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Thermodynamics and vortex physics in shell-shaped Bose-Einstein condensates BRENDAN RHYNO, KARMELA PADAVIC, University of Illinois at Urbana-Champaign, KUEI SUN, The University of Texas at Dallas, COURTNEY LANNERT, Smith College, NATHAN LUNDBLAD, Bates College, SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign — We present a study of thermodynamic and vortex features of shell-shaped Bose-Einstein condensates (BECs). Hollow BECs are being investigated in the Cold Atom Laboratory (CAL) aboard the International Space Station in bubble traps and can also occur in terrestrial optical lattice settings or interiors of neutron stars. In close keeping with the CAL data obtained so far, we employ multiple techniques to compute the BEC critical temperature for a bubble trapped gas focusing on signatures of the topological transition from a filled-to-hollow spherical geometry as the gas adiabatically expands. We find that the critical temperature decreases near linearly with trap detuning frequency and that the presence of a topological transition may be inferred from the gas temperature. Looking towards physics of hollow BEC shells after the transition, we study nucleation of vortices in such systems when rotated. We show that vortex nucleation is energetically favorable in hollow shells at rotation rates smaller than for filled sphere BECs. This critical rotation rate increases with shell thickness in an almost linear fashion as well. Such distinctions between filled and hollow condensates and the topological transition between the two are poised to inform future CAL investigations.

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