Jefferson Lab Report

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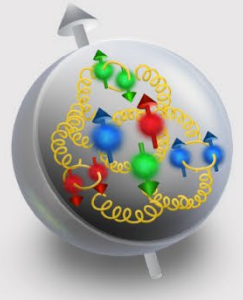
Director

June 21, 2024

TJNAF is managed by Jefferson Science Associates for the US Department of Energy

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Jefferson Lab Is…



Single program DOE-SC Lab with a mission of discovery in the fundamental science of protons, neutrons and atomic nuclei

Home to CEBAF, the preeminent electron-microscope for nuclear physics, hosting the largest nuclear physics user community in the world

Leader in the field of the study of the atomic nucleus and nuclear force with supercomputers

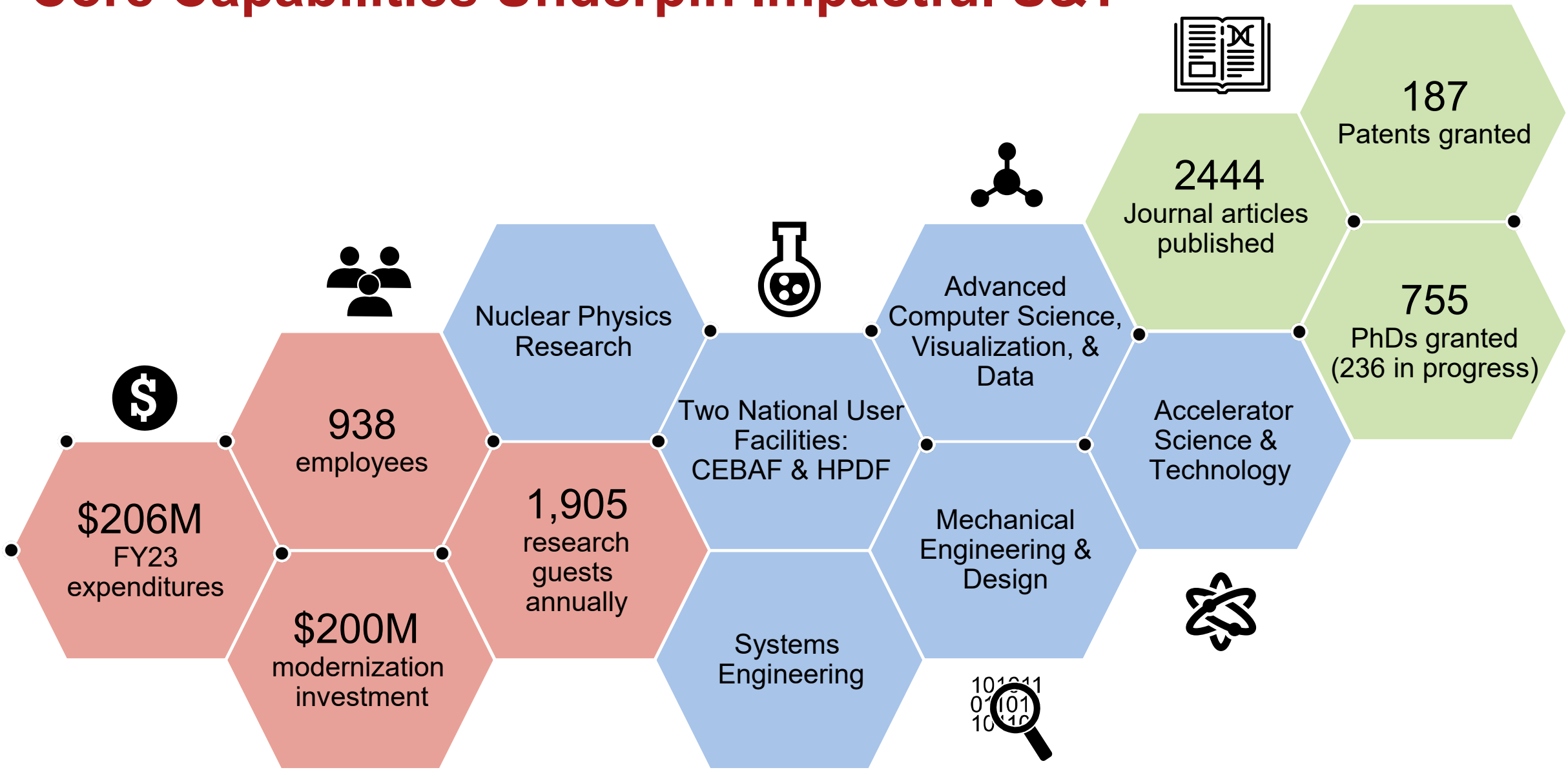
Nation's leader in advanced particle accelerator and cryogenic systems

