

README file

Dataset Title: “**QUANTHEM. Data from numerical simulation of integrable quantum circuits. 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 an integrable quantum circuit (the so-called XXZ integrable quantum circuit) and from numerical evaluation of analytic formulas describing the behavior of such quantum circuit at large space-time scales, in the framework of the "generalized hydrodynamics" (GHD) theory.

The data are presented in:

F. Hübner, E. Vernier, and L. Piroli, Generalized hydrodynamics of integrable quantum circuits, SciPost Physics 18, 135 (2025); DOI: 10.21468/SciPostPhys.18.4.135

Dataset Documentation

The dataset consists of a .zip archive, named **QUANTHEM_QCircDynamics.zip**, containing 17 tabular quantitative data files saved in .txt format and a README file saved in .pdf format (**README_QUANTHEM.pdf**).

All data pertain to the dynamics of the so-called XXZ quantum circuit. This is a one-dimensional local ("brickwork") quantum circuit, which is fully parametrized by two variables: the Trotter step ("tau"), and the anisotropy parameter ("Delta"). Alternatively, one can switch to a "transfer-matrix parametrization", where the two parameters fully specifying the circuit are typically denoted by "x" and "gamma".

The 2 data files named:

QUANTHEM_gaussian_profiles_neel_X_tau=1.57_Delta=4.txt

(with X=dimer, antineel)

correspond to the simulated late-time evolution of the XXZ quantum circuit at the "gaussian points". Here, the system is initialized in a bipartite state, where the left half is initialized in the so-called Néel state, while the right half is either in the dimer or anti- Néel state. The files contain three columns: the values of the space rescaled by the time t (where t is taken to be $t=256$ while the full system size is $L=4096$, both in natural units), the values of the local magnetization, and the values of the local current. The name of the files specifies the values of the parameters chosen for the simulation.

The 2 data files named:

QUANTHEM_GHD_profiles_neel_X_tau=1.57_Delta=4.txt

(with X=dimer, antineel)

correspond to the theoretical GHD predictions for the late-time dynamics of the XXZ quantum circuit at the "gaussian points". Here, the system is initialized in a bipartite state, where the left half is in the so-called Néel state, while the right half is either in the dimer or anti-Néel state. The files contain three columns: the values of the rescaled space, the

values of the local magnetization, and the values of the local current. The name of the files specifies the values of the parameters chosen for the simulation.

The 1 data file named:

QUANTHEM_GHD_profiles_neel_dimer_tau=1.2_gamma=1.05.txt

corresponds to the theoretical GHD predictions for the late-time dynamics of the XXZ quantum circuit. Here, the system is initialized in a bipartite state, where the left half is in the so-called Néel state, while the right half is in the dimer state. The files contain three columns: the values of the rescaled space, the values of the local magnetization, and the values of the local current. The name of the files specifies the values of the parameters chosen for the simulation

The 12 data file named:

QUANTHEM_GHD_profile_X_neel_antineel_tau=Y_gamma=1.05.txt

(with X=averaged_magnetization, staggered_magnetization, current; Y=0.4,0.8, 1.2, 1.6) correspond to the theoretical GHD predictions for the late-time dynamics of the XXZ quantum circuit. Here, the system is initialized in a bipartite state, where the left half is in the so-called Néel state, while the right half is in the dimer state. The files contain two columns: the values of the rescaled space, and the value of the local observable X. The name of the files specifies the values of the parameters chosen for the simulation.

Methodology

All the data were obtained by numerical computations.

The data contained in the 2 data files named:

QUANTHEM_gaussian_profiles_neel_X_tau=1.57_Delta=4.txt

(with X=dimer, antineel)

were obtained by simulating the dynamics of the integrable XXZ circuit at the "gaussian points". This can be done efficiently using the formalism of fermionic gaussian states, which has been used to generate the data. The simulations were performed by choosing a time $t=256$ and a system size of $L=4096$ (both in natural units).

All other data were obtained by numerical solution of the generalized-hydrodynamic (GHD) equations, describing the large-scale space-time dynamics of the XXZ quantum circuit. The data were obtained by using the method explained in the publication:

F. Hübner, E. Vernier, and L. Piroli, Generalized hydrodynamics of integrable quantum circuits, SciPost Physics 18, 135 (2025); DOI: 10.21468/SciPostPhys.18.4.135

Notes

The data are further explained and presented in the publication:

F. Hübner, E. Vernier, and L. Piroli, Generalized hydrodynamics of integrable quantum circuits, SciPost Physics 18, 135 (2025); DOI: 10.21468/SciPostPhys.18.4.135