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New Extraction of the Flavor Decomposition of the Nucleon Electromagnetic Form Factors

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Recent measurements of the neutron's electric to magnetic form factors ratio, $R_n = \mu_n G_E^n/G_M^n$, up to 3.4 (GeV/c)^2 [1] combined with previous $R_p = \mu_p G_E^p/G_M^p$ measurements in the same Q^2 range [2] allowed, for the first time, a detailed comparison of the ratios F_2^n/F_1^n and F_2^p/F_1^p as well as a separation of the up- and down-quark contributions to the form factors at high Q^2 [1,3]. The earlier analysis [3] combined measurements (and the associated uncertainties) of R_n with parametrizations of the other form factors [4], neglecting their uncertainties. Our new analysis [5] expands on the original by including two-photon exchange (TPE) corrections to the proton form factors [6], adding the recent CLAS G_M^n extractions [7], and accounting for the uncertainties in all of the nucleon form factors. With these modifications, we extract a complete set of flavor-separated form factors up to $Q^2 \approx 4.0$ (GeV/c)^2 and compare these results to recent calculations of the up- and down-quark contributions. In this talk we will present our results, emphasizing the TPE correction procedure used to extract the proton form factors and uncertainties, as well as the updated extraction of the magnetic form factor of the neutron. We find large differences between the up- and down-quark contributions to the nucleon form factors suggesting significant flavor dependence in the charge and magnetization distributions. In addition, the strong linear falloff in G_E^p/G_M^p with Q^2 is not present in either the up- and down-quark contributions, and arises in the proton due to a cancellation between the up- and down-quark contributions. Also, our results suggest that the down-quark contributions to the Dirac and Pauli form factors deviate from the $1/Q^4$ scaling, with small differences observed between the Q^2 dependence in F_1 and F_2 for both the up- and down-quark contributions. Moreover, the up and down quarks yield very different contributions to G_E/G_M (and F_2/F_1), and the down-quark contribution to this ratio is not well reproduced by any of the models. Finally, the tension between the CLAS and older G_M^n extractions suggests the need for improved measurements near 1.0 (GeV/c)^2 to obtain reliable information on the down-quark contributions at low Q^2.

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