

# PHY 637: Term Paper Presentation

## Gamma Ray Bursts

Name: Abhinna Sundar

Reg No: MS17204

Department of Physical Sciences

IISER Mohali



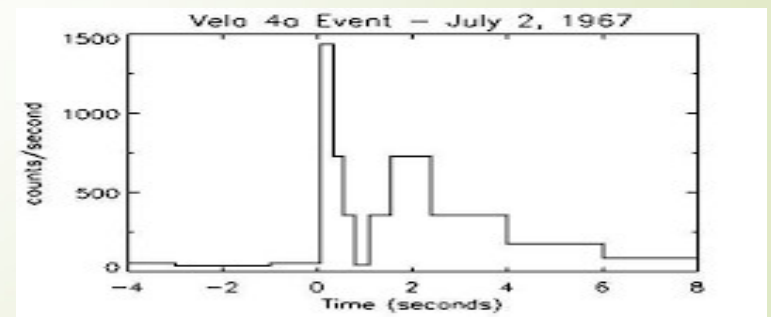


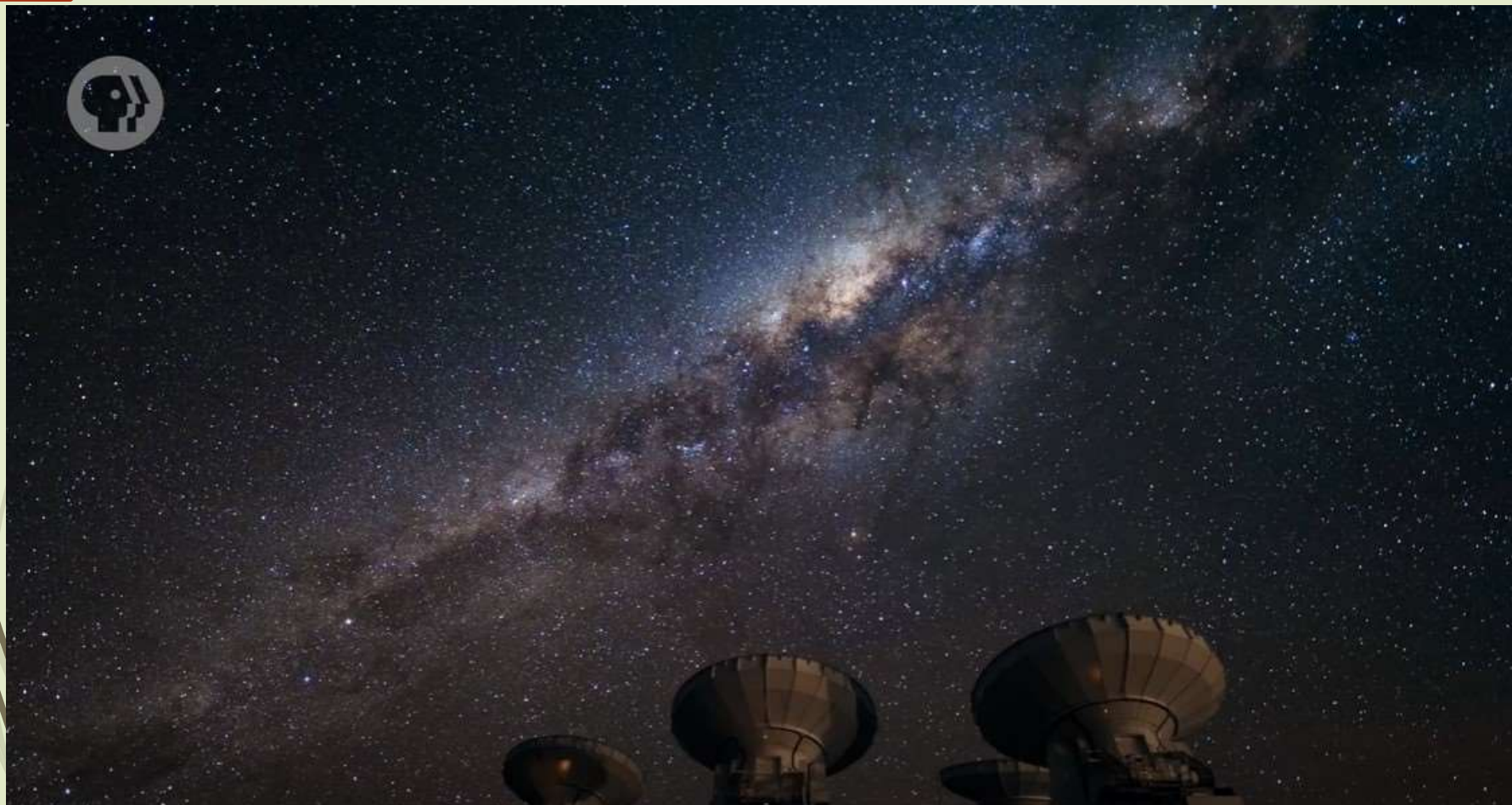
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# Historical background

