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Multi-Marginal Optimal Transport in Quantum Mechanics

The strong-interaction limit of the Hohenberg-Kohn functional defines a multi-marginal optimal transport problem with Coulomb cost. From physical arguments, the solution of this limit is expected to yield strictly-correlated particle positions, related to each other by co-motion functions (or optimal maps), but the existence of such a deterministic solution in the general three-dimensional case is still an open question. A conjecture for the co-motion functions for radially symmetric densities was presented in Phys. Rev. A 75, 042511 (2007), and later used to build approximate exchange-correlation functionals for electrons confined in low-density quantum dots. In this talk I will revisit the whole issue both from the formal and numerical point of view (by means of the entropic regularisation of Optimal Transport), finding that even if the conjectured maps are not always optimal, they still yield an interaction energy (cost) that is numerically very close to the true minimum.