Coupling between exciton-polariton corner modes mediated through edge states

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In recent years there has been a surge of interest in using exciton-polaritons to realize first order topological bandstructures [1-2]. These topological states are well-isolated from disorder and so seem ideal candidates for preserving information. However, this also means that they are well-isolated from each other and so it is hard to imagine coupling together multiple topological states, which would likely be prerequisite for some information processing elements (e.g., two-input logic gates).

Here we consider theoretically the realization of a second order topological polariton bandstructure, which gives rise to zero-dimensional localized corner states in a polariton lattice (Fig. 1). Due to the topological nature, information can be trapped in the corner even in the presence of disorder. We show that in the presence of polariton-polariton scattering, polaritons can scatter from a pumped corner state into an edge state, which again scatter back to another adjacent corner. In this way, we find that as a nonlinear driven-dissipative system exciton-polaritons offer a unique opportunity for realizing spatially localized topological states that can be coupled together.

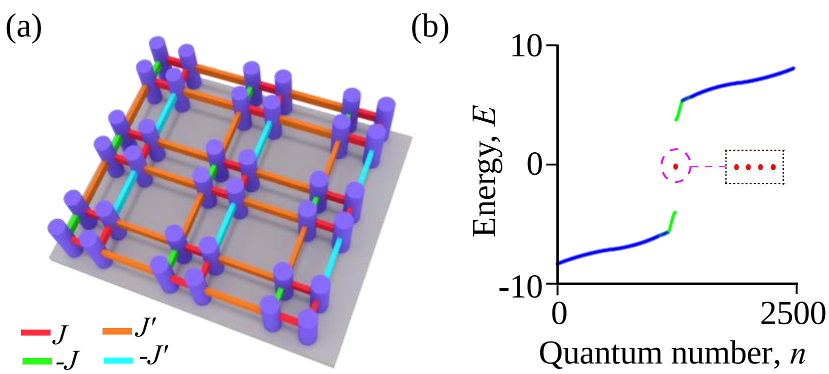

Fig. 1. (a) Schematic diagram of a square lattice formed by coupled exciton polariton micropillars with four different hopping *J, -J, J'*, and *-J'* indicated by four colors. (b) Energy eigen-values of the system consisting of 50 × 50 micropillars, as a function of the quantum number *n*. The modes corresponding to *n*=1249-1252 are the corner states appearing at *E=0*, denoted by red. The bulk and edge states are shown in blue and green respectively.

References

[1] Bardyn, et al., *Phys. Rev. B*, 2015, **91**, 161413(R).

[2] Klembt, et al., *Nature*, 2018, **562**, 7728.