

Keh-Fei Liu – HEP seminar – April 6, 2021  
University of Kentucky

Title: Hadron Cosmological Constant and Parton Degrees of Freedom

Abstract:

I will discuss the origin of the proton mass from the Hamiltonian and gravitational form factor formulations. After examining the mass decomposition in the stress-energy-momentum tensor, it is found that the glue part of the trace anomaly can be identified as the vacuum energy from the glue condensate and gives a CONSTANT restoring pressure which balances that from the traceless part of the Hamiltonian to confine the hadron, much like the cosmological constant Einstein introduced for a static universe. From a lattice calculation of this anomaly in the charmonium, we deduce the associated string tension which turns out to be in good agreement with that from a Cornell potential which fits the charmonium spectrum.

We point out that there is a connected sea parton degree of freedom from the hadronic tensor in the Euclidean path-integral formalism and the quasi-parton from the large momentum effective theory. The separation of the connected and disconnected sea partons is accommodated with the CT18 parametrization of the global analysis of the parton distribution functions (PDFs). This is achieved with the help of the distinct small  $x$  behaviors of these two sea partons and the constraint from the lattice calculation of the ratio of the strange momentum fraction to that of the  $\bar{u}$  or  $\bar{d}$  in the disconnected insertion. We compare the resulting PDFs of this new fit, using the same data set as the original CT18 fits, with the published CT18 family of PDFs.