Title: From the quarks to the cosmos

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The Quantum chromodynamics (QCD) Lagrangian, which is part of the Standard Model of Nuclear and Particle Physics, describes interactions among quarks and gluons. These fundamental particles are bound inside protons, neutrons and other hadrons, yet are never seen directly in nature. Empirical evidence suggests that QCD is a robust theory; however, it does not directly describe how quarks and gluons make up protons, neutrons, and ultimately atomic nuclei. We utilize electron scattering experiments to understand the evolution from quarks and gluons to protons and neutrons. CEBAF at Jefferson Laboratory produces a highly polarized, high-luminosity, 12 GeV electron beam to study this fundamental question of nuclear physics. In this talk, I will describe results from experiments today, where they will lead in the future, and their connections to the cosmos in which we all live.

About David Dean

David Dean is the Deputy Director for Science and Technology (DDST) and Chief Research Officer at Thomas Jefferson National Accelerator Facility. Throughout his career, Dean has been instrumental in pursuing new programs and capabilities that capitalize on institutional strengths.

Dean is an accomplished theoretical and computational physicist, working in the areas of quantum many-body physics as applied to nuclear structure, astrophysics, and quantum chromodynamics. As DDST, he guided the development of the proposal for the High Performance Data Facility, which was awarded to Jefferson Lab in partnership with Lawrence Berkeley National Laboratory in the fall of 2023. Dean has shepherded the lab's Science & Technology portfolio during the past 3½ years, ensuring that project execution for MOLLER (Measurement of a Lepton-Lepton Electroweak Reaction) and the Electron-Ion Collider (EIC) remain on track and that the Continuous Electron Beam Accelerator Facility enables a broad user community to perform world-leading investigations of the strong nuclear force.

Prior to joining Jefferson Lab in January of 2022, Dean led a large national team of scientists in proposing the Quantum Science Center at ORNL and was its inaugural director for two years. His seminal work in quantum information science included the first publication of a quantum computer calculation of ground-state properties of the deuteron. Prior to his associate laboratory director and Physics Division director positions at ORNL, Dean was senior advisor to the Under Secretary for Science at the DOE.

Dean is a fellow of the American Physical Society and the American Association for the Advancement of Science (for his "distinguished contributions to the field of nuclear theory, particularly for development and application of innovative computational techniques and for academic leadership and public service"). He has served on numerous advisory boards and panels. He was a post-doctoral fellow in physics at Caltech and received a doctorate in physics from Vanderbilt in 1991. He has more than 200 publications in theoretical and computational physics.