TMQS Summer School – Miniproject 3

Quantum Contact Processes

In this miniproject, you will consider a fascinating area of research that explores non-equilibrium phenomena in the quantum realm: Quantum contact processes (QCP). Borrowing inspiration from classical contact processes which model how particles on a lattice can become "infected" or "activated" by their neighbors, QCPs translate this concept to the quantum world. Here, the "particles" are qubits, which can be in a superposition of active and inactive states simultaneously. The project is divided in two parts:

Part 1: Tensor-Based Representation of Quantum States and Operations

In the first part, you will model the Lindblad equation, which describes the time evolution of quantum states. To do this, you will need to familiarize yourselves with the density matrix formalism and the transformation of MPOs into MPSs. The implementation will be done using Scikit-TT.

Part 2: Simulation and Analysis of the QFT

In the second part, you will choose an appropriate time integration method and simulate the open dynamics of the quantum contact process, shedding light on the existence and nature of an absorbing state phase transition in one dimension.