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Rigorous lower bounds for the ground state energy of matter

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Abstract

Rigorous lower bounds are derived for the exact ground state energy of neutral matter of bosonic and fermionic types with Coulomb interactions with fixed positive charges by using, in the process, lower bounds for the kinetic energies as some power of an integral of ρ^2 rather than of the familiar $\rho^{5/3}$, where ρ is the particle density. This method, while it leads to a weakening of the bound for fermions, it improves the one for bosons from those in the literature. The bounds for fermionic matter lead to the inescapable conclusion that as more and more matter is put together, thus increasing the number N of electrons, the number k of nuclei, as separate clusters, would necessarily increase and not arbitrarily fuse together, and their individual charges remain bounded. That is, technically, as $N \to \infty$, then *stability* implies that $k \to \infty$ as well, and no nuclei may be found in matter that would carry arbitrarily large portions of the total positive charge available.