Dynamics for a Fermi-Hubbard model coupled to a dissipative photonic mode

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In open interacting many body quantum systems, the competition between various energy scales and the coupling to an external bath lead to rich phase diagrams and interesting phenomena.
In our work, we investigate the many body dynamics of the self ordering phase transition present in atomic systems coupled to quantum light. We consider ultracold interacting fermionic atoms confined in a 1D optical lattice globally coupled to the field of a dissipative cavity mode. It provides a perfect playground to study the steady states and dynamic self-ordering processes of these complex systems. We develop a quasi-exact numerical method based on time dependent MPS methods, as well as an analytic approach going beyond the mean field level by incorporating fluctuations in the coupling between atoms and cavity field.

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