Systematic search for GRB precursors in Fermi, Swift and BATSE

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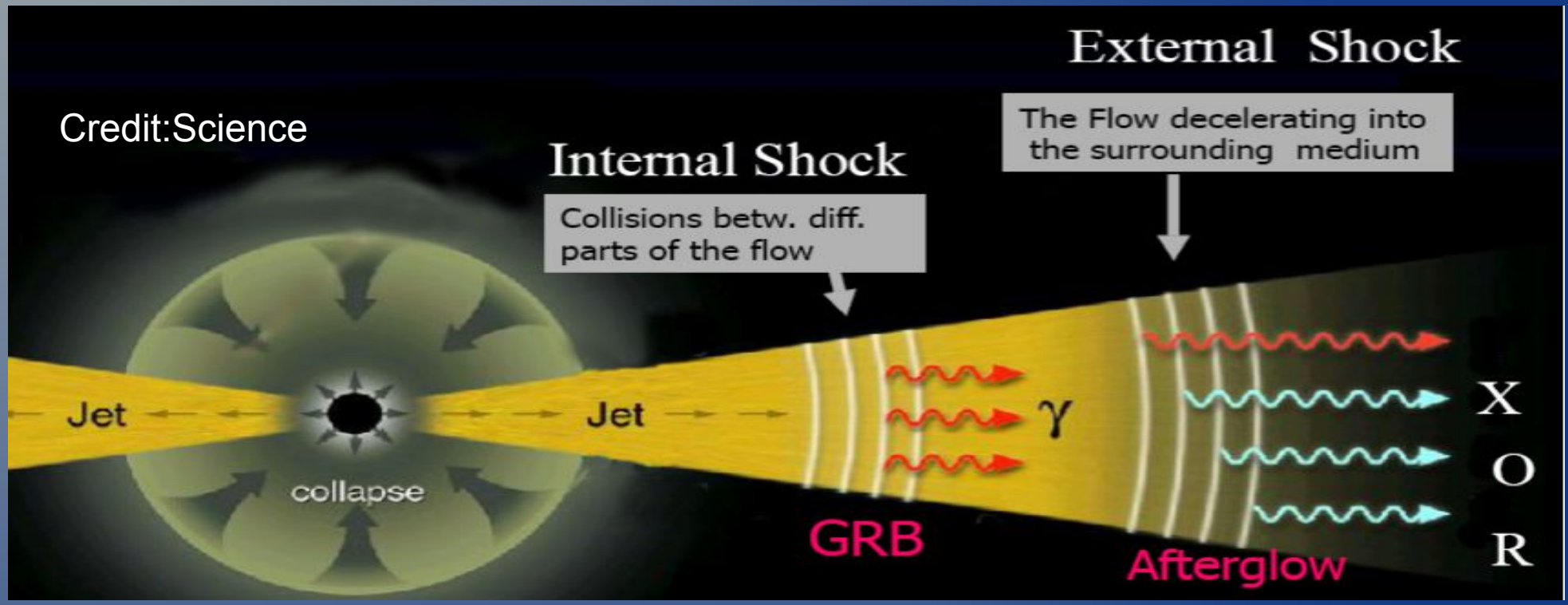
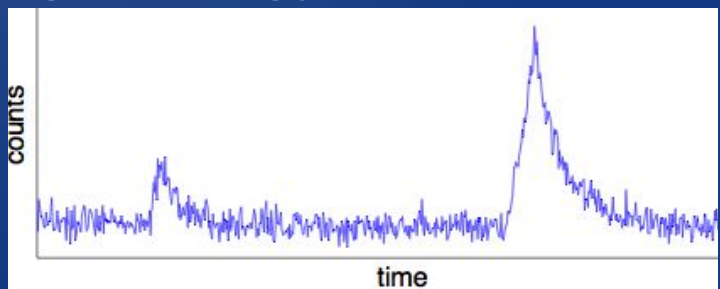
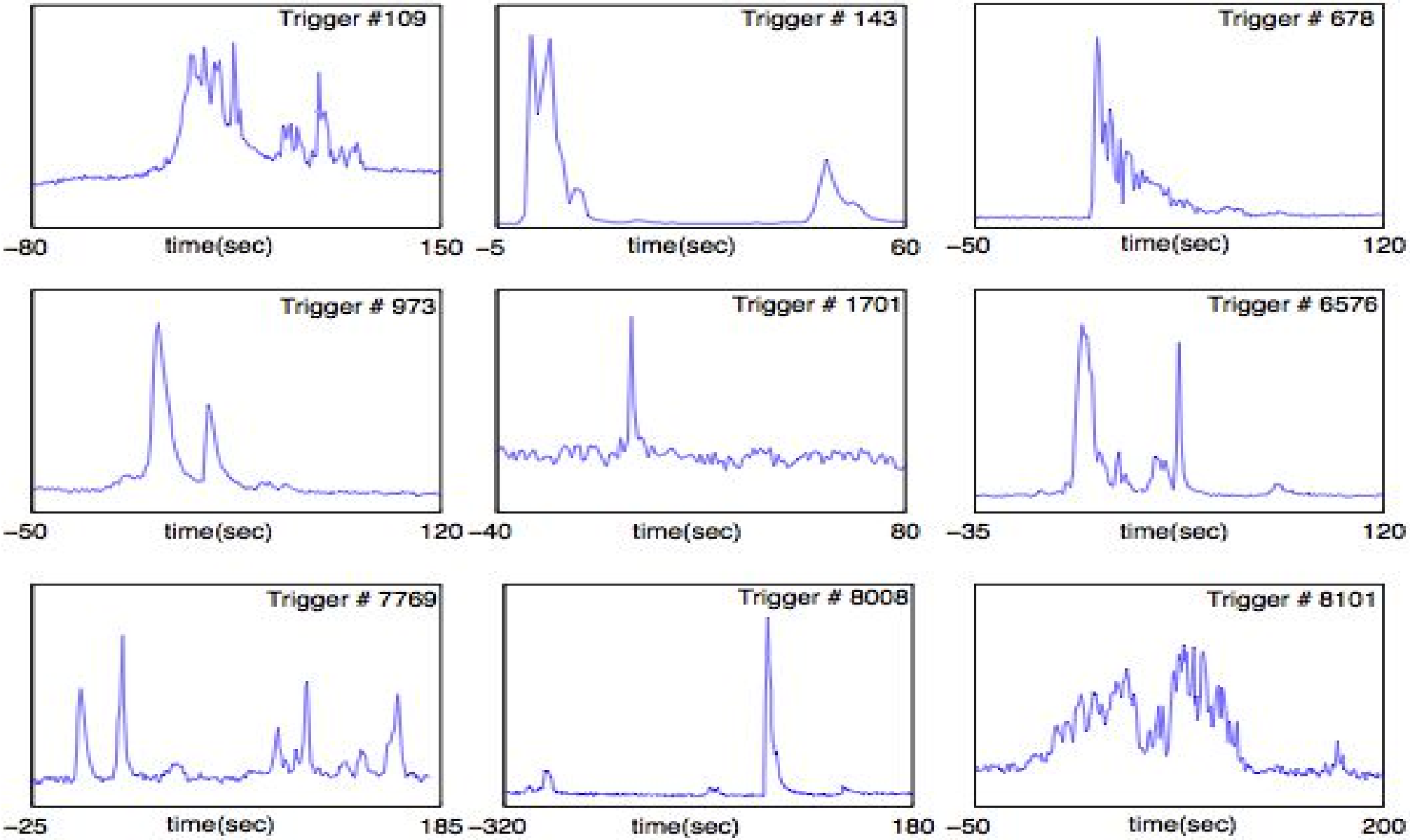
Gamma-ray Bursts (GRBs)



