HERMES Measurements of the Generalized Gerasimov-Drell-Hearn Integral and of Quark-Hadron Duality

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The Gerasimov–Drell–Hearn (GDH) sum rule relates the anomalous 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 has been generalised to photons with virtuality Q^2. In this case it is related to the .rst moment of the spin structure function $g1(x,Q^2)$ measured in deep inelastic scattering (DIS). The kinematics of the HERMES experiment allow for the first time to measure the full generalized GDH integral for several bins over the range $1.2 < Q^2 < 12.0$ GeV^2 and simultaneously separating the photon–nucleon invariant mass squared W2 into resonance and DIS region, $1 < W^2 < 4.2$ and $4.2 < W^2 < 45$ GeV^2, respectively. A similar behaviour is seen for deuteron, proton and neutron: the DIS contribution is sizeable for all Q^2 and even remains of comparable size to the resonance contribution when Q^2 decreases below 3 GeV^2, while the latter disappears fast when Q^2 increases above this value. In the measured range no effects are seen neither from nucleon-resonance excitation nor from higher twists.

As related subject, HERMES results are shown on the validity of the Quark-Hadron Duality, introduced by Bloom and Gilman as relationship between physics concepts underlying resonance production on the one hand and DIS, on the other. For $Q^2 > 1.7$ GeV^2, the spin asymmetry measured in the above defined resonance region is found to agree well with its description in terms of quark degrees of freedom, as measured in the DIS region. This appears to be very similar to the unpolarized case.

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