Chaos in the Bose-Glass Phase of a One-Dimensional Disordered Bose Fluid

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We show that the Bose-glass phase of a one-dimensional disordered Bose fluid exhibits chaotic behavior, *i.e.*, extreme sensitivity to external parameters. Using bosonization, the replica formalism and the nonperturbative functional renormalization group, we find that the ground state is unstable to any modification of the disorder configuration ("disorder" chaos) or variation of the Luttinger parameter ("quantum" chaos, analog to the "temperature" chaos in classical disordered systems). This result is obtained by considering two copies of the system, with slightly different disorder configurations or Luttinger parameters, and showing that inter-copy statistical correlations are suppressed at length scales larger than an overlap length $\xi_{\rm ov} \sim |\epsilon|^{-1/\alpha}$ ($|\epsilon| \ll 1$ is a measure of the difference between the disorder distributions or Luttinger parameters of the two copies). The chaos exponent α can be obtained by computing $\xi_{\rm ov}$ or by studying the instability of the Bose-glass fixed point for the two-copy system when $\epsilon \neq 0$. The renormalized, functional, inter-copy disorder correlator departs from its fixed-point value – characterized by cuspy singularities – *via* a chaos boundary layer, in the same way as it approaches the Bose-glass fixed point when $\epsilon = 0$ through a quantum boundary layer. Performing a linear analysis of perturbations about the Bose-glass fixed point, we find $\alpha = 1$.