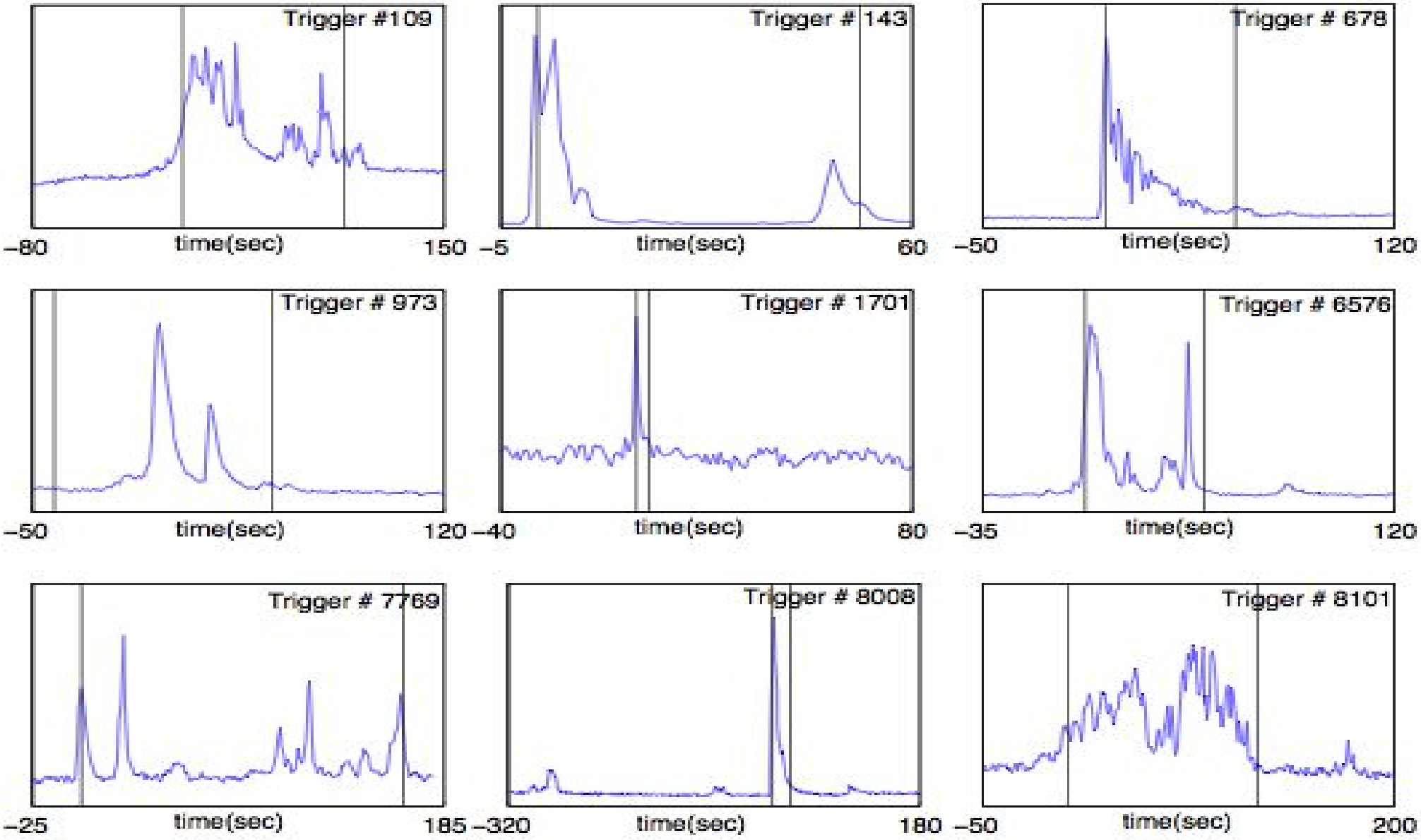
- Formation of compact object (black hole or magnetar)
- Internal shocks in relativistically expanding fireball
- Promising sources of Gravitational Waves+High Energy Neutrinos
- Precursor emission still an open question



