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Chiral gravitational wave background from axion-like fields

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Axions and axion-like particles can be probed through gravitational waves indirectly, often referred to as "audible axions" . The usual concept of audible axion relies on the coupling between the axions and the gauge fields. Here we consider an axion-like mechanism with coupling to the Nieh–Yan term. This interaction leads to the direct and efficient production of gravitational waves during the radiation-dominated era, originating from the tachyonic instability of the gravitational perturbations with the Nieh–Yan term. We calculate the energy spectral density of the chiral gravitational wave background and the comoving energy density of axion-like fields. Based on the numerical results, we explore the parameter space of axion masses and decay constants for detectable gravitational wave signals, either in pulsar timing arrays or space-based gravitational wave detections. [2411.08691 & 2503.20778]

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