DAMOP08-2008-020105

Abstract for an Invited Paper
for the DAMOP08 Meeting of
the American Physical Society

Vortices in Rotating Optical Lattices

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A collection of ultracold atoms subject to a spatially periodic potential energy can exhibit many types of behavior analogous to electrons moving in a crystal lattice. One of the most remarkable correspondences occurs with atoms in a corotating two-dimensional optical lattice and electrons confined in two-dimensions in the presence of a strong magnetic field. In both cases, the remarkable features of the fractional quantum Hall effect emerge. The means that atoms in a rotating optical lattice can contain circulation and quantum vortices and, if the lattice is rotating sufficiently rapidly, can support exotic highly-correlated quantum states. In this talk I will provide a few perspectives on the exciting possibilities that atomic physics is now offering in this area, and present some results showing the effects of the quantization of circulation, the apperance of vortices, and some of the novel features of quantum phase transitions in these systems.