

The 181st HENPIC seminar by Prof. Craig D. Roberts

Title: Perspective on the Emergence of Nature's Principal Mass Scale

Abstract: Visible matter is characterised by a single mass scale; namely, the proton mass. The proton's existence and structure are supposed to be described by quantum chromodynamics (QCD); yet, absent Higgs boson couplings, chromodynamics is scale invariant. Thus, if the Standard Model is truly a part of the theory of Nature, then the proton mass is an emergent feature of QCD; and emergent hadron mass (EHM) must provide the basic link between theory and observation. Nonperturbative, symmetry-preserving tools are necessary if such connections are to be made. In this context, I will sketch recent progress in the application of continuum Schwinger function methods to an array of related problems in hadron and particle physics. Special emphasis will be given to the three pillars of EHM – namely, the running gluon mass, process-independent effective charge, and running quark mass; their role in stabilising QCD; their measurable expressions in a diverse array of observables; and the critical part played by Poincaré invariance in eliminating artificial dynamical effects, in particular, ensuring the invisibility of Lorentz Contraction.

Summary