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Simulation of complexified U(1) lattice gauge theory

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We present an update on our previous studies [1] of pure U(1) lattice gauge theory with a sign problem due to a complex coupling \beta. To that end a novel simulation method is employed:
Configuration space is rewritten as a union of linear submanifolds in complexified space. These submanifolds are the tangent spaces of the Lefschetz thimble decomposition. Therefore the sign problem is drastically reduced.
Tangent spaces are infinite spaces, so we specify boundaries for them, such that homotopy to real field space is in the end ensured.
The Monte Carlo simulation is set up on the tangent space corresponding to the global minimum of the action. The other spaces are taken into account by linear mappings to them, so we can monitor their respective contributions one by one. The relative weights are computed via reweighting.
We discuss simulation results including the scaling of the sign problem with the number of tangent spaces. In particular, promising results are obtained for the beta_I / beta_R > 1 region which is relevant in the context of quantum real-time simulations.
[1] J. M. Pawlowski, M. Scherzer, C. Schmidt, F. P. G. Ziegler, F. Ziesché, „Simulating gauge theories on Lefschetz thimbles“, , 37th International Symposium on Lattice Field Theory, arXiv:2001.09767 [hep-lat]

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