

Precursors from Compact Binary Mergers



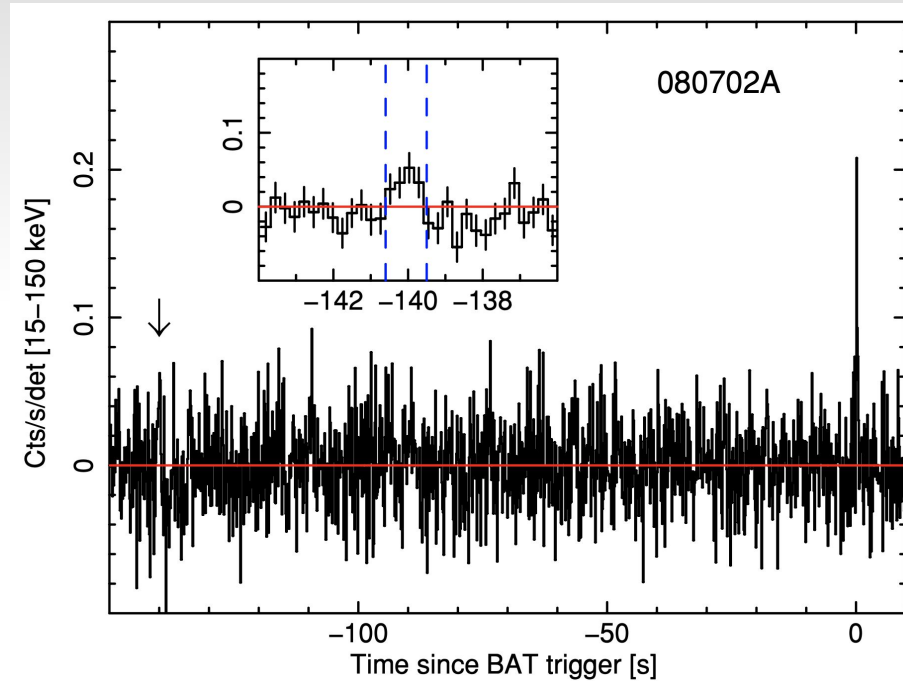
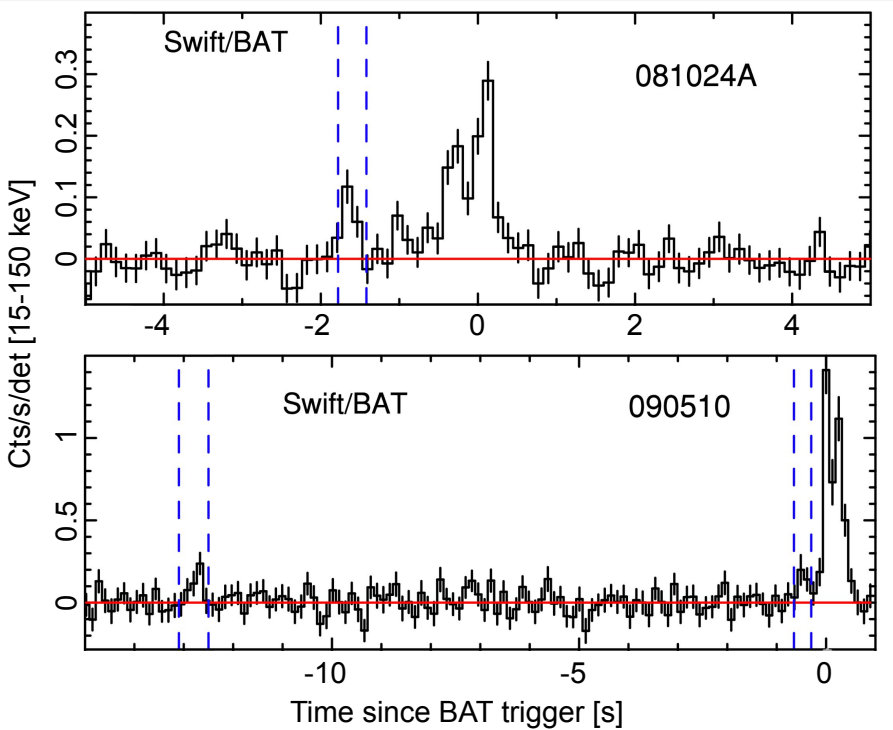
PennState

