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Eigenstate-Assisted Longitudinal Quantum State Transfer and Qubit Storage in Photonic and Spin Lattices ARMANDO PEREZ-LEIJA, MARKUS GRAFE, RENE HEILMANN, ROBERT KEIL, SIMON STUTZER, STEFFEN WEIMANN, Institute of Applied Physics, University Friedrich Schiller Jena, DEMETRIOS N. CHRISTODOULIDES, CREOL, UCF, ALEXANDER SZAMEIT, Institute of Applied Physics, University Friedrich Schiller Jena, JENA TEAM, CREOL TEAM — Coherent transport of quantum information between distant nodes plays a role of paramount importance for developing fair quantum computing technologies. In that vein, in this contribution we propose a novel photonic lattice system allowing the perfect transmission of photon encoded quantum information. The basic idea is to use the stationary nature of the associated eigenstates in order to transfer quantum states over long distances with unit fidelity. The proposed system consists of an array of evanescently coupled waveguides obeying a parabolic law distribution for the coupling strength between neighboring elements. In such an optical system, the eigenstates are readily excited provided single sites are fed with single photons. After the eigenstates have been excited, they propagate for very long distances without any distortion. Once the eigenstate has reached the desired distance, it is transformed into a single-site state simetrically residing on the oposite site of the array, performing so a perfect transfer of the initial state. Using these same principles we demonstrated the possibility of storage qubit in spin chains by exploiting the intrinsic time-invariance of the system eigenstates.

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