



ALD's opening remarks: Looking into the past and the future

Abhay Deshpande
Associate Laboratory Director
Nuclear and Particle Physics Directorate

May 12, 2026



Two Milestones, Many People

The Relativistic Heavy Ion Collider (RHIC): A smashing success

- 25 years of world-class operations
- Groundbreaking discoveries – Quark Gluon Plasma, Gluon Spin
- Sustained scientific output over 25+ years

The Electron-Ion Collider (EIC): Why and Why Now?

- Transformational physics research
- Advanced accelerator, detector, and computing technologies
- AI from design to discovery

World leadership in nuclear & accelerator physics for decades

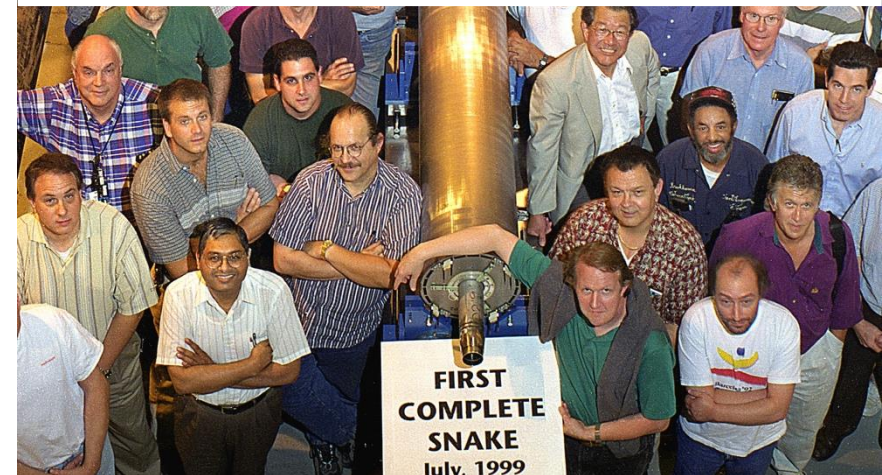
People behind the achievements: THANK YOU!

- Scientists, engineers, technicians, support staff
- From Brookhaven, other DOE Labs, across the U.S., around the world

Support from DOE, Congress, New York State



Breaking ground for RHIC in 1995



Attendees at the 2025 RHIC-AGS Users' Meeting

Safety first

Safety Is How We Succeed

- Own your safety—and watch out for each other
- If something feels wrong, speak up. Every time.
- Make safety part of everything you do—here and at home
- Our standard: everyone goes home safe—stronger than they arrived

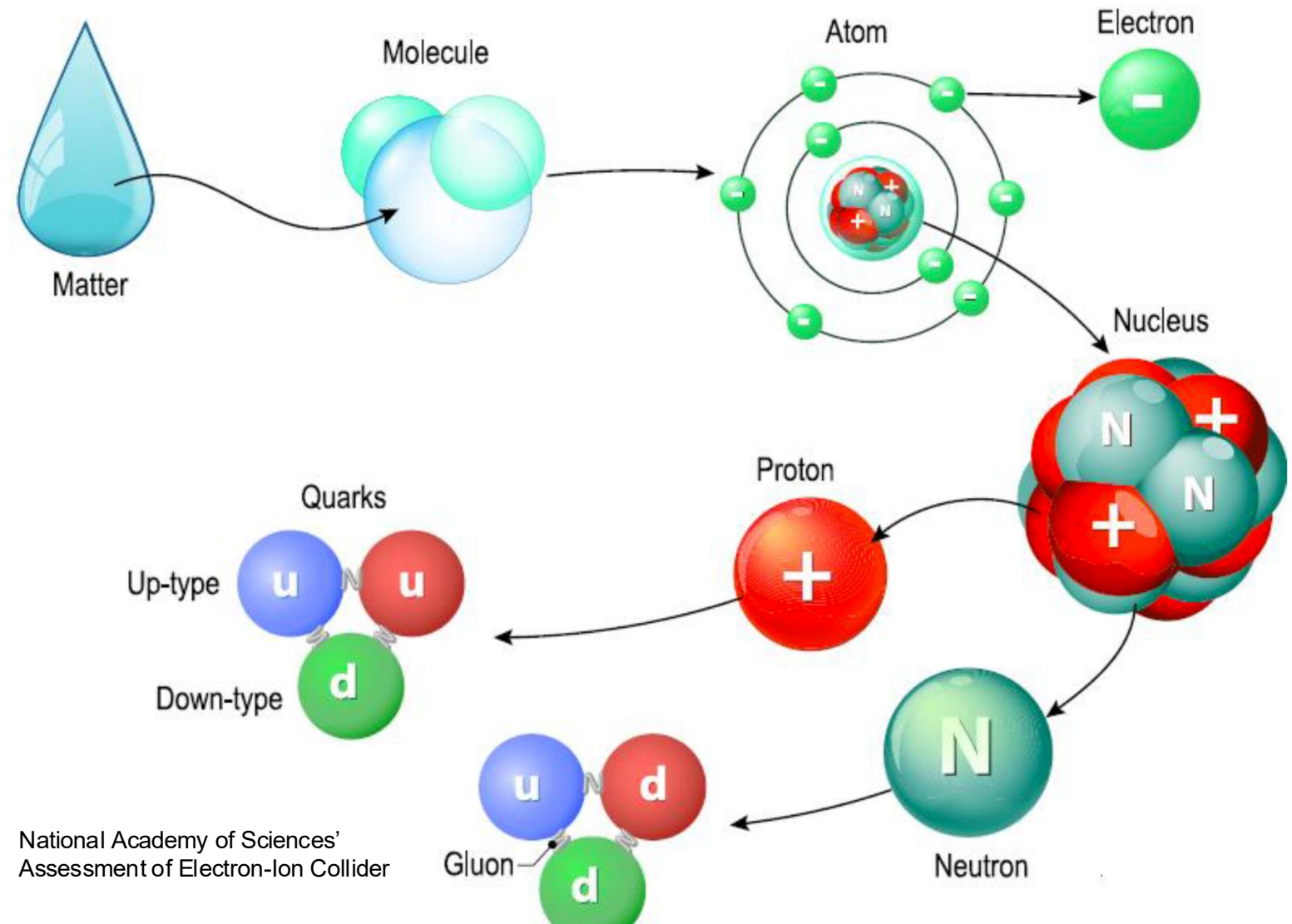
No safety. No science.

Scientific excellence starts with keeping the people safe.

