NEUTRON-PROTON MASS DIFFERENCE - A FUNDAMENTAL QUANTITY CALCULATED

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More than 99% of the mass of the visible universe is made up of protons and neutrons. Both particles are much heavier than their quark and gluon constituents. The existence and stability of atoms rely on the fact that the mass difference between the neutron and the proton is about 0.14%. A slightly smaller or larger value would have led to a dramatically different universe. I show how theoretical breakthroughs and high-performance computing resources have transitioned to a point where these masses, their differences and similar physics observables can be calculated accurately on space-time lattices directly from Quantum Chromodynamics, the strongly interacting theory of quarks and gluons.