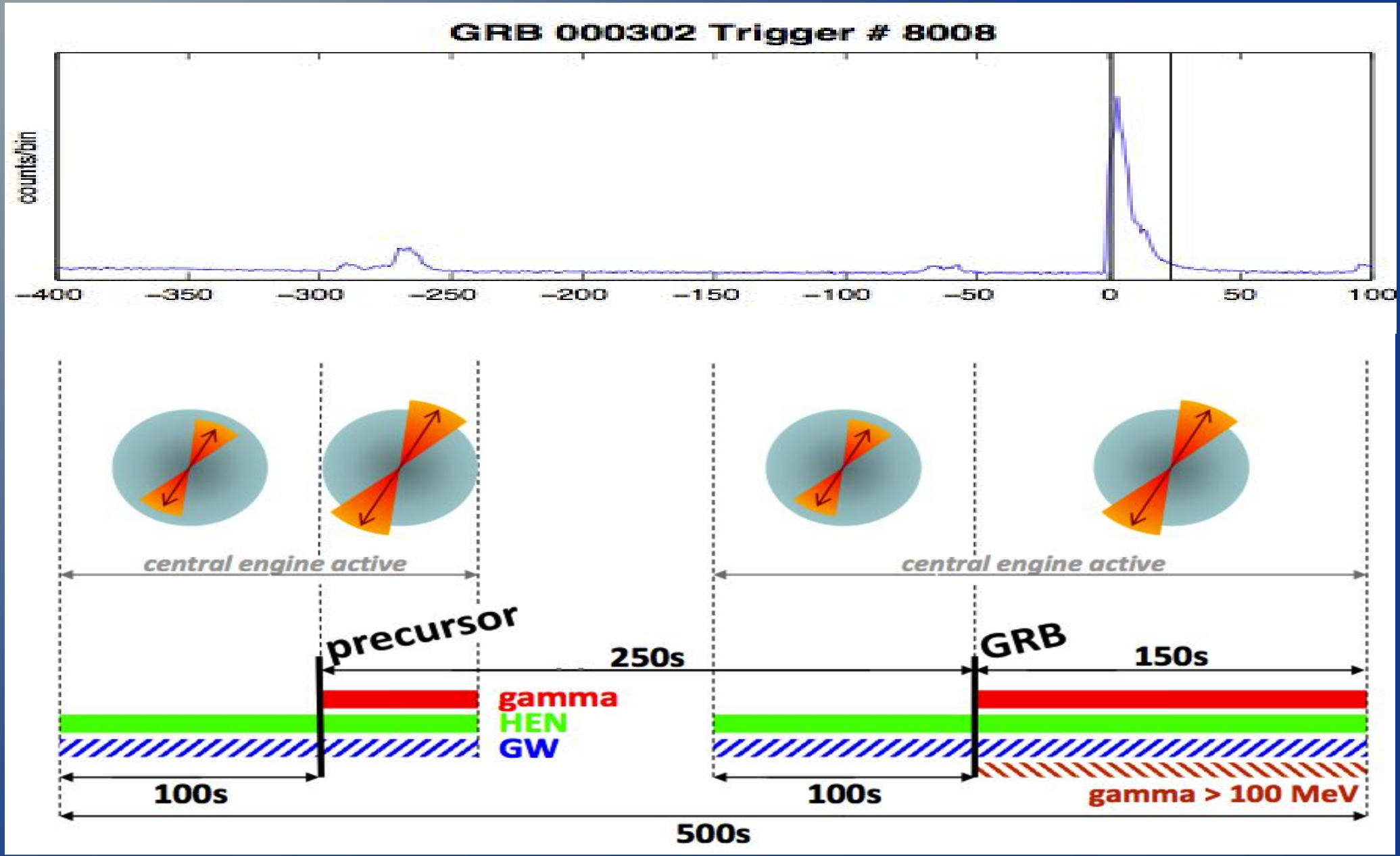
GRB temporal profiles



GRB temporal profiles

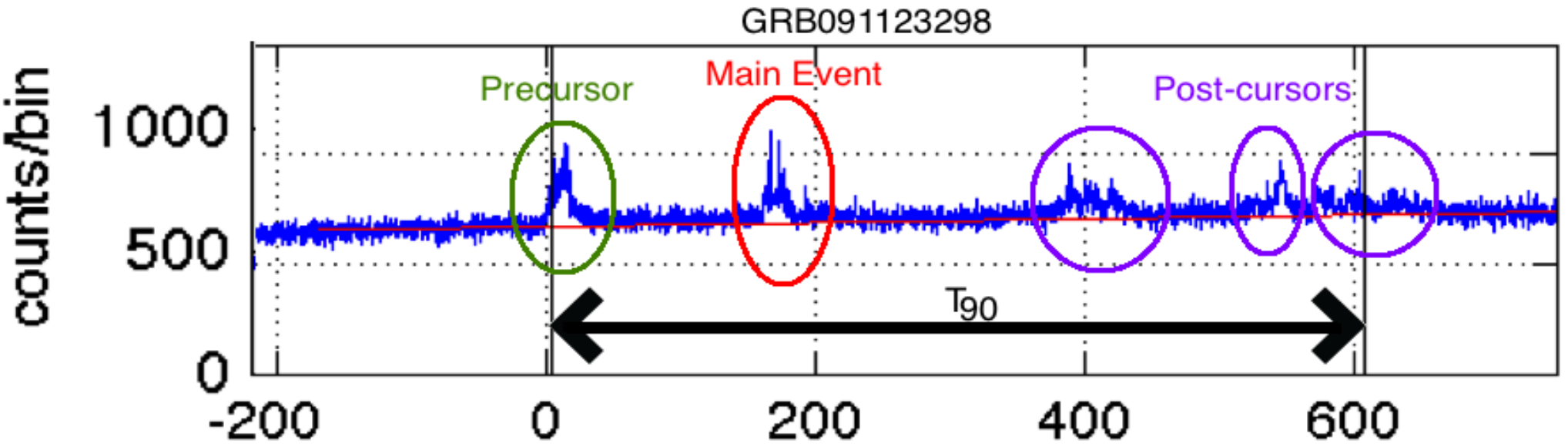


GRBs precursors



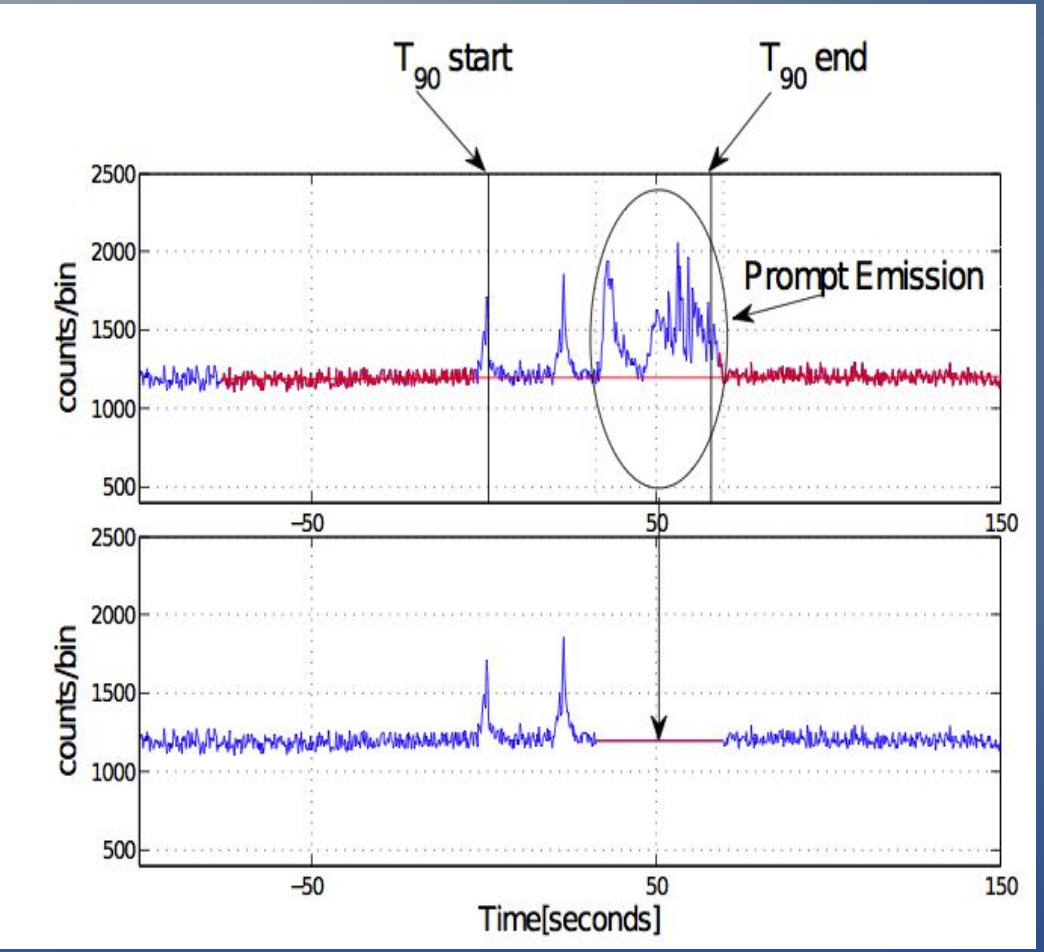
Baret et al. 2011

