Quantum jumps in driven-dissipative disordered many-body systems

Sparsh Gupta

In collaboration with Hari Kumar Yadalam, Manas Kulkarni and Camille Aron

Phys. Rev. A 109, L050201 (2024)

ICTS INTERNATIONAL CENTRE *for* THEORETICAL SCIENCES

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

Dynamics Days Asia Pacific 13
Yukawa Institute for Theoretical Physics, Kyoto University, Japan
July 1st — 5th, 2024

Setup

- Deformed Lindblad Equation:

$$\frac{d}{dt}\rho(t) = \mathcal{L}_\zeta \rho(t), \tag{1}$$

where the ζ-deformed Liouvillian is

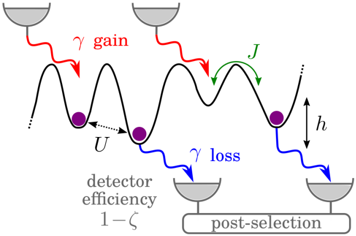
$$\mathcal{L}_\zeta \star = -\mathrm{i}\,[H,\star] + \sum_{\alpha=1}^{M} \left[\zeta O_\alpha \star O_\alpha^\dagger - \frac{1}{2}\left\{ O_\alpha^\dagger O_\alpha, \star \right\} \right] \tag{2}$$

$$H = \sum_{i=1}^{L} h_i n_i - J \sum_{i=1}^{L-1} \left(b_i^\dagger b_{i+1} + \mathrm{H.c.} \right) + U \sum_{i=1}^{L-1} n_i n_{i+1}, \tag{3}$$

$$O_i = \begin{cases} \sqrt{2\gamma}\ b_i^\dagger & \text{if } i \text{ is odd} \\ \sqrt{2\gamma}\ b_i & \text{if } i \text{ is even}\,. \end{cases} \tag{4}$$

- Trace Preserving Evolution equation for density matrix $\rho_\zeta(t)$:

$$\partial_t \rho_\zeta(t) = \Big(\mathcal{L}_\zeta - \mathrm{Tr}\left[\mathcal{L}_\zeta \rho_\zeta(t) \right] \Big) \rho_\zeta(t)\,. \tag{5}$$



Disordered gain-loss model with hardcore bosons.

Results

Initial state $\rho(0) = |1, 0, \cdots, 1, 0\rangle\langle 1, 0, \cdots, 1, 0|$

Complex Spacing Ratios

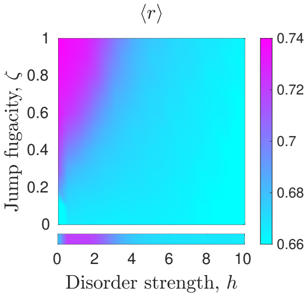
$$\xi_k = \frac{z_k^{NN} - z_k}{z_k^{NNN} - z_k} = r_k e^{i\theta_k},$$

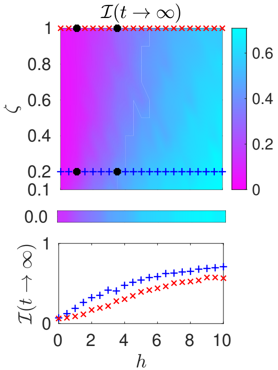
Imbalance

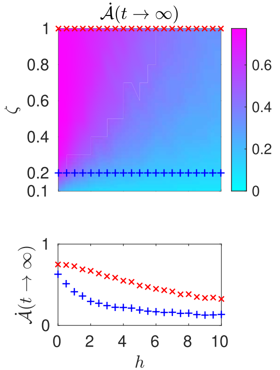
$$\mathcal{I}(t) = \frac{N_O - N_E}{N_O + N_E},$$

Rate of Dynamical Activity

$$\dot{\mathcal{A}}(t) = \frac{1}{\zeta}\partial_t \langle n(t)\rangle_\zeta \qquad (6)$$







Conclusion: Reducing the number of quantum jumps/Postselection can promote the emergence of the localized phase.