Humankind's Quest to Discover the Fundamental Structure of Matter



- What's inside?
- What are we made of?
- What's the "smallest?"
- What can't be broken down any further?

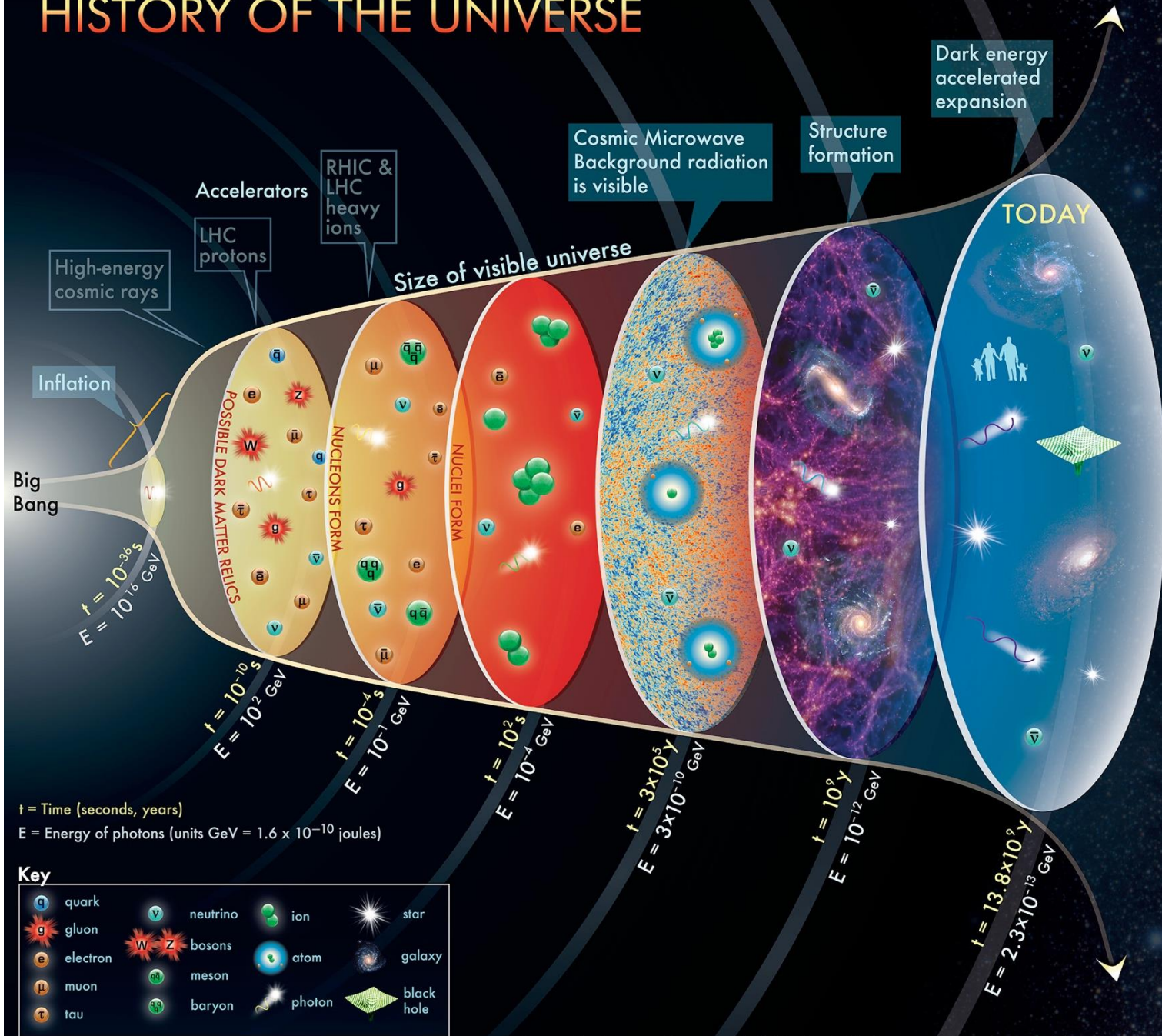




**Quest for understanding the
fundamental structures of matter is also
a journey to the early Universe**

HISTORY OF THE UNIVERSE

Journey to the Early Universe



t = Time (seconds, years)
E = Energy of photons (units GeV = 1.6×10^{-10} joules)

