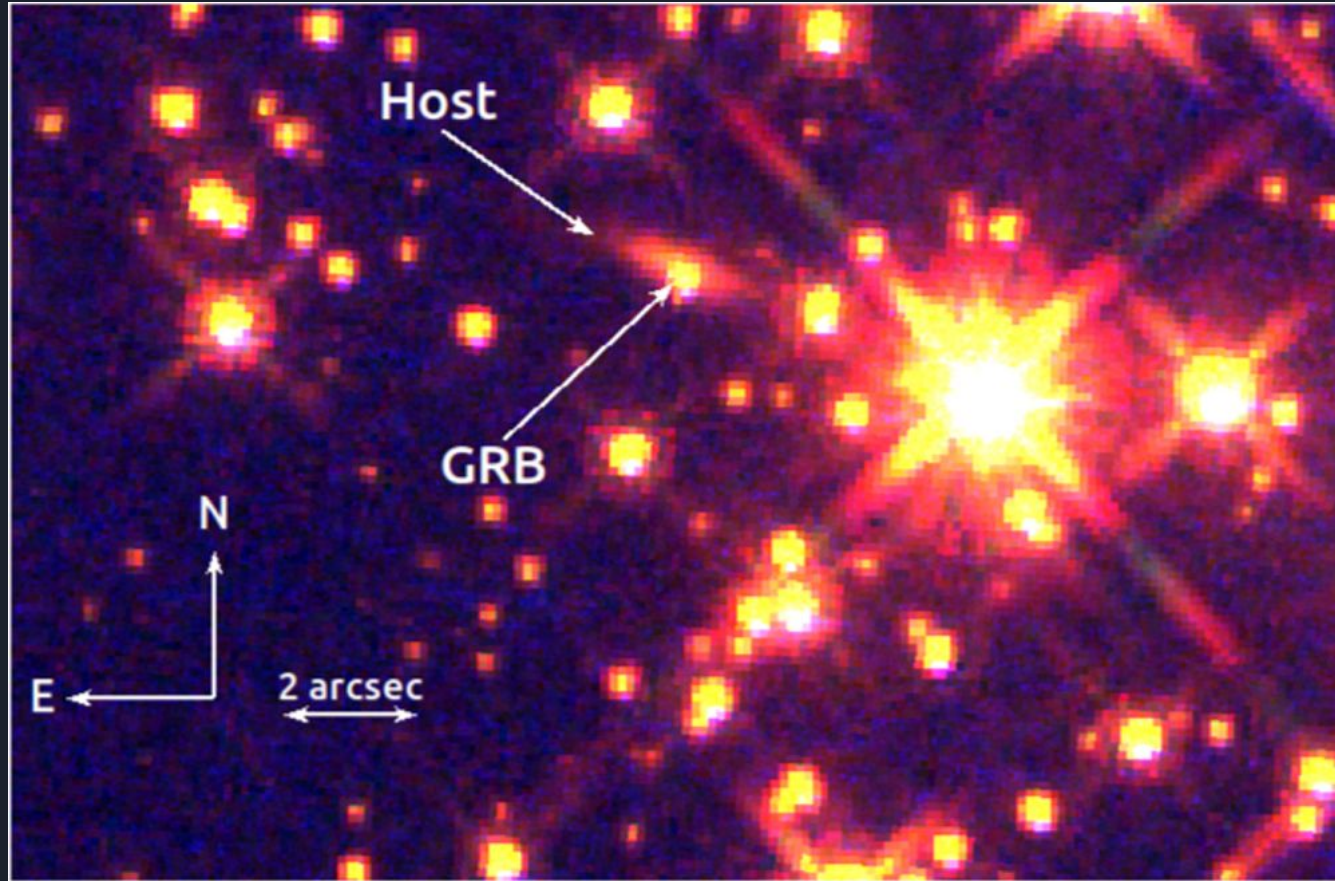
Gamma ray observations from space



Gamma ray observations from ground

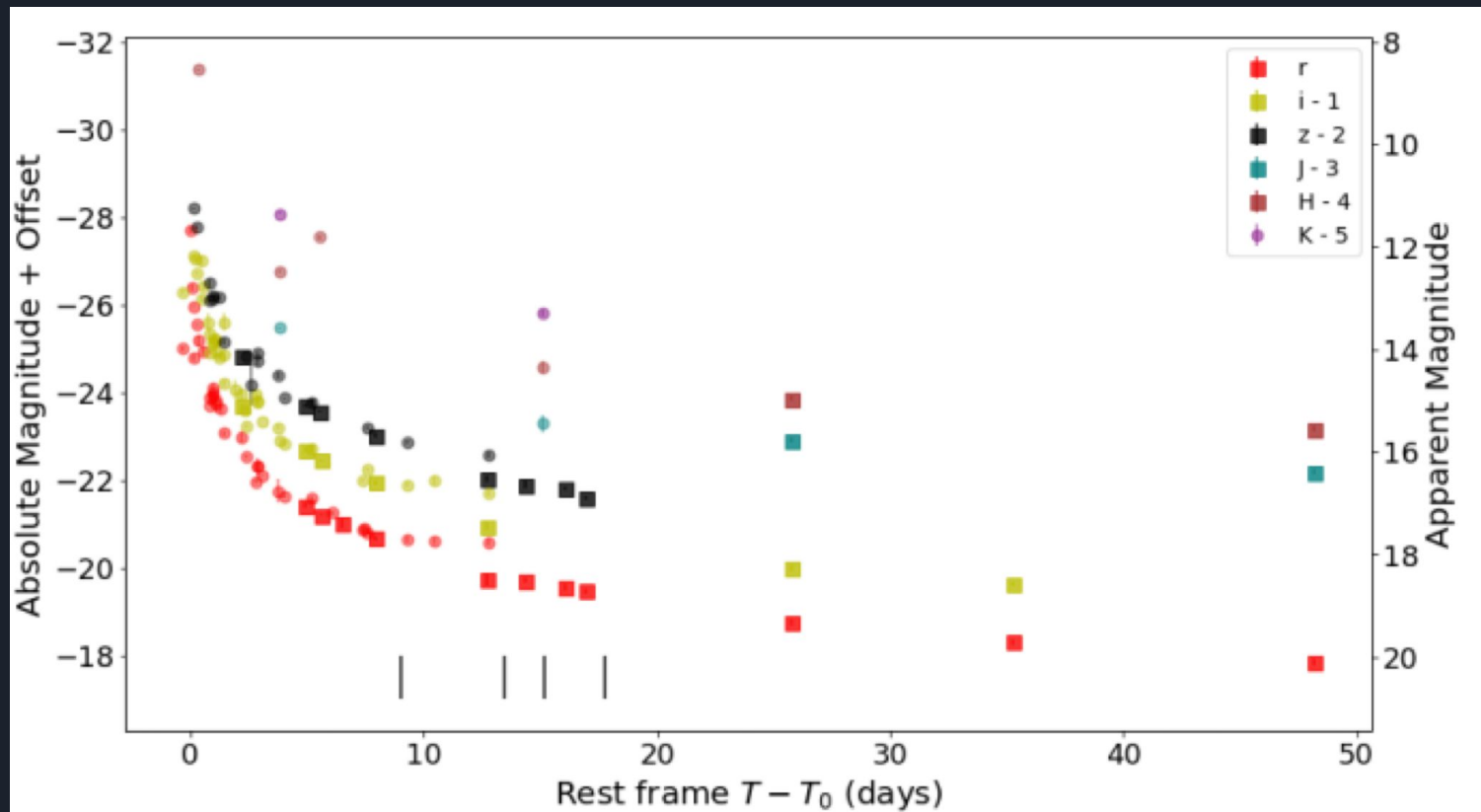


GRB 221009A: The brightest GRB of all time

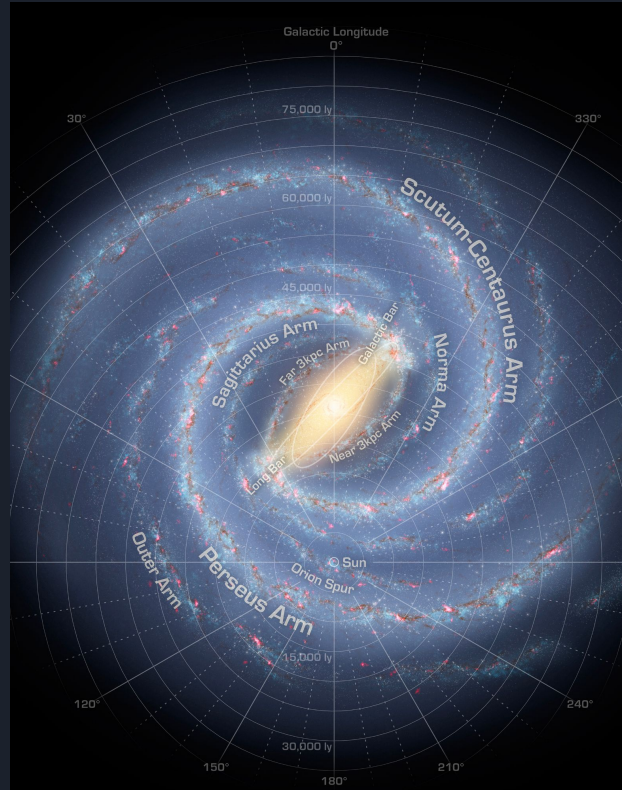


Shrestha et al. 2023

GRB 221009A: The brightest GRB of all time

