Q^2–dependence of the generalised Gerasimov–Drell–Hearn Integral on the deuteron, proton and neutron

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The Gerasimov–Drell–Hearn (GDH) sum rule connects the anomalous contribution κ to the magnetic moment of the nucleon with an energy–weighted integral over the difference of the helicity–dependent photoabsorption cross sections. Originally derived for real photons the GDH integral can be generalised to the case of virtual photons. It then is related to the first moment Γ_1 of the spin structure function $g_1(x, Q^2)$ in deep inelastic scattering (DIS). Data on the proton and on ^{3}He have been presented by HERMES previously [1,2]. The first data set for a deuteron target taken over a large range in Q^2 and photon energy ν is presented now. Together with the data published already this provides an unprecedented measurement of the generalised GDH integral on the deuteron, proton and neutron for $1.2 < Q^2 < 12.0$ GeV^2 and for photon–nucleon centre–of–mass energies W ranging from $1 < W^2 < 45$ GeV^2 thus covering the resonance as well as the deep inelastic scattering region. These data allow the study of the Q^2–dependence of the full GDH integral, which is sensitive to both the Q^2–evolution of the resonance form factors and contributions of higher twist. The resonance contribution is seen to decrease rapidly with increasing Q^2 whereas the DIS contribution remains sizeable down to the lowest measured Q^2. At higher Q^2 the data are found to be in agreement with measurements of the first moment of g_1. From data on the deuteron and proton, the GDH integral for the neutron has been derived and the proton–neutron difference evaluated. This difference is related to the fundamental Bjorken sum rule at high Q^2.

References

[1] HERMES Collaboration, K. Ackerstaff *et al.*, Phys. Lett. **B 444** (1998) 531.

[2] HERMES Collaboration, A. Airapetian *et al.* Phys. Lett. **B 494** (2000) 1.