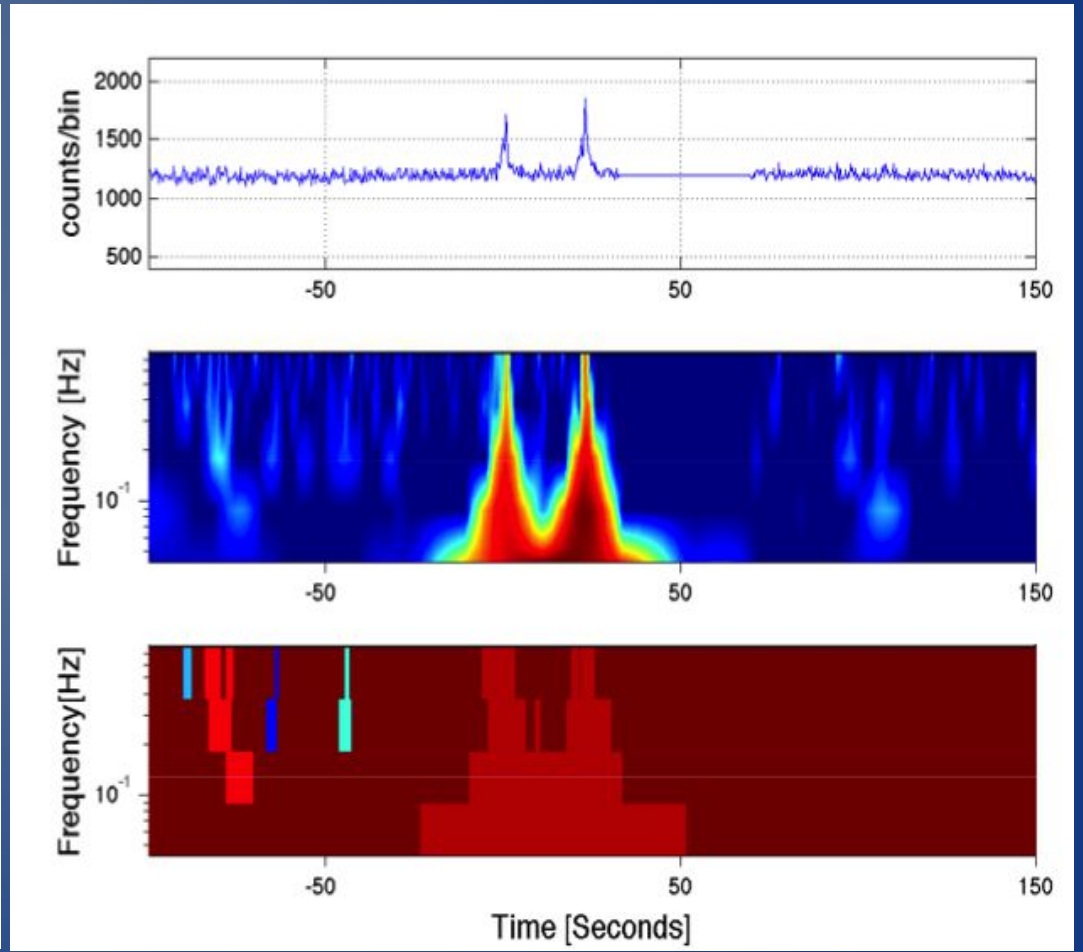
Search For precursors



- Fully automated search
- Excluded human bias and selection effects
- Analyzed sizeable catalogs (Fermi, Swift, BATSE)
- Analyzed post-cursors for the first time

