

Supersolid and Superglass: the Role of Localization

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Abstract: The main theme of this work is the interplay between superfluidity and localization, in a system of strongly correlated Bose particles. Driving this investigation is the long search, almost 50 years, for the controversial phases of matter, such as the so-called supersolid and superglass [1,2,3]. Using state-of-the-art, numerically exact computer simulations, we have carried out an extensive theoretical investigation of the effects of long-range interactions, inhomogeneity, disorder, frustration, and the external potential in a model of lattice Bosons. In particular, we explore the scenario of vacancy and interstitial based supersolid phases of hard core bosons on different types of lattices, interacting repulsively via a nearest-neighbour and next-nearest neighbour potential, an external potential [4]. Secondly, in an attempt to model the physics of a layer of helium adsorbed on a corrugated substrate, an additional superlattice of the absorption sites is imposed to the system of hard core bosons, and the resulting low temperature phase diagram is studied. Finally, the possibility of actually inducing by disorder superfluidity (superglass) in a system that does not display it in the absence of disorder is demonstrated. The quantitative and qualitative predictions at which we have arrived appear to be at least in principle testable experimentally, for example by performing measurements on ultracold atoms in optical lattices or spin-coupling Bose condensation systems [5].

References

- [1] A. J. Leggett. Phys. Rev. Lett., 25:1543, 1970.
- [2] E. Kim and M. Chan. Nature, 427:225, 2004.
- [3] M. Boninsegni and N. Prokofev. Rev. Mod. Phys., 84: 759, 2012.
- [4] O. Nguyen and L. Dang. E. Phys. J. B: 70527:8, 2017.
- [5] J. Li, J. Lee, W. Huang, S. Burchesky, B. Shteynas, F.C. Top, A. O. J. and W. Ketterle. Nature, 543:91, 2017.

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