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Electron Localization in Strongly Correlated Quantum Dots A. D. GÜÇLÜ, Duke, AMIT GHOSAL, UCLA, C. J. UMRIGAR, Cornell, HAROLD U. BARANGER, Duke — We investigate the electronic properties of quantum dots in the low density regime up to $r_s \sim 60$ using variational and diffusion quantum Monte Carlo methods. Quantum dots are highly tunable systems that allow the study of the physics of strongly correlated electrons. With decreasing electronic density, interactions become stronger and electrons are expected to localize at their classical positions, as in Wigner crystallization in an infinite two-dimensional system. We have studied several multi-determinantal wave functions each built from single-particle states of very different nature – LDA, Hartree, or floating Gaussian orbitals – all optimized using an energy minimization technique. We study the density, pair-density, power spectrum, and addition energy as a function of increasing interaction strength. The main physical picture that emerges is: The system (i) first experiences a competition between different possible classical configurations, namely either the magic angular momentum states of the shell structure or those of the quantum mechanical symmetry, and (ii) then finally reaches the strongly localized regime consistent with the classical ground state.

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