Simone Dichiara

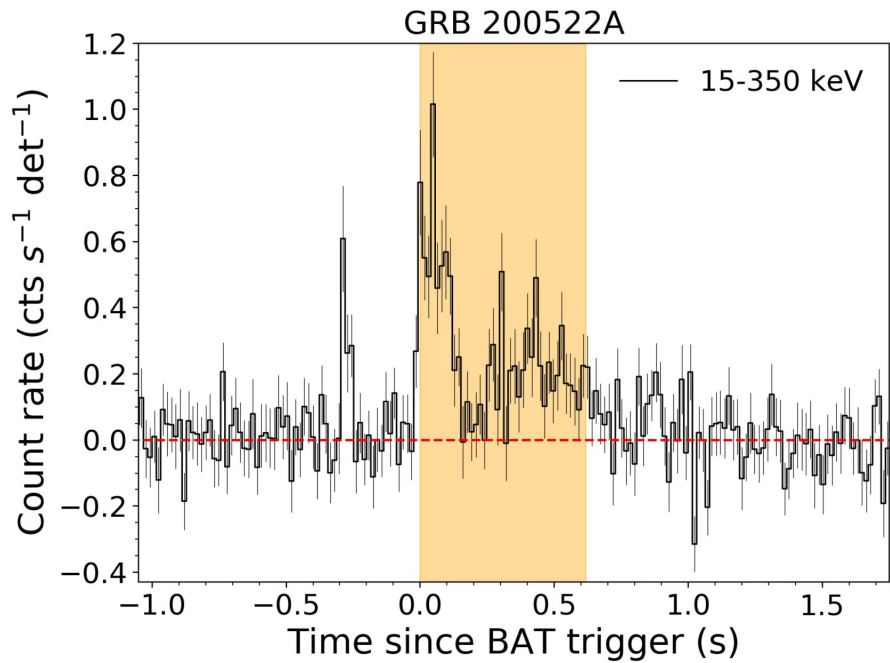
sbd5667@psu.edu



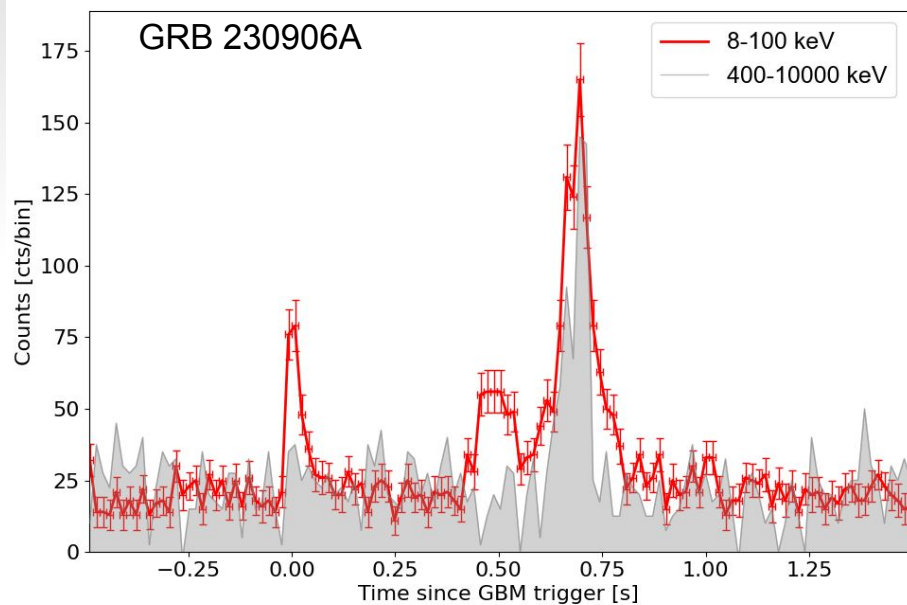
Precursors signals in binary neutron star mergers



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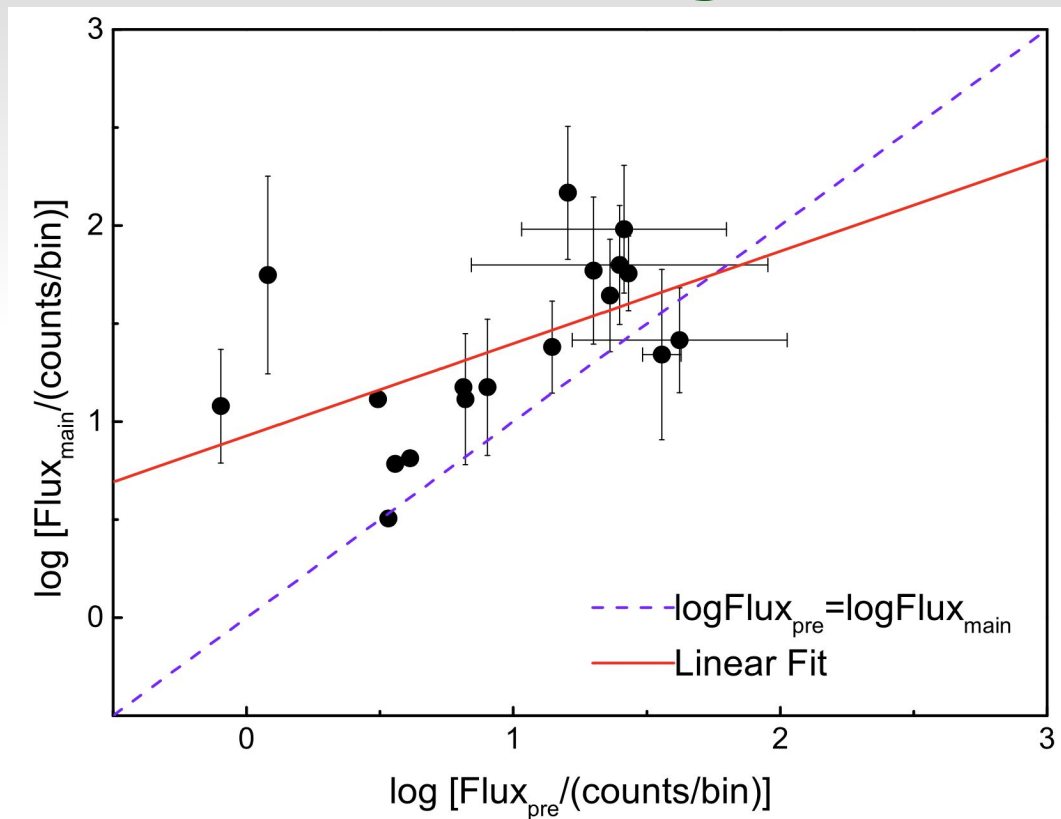


