Spin-orbit Coupling for Bilayer Atomic Bose-Einstein Condensates

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In the initial part of the talk a background material will be presented on the spin-orbit coupling (SOC) for ultracold atoms. At present the SOC is amongst the most active areas of research for ultracold atomic gases [1-4]. Subsequently we shall discuss some recent developments in the area. One of current challenges is to experimentally produce a two-dimensional (2D) SOC of the Rashba type. We shall discuss a novel way of creating the 2D SOC using a bilayer atomic Bose-Einstein condensate (BEC) [5]. The method involves a combination of the Raman-induced one-dimensional SOC within individual atomic layers and the laser-assisted interlayer tunneling. This makes the SOC effectively two-dimensional. By choosing a proper phase difference between the Raman coupling in different layers one can create a 2D SOC of the Rashba type. It is shown that an interplay between the inter-layer tunneling, Raman coupling, and intra-layer atom-atom interaction gives rise to diverse ground-state configurations for the bilayer BEC [5]. We shall also discuss effects due to position-dependent SOC for atomic BECs [6], as well as some other recent work in the area.

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