Bose-Fermi mixtures in a 1D disordered potential

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Abstract

One-dimensional systems allow for a detailed study of the competing effects of disorder and interactions on the localization of a Fermi or Bose gas.[1] While non-interacting fermions are always localized in a random potential, a transition to a superconducting phase occurs for strong enough attractive interactions. Similarly, strong repulsive interactions will trigger the localization of a Bose gas.[1,2] During this talk, I will present the study of an interacting mixture of bosons and spinless fermions in a random potential. Superfluid correlations are enhanced by interspecies interactions, while the disordered potential tries to pin each component of the gas. Using renormalization group methods, supplemented by a variational calculation, we have found several localized or superfluid phases, including a new insulating phase, similar to the Bose glass, in which both species are coupled and localized.[3] We also computed the dynamical structure factor for typical parameters of various ultra-cold atoms experiments. Each phase exhibits its own signature, that could be probed in Bragg scattering experiments.

[1] T. Giamarchi and H. J. Schulz, Phys. Rev. B **37**, 325 (1988)
[2] M. P. A. Fisher *et al.*, Phys. Rev. B **40**, 546 (1989)
[3] F. Crépin, G. Zaránd, P. Simon, Phys. Rev. Lett. **105**, 115301 (2010)