O'Connor+2021



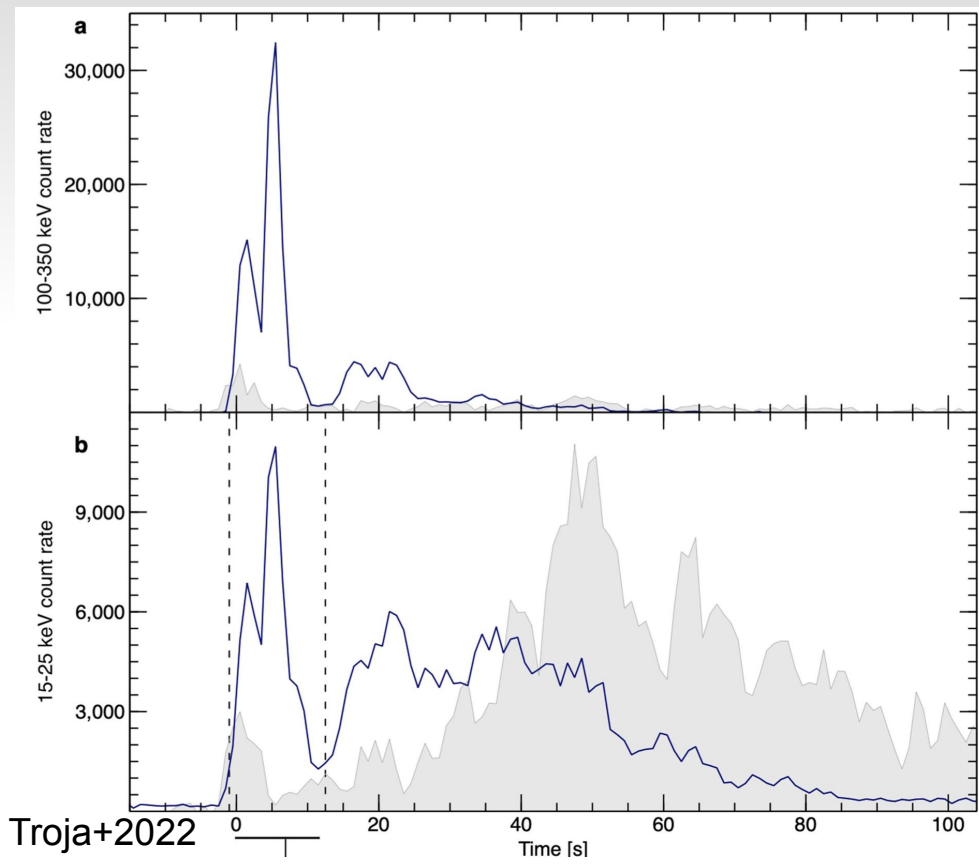
Dichiara+2024 in prep

Precursors signals in binary neutron star mergers

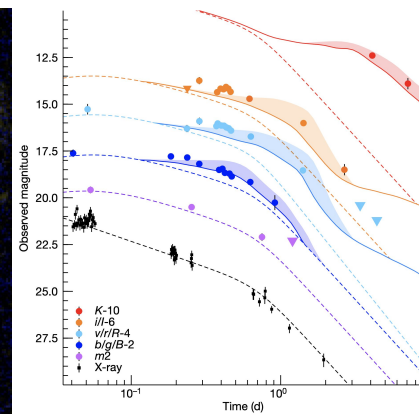
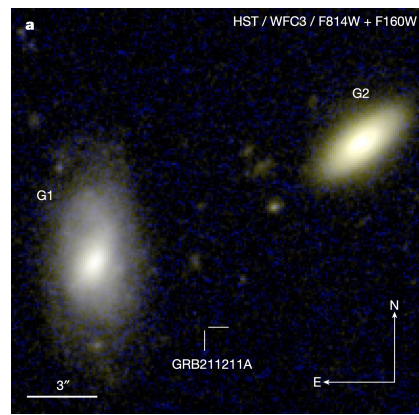


