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Anyons in a tight wave-guide and the Tonks-Girardeau gas

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Anyons with a statistical phase parameter \alpha \in (0,2) are quasi-particles interpolating between bosons and fermions. For topological reasons, they only exist in a 1D or 2D world, ie as excitations of special 2D or 1D systems. There exists a main agreed-upon 2D model (equivalent to usual bosons or fermions carrying Aharonov-Bohm magnetic fluxes of intensity \alpha) but several 1D models. We ask which one, if any, of the latter is selected as the 1D limit of the 2D theory.

We hence consider the dimensional reduction for a 2D system of anyons in a tight wave-guide and prove that both the eigenenergies and the eigenfunctions are asymptotically decoupled into the loose confining direction and the tight confining direction. The limit 1D system in the loose direction is given by the impenetrable Tonks-Girardeau Bose gas independently of \alpha. No trace is thus left, at leading order, of the long-range interactions of the 2D model. This comes about via the acquisition of a special phase factor, which gauges magnetic interactions away for aligned particles.

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