Evolving from single-purpose to multi-program, centered on the High Performance Data Facility

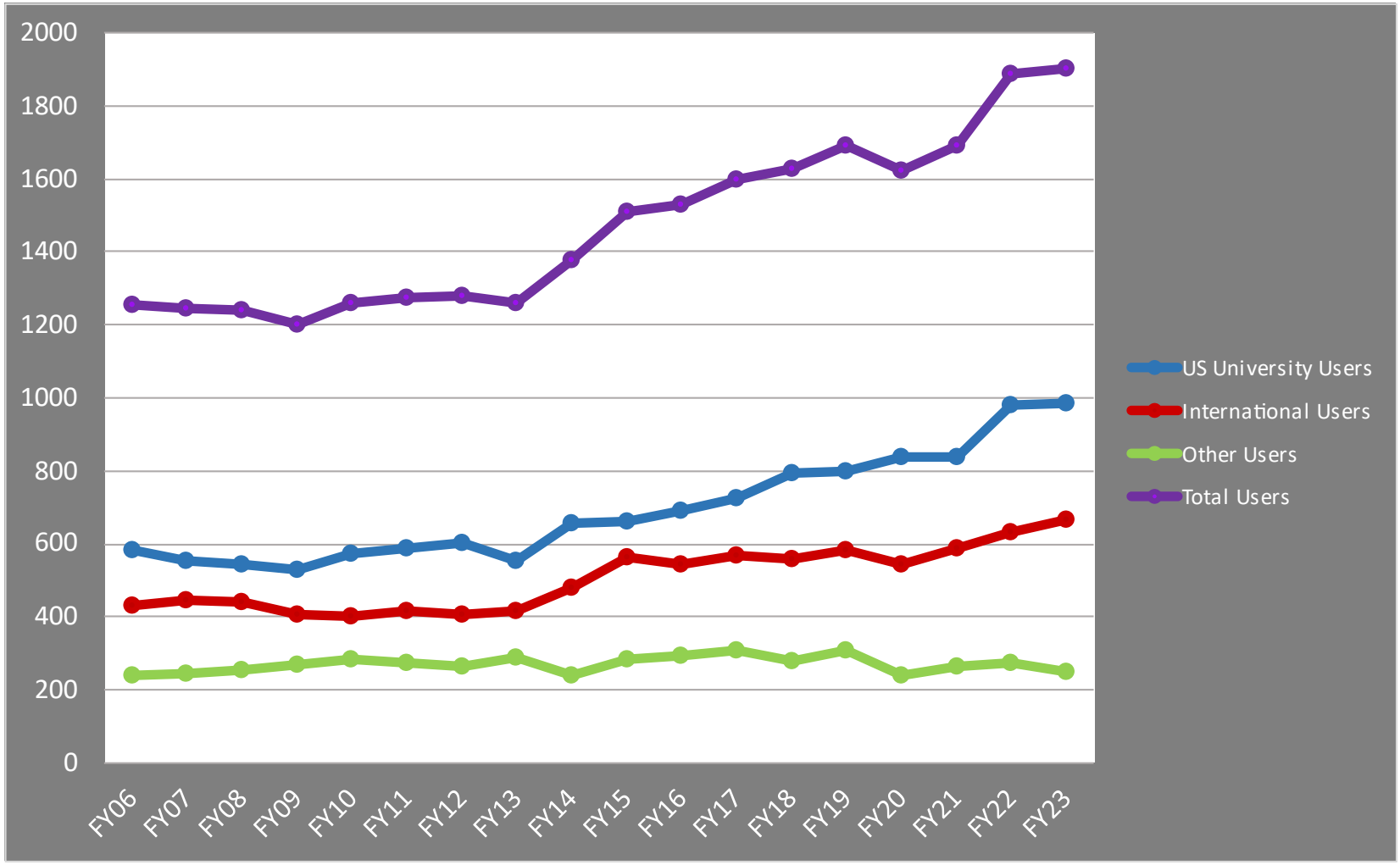
Hampton University
Graduate Studies Program