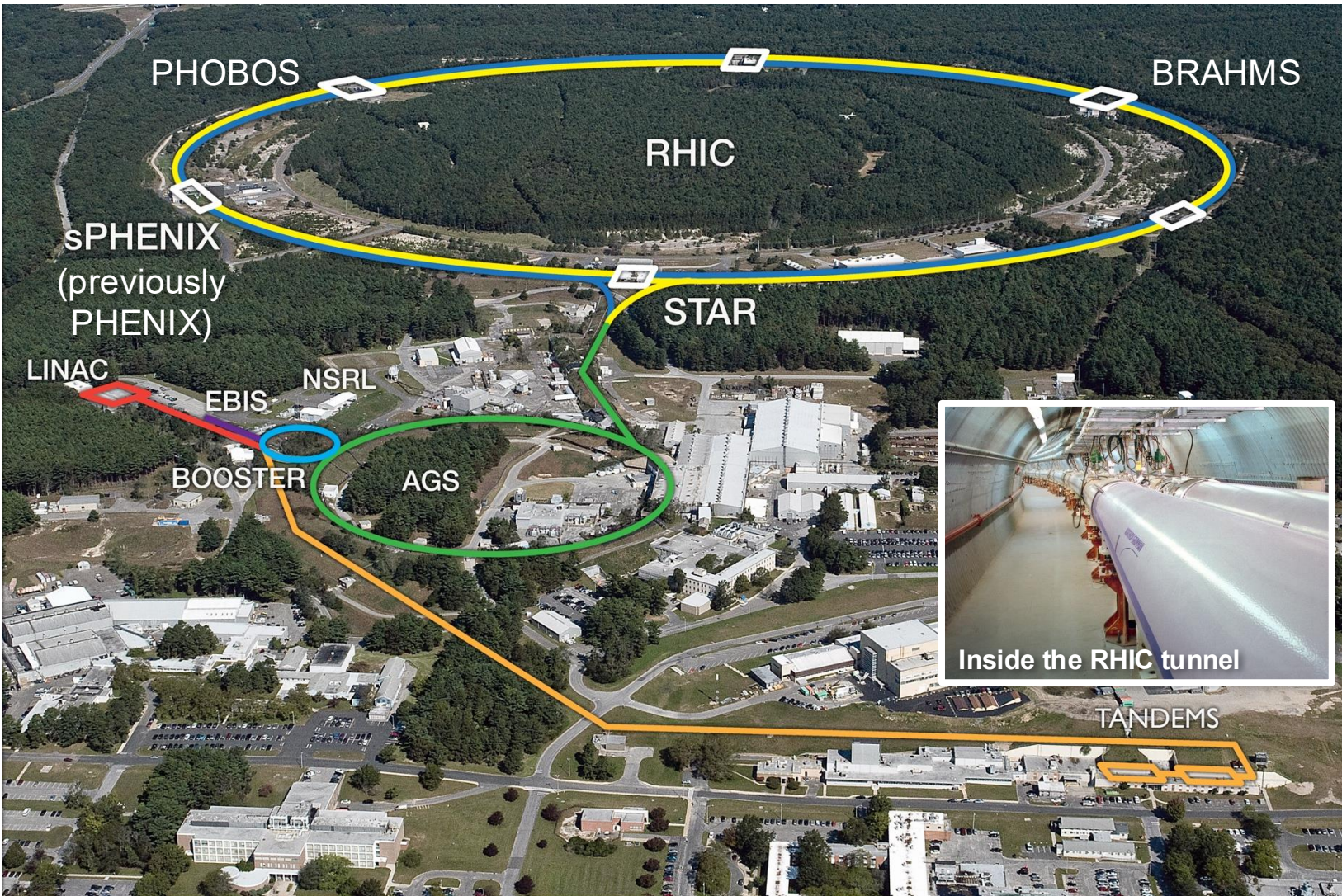
Key

q	quark	v	neutrino	ion	star
g	gluon	W Z	bosons	atom	galaxy
e	electron	meson		photon	black hole
μ	muon	baryon			
τ	tau				

The concept for the above figure originated in a 1986 paper by Michael Turner.

The Relativistic Heavy Ion Collider (2000-2026)

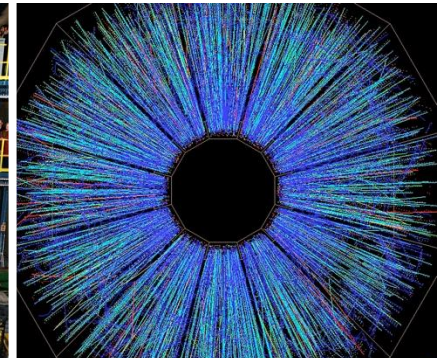
A machine built to explore fundamental matter at the dawn of time



Inside the RHIC tunnel



STAR

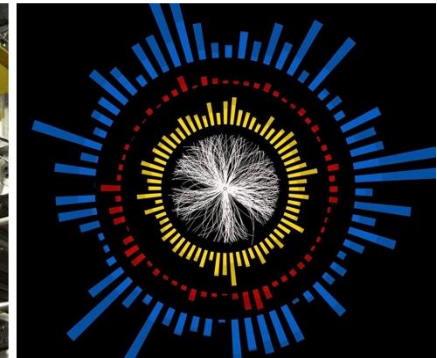


Collaborations, experiments

- PHOBOS: 2000 – 2005
- BRAHMS: 2000 – 2006
- PHENIX: 2000 – 2016
- STAR: 2000 – 2026
- sPHENIX: 2023 – 2026



sPHENIX



RHIC: The World's Most Versatile Collider




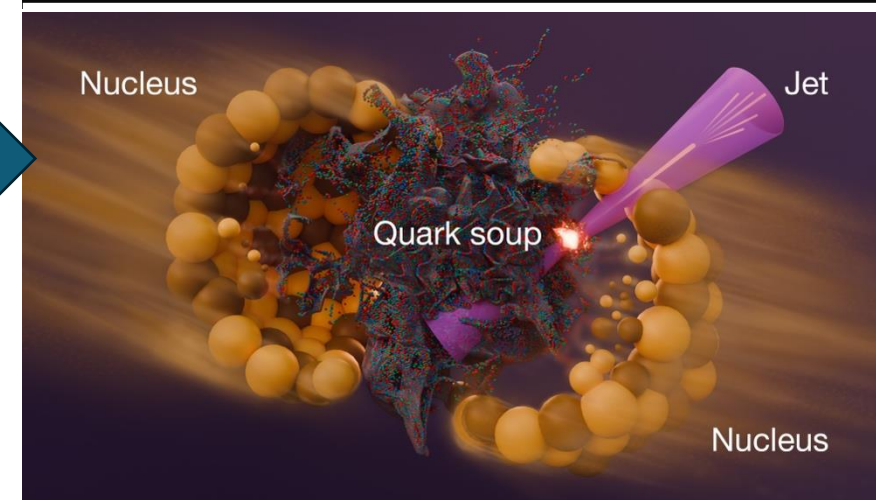
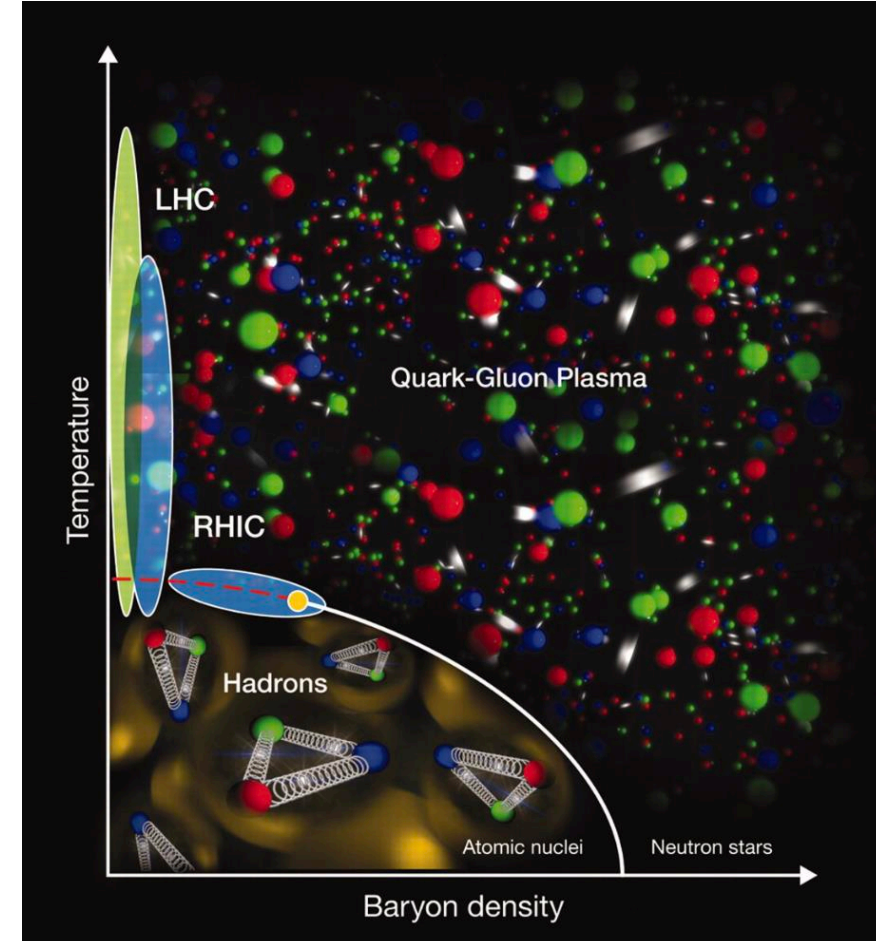
- High-intensity, high-brightness ion and proton sources
- 49 different combinations of energy, ions, and collision configurations
 - 10 different ion species
 - 18 center-of-mass energies
- Innovative accelerator technologies
- Gold-gold collision rates 44 times higher than design
- Only polarized proton collider in the world

