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Simulating the Femto-universe on a Quantum Computer

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We compute the low-lying spectrum of 4D $SU(2)$ Yang-Mills in a finite volume using quantum simulations. In contrast to small-volume lattice truncations of the Hilbert space, we employ toroidal dimensional reduction to the “femtouniverse” matrix quantum mechanics model. In this limit the theory is equivalent to the quantum mechanics of three interacting particles moving inside a 3-ball with certain boundary conditions. We use the variational quantum eigensolver and quantum subspace expansion techniques to compute the string tension to glueball mass ratio near the small/large-volume transition point, finding qualitatively good agreement with large volume Euclidean lattice simulations.

Topical area

Quantum Computing and Quantum Information

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