A vital S&T asset regionally and nationally, and an important community partner

Core Capabilities Underpin Impactful S&T

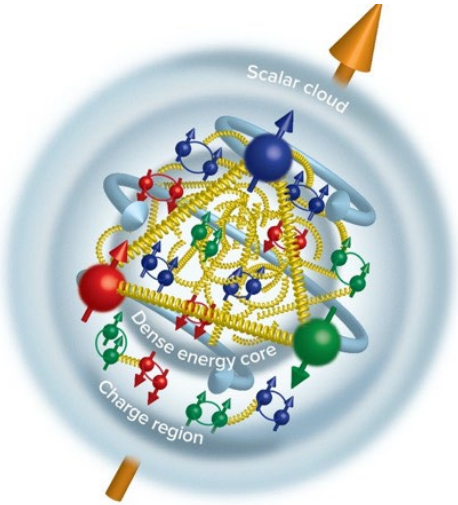


Our User Community is Growing



CEBAF Scientific Highlights

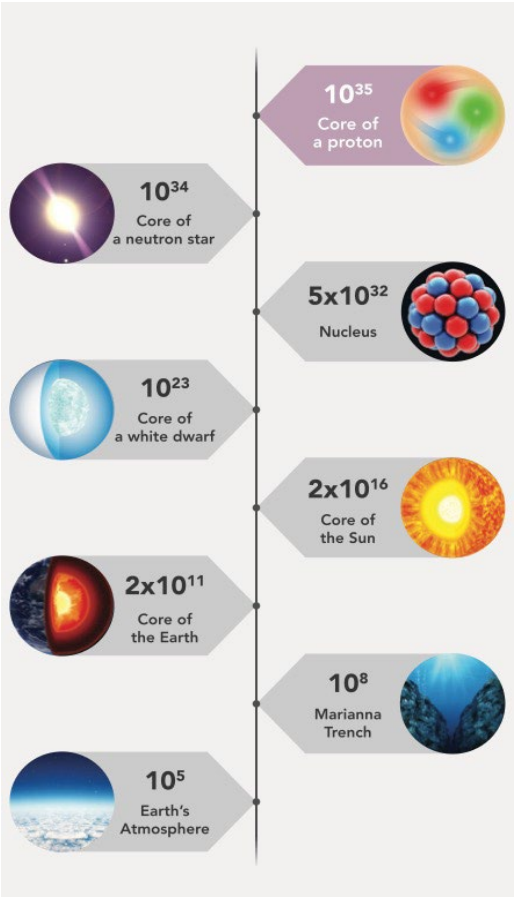
Where is the mass within the proton?

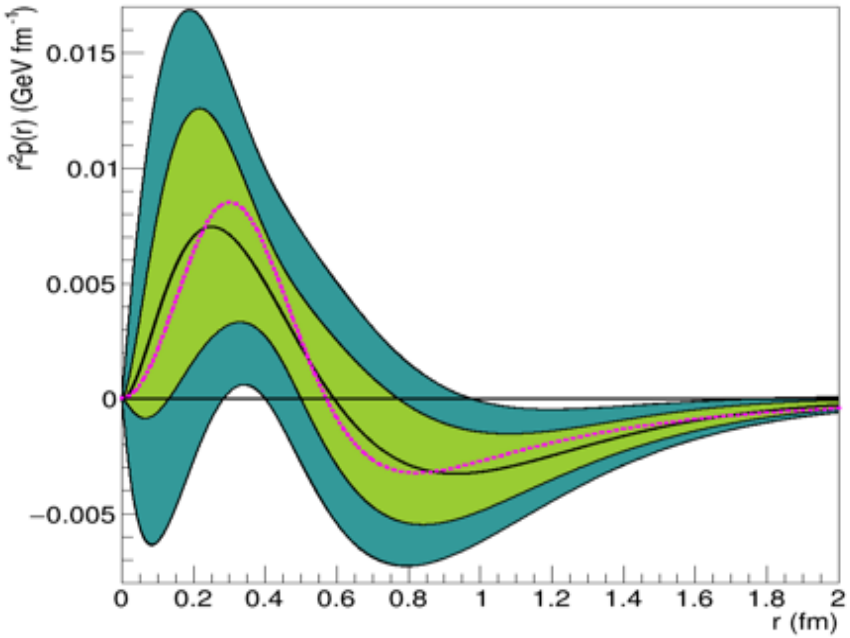


"Determining the gluonic gravitational form factors of the proton," Duran et al, Nature 615, 813 (2023)

