A novel approach for determining spatial moments of the proton charge density

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The internal structure of the nucleon is a field of intensive study. This structure can be experimentally probed through electron elastic scattering off a proton target. This allows the extraction of the proton electric and the magnetic form factors which characterize the charge and the magnetization densities. The spatial moments of the proton charge density are extracted using the electric form factor (EFF) data. Up to now, methods rely on the evaluation of the EFF derivative in the limit of zero four-momentum transfer Q^2 enabling access only to positive even orders of spatial moments. A novel approach [1] based on integral forms of the Fourier transform of the density function allows the determination of spatial moments of densities to any real valued order. Within this approach, we compute spatial moments of different orders from a reanalysis of EFF data obtained with Rosenbluth separation and from low Q^2 experiments covering a range of Q^2 from 2×10^{-4} up to 8.8 GeV^2. We pay specific attention to the evaluation of systematic uncertainties. In this context, the evaluation of the proton charge radius corresponding to the second order moment of the proton charge density will be discussed.

References

[1] M. Hoballah et al. Connecting spatial moments and momentum densities. *Phys. Lett. B 808, 135669*, arXiv:2008.02009 [nucl-th].