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Asymptotic Limit of Momentum Distribution Functions in the Sudden Expansion of a Spin-imbalanced Fermi Gas in One Dimension
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— We study the sudden expansion of a spin-imbalanced Fermi gas in an optical lattice after quenching the trapping potential to zero [1], described by the attractive Hubbard model. Using time-dependent density matrix renormalization group simulations we demonstrate that the momentum distribution functions (MDFs) of majority and minority fermions become stationary after surprisingly short expansion times. We explain this via a quantum distillation mechanism [2] that results in a spatial separation of excess fermions and pairs, causing Fulde-Ferrell-Larkin-Ovchinnikov correlations to disappear rapidly. We further argue that the asymptotic form of the MDFs is determined by the integrals of motion of this integrable quantum system, namely the rapidities from the Bethe ansatz solution. We discuss the relevance of our results for the observation of Fulde-Ferrell-Larkin-Ovchinnikov correlations in 1D systems, related to recent experiments from Rice University [3].

[1] Bolech et al., Phys. Rev. Lett. 109, 110602 (2012)
[2] Heidrich-Meisner et al., Phys. Rev. A 80, 041603(R) (2009)
[3] Liao et al., Nature 467, 567 (2010)

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