- Near threshold J/psi photoproduction experiment
- Inner Gluon radius: 0.52 +/- 0.03 fm
- Charge radius: ~0.84-0.88 fm
- Scalar gluon rad: 1.069+/-0.056 fm

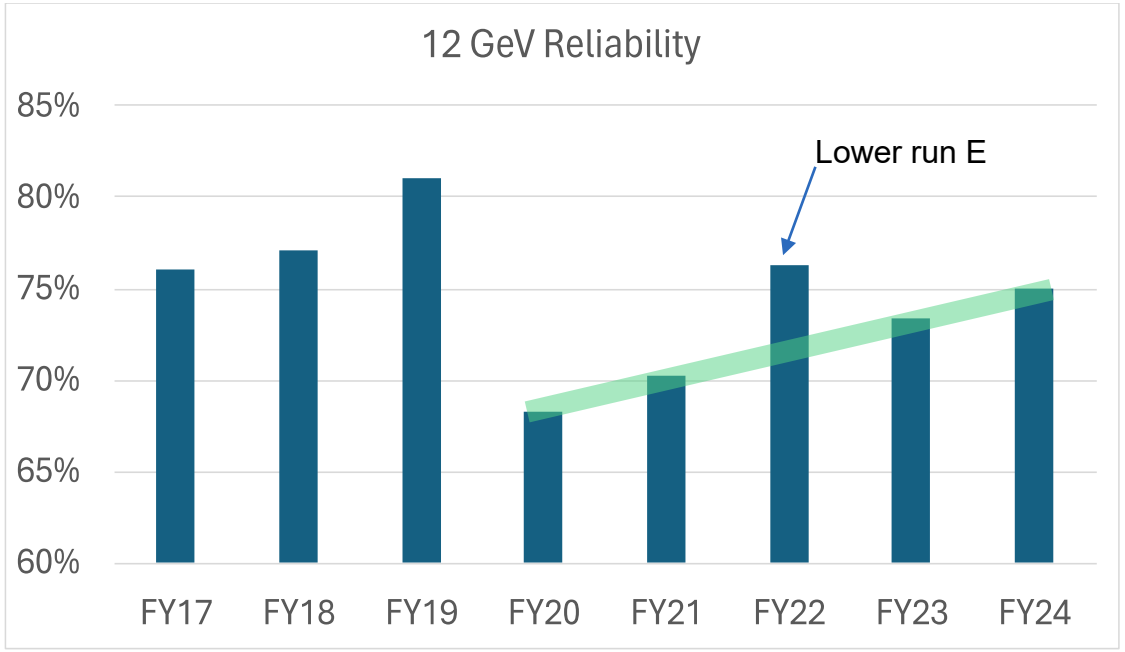
Measuring the pressure inside the proton





