Entanglement beyond statistics in hybrid fermionic systems: A Moshinsky model study

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We investigate quantum correlations in a hybrid many-body system of harmonically confined fermions belonging to two distinguishable interacting species, described by the exactly solvable Moshinsky model. We introduce a physically motivated entanglement measure tailored for such hybrid systems, which excludes exchange correlations among (identical) particles of the same species and captures only genuine (beyond Slater) quantum correlations. Using this measure, we analyze the dependence of entanglement on interaction strength and particle number across different bipartitions. We find that inter-species entanglement increases with both interaction strength and system size, whereas entanglement across bipartitions involving a hybrid subsystem decreases with increasing particle number, indicating an effective screening mechanism. Our results [1] highlight the interplay between particle statistics and entanglement in shaping quantum correlations, and provide a consistent framework to quantify entanglement in fermionic many-body systems.

Reference:

[1] M. D. Jiménez, W. J. Díaz, E. Cuestas, A. Valdés-Hernández & A. P. Majtey, Spatial correlations and entanglement in a hybrid system of N fermion pairs with harmonic interaction, J. Phys. A: Math. Theor. 58 225303 (2025).