Dissipation-assisted Matrix Product Factorization

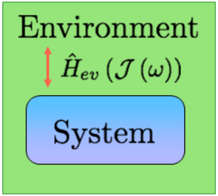
Authors: Alejandro D. Somoza, Oliver Marty, James Lim, Susana F. Huelga and Martin B. Plenio

Speaker: Nicola Lorenzoni

Institut für Theoretische Physik and IQST, Universität Ulm, Ulm 89069, Germany

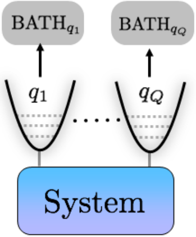
TENSOR NETWORKS + PSEUDOMODES THEORY

Continuous environmental spectrum



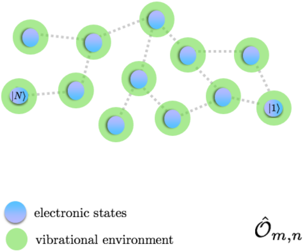
$\equiv$

Discrete environment



$$C(t) = \int_0^\infty d\omega\, \mathcal{J}(\omega) \left(\coth\left(\frac{\beta\omega}{2}\right)\cos(\omega t) - i\sin(\omega t) \right)$$

$$C'(t) = \sum_{q,\pm}^{q=Q} \left[\frac{\omega_q^2 s_q}{2} \left(\coth\left(\frac{\beta_q \omega_q}{2}\right) \pm 1 \right) e^{\mp i\omega_q t - \gamma_q t} \right]$$



electronic states

$$\hat{\rho} = \sum_{m,n=1}^{N} |m\rangle\langle n| \otimes \hat{O}_{m,n}$$

$$\hat{O}_{m,n} = \sum_{j_1,\dots,j_M=1}^{N_b^2} A_{1,j_1}^{(m,n)} A_{2,j_2}^{(m,n)} \dots A_{M,j_M}^{(m,n)} \hat{x}_{j_1} \otimes \dots \otimes \hat{x}_{j_M}$$

TENSOR NETWORKS + PSEUDOMODES THEORY= DAMPF

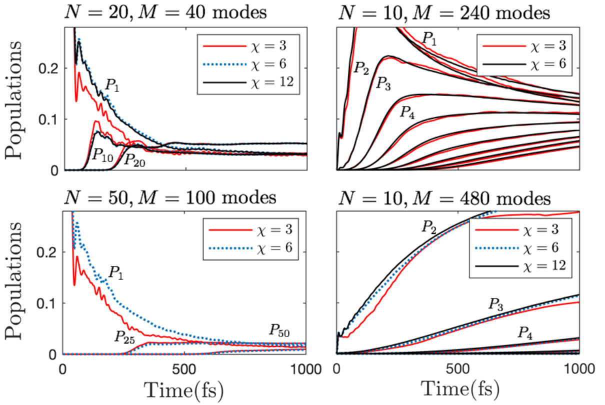
- Numerically exact
- Capable of describing highly structured environments
- Capable of computing environmental quantities
- Highly parallelizable
- Polynomial scaling with system's dimensions
- Memory efficient
- Error control

Model:

$$\hat{H}_S = \hat{H}_e + \hat{H}_v + \hat{H}_{ev}$$

$$\hat{H}_e = \sum_{n=1}^{N} \Omega_n |n\rangle\langle n| + \sum_{m\neq n} J_{m,n} |m\rangle\langle n| \qquad \hat{H}_v = \sum_{n=1}^{N}\sum_{q=1}^{Q} \omega_q \hat{a}^\dagger_{n,q}\hat{a}_{n,q}$$

$$\hat{H}_{ev} = \sum_{n=1}^{N}\sum_{q=1}^{Q} \omega_q \sqrt{s_q} |n\rangle\langle n| \left(\hat{a}_{n,q} + \hat{a}^\dagger_{n,q}\right)$$



[1] Alejandro D. Somoza, Oliver Marty, James Lim, Susana F. Huelga and Martin B. Plenio, Phys. Rev. Lett. 123, 100502, 2019.