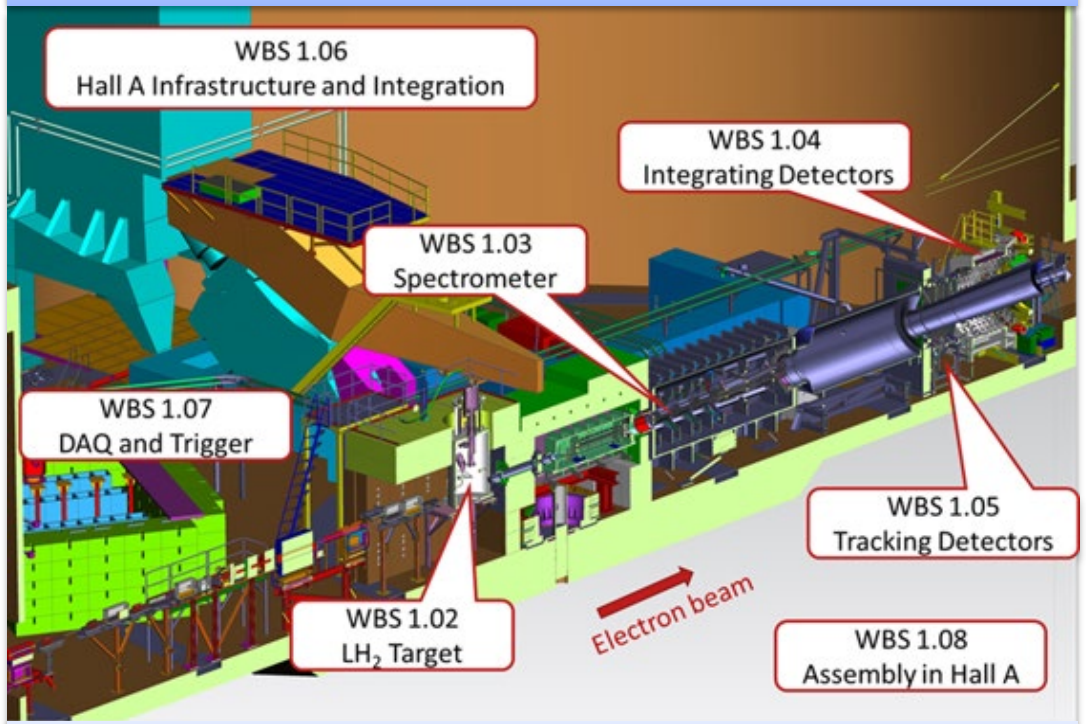
Burkert, V.D., *et al.*, Colloquium: Gravitational form factors of the proton. *Reviews of Modern Physics* **95**, 041002 (2023)

CEBAF Performance and Future Directions



- Improvement efforts (CEBAF Performance Plan) aimed at higher reliability and energy reach required by experiments

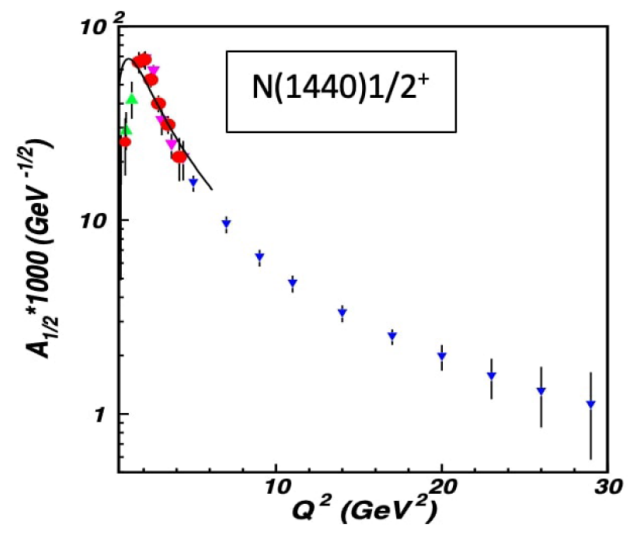
MOLLER Project recently baselined (CD-2)



SoLID science program was endorsed by the 2023 NSAC Long Range Plan (Recommendation #4) as one of the projects "that lay the foundation for the discovery science of tomorrow"

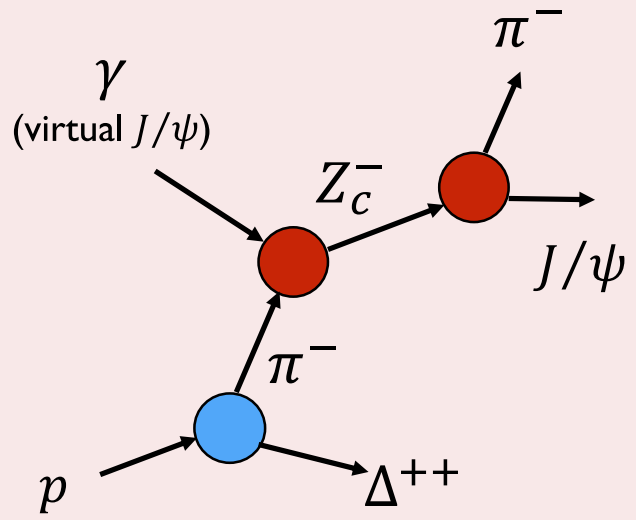
The Physics of CEBAF at 22 GeV

How does QCD generate hadrons?



