



The 181st HENPIC seminar

Perspective on the Emergence of Nature's Principal Mass Scale

Speaker: Prof. Craig D. Roberts

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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.

ABOUT THE SPEAKER:

Prof. Roberts joined the faculty of the School of Physics at Nanjing University in September 2019, where he is also Head of the Institute for Nonperturbative Physics, he received his PhD in theoretical physics from the Flinders University of South Australia in 1988. Following a postdoctoral fellowship at the University of Melbourne, Victoria, Australia, he joined the Theory Group in the Physics Division at Argonne National Laboratory in 1989, first as a postdoctoral fellow, then a staff member; and from 2001-2017, he was Leader of the Theory Group. Prof. Roberts was elected to APS Fellowship in 2001; won the Friedrich Wilhelm Bessel Research Award of the Alexander von Humboldt Foundation in 2003; was honored by the Chinese Ministry of Education as an International Distinguished Professor in 2015; and was selected into the National High-level Talents Plan for Professionals in 2019.



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