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Extraction of the proton radius from electron-proton scattering data

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We perform a new analysis of electron-proton scattering data to determine the proton electric and magnetic radii, enforcing model-independent QCD-based constraints of form factor analyticity. A wide-ranging study of possible systematic effects is performed. An improved analysis is developed that rebins data taken at identical kinematic settings, and avoids a scaling assumption of systematic errors with statistical errors. Employing standard models for radiative corrections, our improved analysis of 2010 Mainz A1 collaboration data yields a proton electric radius rE=0.895(20) fm and magnetic radius rM=0.777(38) fm. A similar analysis applied to world data (excluding Mainz data) implies rE=0.918(24) fm and rM=0.913(37) fm. The Mainz and world values of the charge radius are consistent, and a simple combination yields a value rE=0.904(15) fm that is 4σ larger than the CREMA muonic hydrogen determination. The Mainz and world values of the magnetic radius differ by 2.5σ, and a simple average yields rM=0.847(27) fm. The circumstances under which published muonic hydrogen and electron scattering data could be reconciled are discussed, including a possible deficiency in the standard radiative correction model which requires further analysis.

Oral or Poster Presentation

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