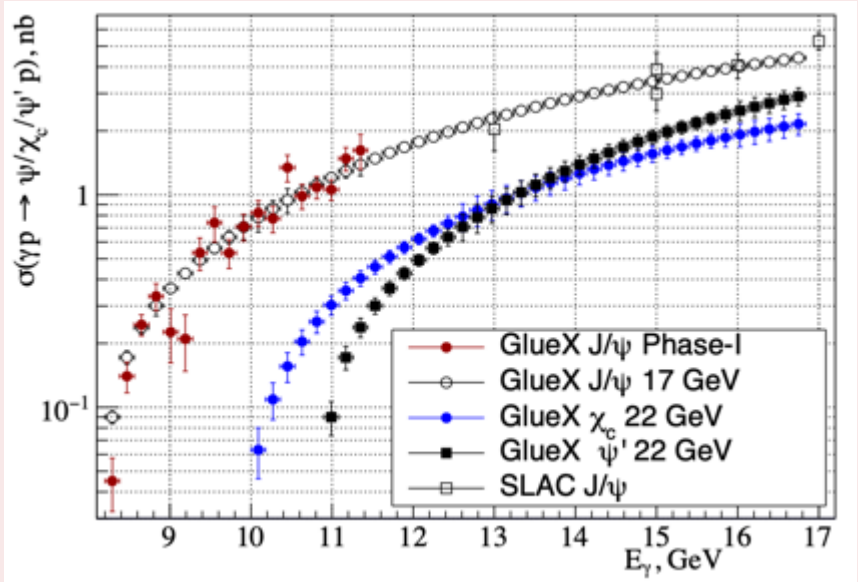
- Q^2 evolution of the γ_vpN* electrocouplings could offer an insight into hadron mass generation and the emergence of the N* structure from QCD
- Simulations indicate JLab22 is the only foreseeable facility to extend these measurements up to 30 GeV^2 and down to α_s/π=0.15 where non-and perturbative QCD coexist.

Are there pure exotic states?



Direct (photon) probe of the $Z_c \to J/\psi\pi$ coupling without rescattering effects provides unique complementary data to constrain interpretation of e^+e^- data.

Can we harness threshold charmonium production to probe proton/gluon properties?

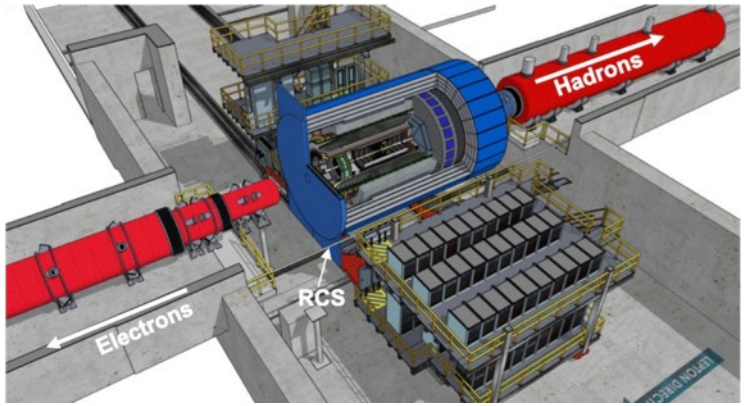


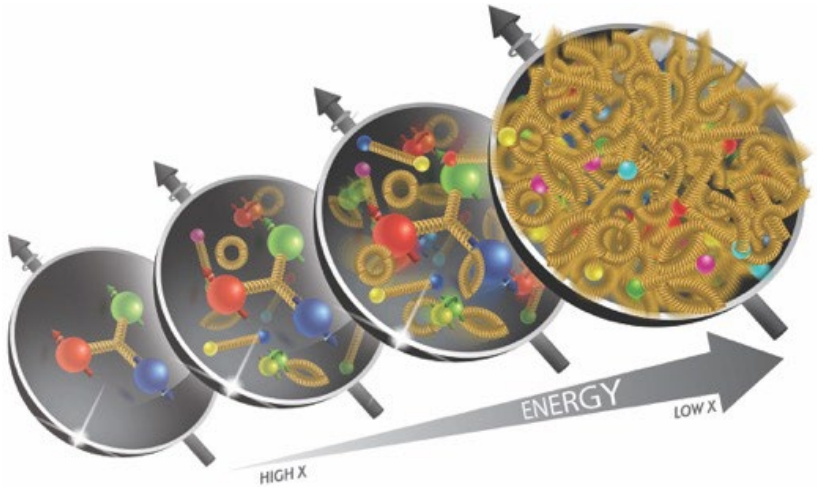
Exclusive charmonium production near threshold probes gluon/mass properties of

