Modelling quantum dot structures in electromagnetic fields

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There exists a broad range of semiconductor nanostructures that have been fabricated. The specific geometry of the structure and the material it is composed of can be, to a great extent, freely selected. This presents a considerable amount of work for theorists attempting to modelling the plethora of nanostructures that already exist and those that have been proposed. In addition, the geometries which can be fabricated with ease aren't necessarily those that can be modelled with 'pen and paper' mathematical tools.

The finite element method is a numerical method sufficiently flexible to examine many of these structures. We demonstrate the utility of this modelling framework by applying it to a variety of structures in electric and magnetic fields. We explicitly compute excitonic energy levels, include corrections due to electron-hole interactions. We compare our results to experimental data for the systems we model; however, we also use this method to assess quantum dot structures that have been proposed but not yet fabricated. In doing so we can design future nanostructures with applications in quantum optics, telecommunications and sensing.