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Schwinger Model at Finite Temperature and Density with Beta VQ

We investigate a quantum gauge theory at finite temperature and density using a variational algorithm for near-term quantum devices. We adapt β -VQE to evaluate thermal and quantum expectation values and study the phase diagram for massless Schwinger model along with the temperature and density.

By comparing the exact variational free energy, we find the variational algorithm work for $T > 0$ and $\beta > 0$ for the Schwinger model. No significant volume dependence of the variational free energy is observed in $\beta/g \in [0, 1.4]$. We calculate the chiral condensate and take the continuum extrapolation. As a result, we obtain qualitative picture of the phase diagram for massless Schwinger model.

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