Exciton Energy Transfer between Asymmetric Quantum Wires
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(EPFL), Switzerland — We present theoretical result and data for the Stokes exciton transfer rate from a narrow quantum wire (n-QWR) to a parallel wide QWR (w-QWR) separated by a wide barrier and also to an array of parallel w-QWRs. The transfer rate is calculated as a function of the distance $d$ between n-QWR and w-QWR and also the array. The dependence of the rate on the temperature and the localization radius is studied for free and localized excitons, respectively. Both the resonant and non-resonant rates are considered. We find that, for energy transfer between two QWRs, the Förster dipole-dipole transfer dominates the transfer rate at short and intermediate distances. The photon-exchange transfer prevails only at an extremely long distance where the rate is negligibly small. This behavior is in contrast with the two-dimensional quantum wells, where the photon-exchange mechanism is dominant except at a very short distance. However, the photon-exchange transfer rate continues to increase as the array size grows to a macroscopic scale due to its slow range dependence while the dipolar rate saturates quickly with the array size. The prediction of the theory is consistent with the data from V-groove GaAs/Al$_x$Ga$_{1-x}$As double QWRs. Supported by the US DOE (SKL), Swedish Foundation for Strategic Research, Swedish Research Council, and Ericsson’s Research Foundation.

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