Long GRBs related to binary mergers

GRB 211211A

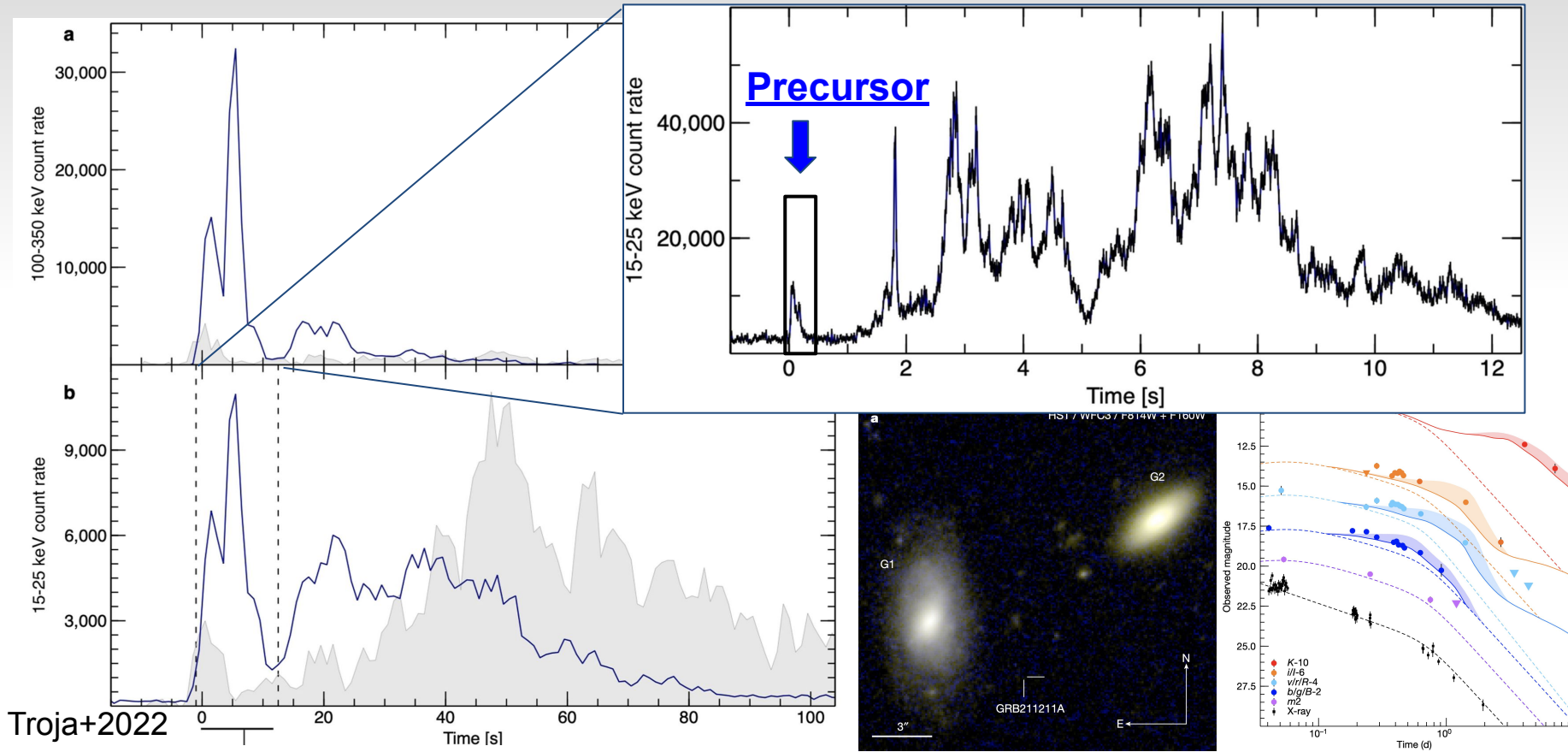


