“Ab initio calculation of the neutron-proton mass difference”

Antonin Portelli, University of Southampton

The existence and stability of atoms relies on the fact that neutrons are more massive than protons. The mass difference is only 0.14% of the average. This tiny mass splitting has significant astrophysical and cosmological implications. A slightly smaller or larger value would have led to a dramatically different universe. Here we show, how this difference results from the competition between electromagnetic and mass isospin breaking effects. We compute the neutron-proton mass splitting and show that it is greater than zero by five standard deviations. Furthermore, splittings in the $\Sigma$, $\Xi$, D and $\Xi_{cc}$ isospin multiplets are determined providing also predictions. We perform lattice Quantum-Chromodynamics plus Quantum-Electrodynamics computations with four, non-degenerate Wilson fermion flavours. Four lattice spacings and pion masses down to 195 MeV are used.

(based on arXiv:1406.4088)