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Toward Strong Interactions in Circular Quantum Dots: Correlation Induced Inhomogeneity AMIT GHOSAL, University of California Los Angeles, ALEV GUCLU, CYRUS UMRIGAR, Cornell University, DENIS ULLMO, LPTMS Orsay, HAROLD BARANGER, Duke University — Physical properties of the electron gas, which describes conduction electrons interacting via Coulomb forces, change dramatically depending on the balance between the strength of the kinetic energy and the Coulomb repulsion. For weak interactions (high density), the system behaves as a Fermi liquid, with delocalized electrons. In contrast, in the strongly interacting limit (low density), the electrons localize and order in a Wigner crystal phase. The physics at intermediate densities is phenomenally rich and not adequately understood. Here we present a study of the intermediate density electron gas (up to $r_s = 18$) confined to a circular quantum dot containing up to 20 electrons. Using an accurate quantum Monte Carlo technique, we show that the correlation induced by increasing interaction strength smoothly causes, first, ring structure and, then, angular modulation in the pair-density without any signature of a cross-over. The excitation energy for certain high-spin states decreases significantly with r_s. Dots with smaller number of electrons are typically more affected by correlation effects.

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