Kilonova

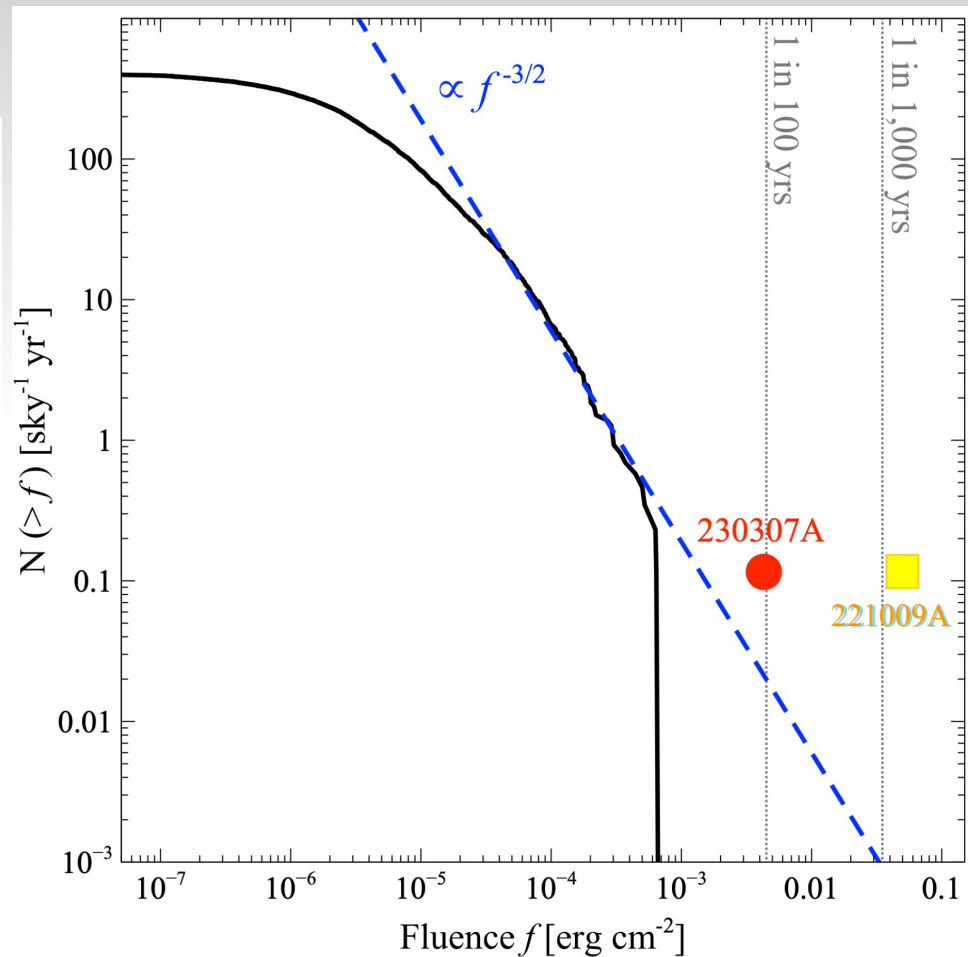
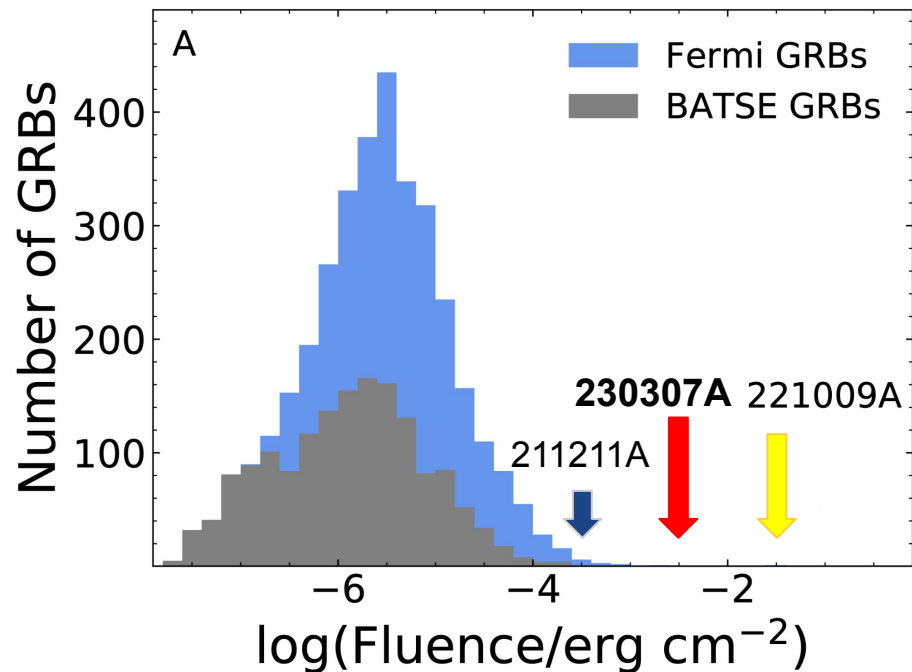


