Abstract for the Eurasia-Pacific Summer School and Conference 2012 (Contributed talk)

Tuning the Kosterlitz-Thouless Transition to Zero Temperature in Anisotropic Boson Systems

Jhih-Shih You[1,2], Hao Lee[1,2], Shiang Fang[1,2], Miguel A. Cazalilla[3,4], Daw-Wei Wang[1,2]

[1]Department of Physics and Frontier Research Center on Fundamental and Applied Sciences of Matter, National Tsing-Hua University, Hsinchu, Taiwan

[2]Physics Division, National Center for Theoretical Sciences, Hsinchu, Taiwan

[3]Centro de Fsica de Materiales CSIC-UPV/EHU. Paseo Manuel de Lardizabal 5, E-20018 San Sebastian, Spain

[4]DIPC, Paseo Manuel de Lardizabal 4, E-20018 San Sebastian, Spain

We study the two-dimensional Bose-Hubbard model with anisotropic hopping. Focusing on the effects of anisotropy on the superfluid properties such like the helicity modulus and the normal-to-superfluid (Berezinskii-Kosterlitz-Thouless, BKT) transition temperature, two different approaches are compared: Large-scale Quantum Monte Carlo simulations and the self-consistent harmonic approximation (SCHA). For the latter, two different formulations are considered, one applying near the isotropic limit and the other applying in the extremely anisotropic limit. Thus we find that the SCHA provides a reasonable description of superfluid properties of this system provided the appropriate type of formulation is employed. The accuracy of the SCHA in the extremely anisotropic limit, where the BKT transition temperature is tuned to zero (i.e. into a Quantum critical point) and therefore quantum fluctuations play a dominant role, is particularly striking.