THEORY OF ELECTRON-HOLE EXCHANGE IN SEMICONDUCTOR QUANTUM DOTS

E. S. Kadantsev[1], **M. Zielinski**[2], **M. Korkusinski**[1], **and P. Hawrylak**[1]

[1] *Quantum Theory Group, Institute for Microstructural Sciences, National Research Council, 1200 Montreal Rd., Ottawa, Canada K1A 0R6*
[2] *Instytut Fizyki UMK, Grudziadzka 5, 87-100 Torun, Poland*

E-mail: ekadants@babylon.phy.nrc.ca

Efficient generation of entangled photon pairs (EPPs) ``on demand'' is required for applications in quantum information processing. The major barrier to generation of EPPs is the so-called ``bright exciton splitting'' originating from the long-range electron-hole exchange interaction. A **k·p** effective mass theory of electron-hole exchange in semiconductor quantum dots will be presented [1]. The matrix element responsible for the ``bright'' exciton splitting in the effective exciton Hamiltonian is identified and analyzed. An excitonic fine structure for a model quantum dot with quasi-two-dimensional anisotropic harmonic oscillator (2DLAHO) confining potential is considered as a function of the shape anisotropy, size, and external fields. Assumptions and limitations surrounding the application of the effective approach to the calculation of excitonic fine structure will be discussed and elucidated with atomistic empirical-tight binding calculations using QNANO computational platform [2].

References

[1] E. Kadantsev and P. Hawrylak, *Theory of exciton fine structure in semiconductor quantum dots: Quantum dot anisotropy and lateral electric field.* Phys. Rev. B **81**, 045311 (2010).
[2] M. Korkusinski, M. Zielinski, and P. Hawrylak, *Multiexciton complexes in InAs self-assembled quantum dots*. J. Appl. Phys. **105**, 122406 (2009).