Discoveries at RHIC

Quark-Gluon Plasma (QGP): A 'Perfect,' Ultra-Dense Fluid

RHIC re-created the quark-gluon plasma of the early universe.

- 4 trillion °C — **hottest matter** ever created at the time.
 - Expected to be a gas, but it **flows like a liquid**.
 - Extremely low viscosity — near the **quantum limit**.
 - Unique transition from **gas to liquid upon heating!**
-
- Extreme density “quenches” energetic “jets” of particles. 
 - Surprising: QGP “droplets” discovered in collisions of small nuclei as well!



Discoveries at RHIC

Gluon's Contribution to Proton Spin & much more

- Unique ability to accelerate/collide spin-aligned protons. → Enabled studies of how **gluons** contribute to proton spin.
- Experiments at CERN, SLAC, DESY & later JLab showed quarks contribute about ~30%.
- RHIC found that **gluons** also contribute to spin, about **as much as the quarks**
 - Measured the anti-quark polarization
 - Established transverse momentum dependent dynamics within the proton → TMDs → transverse position GPD's
- Establishes the groundwork for understanding this important quantum property at the future EIC



Trillions of Collisions, Extraordinary Impacts

- ~300 trillion collisions, in total
- ~450 petabytes of data (raw and derived)
- 3,500+ scientific collaborators from 36 countries (2000-present)
- 650+ scientific publications; 640+ Ph.D.s awarded
- ~220 newsworthy announcements (1991 to present)
- Papers and their impact (1700+ papers, 120,000+ citations)
 - PHENIX (2000-2016, 635 papers, 41.6k Citations),
 - STAR (2000-2026, 869 papers, 61.3k citations)
 - BRAHMS (2000-2006, 90 papers, 6.6k citations)
 - PHOBOS (2000-2006, 121 papers, 10.5k citations)
 - sPHENIX (2023-2026, 8 papers, 80 citations)

RHIC science graduates now in leadership positions at LHC, Jlab, KEK, JPARC and facilities in Europe and Asia





The ultimate recognition

[Click here.....](#)

February 6, 2026

EIC CD3 B approval announced

Feb 3, 2026: Last weekly RHIC planning meeting started in 2000

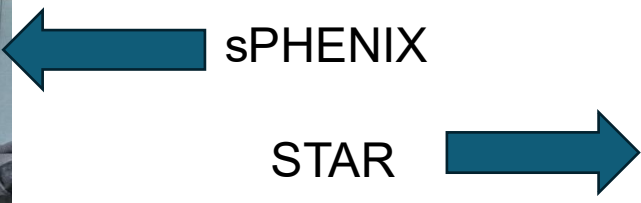


The button that shut RHIC down

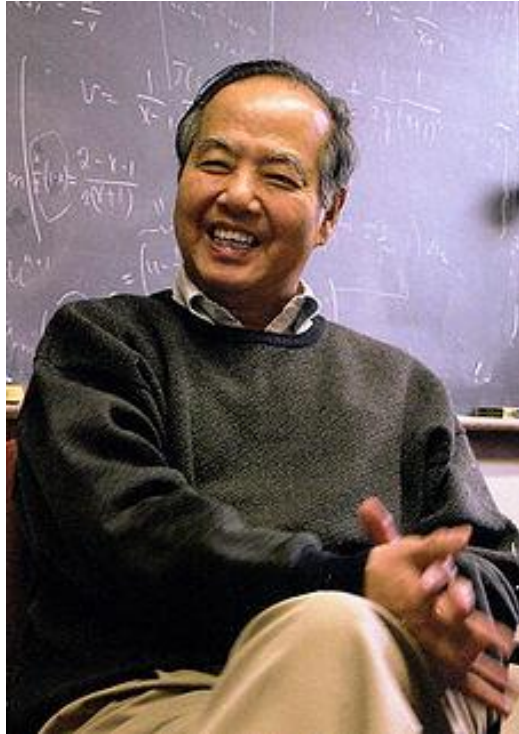


PHYSICS
The only U.S. particle collider shuts down – so a new one may rise

The Relativistic Heavy Ion Collider stops work after more than 25 years of mind-bending discoveries
By Emily Conover



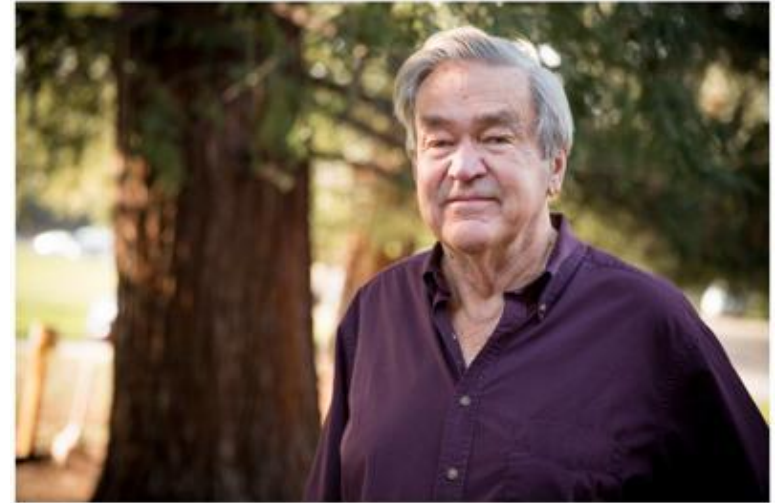
As we say goodbye to RHIC, we also celebrate the lives of three outstanding scientists this week...