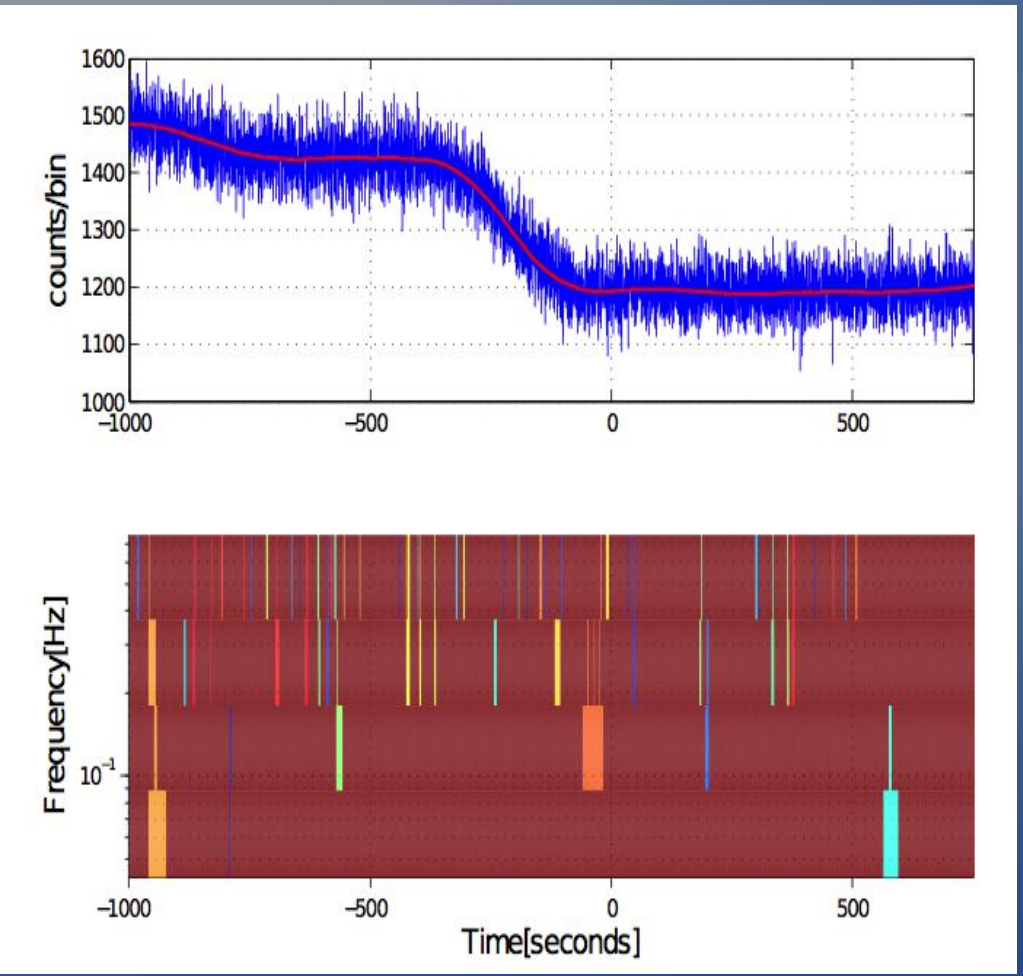
Data Analysis

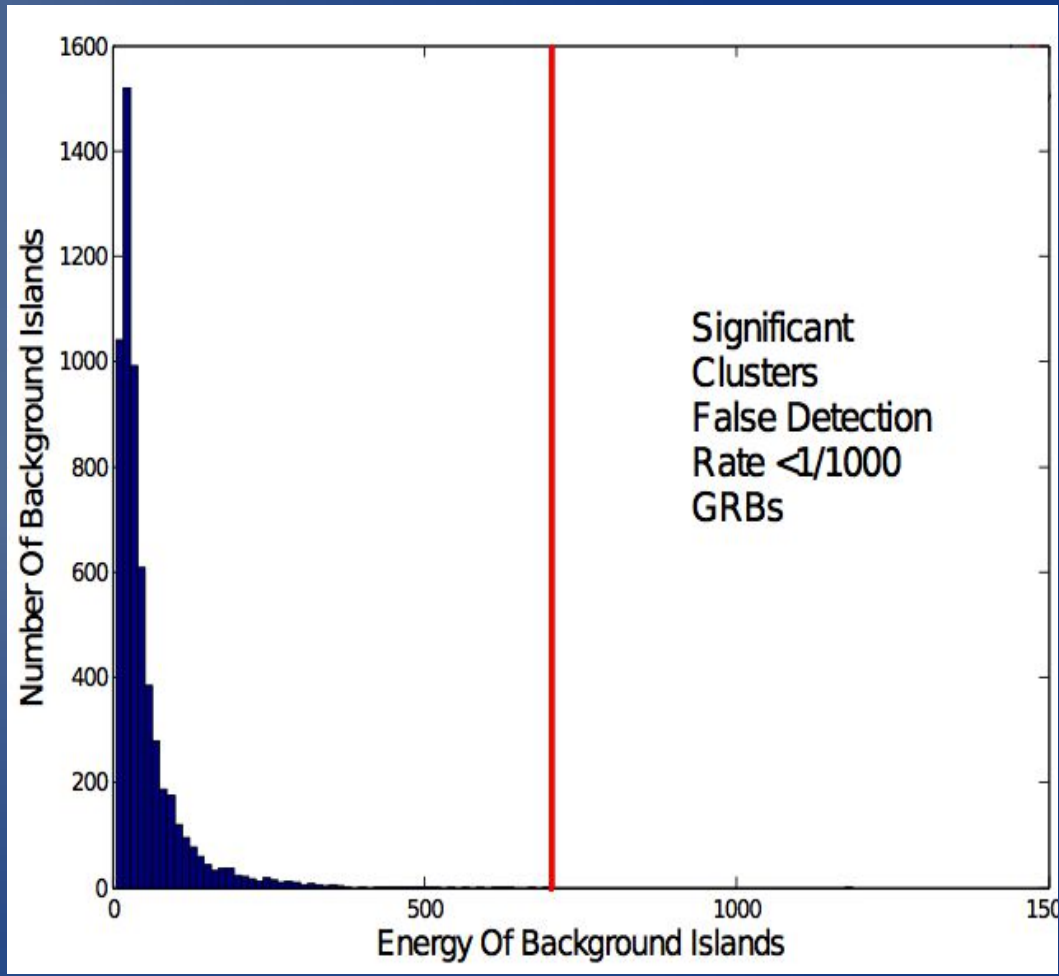




- The main event is removed
- The light curve is analyzed in the time-frequency plane (Chatterji et al. 2004), clusters of signals excess are identified

