INTERACTION EFFECTS IN QUANTUM DOTS IN A MAGNETIC FIELD

A. Puente [1], **M. Pons** [1] **and R.G. Nazmitdinov** [1,2]

[1] *Departament de Fsica, Universitat de les Illes Balears. Palma de Mallorca, Spain*

[2] *Bogoliubov Laboratory of Theoretical Physics, JINR, Dubna, Russia.*

E-mail: Toni.Puente@uib.es

Quantum dots (QDs) have drawn a great deal of experimental and theoretical attention in recent years. In particular, this interest is due to the fact that QDs may provide a natural realization of quantum bit. It is also related to fundamental aspects of strongly correlated *finite* systems, which are different from bulk and can be controlled experimentally [1].

A convenient starting point to treat finite systems is, in many cases, a mean field description like the Hartree-Fock (HF) approach [2,3]. Selfconsistency between the mean field and the single-particle orbitals and total energy minimization are the basic conditions at this level. However, the total energy minimization procedure being of nonlinear nature is still a real challenge for many-body quantum theory. Using a two-dimensional parabolic approximation for confining potential in a closed quantum dot, various approaches including ab initio calculations within diffusion and path integral Monte Carlo methods, Hartree-Fock and spin-density functional methods have been applied with some degree of success to analyze the ground state energies of N-electron QDs [1]. Recently we developed an efficient, numerically stable HF procedure and compare our results with available ones in the literature. We demonstrate that our approach superseds many computational procedures.

Based on our procedure, we show that the magnetic field gives rise to dynamical symmetries of N-electron QDs ($N \leq 20$) for realistic values of the Coulomb interaction-confinement ratio R_W (cf [2,3]). These symmetries manifest themselves as near-degeneracies in the quantum spectrum at specific values of the magnetic field and produce maxima in the addition spectra for specific electron numbers.

Varying the ratio of R_W and the strength of the magnetic field we discuss the evolution of the quantum dot geometry, formed in the ground state, from $N = 2$ to $N = 20$ electrons.

References

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