Nucleon mass and pion-nucleon σ-term
in the covariant baryon chiral perturbation theory

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We analyse the pion mass dependence of the nucleon mass in the covariant $SU(2)$ baryon chiral perturbation theory up to the p^4-order accuracy with explicitly including $\Delta(1232)$ degrees of freedom. We perform global fits to lattice QCD data for $N_f = 2$ and $N_f = 2 + 1$ flavor ensembles with pion masses below 450 MeV. For our chiral extrapolator we use the extended-on-mass-shell renormalization scheme and also include finite volume corrections. Through the Hellmann-Feynman theorem we obtain the $\sigma_{\pi N}$-term at the physical point by the fitted low energy constants.

Presently the value for the $\sigma_{\pi N}$-term is still rather uncertain. Estimates from lattice QCD and πN scattering data range from 37 MeV to 64 MeV [1,2]. The $\sigma_{\pi N}$-term is not only a fundamental QCD object but also enters the scattering cross section prediction for dark matter searches for which a more precise value is needed [3]. In our work we use an improved chiral extrapolator, where the underlying effective field theory is the same as in [2], as compared to the one presently employed in literature.

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