Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Gravitational Effects on Collective Modes of Superfluid Shells KARMELA PADAVIĆ, University of Illinois at Urbana-Champaign, KUEI SUN, The University of Texas at Dallas, COURTNEY LANNERT, Smith College, SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign — We study the effects of gravity on collective excitations of shell-shaped Bose-Einstein condensates (BECs). Superfluid shells are of general interest as examples of hollow geometries that can be produced in ultracold atoms in bubble-trap potentials or optical lattices. Our approach to analyzing superfluid shells is based on a Gross-Pitaevskii mean field theory and hydrodynamic equations derived from it. Considering a spherically symmetric BEC in general, there are distinct collective excitation spectra for the cases of a fully filled sphere and a very thin shell. Furthermore, an adiabatic change in the potential producing a slow transition from one geometry to the other shows a characteristic evolution. Given that in most realistic experimental conditions gravity cannot be neglected we investigate its effects on the equilibrium profile and the collective modes in the very thin shell limit. We analytically obtain the full excitation spectrum for the thin shell geometry and account for gravity perturbatively at length and energy scales that describe a stable matter-wave bubble. We find that gravity breaks spherical symmetry of the equilibrium density profile and affects the collective excitations by coupling adjacent modes in the angular direction.

Kuei Sun
The University of Texas at Dallas

Date submitted: 04 Nov 2015 Electronic form version 1.4