Negative-mass quantum hydrodynamics with spin-orbit coupled BECs

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In recent years, spin-orbit coupled BECs have become a major focus of research for the investigation of quantum dynamics. Spin-orbit coupling can be induced in a BEC by Raman dressing techniques and is associated with artificial gauge fields and roton-like minima in the dispersion relation. Here we present experimental studies of quantum hydrodynamical effects connected to the peculiar dispersion relation of a spin-orbit coupled BEC. For example, under appropriate conditions the dispersion can feature a region of negative curvature, which implies a negative effective mass of the atoms. In our experiments we observe negative mass effects by probing the response of a BEC to an applied force. The current status of the BEC research at Washington State University will be discussed.