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From the tabletop to the Big Bang: Quantum simulators of false vacuum decay

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False vacuum decay (FVD) plays a vital role in many models of the early Universe, with important implications for inflation, the electroweak vacuum, and gravitational waves. However, it is also a highly non-perturbative and non-equilibrium process which is challenging to model theoretically, with existing Euclidean methods relying on numerous assumptions that have yet to be empirically tested.

An exciting route forward is to use laboratory experiments which undergo transitions analogous to FVD, allowing nature to simulate all of the relevant physics for us. In this talk, I will discuss ongoing work to develop such analogue FVD experiments within the Quantum Simulators for Fundamental Physics (QSimFP) program. In particular, I will present numerical lattice simulations of ultracold atom systems undergoing FVD, and discuss outstanding challenges in using upcoming experimental data to understand the early Universe.

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