Long GRBs related to binary mergers

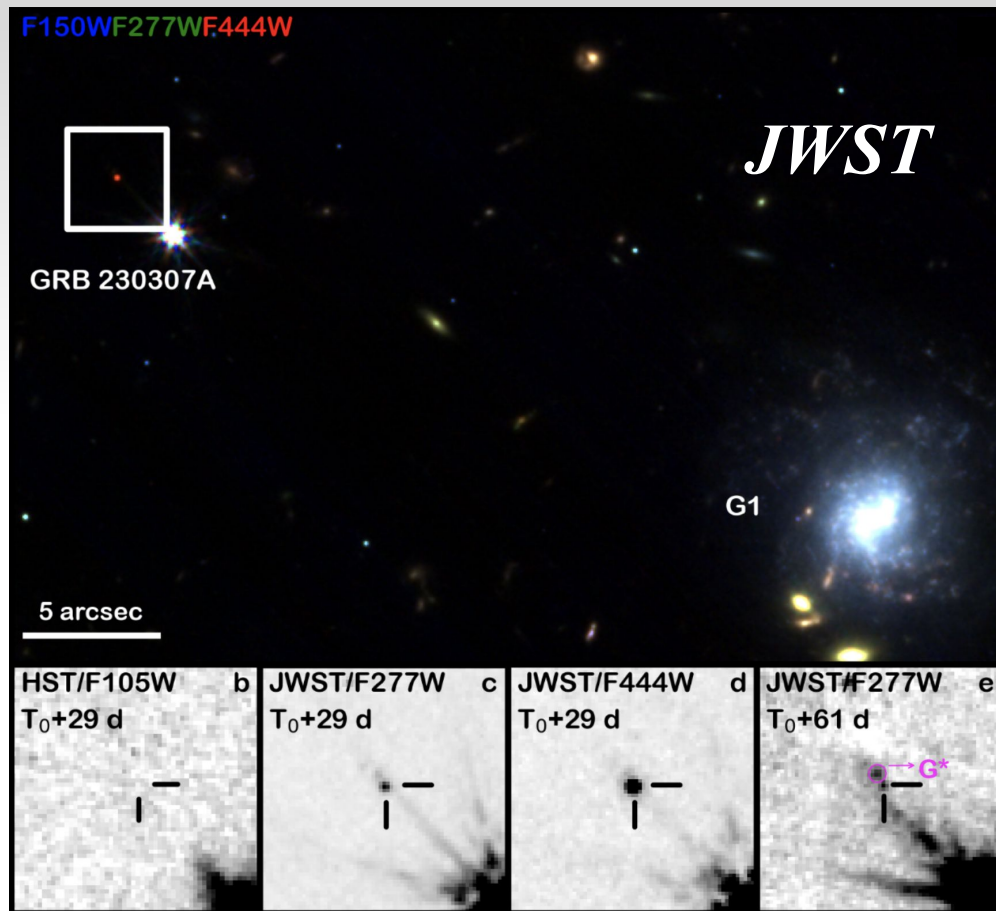
GRB 211211A



The bright GRB 230307A

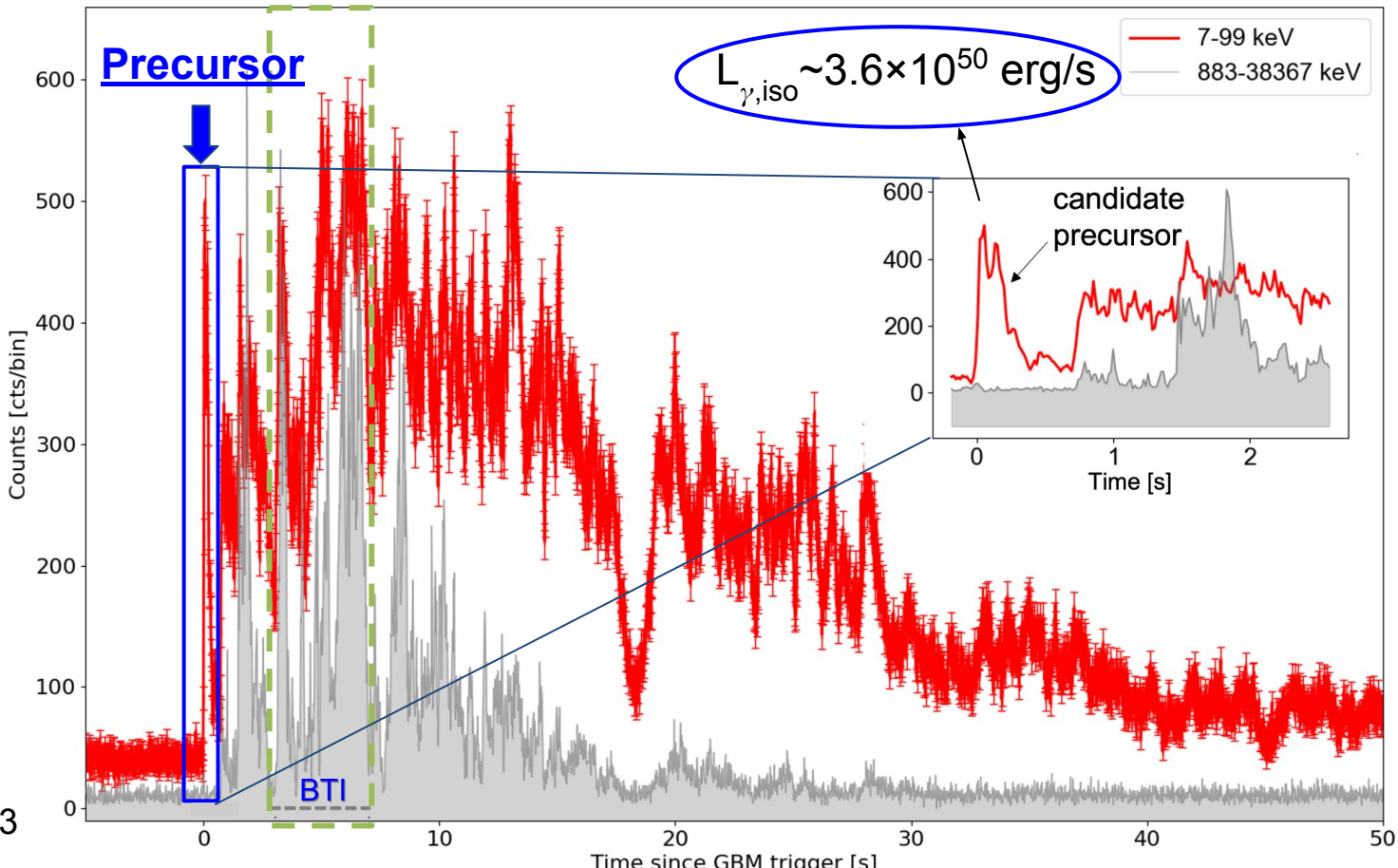


EM counterpart from BNS mergers

