

Gauge-Independent Gravitational Waves from Supercooled Phase Transitions in a Minimal Dark U(1) Sector

Friday, 17 April 2026 19:30 (25 minutes)

First-order phase transitions in hidden gauge sectors can generate stochastic gravitational wave backgrounds and provide a powerful new probe of dark sector physics. In this talk, I will present a gauge-independent analysis of gravitational waves from a minimal dark U(1) sector containing a dark Higgs and a dark photon, with the option of an additional vectorlike dark fermion as a viable dark matter candidate. By combining the Nielsen identity with a controlled derivative expansion and power-counting framework, one can construct a gauge-independent effective action in both the high-temperature and supercooled low-temperature regimes, thereby obtaining robust predictions for bubble nucleation and the resulting gravitational wave signals. I will discuss how the microscopic model parameters map onto detector-facing observables ranges relevant to pulsar timing arrays and future space-based interferometers. The results show that supercooled phase transitions generally lead to stronger and more readily detectable signals than parametrically high-temperature transitions, while also highlighting the complementarity between gravitational wave observations and dark matter phenomenology in this minimal dark-sector setup. Our results provide the most reliable and concrete predictions to date for a minimal gauged dark sector.

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