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Novel Features of Hadronic Form Factors[1]

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The increasingly common use of the double-polarization technique to measure the nucleon electromagnetic form factors, in the last 15 years, has resulted in a dramatic improvement of the quality of all four nucleon electromagnetic form factors, G_{Ep}, G_{Mp}, G_{En} and G_{Mn}. It has also completely changed our understanding of the proton structure, having resulted in a distinctly different Q^2-dependence for G_{Ep} and G_{Mp}, contradicting the prevailing wisdom of the 1990's based on cross section measurements and the Rosenbluth separation method, namely that G_{Ep} and G_{Mp} obey a "scaling" relation $\mu G_{Ep} \sim G_{Mp}$. A direct consequence of the faster decrease of G_{Ep} revealed by the JLab polarization experiments was the disappearance of the early scaling $F_2/F_1 \sim 1/Q^2$ predicted by perturbative QCD. Electromagnetic form factors encode the information on the structure of a strongly interacting many-body system of quarks and gluons, such as the nucleon. Much theoretical efforts have been made to understand the nucleon form factors. This reflects the fact that a direct calculation of nucleon form factors from the underlying theory, Quantum Chromodynamics, is complicated as it requires, in the few GeV momentum transfer region, non-perturbative methods. Therefore, in practice it involves approximations which often have a limited range of applicability. The unexpected results of the nucleon electromagnetic form factors using double-polarization high-precision experiments, have challenged our theoretical understanding of the structure of the nucleon. They have triggered several new theoretical developments, which will be discussed.

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