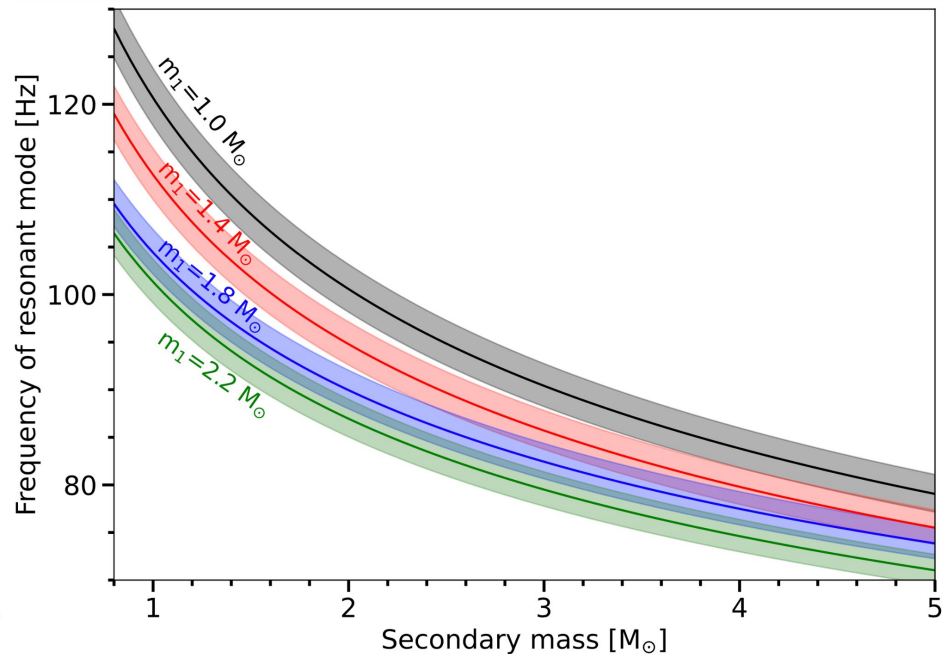
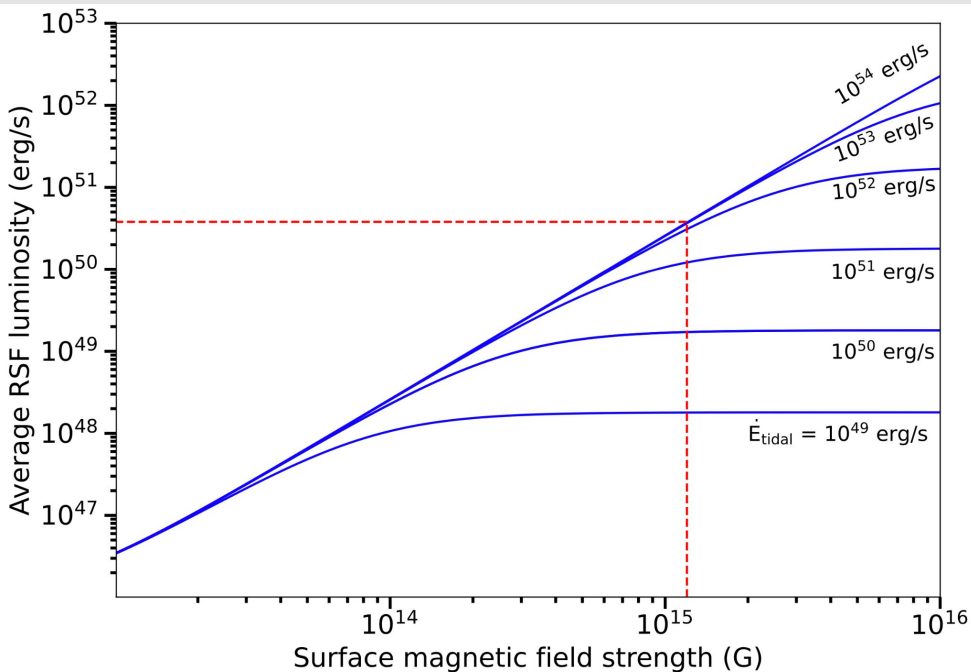


GRB 230307A

Another long GRB with **kilonova** (see Levan+2023, Yang+2023)

