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Nucleon spin structure in Holographic QCD

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Spin observables yield a wealth of tests to our current understanding of the nucleon internal structure. In particular, novel challenging experimental data from Jefferson Lab have been published on the so-called generalized spin polarizabilities, which quantify the spin-dependent internal rearrangement of the nucleon probed by an external virtual photon. We compute the resonance contribution to the nucleon spin structure functions at low energy in the Witten-Sakai-Sugimoto model of holographic QCD. Our analysis includes both spin 3/2 and spin 1/2 nucleon resonances with positive and negative parity. We determine, in turn, the helicity amplitudes for nucleon-resonance transitions and the resonance contributions to the neutron and proton generalized spin polarizabilities. Extrapolating the model parameters to realistic QCD data, our analysis agrees with the observation that the $\Delta(1232)$ resonance gives the dominant contribution to the forward spin polarizabilities at low momentum transfer. As expected, the contribution of the $\Delta(1232)$ to the longitudinal-transverse polarizabilities is instead negligible. Our analysis shows that different spin 1/2 resonances give different contributions, in sign and magnitude, to the generalized longitudinal-transverse spin polarizabilities.

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