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Short-range Calogero-Sutherland models and Jastrow-like wavefunctions

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A well-known property of the original Calogero and Sutherland quantum N-body models is the fact that their ground states factorize over the A_{N-1} root system, that is, they are of the so-called Jastrow form

$$\psi(\mathbf{x}) = \prod_{i=1}^{N} \rho(x_i) \cdot \prod_{1 \leqslant i < j \leqslant N} \chi(x_i - x_j) \,.$$

This property makes it possible to compute some correlation functions of the latter models by exploiting their connection with the Gaussian and Dyson's circular ensembles in random matrix theory. A natural problem already tackled in the seventies by Calogero and Sutherland was the classification of all quantum models with one- and two-body interactions admitting a Jastrow ground state, a problem which was finally settled at the turn of the century by Koprucki and Wagner.

In this talk I will discuss an analogous classification of all quantum many-body models with nearest and next-to-nearest-neighbors interactions whose ground state takes the Jastrow-like form

$$\psi(\mathbf{x}) = \prod_{i} \rho(x_i) \cdot \prod_{i} \chi(x_i - x_{i+1}) \,.$$

These models, originally introduced by Jain and Khare in 1999, can be regarded as a short-range version of the original Calogero and Sutherland models, and actually feature similar properties, as I will discuss in my talk. For instance, their Jastrow-like ground states can be regarded as the joint probability density of the eigenvalues of some pseudo-integrable quantum systems. One can also construct spin versions of these models, which yield partially solvable spin chains featuring short-range (near-neighbors) interactions.

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