APR15-2015-020051

Abstract for an Invited Paper
for the APR15 Meeting of
the American Physical Society

Proton - a fascinating relativistic many-body system - remains puzzling[1]

HAIYAN GAO, Duke Univ and Duke Kunshan University

Proton, a fundamental building block of visible matter in the universe, is a facinating relativistic many-body system. It is also nature's best laboratory to study strong interaction and quantum chromodynamics, the theory describing it. Despite decades of studies and many discoveries, proton remains puzzling. While the LHC discovery of the Higgs boson validates the mechanism for some fundamental particles to have masses in Standard Model, Higgs is almost irrelevant to the mass of the proton. The European Muon Collaboration discovered in late 1980s that quarks inside the proton contribute only about a quarter to the total spin of the proton. This discovery generated major theoretical and experimental efforts in the last two decades trying to piece together the total spin of the proton. While the proton spin is becoming less puzzling, another new puzzle about proton developed in the last a few years concerning the "size" of the proton. The ultrahigh precise value of the proton charge radius determined from muonic hydrogen Lamb shift measurements is 7-8 smaller than values determined from electron-proton scattering experiments and hydrogen Lamb shift measurements. In this talk, I will review these puzzles and the efforts to solve them.

[1]This work is supported by the U. S. Department of Energy under Contract No. DE-FG02-03ER41231.