Contribution ID: **99** Type: **Parallel Talk**

Proton and neutron electromagnetic charge radii and magnetic moments from $N_f = 2 + 1$ lattice QCD

Tuesday, 1 August 2023 13:30 (20 minutes)

We present results for the electromagnetic form factors of the proton and neutron computed on the $(2 + 1)$-flavor Coordinated Lattice Simulations (CLS) ensembles including both quark-connected and -disconnected contributions. The Q^2-, pion-mass, lattice-spacing, and finite-volume dependence of our form factor data is fitted simultaneously to the expressions resulting from covariant chiral perturbation theory including vector mesons amended by models for lattice artefacts. From these fits, we determine the electric and magnetic charge radii and the magnetic moments of the proton and neutron. To assess the influence of systematic effects, we average over various cuts in the pion mass and the momentum transfer, as well as over different models for the lattice-spacing and finite-volume dependence, using weights derived from the Akaike Information Criterion (AIC). Our results for the magnetic moments of the proton and neutron are in good agreement with the experimental values and have a relative precision of about $2.5\,\%$ and $4\,\%$, respectively. For the electromagnetic charge radii of the proton, we achieve a $1.5\,\%$-level precision.

Topical area

Structure of Hadrons and Nuclei

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Session Classification: Structure of Hadrons and Nuclei