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## New Physics through a Multimessenger Lens: Searching for Axion-like Particles from Transient Astrophysical Events

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Axion-like particles (ALPs) are a well-motivated candidate for constituting a significant fraction of dark matter in the Universe. They are produced in high-energy environments of core-collapse supernovae (CCSNe) or binary neutron star (BNS) mergers via Primakoff process. As they enter the Milky Way's magnetic field, ALPs could undergo conversion into gamma rays, resulting in a characteristic spectrum peaking in the MeV energy range. As CCSNe and BNS mergers are progenitors of gamma-ray bursts (GRBs), studying the gamma-ray spectra of GRBs can be used as a probe of the physical properties of ALPs.

Here, we present the results from ALP searches using the *Fermi* Large Area Telescope (LAT) observations of long-duration GRBs using both the standard and LAT's Low Energy (LLE) technique. Using the LLE technique, we report the *Fermi* sensitivity limits to detect ALPs to distances up to  $\sim 10$  Mpc, which is comparable to the standard LAT analysis results. We also share the preliminary constraints on the ALP-photon coupling using the LAT-detected long-duration GRBs with precursors. Furthermore, we offer an overview and motivation for utilizing the already-in-place multimessenger infrastructure for future ALP searches from BNS mergers and short-duration GRBs. Finally, we introduce new venues for exploring new physics guided by the current and future multimessenger efforts, which will allow us to establish competitive upper limits on the ALP parameter space.

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