Observation of Non-Hermitian Edge Burst Effect in One-Dimensional Photonic Quantum Walk

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Non-Hermitian systems can exhibit unique quantum phases without any Hermitian counterparts. For example, latest theoretical studies predict a new surprising phenomenon that bulk bands can localize and dissipate prominently at the system boundary, which is dubbed the non-Hermitian edge burst effect. Here we realize a one-dimensional non-Hermitian Su-Schrieffer-Heeger lattice with bulk translation symmetry implemented with a photonic quantum walk. Employing time-resolved single-photon detection to characterize the chiral motion and boundary localization of bulk bands, we determine experimentally that the dynamics underlying the non-Hermitian edge burst effect is due to the interplay of non-Hermitian skin effect and imaginary band gap closing. This new non-Hermitian physical effect deepens our understanding of quantum dynamics in open quantum systems.

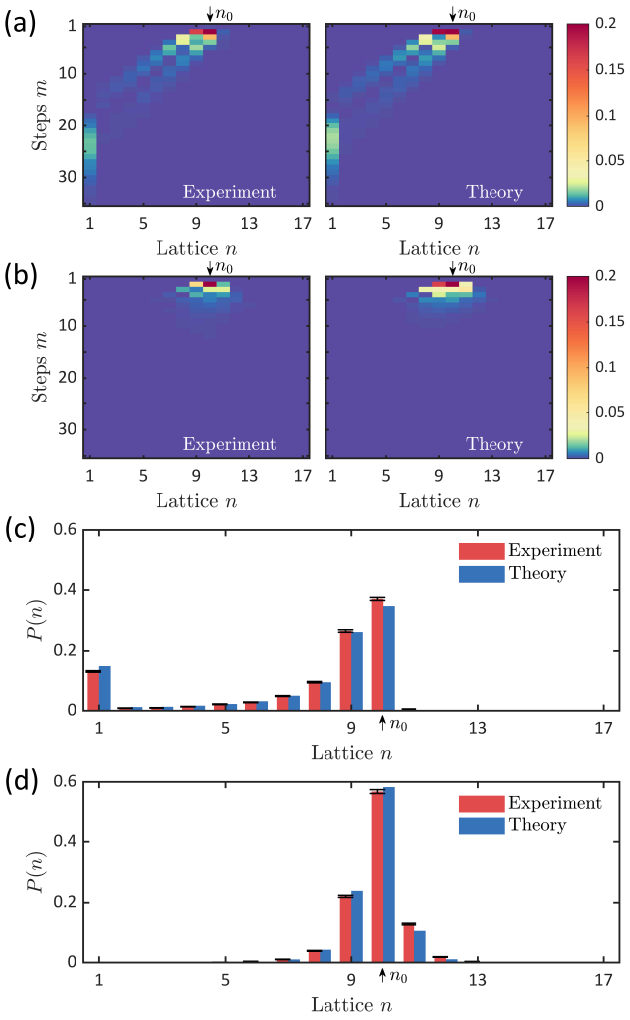

Figure 1: Experimental measurements of photon dissipations(a) and (b) Photon dissipation probabilities $p(n, m)$ with $|\phi_0>=|10,+>$, $N = 17$, $t_1 = t_2 = 0.4$ in (a), and $t_1 = 0.88$, $t_2 = 0.4$ in (b). Left (right) panel: experimental (theoretical) results with high (low) dissipation in red (blue). (c) and (d) are accumulated dissipations $P(n)$ which correspond respectively to (a) and (b), with experimental (thoretical) results drawn in red (blue). Error bars stand for 1 standard deviations