Executive Summary

What's the contribution about?

This contribution will guide through the study reported in a recent paper by E. Burns et al. published in Ap.J. Letters in January 2021. In this paper we perform a population-level search for short gamma-ray bursts (SGRBs) with magnetar giant flare (MGF) origin.

What have we done?

We define a set of 250 well localized GRB combining the data from CGRO-BATSE, Konus-WIND, Swift-BAT, Fermi-GBM and exploiting additional IPN measured properties, and we perform a likelihood analysis to find the chance that a SGRB is produced in a local (<50 Mpc) star-forming galaxy (find more details in the proceeding and/or in the presentaion). We identified 4 events which are incompatible with a cosmological origin, being them extremely short (a few milli-seconds) and having an intrinsic energetic 5 order of magnitude lower than typical SGRB powered by neutron star mergers.

Why is it relevant / interesting?

This finding is relevant because

- 2 of the 4 found MGF events are newly identified, doubling the statistics of previously known extragalactic MGFs;
- the 4 events deviate from the null hypothesis (having a non-local origin) at more than 99.9% (>5 sigma) confidence;
- the 4 events have similar characteristics in terms of duration and energetics, which are compatible with the expectation of a MGF origin;
- the rate of 4 out of 250 events implies that the 2% of detected SGRBs are of MGF origin, which is compatible with the 1-8% range found on literature;
- we could constrain the power-law index of the MGFs intrinsic energetics distribution to 1.7±0.4;
- despite the small sample of known MGF (7 in total, both Galactic and extragalactic) we inferred an intrinsic volumetric rate of MGFs being ∼380000 $\mathrm{Gpc^{-3}yr^{-1}}$ (for comparison, the local rate estimated for NS mergers is ∼320 $\mathrm{Gpc^{-3}yr^{-1}}$, while it is ∼100 $\mathrm{Gpc^{-3}yr^{-1}}$ the local rate for Collapsars, which produce long GRB).
- the estimated rate and the type of host galaxies (with high star formation rates), favor core-collapse supernova (CCSN) as the dominant formation channel for magnetars, with at least 0.5% of CCSN resulting in magnetars.
- our results suggest that some magnetars produce multiple MGFs: this would be the first known source of repeating GRBs.