T. D. Lee



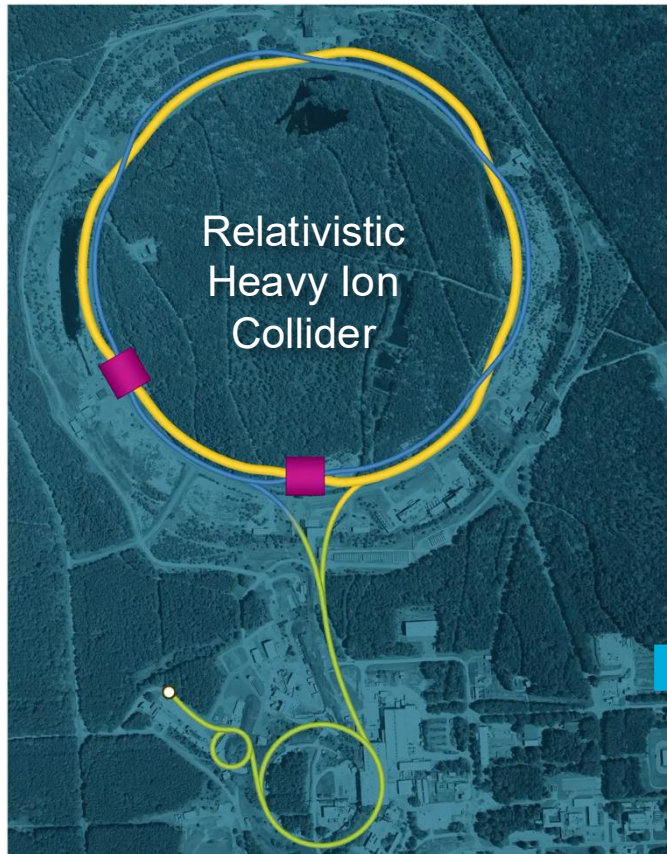
Sam Aronson



James D. Bjorken

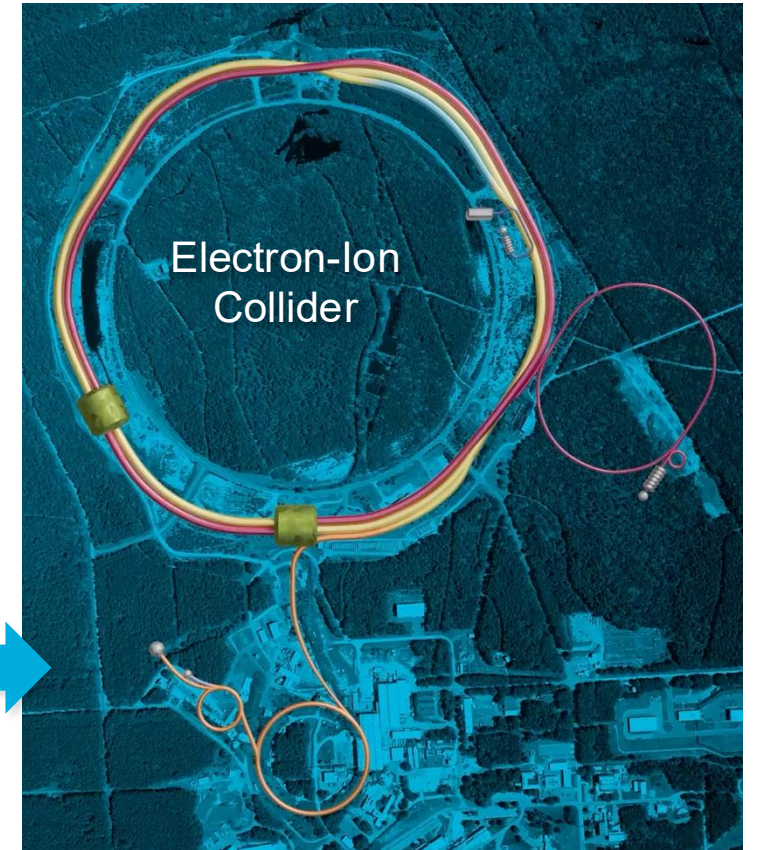
Stay tuned for eulogies by Shoji Nagamiya (Thursday), Bill Zajc & Doon Gibbs (Friday) and Raju Venugopalan (Friday)

A New Era of Discovery: From RHIC to the Electron-Ion Collider (EIC)



Building on the ~\$2 billion+ investment in RHIC:

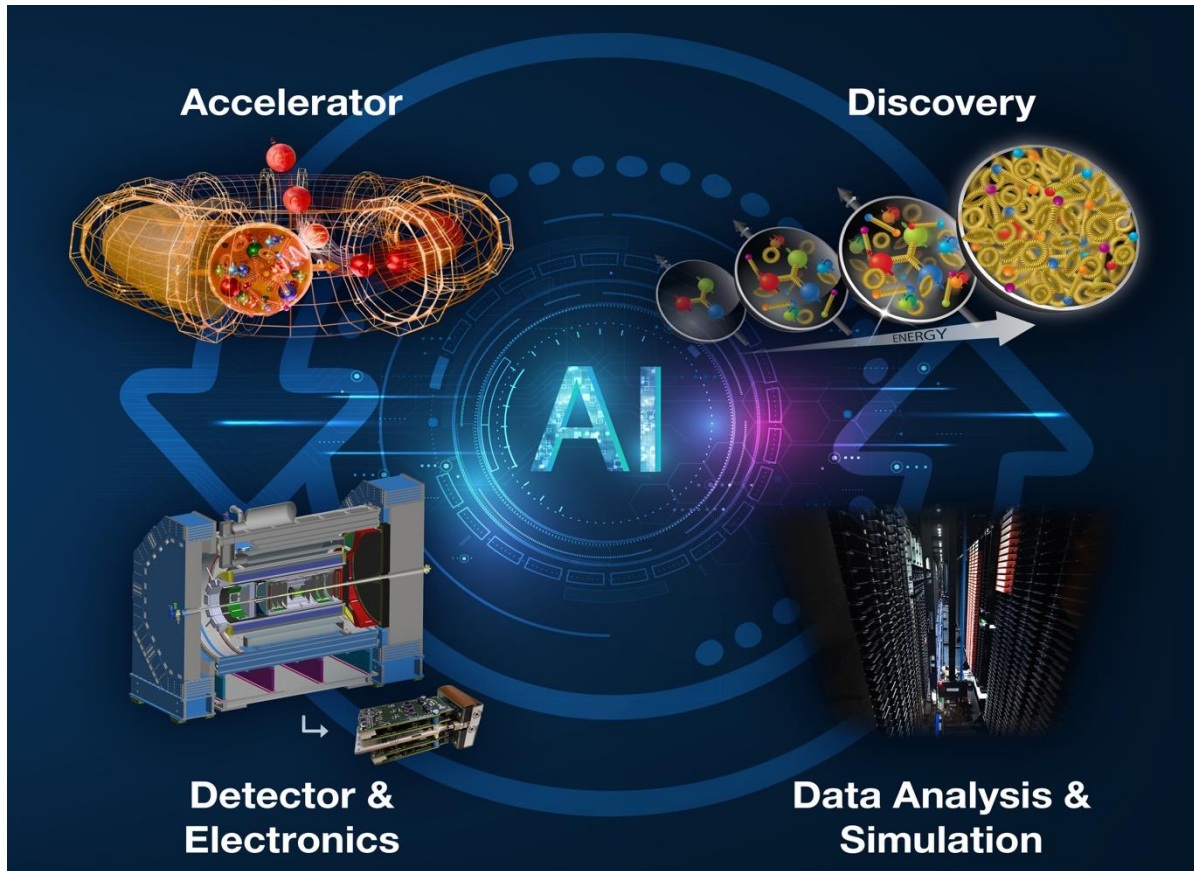
- Re-use existing tunnel
- Minimal modification to ion beam complex (yellow)
- New electron beam facility



