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Detection of the third class of gamma-ray bursts: magnetar giant flares.

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Around 11.4 million years ago a young, highly magnetized neutron star, a magnetar, in the Sculptor galaxy released an enormous amount of energy in the form of a giant flare. On April $15^{\rm th}$ 2020 some of the emitted photons were detected by a number of gamma-ray telescopes around Earth and Mars. While the analysis of this event, GRB 200415A, was interesting in its own right, it resulted in broader implications for both magnetar and gamma-ray burst (GRB) science.
The resulting population study of magnetar giant flares (MGFs), led to the unambiguous identification of a distinct population of 4 local (<5 Mpc) short GRBs. While identified solely based on alignment to nearby star-forming galaxies, their rise time and isotropic energy release are independently inconsistent with the larger short GRB population at >99.9% confidence. These properties, the host galaxies, and non-detection in gravitational waves all point to an extragalactic MGF origin. The inferred volumetric rates for events above 4×10^{44}erg of $R = 3.8^{+4.0}_{-3.1}\times10^{5}{\rm Gpc}^{-3}{\rm yr}^{-1}$ place MGFs as the dominant gamma-ray transient detected from extragalactic sources. As previously suggested, these rates imply that some magnetars produce multiple MGFs, providing a source of repeating GRBs. The rates and host galaxies favor common core-collapse supernova as key progenitors of magnetars.

Keywords

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Experimental Results

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