Data Analysis

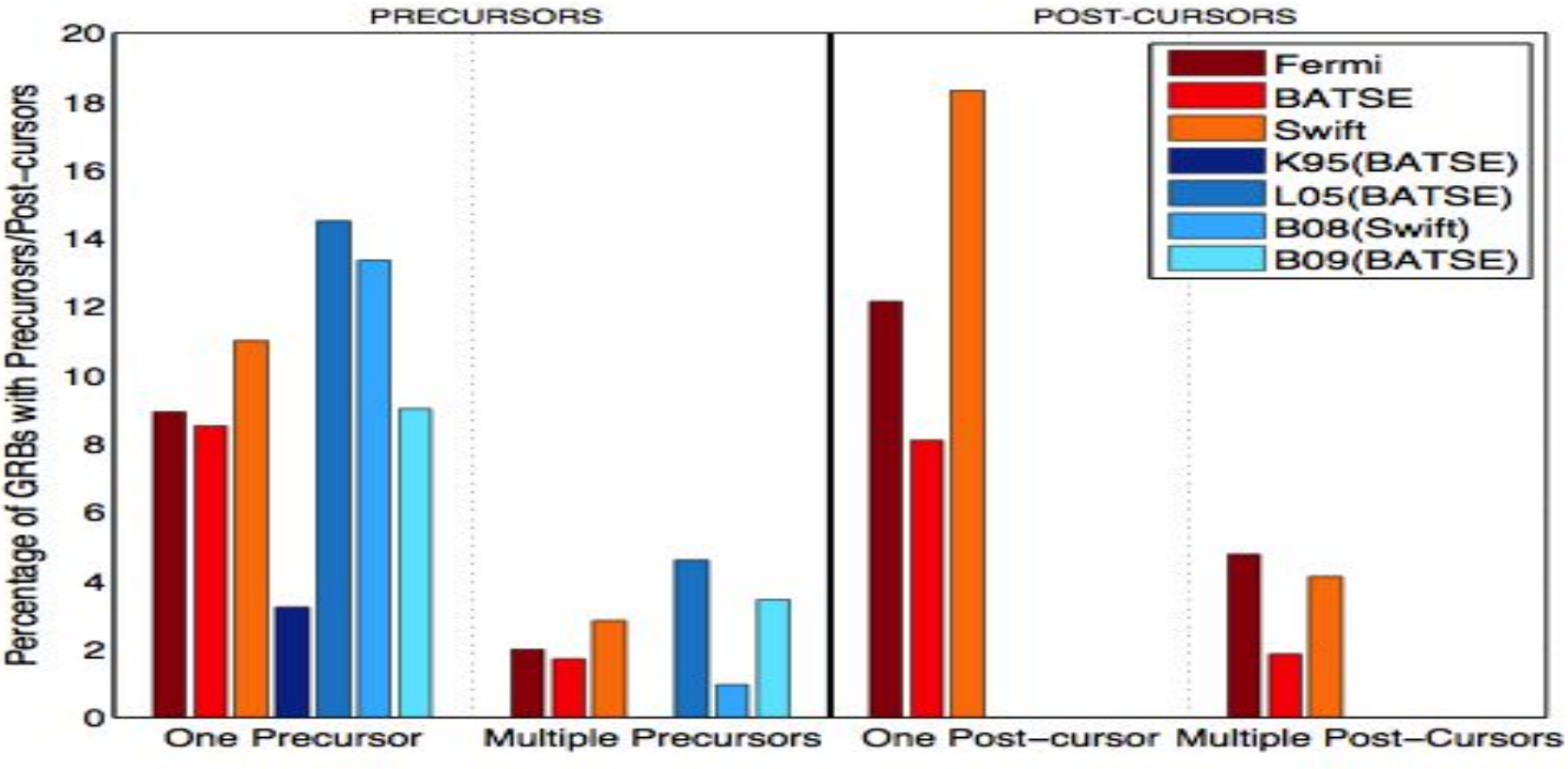




- The background is simulated by generating mock Poissonian noise
- Significance of the clusters is assigned through comparison with the background distribution

Results - Precursor Occurence

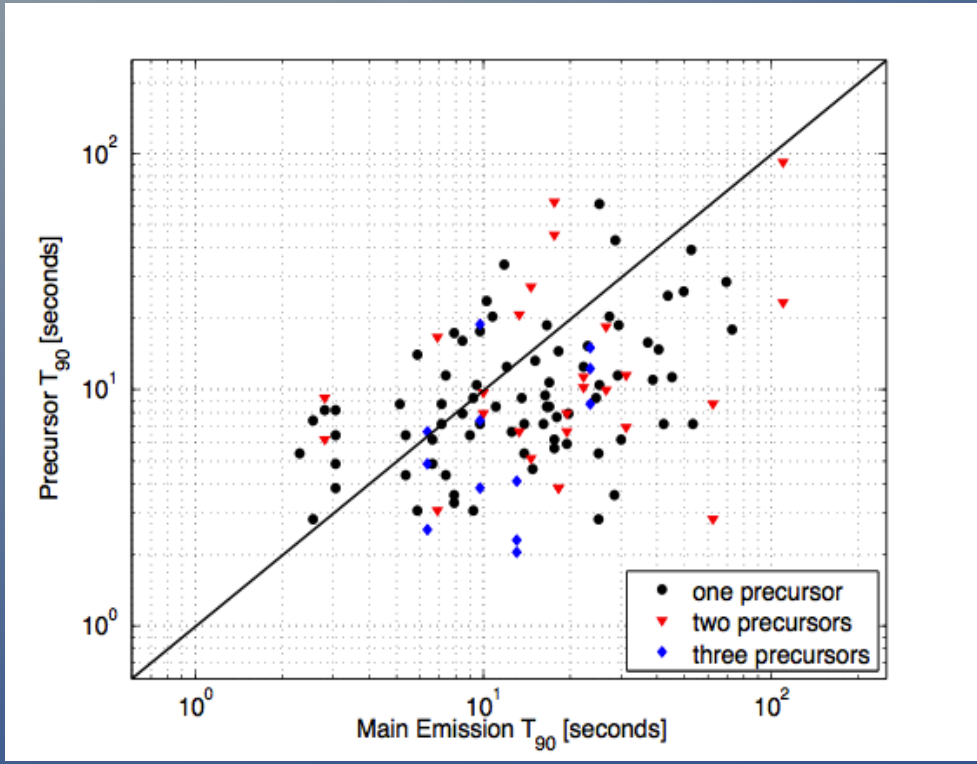
Analyzed 2815 GRBs, identified precursors in 310 and post-cursors in 415

