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Observing Invisible Axions with Gravitational Waves

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Axions are among the best motivated candidates for new physics. If the Peccei-Quinn symmetry associated with an axion has been ever restored after inflation, topological defects of the axion field (in particular strings) form and produce an irreducible contribution to the stochastic gravitational wave background during the evolution of the Universe. After reviewing recent progress in the understanding of the dynamics of such objects, I will discuss the resulting gravitational wave spectrum by combining effective field theory analysis with the numerical evolution of the field theory equations. I will show that a single ultralight axion-like particle with a decay constant larger than 10^{14} GeV and any mass between 10^{-18} and 10^{-28} eV leads to an observable gravitational wave spectrum, and is compatible with constraints from dark matter overproduction, isocurvature and dark radiation. Crucially, the spectrum extends over a wide range of frequencies and the resulting signal could be detected by multiple experiments. I will also comment on the recent possible NANOgrav signal in light of these results.

Speaker

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