

## FORMATION AND PROPERTIES OF ELECTRON CRYSTALLITES IN QUANTUM DOTS

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The two-step method [1] of symmetry breaking at the unrestricted Hartree-Fock (UHF) level and of subsequent post-Hartree-Fock restoration of the broken symmetries via projection techniques is reviewed for the case of two-dimensional semiconductor quantum dots (QD's). In the context of condensed-matter nanophysics, this method constitutes a novel theoretical and computational approach, which is able to describe a wide variety of strongly correlated phenomena in QD's in both the zero and finite magnetic-field ( $B$ ) regimes. These include [1]: (I) Formation and rotation of rigid ( $B = 0$ ) and floppy (finite  $B$ ) Wigner molecules; (II) Chemical bonding, dissociation, and spatial entanglement in quantum dot molecules, with potential technological applications to quantum logic gates [2]; (III) Pinning and distortions of Wigner crystallites due to defects or impurities.

At high magnetic fields, the two-step method yields analytic many-body wave functions (rotating-electron-molecule wave functions [3]), which are an alternative to the composite-fermion and Jastrow-Laughlin approaches. The rotating-Wigner-molecule approach provides [3] a new point of view of the fractional quantum Hall effect in QD's, with possible implications for the thermodynamic limit.

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