Nucleon Electroweak Form Factors: Analysis of their Spectral Functions

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We investigate the imaginary parts of the nucleon electromagnetic and axial form factors close to threshold in the framework of heavy baryon chiral perturbation theory. For the isovector electromagnetic form factors, we recover the well known strong enhancement near threshold. For the isoscalar ones, we show that there is no visible enhancement due to the three-pion continuum. This justifies the use of vector meson poles only in dispersion-theoretical calculations. We also calculate the imaginary part of the nucleon isovector axial form factor and show that it is small in the threshold region.

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On the Analysis of the Pion-Nucleon σ-Term: The Size of the Remainder at the Cheng-Dashen Point

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We calculate the one-loop contributions of order M_π^4 to the difference Δ_R between the on-shell pion-nucleon scattering amplitude $\bar{D}^+(0, 2\ M_\pi^2)$ at the Cheng-Dashen point $\nu = 0, t = 2\ M_\pi^2$ and the scalar form factor $\sigma(2M_\pi^2)$ in the framework of heavy baryon chiral perturbation theory. We proof that to this order Δ_R contains *no* chiral logarithms and therefore it vanishes simply as M_π^4 in the chiral limit. Numerically, we find as an upper limit $\Delta_R \simeq 2\ MeV$.

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Determination of the Low-Energy Constants of the Next-to-Leading Order Chiral Pion-Nucleon Lagrangian

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The next-to-leading order chiral pion-nucleon Lagrangian contains seven finite low-energy constants. Two can be fixed from the nucleon anomalous magnetic moments and another one from the quark mass contribution to the neutron-proton mass splitting. We find a set of nine observables, which to one loop order do only depend on the remaining four dimension two couplings. These are then determined from a best fit. We also show that their values can be understood in terms of resonance exchange related to Δ excitations as well as vector and scalar meson exchange. In particular, we elucidate the role of the fictitious scalar-isoscalar meson. We also discuss the chiral expansion of the two P-wave scattering volumes P_1^- and P_2^+ as well as the isovector S-wave effective range parameter b^-. The one-loop calculation is in good agreement with the data. The difference $P_1^- - P_2^+$ signals chiral loop effects in the πN P-waves.