Modern expressions for three-body forces lead to the collapse of neutron matter

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Abstract:

Nuclear systems ranging from light nuclei to massive neutron stars can be well described by nucleons interacting through two-body and three-body forces. From electrostatics we know that two identical uniformly charged spheres repel at any distance but the repulsion disappears when the spheres completely overlap. Similarly, in some modern expressions of nuclear three-body force (Illinois, Urbana) it is assumed that the nuclear repulsion between the three nucleons is zero when they occupy the same position in space. I shall discuss the mathematical proof, which shows that such form of the three-body force leads to the collapse of large neutron systems: \( N \) neutrons form a bound system with the energy growing as \( N^3 \) (the effect becomes visible for \( N > 10000 \)). I shall also shortly review the existing knowledge regarding the stability of matter.