Creating and Probing Topological Band Structures with Ultracold Atoms

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In these lectures we will look at the practical task of realizing topological band-structures for ultracold atoms. As these atoms are electrical neutral, they don't feel the Lorentz force that is typically responsible for the Hall effect. We will therefore review several techniques to simulate these effects, including rotating quantum gases, Raman dressing, laser-induced hopping in deep lattices and lattice modulation. In addition we will discuss different ways to probe the resulting structures, including transport and interferometric probes. Finally, we will look at some of the challenges associated with realizing strongly correlated topological phases.

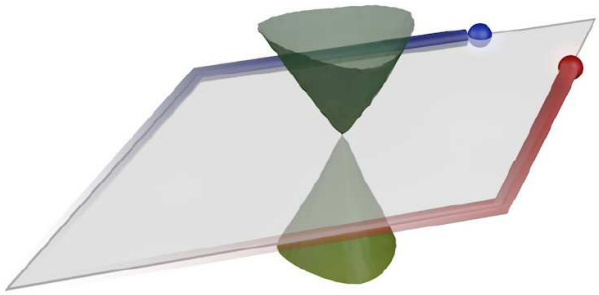

Figure 1: Ultracold bosons allow for direct interferometric measurements of the Berry flux by employing a momentum-space analogue of Aharonov-Bohm interferometry.