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Probing axion-like particles with multimessenger observations of neutron star mergers

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Axion-like particles (ALPs) can be copiously produced in binary neutron star (BNS) mergers through nucleon-nucleon bremsstrahlung if the ALP-nucleon couplings g_{aN} are sizable. Furthermore, the ALP-photon coupling $g_{a\gamma}$ may trigger conversions of ultralight ALPs into photons in the magnetic fields of the merger remnant and of the Milky Way. This effect would lead to a potentially observable short gamma-ray signal, in coincidence with the gravitational-wave signal produced during the merging process.
This event could be detected through multi-messenger observation of BNS mergers employing the synergy between gravitational-wave detectors and gamma-ray telescopes.

In this work, we study the sensitivity of current and proposed MeV gamma-ray experiments to detect such a signal. We find that the proposed instruments can reach a sensitivity down to $g_{a\gamma}$
$gtrsim$few $\times\ 10^{-13}$ GeV^{-1} for m_a
$lesssim 10^{-9}$~eV, comparable with the SN 1987A limit.

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