

README file

Dataset Title: “**QUANTHEM. Data from numerical simulation of the averaged entanglement entropy in monitored free fermion dynamics with U(1) symmetry. Version 1**”

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Dataset Content

The dataset contains data generated in the framework of Horizon Europe ERC QUANTHEM project. The data were obtained from numerical simulation of the averaged

entanglement entropy in monitored free fermion dynamics with $U(1)$ symmetry, when the system is initialized in a Néel state. The data are presented in:

M. Fava, L. Piroli, D. Bernard, and A. Nahum, Monitored fermions with conserved $U(1)$ charge, Phys. Rev. Res. 6, 043246 (2024); DOI: 10.1103/PhysRevResearch.6.043246

Dataset Documentation

The dataset consists of a .zip archive, named **QUANTHEM_EntDynamics.zip**, containing 24 tabular quantitative data files saved in .txt format and a README file saved in .pdf format (**README_QUANTHEM.pdf**).

The 4 data files named:

QUANTHEM_averageS1_plateau_time_cutoff=X_timeStep=Y_jValue=1_gammaValue=Z.txt

(with $X=50, 90, \text{ or } 130$; $Y=0.01, 0.02, \text{ or } 0.005$; $Z=0.25, 0.5, 1, 2$)

correspond to the von Neumann entanglement entropy averaged over the time interval $[t_{\text{plateau}}, t_{\text{max}}]$. Here, t_{plateau} is the time at which the averaged entanglement entropy becomes approximately constant, while t_{max} is the maximum simulation time. The files contain three columns: system size, value of the averaged von Neumann entropy, and statistical errors. The name of the files specifies the values of the parameters chosen for the simulation:

- plateau_time_cutoff is t_{plateau}
- timeStep is the value of the discrete step taken to approximate the continuous time evolution
- jValue is the value of the hopping strength
- gammaValue is the value of the monitoring rate

The 20 data files named:

QUANTHEM_averageS1_vs_t_numModes=X_timeStep=Y_jValue=1_gammaValue=Z.txt

(with $X=8, 16, 32, \text{ or } 64$; $Y=0.01, 0.02, \text{ or } 0.005$; $Z=0.25, 0.5, 1, 2$)

correspond to the averaged von Neumann entanglement entropy as a function of time. The files contain three columns: time, value of the averaged von Neumann entropy, and statistical errors. The name of the files specifies the values of the parameters chosen for the simulation:

- numModes is the number of fermionic modes, namely half the system size
- timeStep is the value of the discrete step taken to approximate the continuous time evolution
- jValue is the value of the hopping strength
- gammaValue is the value of the monitoring rate

Methodology

The data were obtained by solving numerically a stochastic Schrodinger equation associated with the time evolution of a one-dimensional system of monitored fermions with $U(1)$ symmetry (initialized in the Néel state). For each of the values of the dynamical parameters, we have simulated many (at least 80) quantum trajectories of the stochastic Schrodinger equation, each corresponding to a history of random measurement outcomes. The data correspond to the values of the entanglement entropy averaged over many quantum trajectories.

Notes

The data are explained in the publication:

M. Fava, L. Piroli, D. Bernard, and A. Nahum, Monitored fermions with conserved $U(1)$ charge, Phys. Rev. Res. 6, 043246 (2024); DOI: 10.1103/PhysRevResearch.6.043246