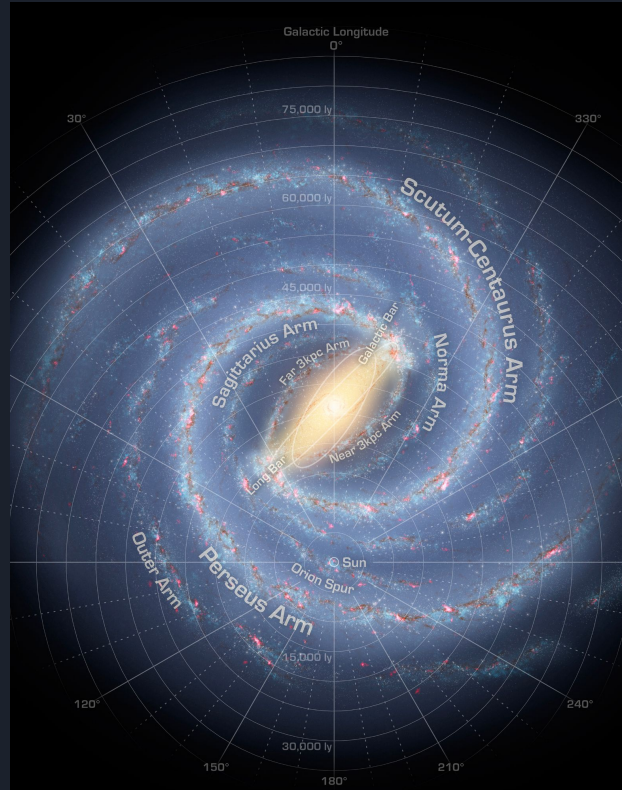


GRB in our own galaxy??



GRB in our own galaxy??

- 1 event every 100,000 - 1 million years
- Only <10% would point towards the Earth



GRB in our own galaxy??

- 1 event every 100,000 - 1 million years
- Only <10% would point towards the Earth

