

Problem 1. *Install TeNPy*

Install the library `TENPY` to perform MPS studies in Python. You need the Python version 3.5 or newer and the modules NumPy and SciPy. You can find the installation instruction at tenpy.github.io/INSTALL.html.

Problem 2. *DMRG and XXZ model*

Consider the spin 1/2 1D XXZ model:

$$H = - \sum_i^N \left[\sigma_i^+ \sigma_{i+1}^- + \sigma_i^- \sigma_{i+1}^+ + \frac{\Delta}{2} \sigma_i^z \sigma_{i+1}^z \right]. \quad (1)$$

Using the library `TENPY`, implement the model (1) for a chain of $N = 30$ spins and different values of Δ . Study the ground state and the correlation length of this system via DMRG with a maximum bond dimension $\chi = 50$.

This task is performed in the example code `xxz_groundstate.py` provided with the `TENPY` installation. You can have a look at it and at the documentation at tenpy.github.io. You will use the module `SpinChain` from `tenpy.models.spins`, module `MPS` from `tenpy.networks.mps` and `run_DMRG` from `tenpy.algorithms.dmrp`. Make sure to understand the associated documentation and to be able to reproduce the example code.