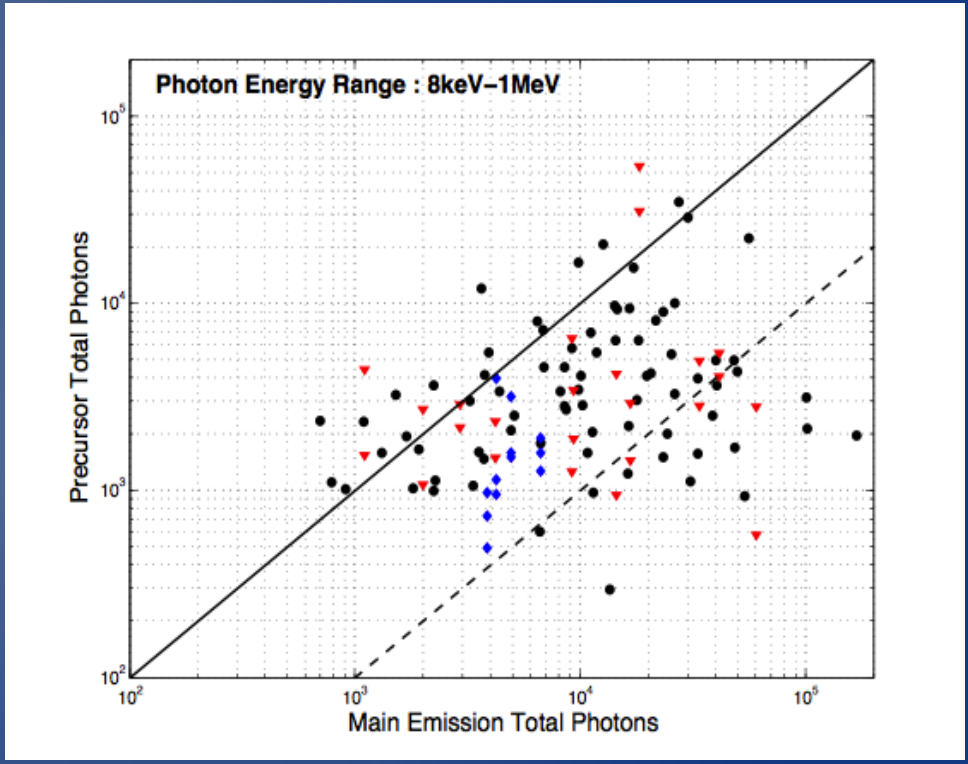


Koshut et al. 1995, Lazzati 2005, Burlon et al. 2008, Burlon et al. 2009

- A significant fraction of GRBs is preceded by precursors

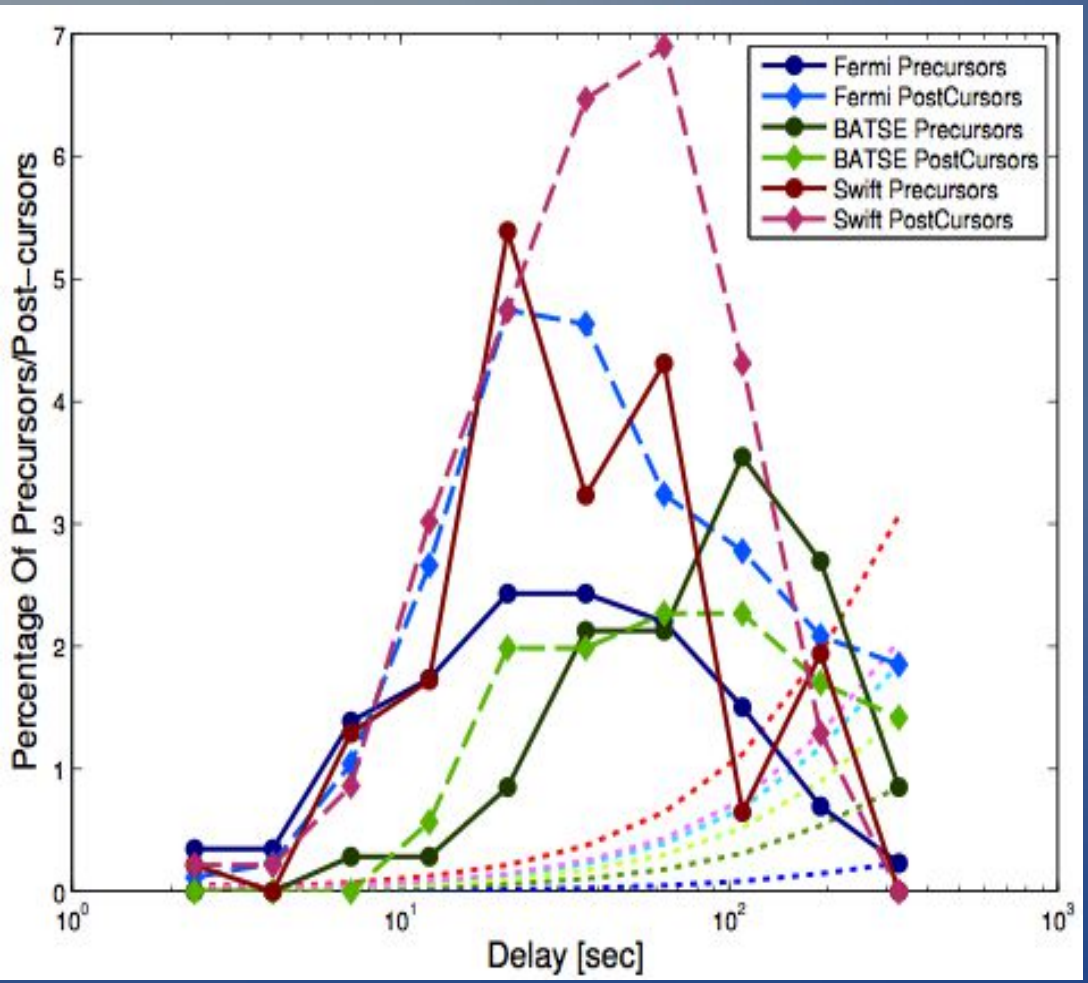
Results – Precursors and Main Event





No significant correlation between the properties of the precursors and the main events.

Results – Delay Distribution



- Delays >100s
- Detections due to background are negligible
- Not significant detector effects

Summary

- Some GRBs show long periods of quiescence
- Precursors and post-cursors show similar properties
- Searching for non-EM signals from GRBs, the entire time interval of gamma emission needs to be taken into account