Pulse decay time analysis of *Fermi* GBM gamma-ray bursts and magnetar giant flares

Honours project

1 Project summary

Gamma−ray bursts (GRBs) one of the most luminous sources in the universe with redshifts reaching up to $z \approx 10$ [1], making them ideal cosmological probes. They are classified based on their emission duration (T_{90}), with short gamma-ray bursts (SGRBs) lasting $T_{90} < 2$ seconds and long gamma-ray bursts (LGRBs) exceeding 2 seconds. While LGRBs are well-characterized, the Vela satellites in 1979 detected sources resembling SGRBs that originate from nearby star-forming galaxies. These sources, known as Magnetar Giant Flares (MGFs), arise from highly magnetised neutron stars (magnetars) and exhibit temporal structures similar to cosmological SGRBs. As a result, some MGFs are misclassified as SGRBs, causing uncertainties in cosmological studies.

2 Aim and objectives

This data analysis honours project aims to study the pulse decay time of GRBs and MGFs using Fermi Gamma-ray Burst Monitor (GBM) data. The objective are:

- Retrieve SGRB and MGF Fermi GBM data
- Fit the Norris function [2] to the pulse profiles of the sources (a python script for the Norris function is available)
- Analyse and compare the decay time of SGRBs and MGFs
- Discuss the implications

This study will help distinguish between GRBs and MGFs based on their pulse decay features, improving classification accuracy and enhancing our understanding of these transients.

3 Requirements

The student should have basic understanding of Linux operating system and Python programming language.

4 Supervisor details

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References

[1] L. Amati and M. Valle. Measuring cosmological parameters with gamma ray bursts. *International Journal of Modern Physics D*, 22(14):1330028, 2013.

[2] J. Norris, J. Bonnell, D. Kazanas, J. Scargle, J. Hakkila, and T. Giblin. Long-lag, wide-pulse gamma-ray bursts. *The Astrophysical Journal*, 627(1):324, 2005.