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Vortex formation in spin-orbit coupled Bose-Einstein condensates

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Using techniques that exploit the high precision atomic physics, we have exquisite control over several degrees of freedom in an ultracold atomic system, with which we can create analogues to a broader class of physical systems through the principle of quantum simulation. Raman transitions give us the ability to effect a "spin-orbit coupling" in our ultracold gas, by facilitating the transfer of momentum to the atoms from light in a controlled way. In this system, vortices may arise when the spin-orbit coupling is designed with a spatial dependence that simulates a magnetic field in one direction for one spin, and the opposite direction for another. With numerical tools, we investigate the formation and interaction of vortices created in such as system as a means of probing the superfluidity of the spin-orbit coupled sample. Finally, we discuss our experimental progress in realizing such a system.

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