A Circular Model for Electron Configurations in 2D Heterostructures at High Magnetic Field

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The principles of self-organization of one-component charged particles, confined in circular external potentials are discussed by means of a circular model (CM) approach. We focus on the pinned quantum electron configurations localized in 2d heterostructures by intense magnetic fields. In the CM we derive a system of equations which allows us to determine equilibrium configurations for an arbitrary, but finite, number of charged point particles distributed over several rings. Our approach reduces significantly the computational effort in minimizing the energy of equilibrium configurations and demonstrates a remarkable agreement with the values provided by molecular dynamics (MD) calculations. The predictions of our model may in fact be used to feed other methods with sensible initial configurations to help minimize computational effort. With the increase of particle number, we find a steady formation of a centered hexagonal lattice that smoothly transforms to valence circular rings in the ground-state configurations. Although we address the classical limit of a quantum system, our approach could also shed light on the nature of self-organization of colloidal particles in organic solvents, charged nanoparticles absorbed at oil-water interfaces, electrons trapped on the surface of liquid helium or ionized plasmas.

REFERENCES

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FIGURES

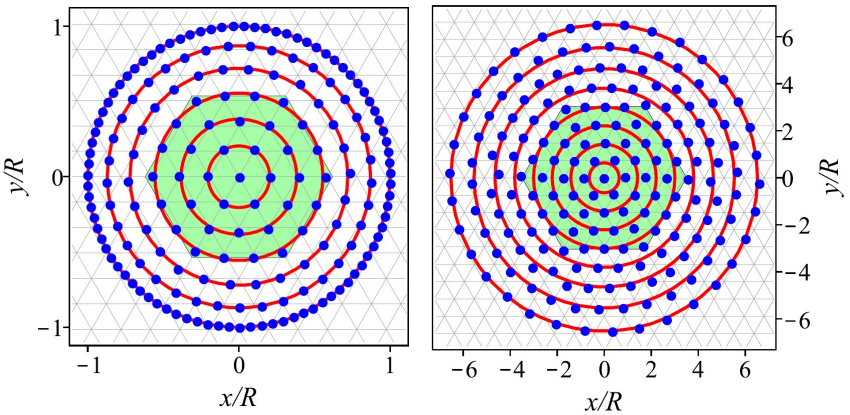

Figure 1: Examples comparing the CM (rings) and the MD results (dots) for $n = 187$ particles confined in disk (left) or harmonic (right) potentials. The *core* (green) region with {**1**,**6**,**12**,**18**,**24**} particles exhibits a clear hexagonal pattern. The external *valence* shells show an almost perfect circular structure.