Welcome to NuSTEAM/NuPUMAS Traineeship programs at BNL

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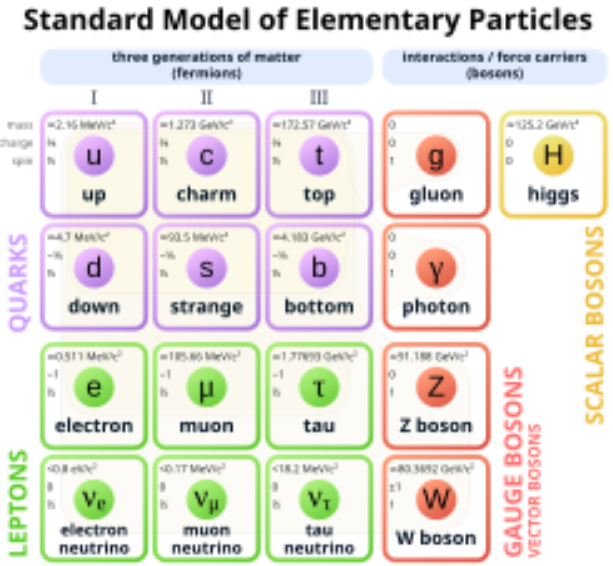
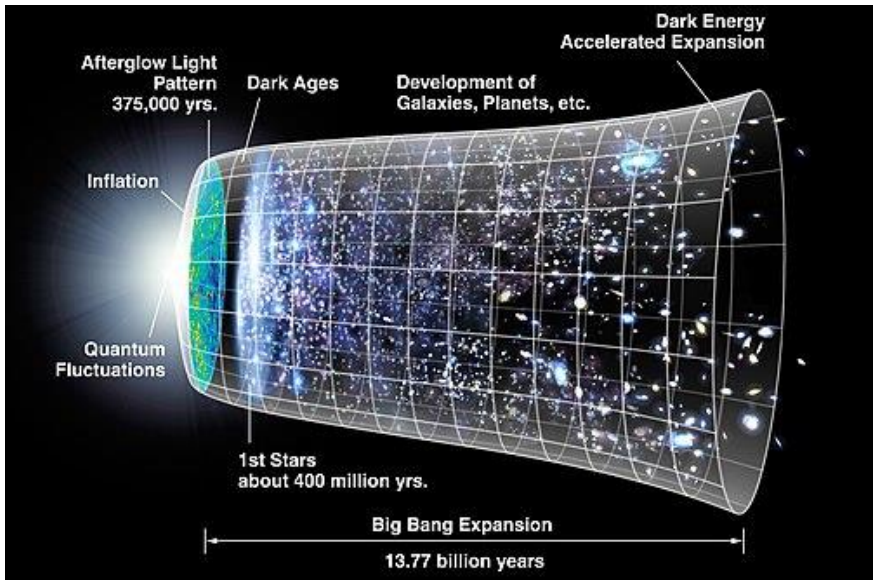
Nuclear and Particle Physics at BNL

https://www.bnl.gov/npp/

Exploring the building blocks of matter and the nature of space and time

Vibrant programs in experimental and theoretical research in nuclear and high-energy physics, accelerator design, and isotope production. Full mission statement





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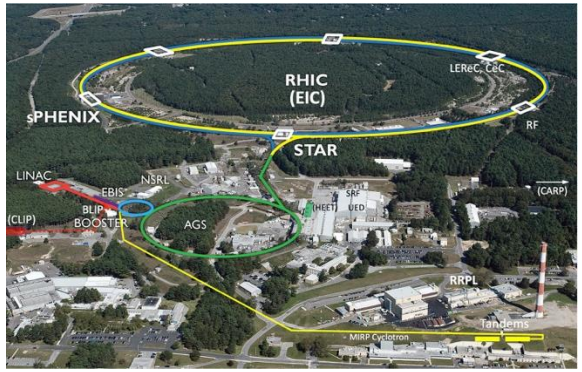
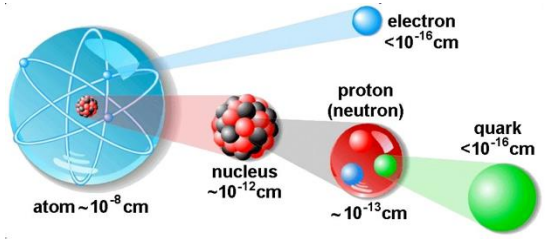
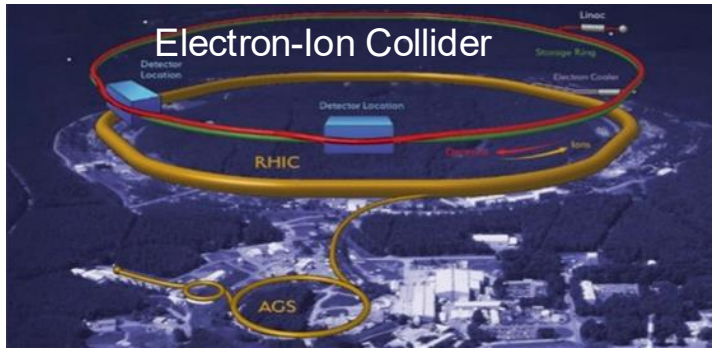
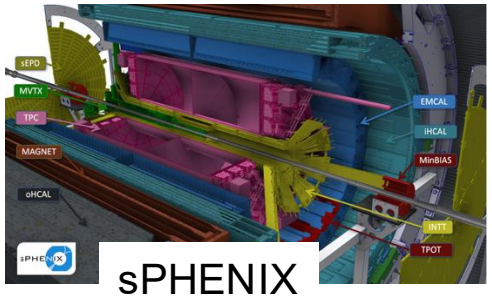
Frontier Science Programs in nuclear and particle physics, for decades to come.



