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Size and shape of Mott regions for fermionic atoms in a two-dimensional optical lattice TIAGO MENDES SANTOS, THEREZA PAIVA, RAIMUNDO R. DOS SANTOS, Federal University of Rio de Janeiro (UFRJ) — We investigate the harmonic-trap control of size and shape of Mott regions in the Fermi Hubbard model on a square optical lattice. The use of Lanczos diagonalization on clusters with twisted boundary conditions, followed by an average over 50-80 samples, drastically reduce finite-size effects in some ground state properties; calculations in the grand canonical ensemble together with a local-density approximation (LDA) allow us to simulate the radial density distribution. We have found that as the trap closes, the atomic cloud goes from a metallic state, to a Mott core, and to a Mott ring; the coverage of Mott atoms reaches a maximum at the core-ring transition. A "phase diagram" in terms of an effective density and the on-site repulsion is proposed, as a guide to maximize the Mott coverage. We also predict that the usual experimentally accessible quantities, the global compressibility and the average double occupancy (rather, its density derivative) display detectable signatures of the core-ring transition. Some spin correlation functions are also calculated, and predict the existence Néel ordering within Mott cores and rings.

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