Contribution ID: **42** Type: **not specified**

Nano-Hertz gravitational waves and sub-GeV dark matter from a classically conformal phase transition

Wednesday, September 24, 2025 4:45 PM (15 minutes)

Strong first-order phase transitions offer a compelling explanation for the stochastic gravitational wave background in the nano-Hertz range measured by pulsar timing arrays (PTA). In this talk, I will consider a dark Higgs mechanism in a classically conformal dark sector where the symmetry breaking of a dark $U(1)'$ gives rise to a gravitational wave background that can fit the PTA data. The vacuum expectation value of the dark Higgs field is found to lie in the MeV-GeV range and sources the mass of a stable fermionic sub-GeV dark matter candidate. The dark sector is coupled to the Standard Model via kinetic mixing of the $U(1)'$ gauge boson with hypercharge, which is tightly constrained by laboratory searches. I will discuss these accelerator constraints as well as cosmological constraints on the decay of the dark Higgs boson after the phase transition. Finally I will present the results of a global fit and show that the model has viable parameter space where it fits the PTA data, reproduces the observed relic abundance and satisfies all relevant constraints.

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Session Classification: Parallel 5

Track Classification: Parallel