Theory and computation highlights in April, 2019
(May 5, 2019)

The proton charge radius is a fundamental quantity of nuclear physics and attests to the hadron's finite spatial extent and composite internal structure. Its experimental determination and precise value have become the subject of great interest, with different values obtained from atomic physics measurements (muonic and electronic) and elastic electron-proton scattering ("proton radius puzzle"). A collaboration of JLab theorists (J.M. Alarcon, C. Weiss) and experimentalists has extracted the proton charge radius from the electron-proton scattering data, using a novel theoretical method combining chiral effective field theory and dispersion analysis, developed in the Theory Center [Phys.Rev. C99 (2019) 044303]. The extracted radius of 0.844(7) fm is consistent with the high-precision muonic hydrogen results, resolving a long-standing discrepancy. The theoretical methods can be extended to describe other low-Q^2 nucleon form factors and generalized parton distributions.

The determination of resonances properties of hadrons is a major focus of experiments in Hall B and D at Jefferson Lab, and also worldwide. JLab Theory Staff and The Hadron Spectrum Collaboration (HadSpec) have been using lattice Quantum Chromodynamics methods to calculate scattering amplitudes. In two recent papers, they have investigated $K^*\pi$ elastic scattering (arXiv:1904.03188) searching for a resonance in S-wave scattering, and $\pi\omega$ and $\pi\varphi$ scattering (1904.04136) in which the b_1 resonance is found.

In a joined effort, JPAC and members of the CLAS collaboration evaluated resonance contributions into inclusive electron scattering from the results on the nucleon resonance electroexcitation amplitudes determined by CLAS in exclusive meson electroexcitation, and a new paper [arXiv:1904.08016] from this joint effort is submitted to Phys. Rev. C for publication. Synergistic efforts between the studies of inclusive and exclusive reactions allow us to gain inside into the nucleon parton distributions (PDFs) at large values of Bjorken variable x_B in the resonance region. This extension of the knowledge on nucleon PDFs to large x_B is of particular importance for understanding the discovery potential of the mass reach at the LHC, as well as for comparing with new information on nucleon PDFs extracted from recent Lattice QCD calculations of the novel quasi-/pseudo-PDFs.