Many-particle theory of anyons in 1D

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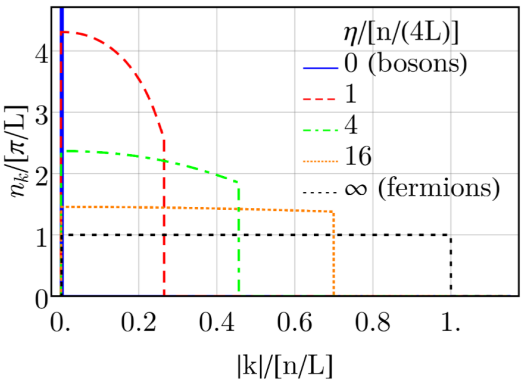
In one spatial dimension, anyons in the original description of Leinaas and Myrheim are formally equivalent to locally interacting bosons described by the Lieb-Liniger model. I will explain this parallel, particularly including the many-body bound states from the attractive Lieb-Liniger model and discuss its Bethe ansatz solution. I will subsequently introduce the second quantization formalism for the present anyons and the generalized Jordan-Wigner transformation that connects them to the bosons of the Lieb-Liniger model. In particular, I will point out the subtle differences between interacting bosons and anyons in 1D.

$$a_p^\dagger a_q^\dagger = e^{\mathrm{i}\phi_\eta(p-q)} a_q^\dagger a_p^\dagger, \qquad \phi_\eta(k_{j+1}-k_j) = 2\arctan\left[\eta/(k_{j+1}-k_j)\right]$$
$$a_p a_q^\dagger = e^{-\mathrm{i}\phi_\eta(p-q)} a_q^\dagger a_p + \delta(p-q)$$



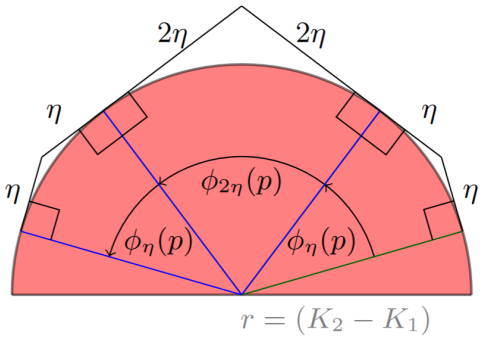


FIG. 1. (top) The creation and annihilation operators of anyons in one dimension obey special quantum brackets (generalized commutation and anti-commutation relations). (left) The anyonic particle statistics interpolates between the Bose-Einstein and the Fermi-Dirac statistics. (right) Two anyons can fuse to form a single anyon with an altered statistical parameter. This has a pleasant geometrical interpretation.