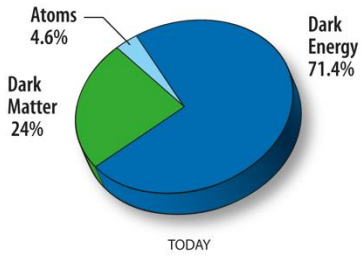
To understand sub-atomic world deeper and deeper

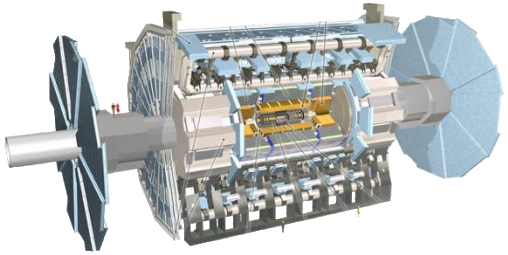




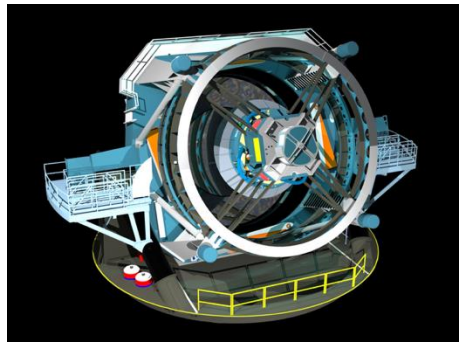


sPHENIX

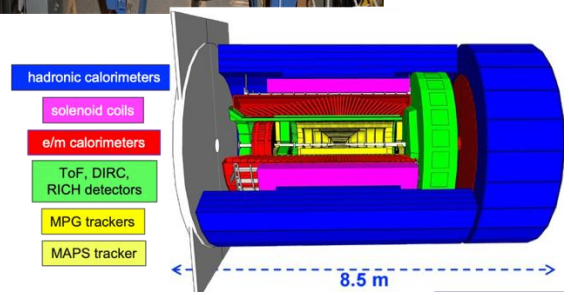




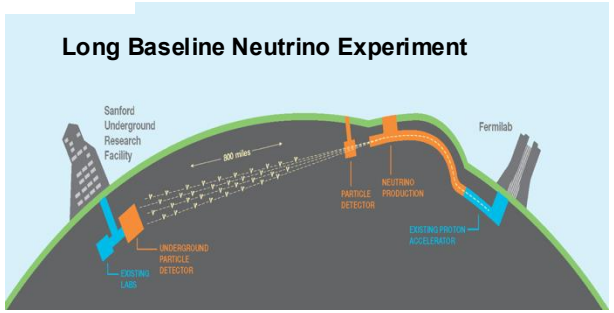
ATLAS @ LHC, at CERN



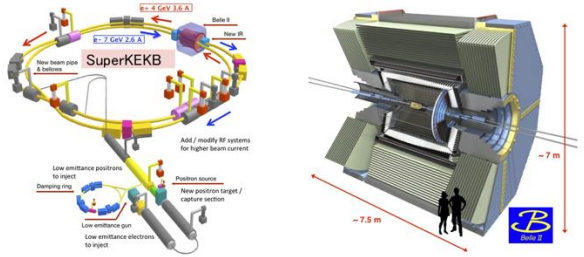
Rubin Observatory in Chile



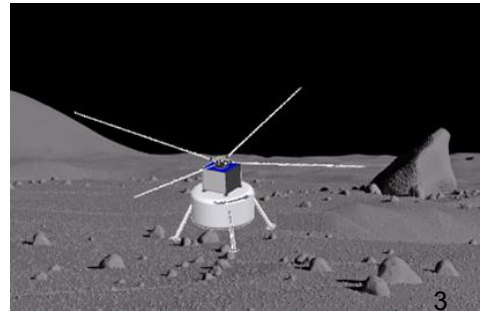
ePIC



DUNE at FNAL



Belle II at SuperKEKB, Japan



LuSEE-Night, far-side of moon

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High-energy and Nuclear Theory groups; Software and Computing facility
RIKEN-BNL Research Center (RBRC); Center for Frontiers in Nuclear Science (CFNS)