Partnership between U.S. Department of Energy, Brookhaven Lab, Thomas Jefferson National Accelerator Facility, New York State, and collaborators around the world.

The Electron-Ion Collider

An AI End-to-End Facility

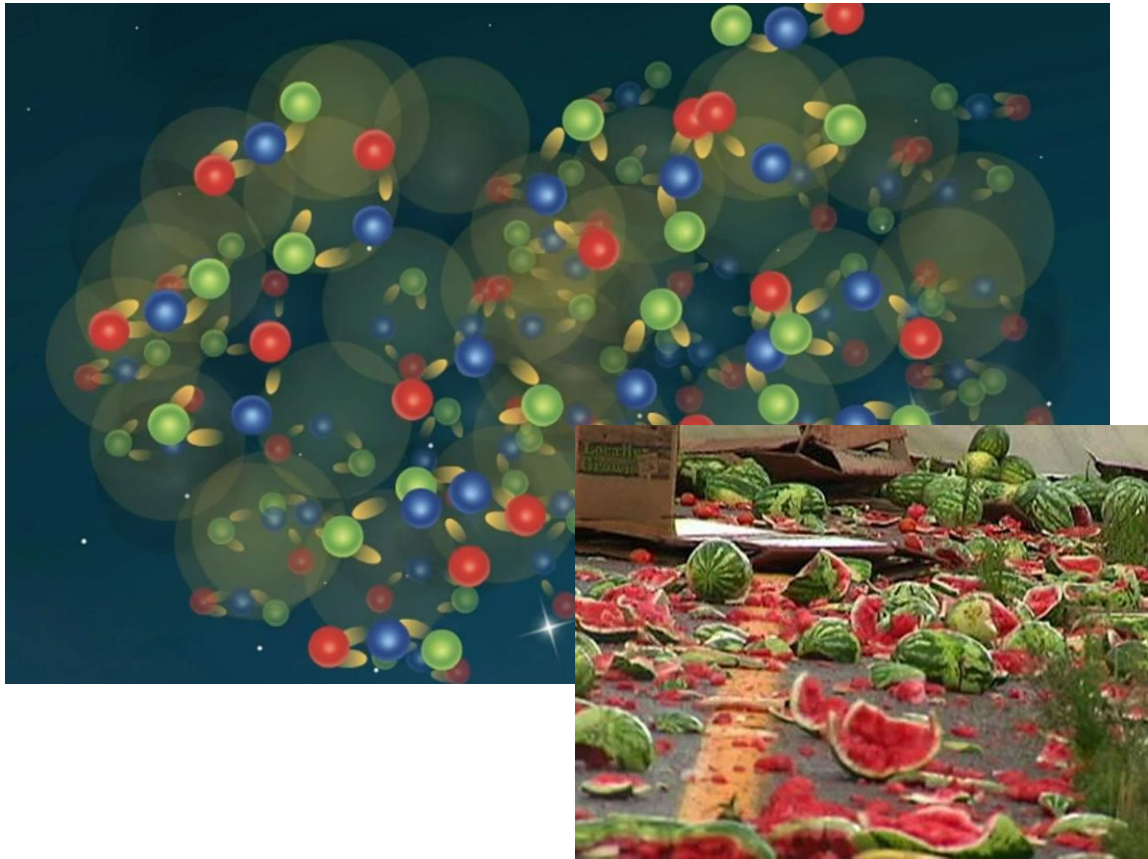


- First large-scale facility to leverage AI from the design and R&D phases to discovery.
- Accelerator, detector, and data analysis will all use — and push the evolution of — advanced AI techniques with potential impacts for other fields and facilities.
- A BNL grown foundation model: “FM4NPP” exceptionally promising.... Additional project on accelerator controls and operations underway

