A Determination of the Nucleon Tensor Charge

L. Gamberg[a,b]

[a]*Department of Physics and Astronomy,*
University of Pennsylvania, Philadelphia, PA 19406, U.S.A.
[b]*Department of Physics and Astronomy,*
Tufts University , Medford, MA 02155 U.S.A.

Like the axial vector charges, defined from the forward nucleon matrix element of the axial vector current on the light cone, the nucleon tensor charge, defined from the corresponding matrix element of the tensor current, is essential for characterizing the momentum and spin structure of the nucleon. These charges, which are first moments of the quark helicity and transversity distribution functions, can be measured, in principle, in hard scattering processes. Because there must be a helicity flip of the struck quark in order to probe the transverse spin polarization of the nucleon, the transversity distribution (and thus the tensor charge) decouples at leading twist in deep inelastic scattering [1], whereas no such suppression appears in Drell-Yan processes [2]. This makes the tensor charge difficult to measure and its non-conservation makes it difficult to predict. While there may be constraints on the leading twist quark distributions through positivity bounds (e.g. the inequality of Soffer [3, 4]), aside from model dependent calculations (e.g. the QCD sum rule approach [5, 6]) there are no definitive theoretical predictions for the tensor charge. We pursue a different route. Exploiting an approximate phenomenological SU(6) symmetry of the light axial vector mesons ($a_1(1260)$, $b_1(1235)$ and $h_1(1170)$) and using pole dominance, we calculate the tensor charge [7]. The result is simple in form and depends on the decay constants of the axial vector mesons and their couplings to the nucleons, along with the average transverse momentum of the quarks in the nucleon. The result is compared with other estimates, particularly the QCD sum rule approach and the Nambu-Jona-Lasinio chiral soliton model [8]. We also explore some hypothetical photoproduction processes for which measurements of the tensor charge may be feasible.

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