Chiral Perturbation Theory and the first moments of the Generalized Parton Distributions in a Nucleon

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We discuss the first moments of the parity-even Generalized Parton Distributions (GPDs) in a nucleon, corresponding to six (generalized) vector form factors. We evaluate these fundamental properties of baryon structure at low energies, utilizing the methods of covariant Chiral Perturbation Theory in the baryon sector (BChPT). Our analysis is performed at leading-one-loop order in BChPT, predicting both the momentum and the quark-mass dependence for the three (generalized) isovector and (generalized) isoscalar form factors, which are currently under investigation in lattice QCD analyses of baryon structure. We also study the limit of vanishing four-momentum transfer where the GPD-moments reduce to the well known moments of Parton Distribution Functions (PDFs). For the isovector moment $\langle x \rangle_{u-d}$ our BChPT calculation predicts a new mechanism for chiral curvature, connecting the high values for this moment typically found in lattice QCD studies for large quark masses with the smaller value known from phenomenology. Likewise, we analyze the quark-mass dependence of the isoscalar moments in the forward limit and extract the contribution of quarks to the total spin of the nucleon.