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Unconventional Bose-Einstein condensation with Rashba coupling in optical lattices IAN MONDRAGON-SHEM, BORIS A. RODRIGUEZ, Instituto de Fisica, Universidad de Antioquia, AA 1226, Medellin, CONGJUN WU, Department of Physics, University of California, San Diego, California 92093 — We study the effect of Rashba spin-orbit coupling on the ground state properties of ultracold bosonic atoms in optical lattices. The Rashba coupling in the center-of-mass of the bosons is generated by spatially varying external laser fields which couple to the internal degrees of freedom of the atoms. As a result of the spin-orbit coupling, the ground state of the system acquires a finite quasi-momentum $\vec{k}_0$, which spontaneously breaks time-reversal symmetry. The Gross- Pitaevskii many-body ground state, the current density and the pseudo-spin density distributions are calculated in the high- particle-density superfluid regime, and time-of-flight calculations are carried out. In the low-particle-density regime, the phase diagram is computed showing the effect of the coupling on the Mott insulator-to-superfluid transition using a modified Bose-Hubbard model. We supplement this with the computation of the ground state of the system with a superimposed harmonic trap using a Gutzwiller ansatz, which shows the effect of the Rashba coupling on the wedding-cake structure of the system.

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