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Lattice Calculation of the Proton Charge Radius

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The charge radius of the proton has been measured in scattering and spectroscopy experiments using both electronic and muonic probes. The electronic and muonic measurements have a currently unresolved five sigma discrepancy, giving rise to what is known as the proton radius puzzle.

Since the neutron charge radius is known, measurement of the proton charge radius on the lattice typically involves determination of the isovector form factors at various 4-momentum transfers Q^2 and then determining the slope at $Q^2 = 0$. However, due to the discretization of momentum on the lattice, there is a systematic uncertainty from extrapolation of the slope to $Q^2 = 0$. One can access negative values of Q^2 if one breaks isospin symmetry by introducing a nonzero mass splitting between the up and down quarks and then extrapolating to the limit where this splitting vanishes. We present preliminary results from this method at unphysical quark masses to determine if this method has the potential to reduce uncertainties.

Primary authors: GREBE, Anthony (Massachusetts Institute of Technology); Prof. SHANAHAN, Phiala (Massachusetts Institute of Technology); Dr DETMOLD, William (MIT)

Presenter: GREBE, Anthony (Massachusetts Institute of Technology)

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