Mass Effects on the Entanglement Features of an Exactly Soluble Quantum Few-Body System

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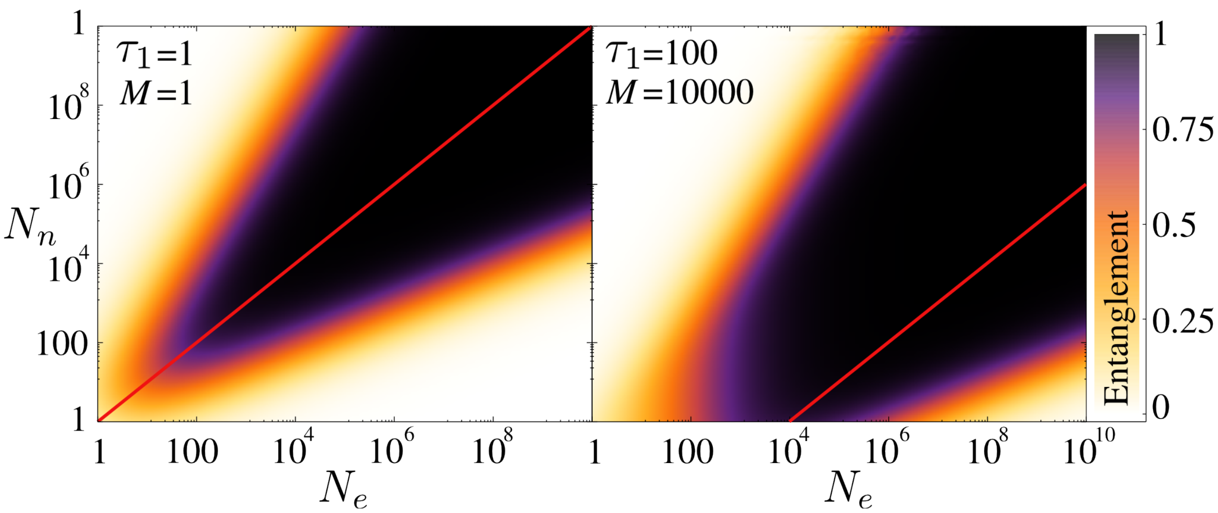
We explore the entanglement features of the eigenstates of an exactly soluble few-body model consisting of N_n "nuclei" and N_e "electrons" which interact harmonically between themselves and, moreover, they are confined by an harmonic potential well [1,2]. We analytically compute the amount of entanglement exhibited by the wave functions corresponding to the ground and some excited states of this model; we investigate its dependence upon the different parameters characterizing the system, such as the relative strength between the two-particle interaction and the confining harmonic potential, the number of particles and their masses. Particular attention is paid to the dependence of the entanglement on the ratio of the masses of the constituent particles. It is observed that the entanglement associated with bipartitions of the system tends to be maximum when the subsystems have equal masses. When the subsystem masses become increasingly different entanglement gradually fades tending to zero when the corresponding masses are very different. The connection between this fact and the validity of the Born-Oppenheimer approximation is explored in detail.



References:

[1] M. Moshinsky, Am. J. Phys. **36**, 52 (1968), Erratum: Am. J. Phys. **36**, 763 (1968)..

[2] P. A. Bouvrie, A. P. Majtey, A. R. Plastino, P. Sánchez- Moreno, and J. S. Dehesa, Eur. Phys. J. D **66**, 1 (2012).