

# Whispers from the Dark Universe - Particles & Fields in the Gravitational Wave Era

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## WHISPERS FROM THE DARK UNIVERSE - PARTICLES & FIELDS IN THE GRAVITATIONAL WAVE ERA

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24 - 27 September 2024 DESY Hamburg, Germany



Contribution ID: 116

Type: **not specified**

## Gravitational waves from domain wall collapse, and application to nanohertz signals with QCD-coupled axions

*Wednesday 25 September 2024 17:02 (16 minutes)*

We study for the first time the gravitational waves generated during the collapse of domain walls, incorporating the potential bias in the lattice simulations. The final stages of domain wall collapse are crucial for the production of gravitational waves but have remained unexplored due to computational difficulties. As a significant application of this new result, we show that the observed NANOGrav, EPTA, PPTA, and CPTA data, which indicate stochastic gravitational waves in the nanohertz regime, can be attributed to axion domain walls coupled to QCD. In our model, non-perturbative effects of QCD induce a temperature-dependent bias around the QCD crossover, inducing the rapid collapse of the domain walls. We use sophisticated lattice simulations that account for the temperature-dependent bias to measure the gravitational waves resulting from the domain wall annihilation. We also discuss the future prospects for accelerator-based searches for the axion and the potential for the formation and detection of primordial black holes.

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**Session Classification:** Parallel Wednesday Cosmo 1

**Track Classification:** Cosmology & Astroparticle Physics