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Particle partition entanglement of Luttinger liquids C.M. HERDMAN, University of Waterloo, ADRIAN DEL MAESTRO, University of Vermont
— We consider the Rényi entanglement entropy of a Luttinger liquid under a particle bipartition. Using Luttinger liquid theory, we demonstrate that the leading finite-size scaling of the second Rényi particle entanglement entropy is logarithmic in the system-size with a prefactor that is the inverse Luttinger parameter. While higher order corrections depend on the short distance physics, the leading order scaling depends only on the sole dimensionless parameter that characterizes the low energy physics; this contrasts with the leading entanglement entropy scaling under a spatial bipartition, for which the scaling coefficient is universal and independent of the Luttinger parameter. Additionally, using quantum Monte Carlo calculations, we explicitly confirm the Luttinger liquid theory scaling for the Lieb-Liniger model of delta function interacting bosons in the one-dimensional spatial continuum; we find that the scaling coefficient of the 2nd Rényi particle entropy of the ground state of the Lieb-Linger model agrees with the Luttinger parameter determined from the Bethe ansatz.

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