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Axion Gamma-Ray Signatures from Quark Matter in Neutron Stars and Gravitational Wave Compar- isons

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We present a theoretical model for detecting axions from neutrons stars in a QCD phase of quark matter. The axions would be produced from a quark-antiquark pair $u\bar{u}$ or $d\bar{d}$, in loop(s) involving gluons. The chiral anomaly of QCD and the spontaneously broken symmetry are invoked to explain the non-conservation of the axion current. From the coupling form factors, the axion emissivities ϵ_a can be derived, from which fluxes can be determined. We predict a photon flux which may be detectable by Fermi LAT, and limits on the QCD mass m_a. In this model, axions decay to gamma rays in a 2-photon vertex. We may determine the expected fluxes from the theoretical emissivity. The sensitivity curve from the Fermi Large Area Telescope (Fermi LAT) would allow axion mass constraints for neutron stars as low as $m_a \leq 10^{-14}$ eV $95\%C.L.$. Axions could thus be detectable in gamma rays for neutron stars as distant as 100 kpc. A signal from LIGO GWS 170817 could be placed from the NS-NS merger, which gives an upper limit of $m_a \leq 10^{-10}$ eV.

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