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Synthetic spin and orbital angular momentum coupling in quantum gases KUEI SUN, CHUNLEI QU, CHUANWEI ZHANG, The University of Texas at Dallas — The recent experimental realization of synthetic spin and linear momentum (SLM) coupling for ultracold atoms (both bosons and fermions) provides a completely new platform for exploring new quantum physics in spin-orbit coupled superfluids. Nowadays, spin-orbit coupled Bose-Einstein condensates (BEC) and degenerate Fermi gases have emerged as one of the most important frontiers of ultracold atomic physics. We pioneer the route and propose a scheme to realize another important and fundamental coupling between spin and orbital angular momentum (SOAM) in ultracold atoms using higher-order Laguerre-Gaussian laser beams. We study the ground state properties of SOAM coupled BEC in various natural geometries in experiments. We find rich phase diagrams reflecting the interplay between SOAM coupling, interaction, and external trapping. Our system, unlike the SLM coupled ones in current experiments, is naturally suited for exploring strong many-body effects with spin-orbit coupling.

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