Cavity enhanced transport of excitons

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We show that exciton-type transport in certain materials can be dramatically modified by their inclusion in an optical cavity: the modification of the electromagnetic vacuum mode structure introduced by the cavity leads to transport via delocalized polariton modes rather than through tunneling processes in the material itself. This can help overcome exponential suppression of transmission properties as a function of the system size in the case of disorder and other imperfections. We exemplify massive improvement of transmission for excitonic wave-packets through a cavity, as well as enhancement of steady-state exciton currents under incoherent pumping. These results have direct implications for experiments with disorderd organic semi-conductors. We propose that the basic phenomena can be observed in quantum simulators made of Rydberg atoms, cold molecules in optical lattices, as well as in experiments with trapped ions.