Deep inelastic scattering from polarized deuterons ◇

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The spin-dependent structure function of the deuteron g_{1D}, is calculated within a covariant framework. The off-shell structure of the bound nucleon gives corrections to the convolution model at a level of half a percent for x below 0.7, increasing to more than five percent at larger x. Overall, the dominant source of error comes from the lack of knowledge associated with the deuteron D-state, which may introduce an uncertainty in the neutron spin structure function g_{1n}, extracted from deuterium data of up to ten percent for x around 0.2.

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Novel Pion Electroproduction Low Energy Theorems

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We present novel low-energy theorems for the P-wave multipoles $2M_{1+}+M_{1-}$, $M_{1+}-M_{1-}$, E_{1+}, and $L_{1\pm}$ for neutral pion electroproduction off protons. These should be very useful for the analysis of existing or future threshold data.

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Chiral prediction for the πN S-wave Scattering Length

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We evaluate the S-wave pion-nucleon scattering length a^- in the framework of heavy baryon chiral perturbation theory up-to-and-including terms of order M_π^4. We show that the order M_π^4 piece of the isovector amplitude at threshold, T^-_{thr}, vanishes exactly. We predict for the isovector scattering length $0.088\ M_{\pi^+}^{-1} \leq a^- \leq 0.096\ M_{\pi^+}^{-1}$.

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The Reaction $\pi N \to \pi\pi N$ at Threshold in Chiral Perturbation Theory

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In the framework of heavy baryon chiral perturbation theory, we give the chiral expansion for the $\pi N \to \pi\pi N$ threshold amplitudes D_1 and D_2 to quadratic order in the pion mass. The theoretical results agree within one standard derivation with the empirical values. We also derive a relation between the two threshold amplitudes of the reaction $\pi N \to \pi\pi N$ and the $\pi\pi$ S-wave scattering lengths, a_0^0 and a_0^2, respectively, to order $\mathcal{O}(M_\pi^2)$. We show that there are uncertainties mostly related to resonance excitation which make an accurate determination of the $\pi\pi$ scattering length a_0^0 from the $\pi\pi N$ threshold amplitudes at present very difficult. The situation is different in the $\pi\pi$ isospin two final state. Here, the chiral series converges and one finds $a_0^2 = -0.031 \pm 0.007$ consistent with the one-loop chiral perturbation theory prediction.

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