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Förster coupling in realistic nanoparticle circuits PATRICK REBENTROST, MIKE STOPA, ALAN ASPURU-GUZIK, Harvard University —
Semiconductor nanoparticles could potentially be used to build artificial light-harvesting systems and electrically controlled excitonic circuits. We derive a new method for computing the Förster coupling between nanoparticles in an arbitrary electrostatic environment. We calculate the self-consistent electronic structure of an exciton, including the electron-hole attraction, in a nanoparticle within the two band effective mass approximation. Self-interaction of the electron and the hole are removed and the eigenstate is approximated as a product state of the electron and the hole wavefunctions. The environment is incorporated via boundary conditions on Poisson's equation and arbitrary dielectric background. The transfer rate of the exciton via Förster coupling to a neighboring nanoparticle is computed, without making a dipole approximation, from the results of the self-consistent calculation. Departure from the usual $1/R^3$ dependence are calculated, as well as specific cases where gates or additional nanoparticles are present.

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