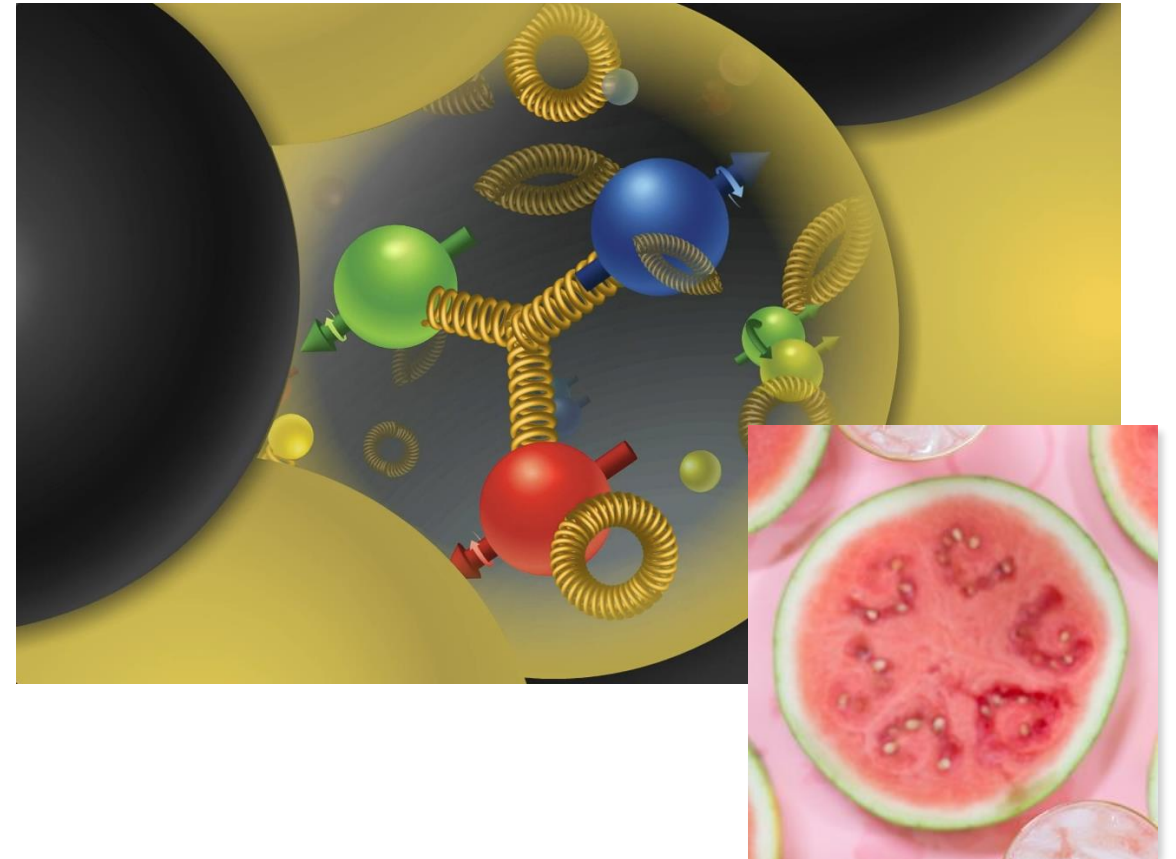
The Electron-Ion Collider

RHIC Smashed Ions, EIC Will 'Slice'

RHIC



EIC



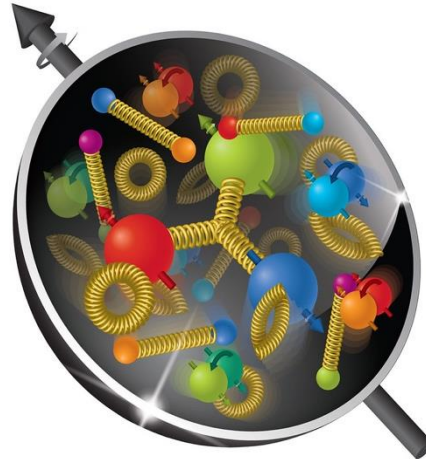
The Electron-Ion Collider

Answers to Nobel-Prize-Worthy Questions

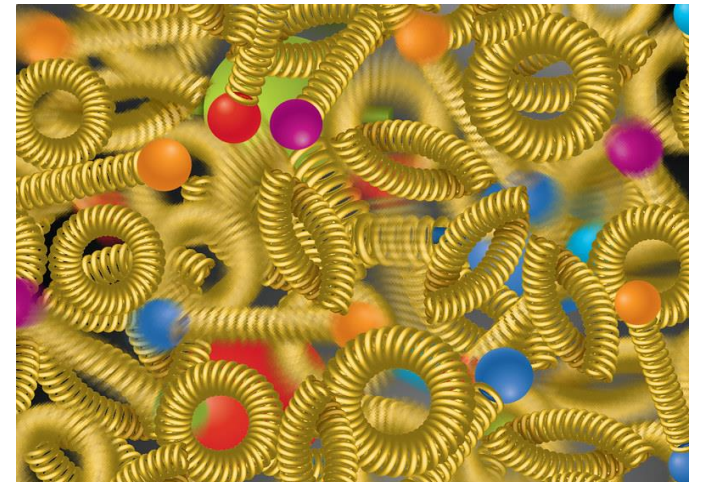
How do nearly massless quarks and gluons generate the mass of all visible matter — everything we see in the universe today?



How is proton spin — a fundamental property used in medical imaging yet not fully understood — influenced by quarks and gluons?



What is the nature of the gluons that “glue” visible matter together, and how do they generate the strongest force in nature?



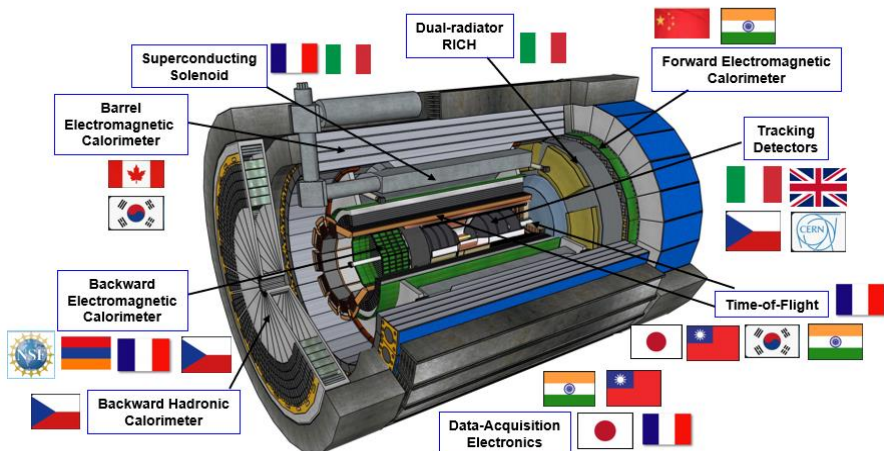
The Electron-Ion Collider

Attracting Worldwide Attention, Collaborators



The EIC design and construction has many scientific and technical challenges, creating opportunities for worldwide collaborators to become part of this exciting endeavor.

