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Decay of correlations and absence of superfluidity in the disordered Tonks-Girardeau gas

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In view of the woefully short list of rigorous results on disordered systems with interaction, limiting or integrable model systems present a testing ground for numerical works, conjectures and ideas. In the bosonic case, the limiting case of hard-core repulsive interaction is such an example: in the lattice set-up this amounts to studying the XY-spin Hamiltonian with a random magnetic field, and in the continuum this is the Tonks-Girardeau model with a random potential. Both models can be related to non-interacting fermions in an external random potential.
In this talk I will mainly report on results concerning the Tonks-Girardeau gas subject to a random external potential.
If the disorder is such that the underlying one-particle Hamiltonian displays localization, which is known to be generically the case, correlations in the many-body eigenstates are shown to decay exponentially. Moreover, there is no Bose-Einstein condensation and no superfluidity, even at zero temperature.
(This is based on joint works with R. Sims and R. Seiringer.)

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