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theoretical condensed matter physics, many-body physics, spin physics, nano- and quantum devices

We are a "Solid-State Quantum Theory Group" at the Department of Electrophysics, NCTU. Our primary research interests are in the following themes: **(a) Theory of quantum light sources:** For over a decade, we have devoted ourselves to the studies of the underlying physics in the single-photon and entangled photon emission from semiconductor quantum dots, including the multi-exciton physics, excitonic fine structures, and exciton dynamics. We have developed an unified theory and multi-scaled numerical techniques for studying strained InAs self-assembled quantum dots and un-strained GaAs droplet epitaxial quantum dot (See Fig.1), both of which are two of the most crucial nanostructures for photonic applications. Our theoretical studies often provide useful physical explanations for existing experimental observations, and in some cases even predicted new physics confirmed by later experiments. **(b) Magnetism of magnetic ion doped nanocrystals:** Magnetic ion doped semiconductor nanocrystals (typically, CdSe:Mn quantum dots; See Fig.2) is regarded as promising building blocks in spintronics. Besides the application potential, the rich spin and magnetism properties have attracted a great deal of attention in fundamental research as well. In the subject, we have developed a powerful theory that allows us to deal with the nanocrystal doped by a huge number of magnetic ion dopants, beyond the widely used simple mean field theory and with no need of large-scaled computation. Our theory has successfully applied to expose the hidden anti-ferromagnetism in paramagnetic CdSe:Mn nanocrystals, and make significant progresses in the rapidly developing field of spintronics. Currently, the following two themes are also being under our study. **(c) Energy transfer theory (d) two-dimensional Dirac materials.**

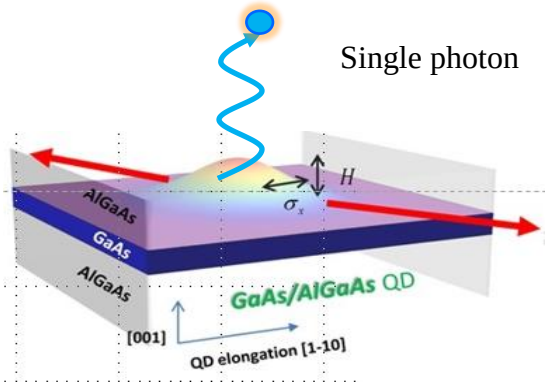

Fig.1 Quantum dot single-photon source.

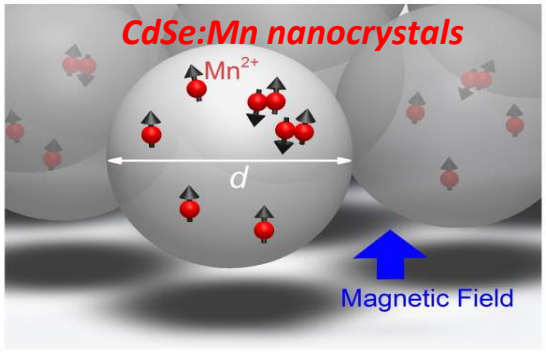

Fig.2 Magnetic-ion doped semiconductor nanocrystals.