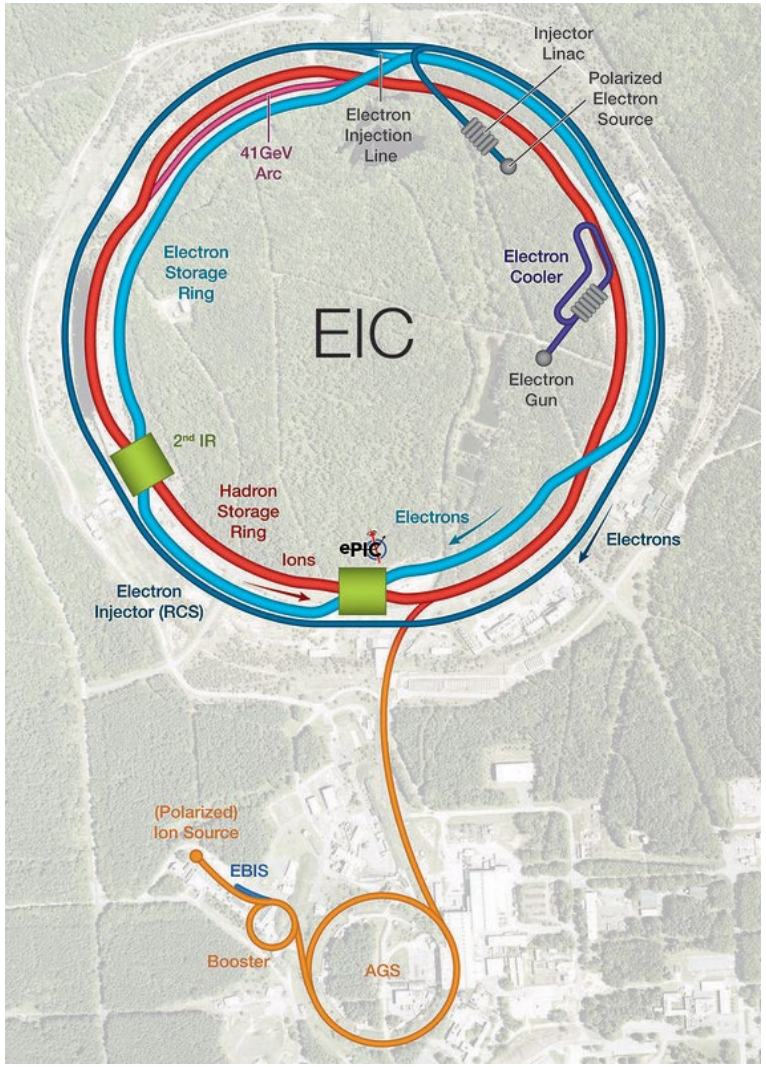
A. Accardi et al., Strong Interaction Physics at the Luminosity Frontier with 22 GeV Electrons at Jefferson Lab, arXiv:2306.09360 (2023), and European J. Phys. (in press, 2024).

Electron-Ion Collider

- Jefferson Lab is partnering with BNL in the design and construction of the Electron-Ion Collider
- Jefferson Lab has roles in
  - Accelerator: SRF, Cryogenics, magnets, …
  - Detector: design and specific systems; jointly with BNL supporting ePIC collaboration
- Progressing on long-lead procurements after CD-3A approval








Questions

Notional Timelines

- Accelerator team has worked up an early schedule and cost estimate
  - Schedule assumptions based on a notional timing of when funds might be available (near EIC ramp down based on EIC V3 profile)
  - For completeness, Moller and SoLID (part of 12 GeV program) are shown; positron source dev shown

- EIC Project is shown