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Dynamics of an Electric Flux String Across the Roughening Region in a (2+1)D Lattice Gauge Theory

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The realm of particle physics is full of astonishing phenomena and open problems. One is confinement, typical of QCD in (3+1)D with SU(3) gauge group. Lattice Gauge Theory (LGT) enables us to study it numerically with Tensor Networks. We focus on the pure Z_2 LGT in (2+1)D, dual to the quantum Ising model, which preserves criticality while reducing degrees of freedom. Our numerical investigations delve into confinement and the dynamical characterization of electric flux strings. We have confirmed critical values in the vacuum sector through finite-size scaling of entropy and analysis of a t'Hooft electric string using Matrix Product States (MPS). The introduction of two static charges generates an electric fluxtube, that is, the static potential. As we vary g in the confined phase, we observe Lüscher corrections to the potential in the rough region, where the string becomes less rigid and its width increases.
A novel aspect of this work is the dynamical study of Pure Gauge Z_2 theory, enabled by MPS versatility in time evolution. In the confined phase, both entropy of the system and string width increase slowly. In the roughening region, we see variable growth rates in string width as a function of g, while entropy growth remains consistent and independent of coupling and string length. Our results align with the linear entropy growth predicted for bosonic string model. These insights significantly enhance our understanding of rough phase dynamics and lay a strong groundwork for exploring other sectors of the theory and various lattice gauge theories.

Secondary track

T05 - QCD and Hadronic Physics

Authors: DI MARCANTONIO, Francesco (EHU/UPV); Dr PRADHAN, Sunny (EHU/UPV); Dr VALLECORSA, Sofia (CERN); Dr BAÑULS, Mari Carmen (MPQ); Dr RICO ORTEGA, Enrique (CERN)

Presenter: DI MARCANTONIO, Francesco (EHU/UPV)

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