Abstract Submitted
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Vortices, antivortices and superfluid shells separating Mott-insulating regions[1] KAUSHIK MITRA, C.J. WILLIAMS, C.A.R. SA DE MELO, Joint Quantum Institute, NIST, Gaithersburg and University of Maryland, College Park — Atomic or molecular bosons in harmonically confined optical lattices are known to exhibit a wedding cake structure consisting of insulating (Mott) shells. We show that between the Mott regions, superfluid shells emerge as a result of fluctuations due to finite hopping. It is found that the order parameter equation in the superfluid regions is not of the Gross-Pitaeviskii type except near the insulator to superfluid boundaries. The excitation spectra in the Mott and superfluid regions are obtained, and it is shown that the superfluid shells posses low energy sound modes with spatially dependent sound velocity described by a local index of refraction directly related to the local superfluid density. Lastly, the Berezinski-Kosterlitz-Thouless transition and vortex-antivortex pairs are discussed in thin (wide) superfluid shells (rings) limited by three (two) dimensional Mott regions. The transition temperature of each superfluid region is dependent on the filling factor of the Mott shells that limit their boundaries.

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