- The battle between US and the USSR (the 'cold' war)
- Signing of Nuclear Test Ban Treaty
- The detection of first Gamma-Ray signals by Vela satellites
- Resembled neither nuclear nor the solar flare activity
- Earlier theories: Comet Impact on Neutron stars
- Randomness in signal detection meant that they must be coming from incredible far away distances

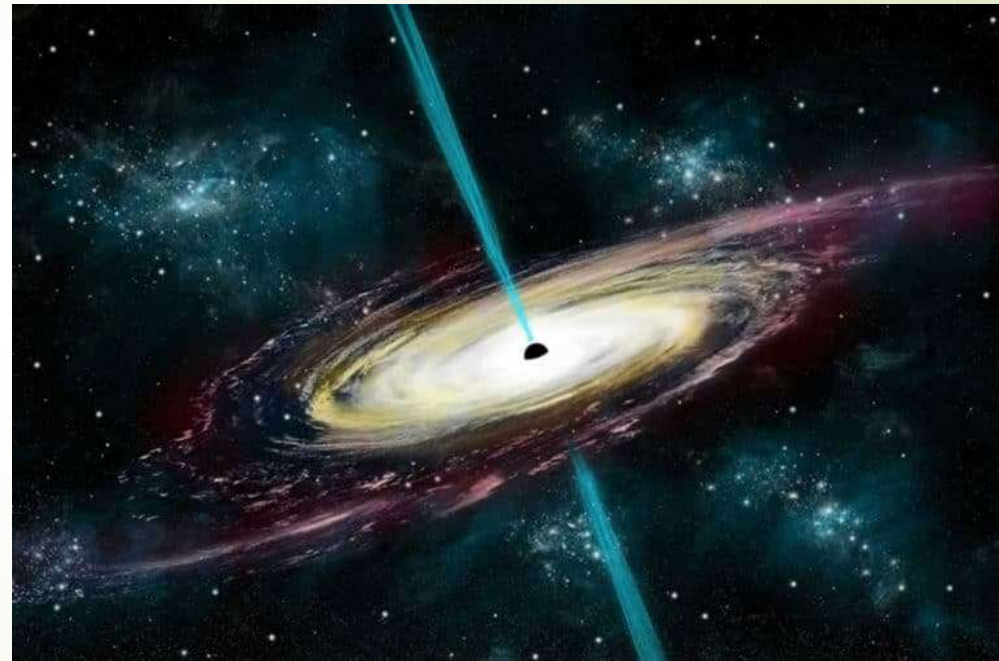






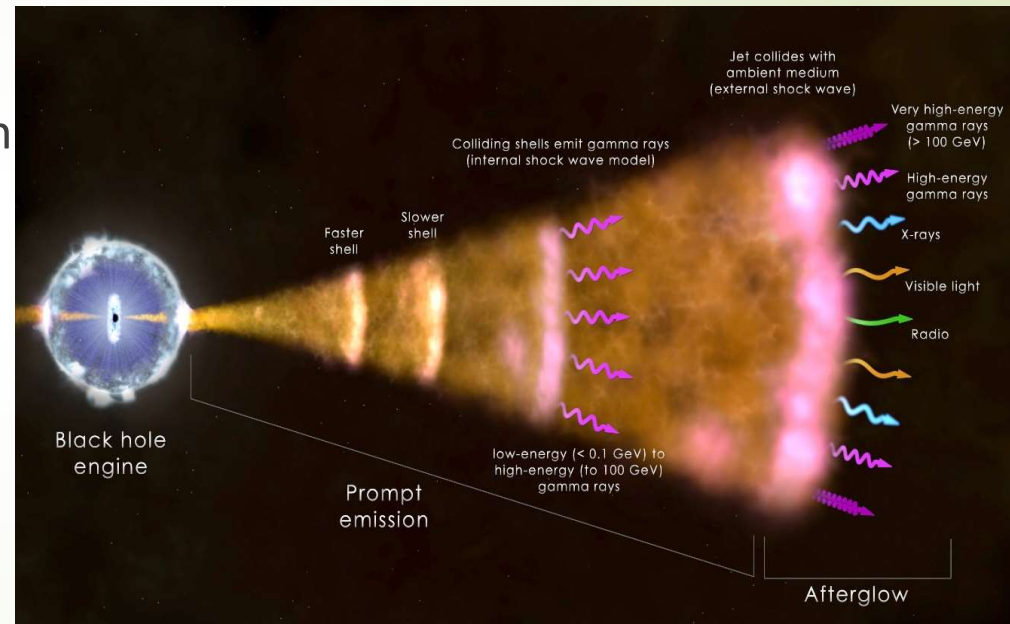
# Introduction

- Most powerful events in the universe
- Distribution: Isotropic in nature
- Bursts could last few milliseconds to several hours
- Their energies ( $10^{44}$  J) are beamed
- Flash of gamma-rays are accompanied by an 'afterglow'
- GRB 080319B (farthest object visible to the naked eye) – 19<sup>th</sup> March 2008

