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Localization and Superfluidity of Interacting Bose Gases in the Presence of Disorder

In this contribution, we discuss many-body Anderson localization in Bose gases with weak repulsive interactions [1,2]. We show that, while the ground state is extended owing to the strong interactions, the collective excitations, ie the Bogolyubov quasi-particles, are Anderson localized . We develop an analytical approach, which allows us to derive exact results, and draw a clear physical picture, which reveals the relevance of screening. A consequence of the latter is that the localization properties of Bogoliubov quasi-particles are radically different from those of single particles. For instance, we find that the localization features a maximum when the healing length of the condensate is of the order of the correlation length of the disorder. Numerical calculations in support of our analytical calculations are also presented. We also discuss recent results on the superfluidity of a disordered Bose gas at finite temperature. We show that the superfluid properties show a nontrivial behavior versus temperature and disorder, and discuss its relation to localization [3].

References

- [1] P. Lugan, D. Clément, P. Bouyer, A. Aspect, and L. Sanchez-Palencia, Phys. Rev. Lett. 99, 180402 (2007).
- [2] P. Lugan and L. Sanchez-Palencia, Phys. Rev. A 84, 013612 (2011).
- [3] S. Lellouch and L. Sanchez-Palencia, in preparation (2012).