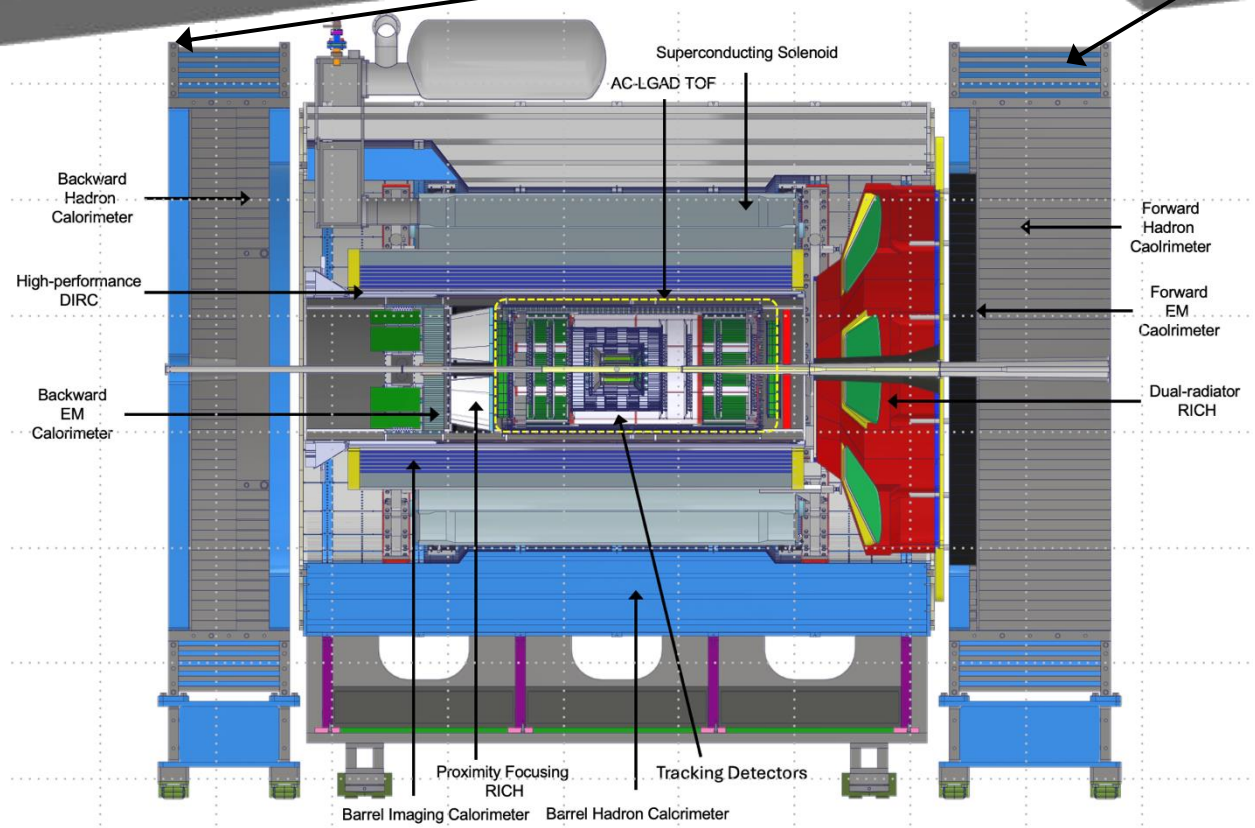
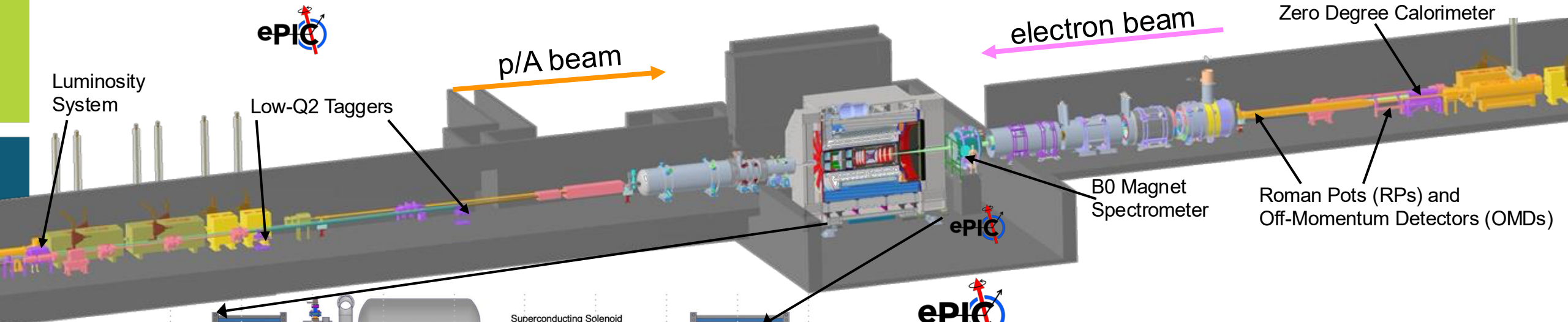
- **EIC U.S. Partners** (performing work and/or providing materials)
 - Brookhaven and Jefferson Lab among eight, total, national laboratories
 - 22 universities
- **EIC Collaborators** (developing experiments, contributing expertise)
 - EIC User Group: 1,558 members and increasing
 - 907 institutions worldwide representing 41 countries
 - 80+ U.S. universities



Department of Energy Lab Partners



ePIC – The EIC State-of-the-Art General-Purpose Detector



26 subsystems over ± 40 m to measure particle momenta, energy and particle type

- 3 electromagnetic calorimeters
- 3 hadronic calorimeters
- Silicon and Multi-pattern gas detectors
- 3 RICH detector + time-of-flight
- 7 Auxiliary detectors (Si + HCal + ECals)
- electron and hadron polarimetry

Integration, Installation and Infrastructure
Non-Beam Commissioning

Highest scientific flexibility

- fully streaming readout electronics and data acquisition
- integration AI/ML capabilities from the start

EIC: The Time Is Now

Transformative discovery potential

- Reveal internal structure of the building blocks of visible matter
- Unravel the origin of mass and the mystery of proton spin

Global leadership in nuclear and accelerator physics

- Only collider of its kind in the world
- Cutting-edge advantage for U.S. and DOE
- Attracting international collaboration, talent, and investment

Advanced technologies

- Benefits to society, economy, and industries
- Groundbreaking application and development of AI/ML

Significant investments, commitments

- Planned global commitments, in-kind contributions, and expressed interest

Available infrastructure, skilled workforce

- RHIC to EIC transition
- Partnerships with DOE labs and universities



Briefing Energy Secretary Chris Wright on the EIC



ePIC Collaboration's detector planning mtg. in 2026

We have the people who will make the EIC happen because of the expertise we have developed by building and running RHIC.

