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Physics of Hollow Bose-Einstein Condensates[1] KARMELA PADAVIC, University of Illinois at Urbana-Champaign, KUEI SUN, The University of Texas at Dallas, FRANCES YANG, Smith College, COURTNEY LANNERT, University of Massachusetts, SMITHA VISHVESHWARA, University of Illinois at Urbana-Champaign — We study properties of BEC's in spherically symmetric traps that allow the possibility of deforming the condensate smoothly from a filled sphere to a hollow shell. The deformation undergoes a distinct change in topology in going from a filled condensate to one with a hollow region. We show that collective modes of BECs reflect such a change and the associated appearance of a new inner boundary. We show distinct non-monotonic behavior and a dip-like feature in spherically symmetric modes. High angular momentum modes are particularly sensitive to the topological change as they correspond to surface waves localized to boundaries; the appearance of a new boundary creates a redistribution of nodes and collective mode structure. The findings are not only relevant to various physical systems that have been discussed in the past in the context of condensate shells, such as shells in neutron stars and superfluid-Mott structures in optical lattices, but also to a new set of upcoming experiments in NASA's Cold Atomic Laboratory in which this very tuning between filled and hollow spheres is anticipated.

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