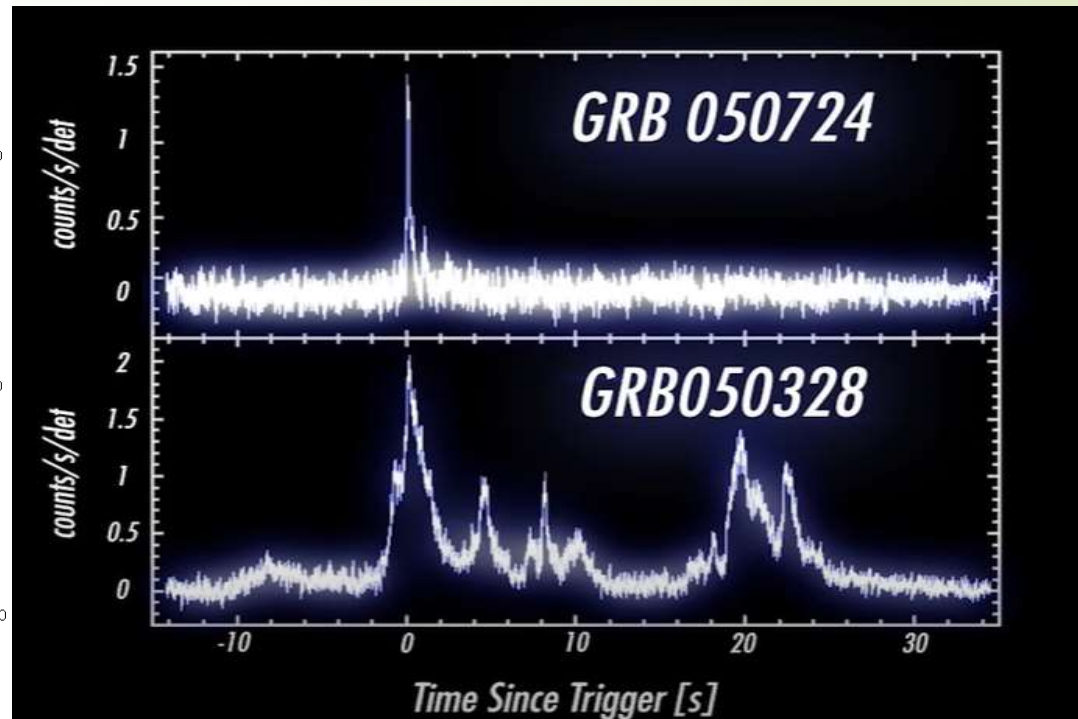
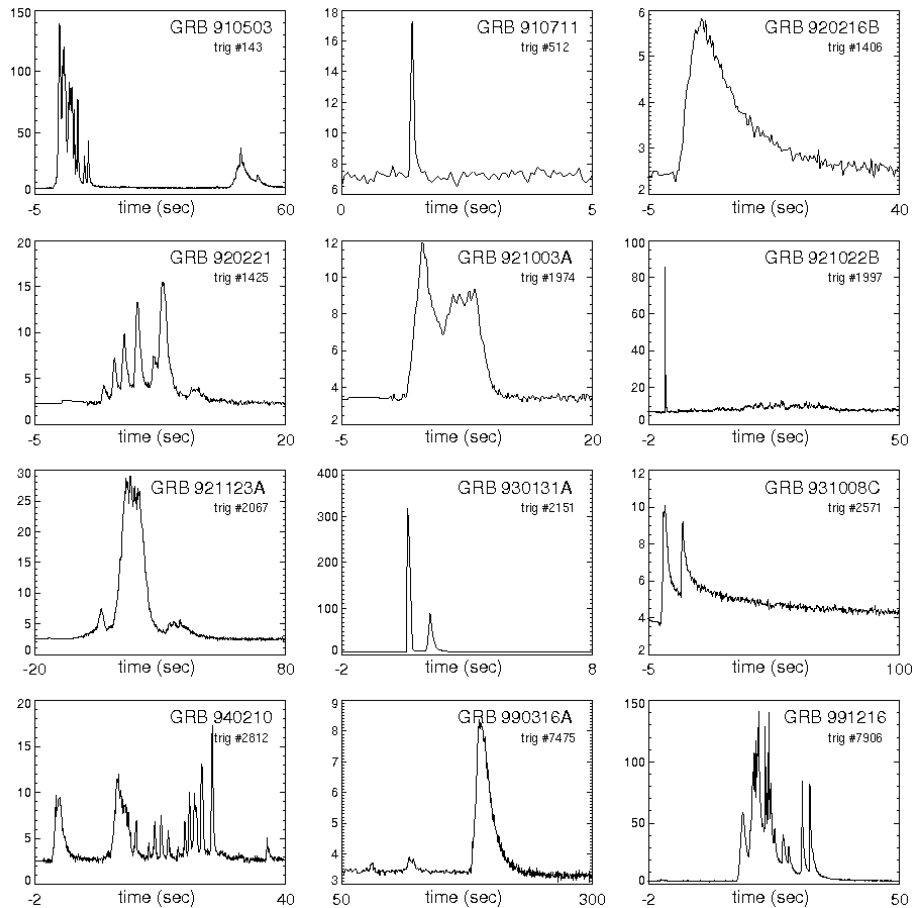


