

Gamma-ray burst minimum variability timescales with *Fermi*/GBM

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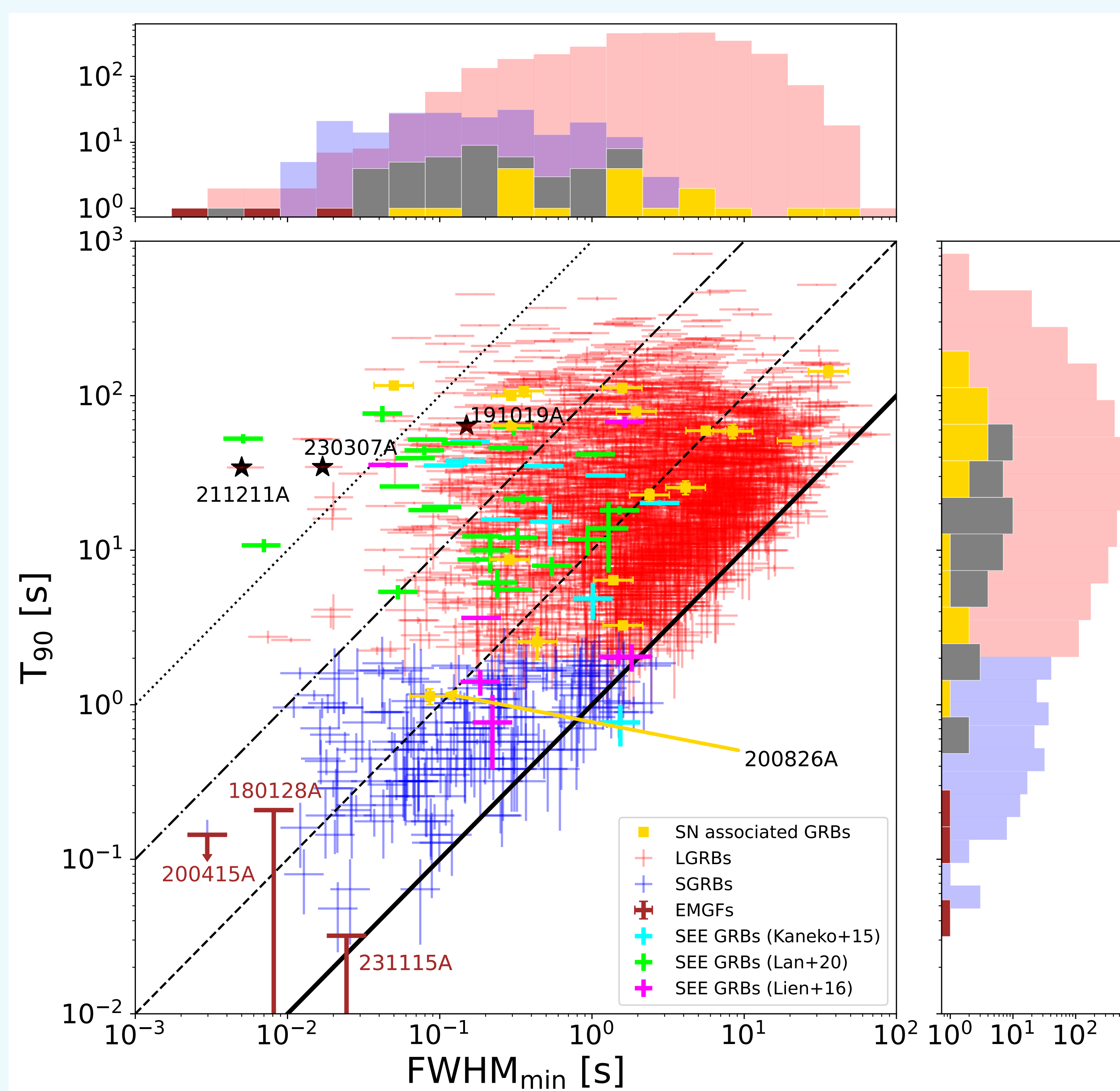


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ABSTRACT

γ -ray bursts (GRBs) have traditionally been classified by duration as **long (LGRBs)** or **short (SGRBs)**, with the former believed to originate from **massive star core-collapse** and the latter from **compact binary mergers**. However, events such as the **SGRB 200826A** (coming from a collapsar) and the **LGRBs 211211A** and **230307A** (associated with a merger) suggest that **duration-based classification could sometimes be misleading**. Recently, the **minimum variability timescale (MVT)** has emerged as a **key metric for classifying GRBs**. We calculated the MVT, defined as **the full width at half maximum (FWHM) of the narrowest pulse in the light curve**, using an independent dataset from *Fermi*/GBM, and we compared our results with other MVT definitions. We updated the MVT- T_{90} plane and analysed peculiar events such as long-duration merger candidates 211211A, 230307A, and other **short GRBs with extended emission (SEE-GRBs)**. We also examined extragalactic magnetar giant flares (EMGFs). We used the MEPSA algorithm to identify the shortest pulse in each GRB light curve and measured its FWHM. We calculated the MVT for around 3700 GRBs, 177 of which have spectroscopically known redshift. The **SEE-GRBs and SGRBs share similar MVTs** (from a few tens of to a few hundred ms), indicating a **common progenitor**, while EMGFs exhibit even shorter values (from a few ms to a few tens of ms). For LGRBs, we confirm the correlations of MVT with peak luminosity and Lorentz factor. We confirm that although MVT alone cannot determine the GRB progenitor, it is a **valuable tool** when combined with other indicators, as it helps **flag long-duration mergers and distinguish MGFs from typical SGRBs**.

The T_{90} -minimum variability plane: a tool to identify long γ -ray bursts from compact object mergers



Kilonova-associated long bursts have a short min variability timescale

