Theta-Quench Schwinger Lab: Short Report

Hypothesis:

Stronger theta quenches increase transition signatures and stabilizer magic;
higher-magic snapshots should be harder for NNQS training.

Model:

1+1D lattice Schwinger model (open boundaries), staggered fermions,
Gauss-law-eliminated spin Hamiltonian H = H_pm + H_ZZ + H_Z + const.

Numerics:

Small-N exact diagonalization + real-time evolution (dense/Krylov),
Pauli-batched stabilizer Renyi magic (M2), autoregressive NNQS fitting.

Artifacts:

validation: outputs/validation.json

quench summary: outputs/quench_summary.csv

nnqs metrics: outputs/nnqs/nnqs_snapshot_metrics.csv

Validation checks:

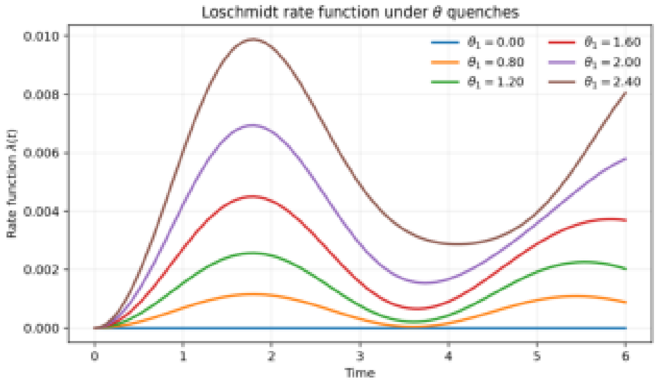
Hermitian H0/H1: True / True

Norm drift: 3.109e-15

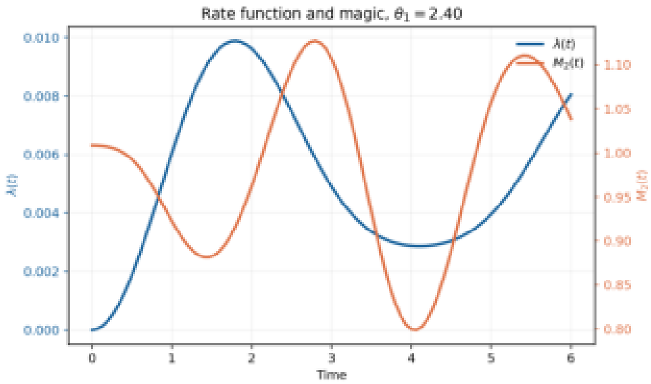
Dense-vs-Krylov diff: 9.667e-15

Magic sanity |T>^n: 1.4384103622589088

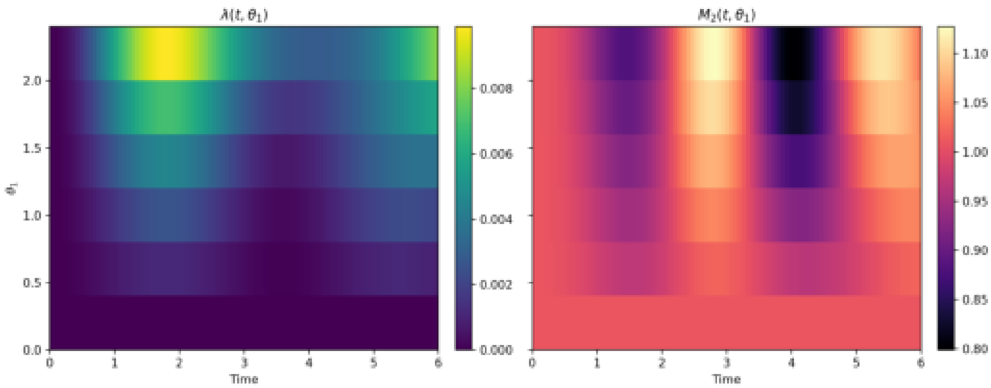
Key Results I: Dynamics + Magic



Loschmidt rate family across quench endpoints.

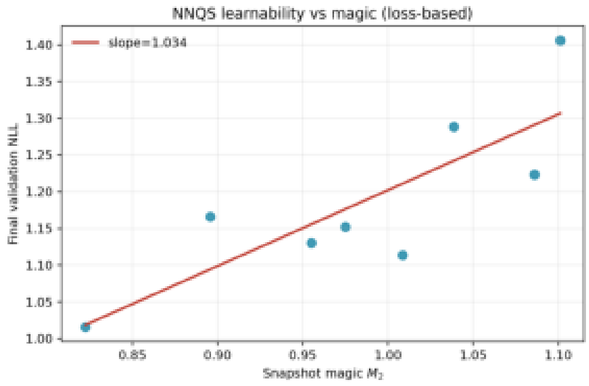


Overlay of transition diagnostic and stabilizer magic M2(t).

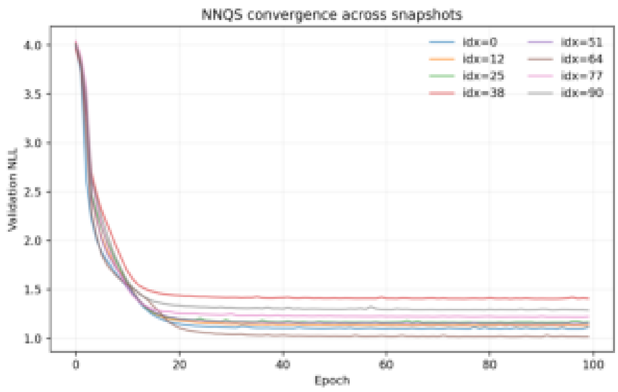


Heatmap view over (time, theta1).

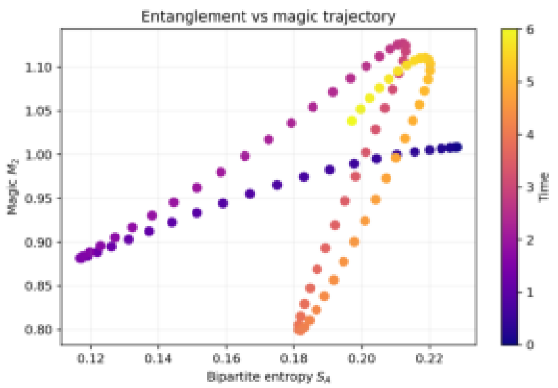
Key Results II: Learnability



NNQS final validation loss vs snapshot magic.



NNQS optimization trajectories over training epochs.



Entanglement vs magic trajectory (complementary diagnostic).

Roadmap

1) Increase system size via symmetry sectors and sparse block structure.

2) Add sampled/approximate magic estimators for $N > 12$.

3) Extend NNQS architectures (Transformer/MADE) and measurement bases.

4) Build Trotterized circuit path for hardware-facing experiments.

Caveat:

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  Current claims are small-N exact results; trend-level, not thermodynamic-limi
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