Theory and computation highlights in September, 2021
(Contribution to the Director's Monthly Report to JSABOD)
October 7, 2021

The Theory led JLab LDRD project in QIS is acquiring new technology to improve the number and scaling of single photon detectors. The Lab will evaluate and deploy Superconducting Nanowire Single Photon Detectors (SNSPD-s). Two channels have been acquired from Quantum Opus. These detectors have about 1000x improvement in resolution time compared to the existing Transition Edge Sensors used in the UVA system. JLab electronics has ordered the components to build an upgraded version of the f-ADC systems used in other projects to meet the higher speed requirements of the SNSPD system.

Recently, the LHCb Collaboration announced observation of another X-like candidate, this time however, containing two charm quarks instead of a charm-anti-charm pair, labeled T_{cc}. In a recent paper [arXiv:2108.06002], theorists of JPAC have performed a first-principle amplitude analysis of the T_{cc} signal, and their study of the pole behavior suggests that it may originate from a $D^{*+}D^0$ virtual state.

The Jefferson Lab Angular Momentum (JAM) Collaboration completed a new global QCD analysis [arxiv:2109.00677] of unpolarized parton distributions within a Bayesian Monte Carlo framework, including new *W*-lepton production data from the STAR Collaboration at RHIC and Drell-Yan di-muon data from the SeaQuest experiment at Fermilab. The impact of these two new measurements on the light antiquark sea in the proton, and the antidown-antiup asymmetry in particular, was assessed. The SeaQuest data were found to significantly reduce the uncertainty on the antidown/antiup ratio at large parton momentum fractions, strongly favoring an enhanced antidown sea, in general agreement with model calculations based on chiral symmetry breaking in QCD.

An important input for the calculation of the two-photon exchange correction to the muonic deuterium Lamb shift is the unpolarized forward doubly-virtual Compton scattering off the deuteron. A collaboration between theorists at the University of Mainz and Jefferson Lab has performed a high-precision model-independent calculation [arXiv:2109.08223] of the amplitude in the framework of pionless effective field theory, up to next-to-next-to-next-to-leading order, including the dependence on the photon virtuality for the first time. With this input, the work also studies the lowest spin-independent deuteron generalized polarizabilities.