# Mechanisms involved

- ❑ Core collapse of a supermassive star
- ❑ Sends out jets of material which slams into the outer material creating enormously high temperatures and sending off gamma-rays
- ❑ After this prompt emission, comes the long wavelength 'afterglows' (radio, MW, infrared, visible, UV and x-rays)
- ❑ Afterglow emission: synchrotron emission
- ❑ Dark Bursts: no afterglow in optical waveband (50%)



# GRB Light Curves



# Long GRBs

- Duration > 2 seconds
- Constitutes 70% of the total GRBs
- Brightest Afterglows (studied in greater detail)
- Death of massive stars, core-collapse supernovae (sometimes called as hypernova)

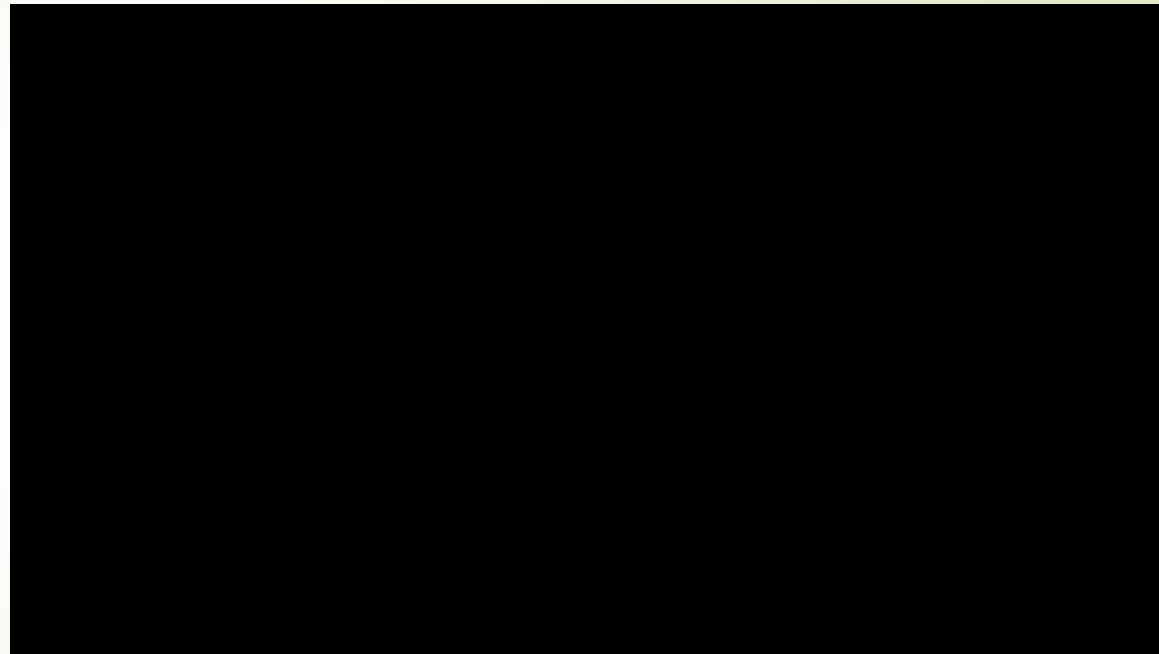


Crab Supernova Explosion , Source: ESA/ Hubble



# Short GRBs

- Duration  $< 2$  seconds
- Constitutes for about 30% of the GRBs
- Source: Neutron star mergers, or a neutron star and a black hole merger
- Famous event: GW detection accompanied by a gamma ray burst (NGC 4993)



Neutron Star Merger, Source: NASA's official website

# Conclusions

- Most powerful events occurring in the universe
- Produced by monster collisions between cosmic objects
- Gamma rays could be very harmful; could disrupt our biochemical machinery
- We are the lucky spectators of these wonderful shows



# Thank You