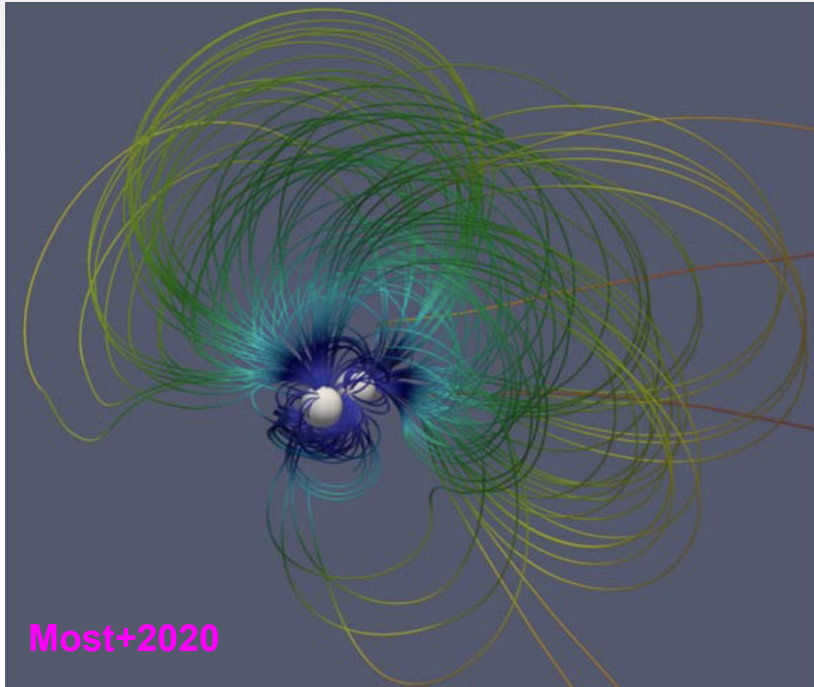


Possible interpretations: Resonant Shattering Flare

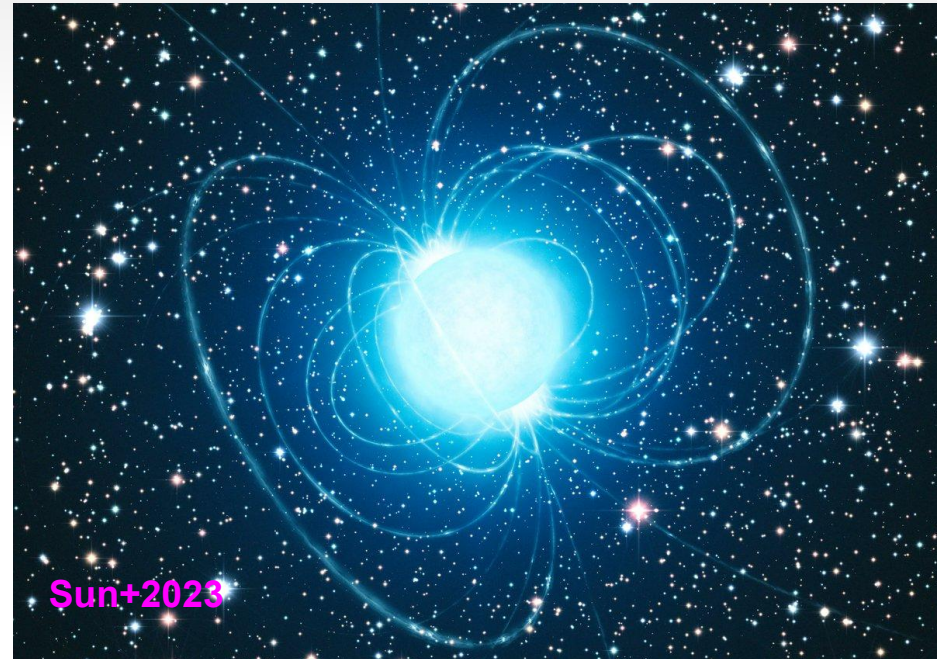


Possible interpretations: Other scenarios

- **Pre-merger:** Strongly magnetized binary NS system connected by a magnetic flux tube



- **Post-merger:** rapidly spinning, highly magnetized NS remnant



Summary

- Short signals preceding the main emission were found in the light curves of short GRBs and long GRBs associated with kilonovae (GRB 211211A and GRB 230307A)
 - The combination of soft spectrum and short variability deviates from the general trend of prompt GRB emission → **precursor signal powered by a different mechanism**
 - Possible explanations:
 - **Pre-merger** models (as the one invoking a **Resonant Shattering Flare**) require the merging NS to retain a **high magnetic field** ($\gtrsim 10^{15}$ G) within its core.
 - **Post-merger** models invoke a **rapidly spinning, highly magnetized NS**, where the rotational energy is extracted by some MHD processes and then released into a high-entropy fireball
 - **what is the origin of precursor?**
an enigma for multi-messenger astronomy!!!! ←
- Simultaneous detection of gravitational waves would dispel any doubt about the nature of the signals and it could be used to **constrain the properties the tidal resonant shattering**, the **magnetic field** and the **equation of state of dense matter**

Thank you!

<https://arxiv.org/abs/2307.02996>

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