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Radiation from Global Topological Strings using Adaptive Mesh Refinement

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The groundbreaking detection of gravitational waves by LIGO has opened up a brand new window into observational cosmology, catalysing research into gravitational wave signatures from a wide range of astrophysical and cosmological sources. In this work, we calculate accurate radiative signatures from topological 'cosmic' strings, implementing adaptive mesh refinement (AMR) simulations of global strings using the numerical relativity code, GRChombo. We investigate the resulting massless (Goldstone boson or axion) radiation and massive (Higgs) radiation signals, using quantitative diagnostic tools and geometries to determine the eigenmode decomposition of these radiation components. Given analytic radiation predictions, we compare the oscillating string trajectory with a backreaction model accounting for radiation energy losses, finding excellent agreement: we establish that backreaction decay is accurately characterised by the inverse square of the amplitude being proportional to the inverse tension μ for 3⊠λ⊠100. We conclude that analytic radiation modelling in the thin-string (Nambu-Goto) limit provides the appropriate cosmological limit for global strings. We also make a preliminary study of massive radiation modes, including the large λ regime in which they become strongly suppressed relative to the preferred massless channel. We comment on the implications of this study for predictions of axions and gravitational waves produced by cosmic string networks.

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