

EXPOSING THE MASS AT THE HEART OF VISIBLE MATTER

Craig D. Roberts

Physics Division, Argonne National Laboratory, Argonne Illinois 60439, USA

Exposing the mass at the heart of visible matter Classical QCD is a non-Abelian local gauge theory. Remove the current-quark mass and there's no scale left. There is no dynamics in a scale-invariant theory; only kinematics: the theory looks the same at all length-scales so there can be no clumps of anything. Therefore, bound-states are impossible and our Universe can't exist. The Higgs boson doesn't solve this problem. Normal matter is constituted from light-quarks; and the mass of protons and neutrons, the kernels of all visible matter, are 100-times larger than anything the Higgs can produce. Hence the question: "Where did it all begin?" can be rephrased: "Where did it all come from?" Answers and explanations depend on the observer's preferred frame of reference and resolving scale. At a scale typical of contemporary experiment, the dynamical chiral symmetry breaking paradigm provides an excellent, intuitive method to explicate and understand the associated emergent phenomena. This perspective leads to numerous predictions that can be tested at JLab12, *e.g.* related to hadron elastic and transition form factors, PDFs, GPDs and TMDs, some of which will be elucidated in this presentation.