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A quantum computing study of the static potential in (2+1)D QED

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Current noisy quantum computers can be already used to investigate properties
of quantum systems. Here we focus on lattice QED in (2+1)D including fermionic matter.
This complex quantum field theory with dynamical gauge and matter fields has similarities
with QCD, in particular asymptotic freedom and confinement.
We define a suitable setup to measure the static potential between two static charges as a function of their distance and
use a quantum computation to explore the Coulomb, the confinement and the string breaking regimes.
A symmetry-preserving variational quantum circuit is employed for the creation of the ground state
of the theory at various coupling constant values corresponding to different
physical distances. We confirm that classical simulations for the static potential agree with
quantum simulations of the system and also with results from quantum experiments on a trapped-ion device.
Moreover, we visualize the relevant flux configurations that contribute to the quantum ground state
in the different distance regimes of the potential giving thus insight into the mechanisms
of confinement and string breaking.

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