Mission of Nuclear and Particle Physics Directorate at BNL

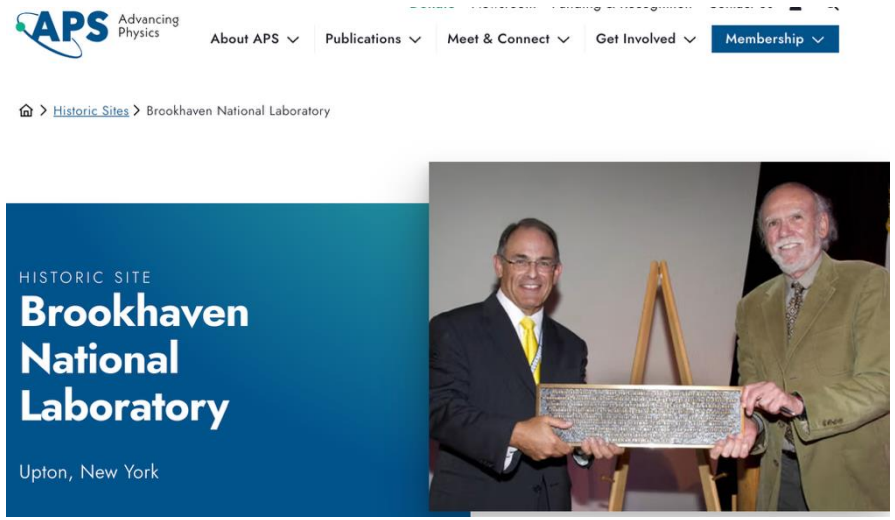
Our mission is to lead and support discovery-based, innovation-driven research at the frontiers of the subatomic world. We are world-leading in nuclear physics research, building and operating accelerator-based user facilities that serve international scientific communities. We also play a leading role in global particle physics programs that push the limits of precision and expand our understanding of the cosmos. Our pursuit of this fundamental and discovery research yields scientific and technological breakthroughs, and also applications that benefit society—such as radioisotopes used to support industrial, medical and national security needs.

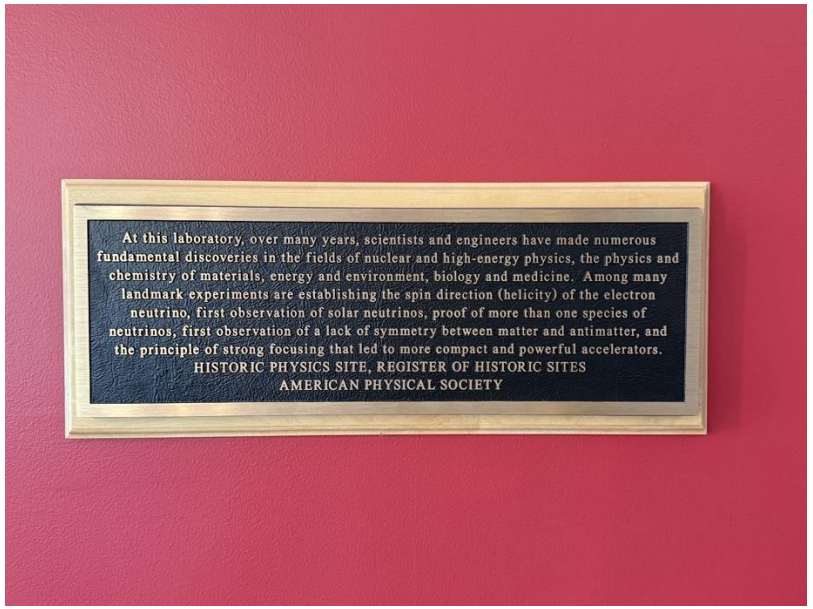
BNL as an APS Historical Site (2011)

At this laboratory, over many years, scientists and engineers have made numerous fundamental discoveries in the fields of nuclear and high energy physics, the physics and chemistry of materials, energy and environment, biology and medicine. Among many landmark experiments are establishing the **spin direction (helicity) of the electron neutrino, first observation of solar neutrinos, proof of more than one species of neutrinos, first observation of a lack of symmetry between matter and antimatter**, and the principle of strong focusing that led to more compact and powerful accelerators.

Other significant achievements by BNL scientists:

- The discovery of the **Omega Minus Particle** in 1964;
- The **co-discovery of the J/psi**, a charm-anticharm vector meson, that required a fourth quark.





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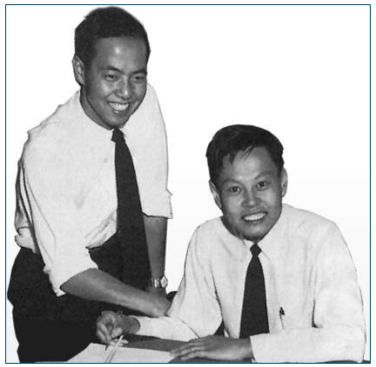
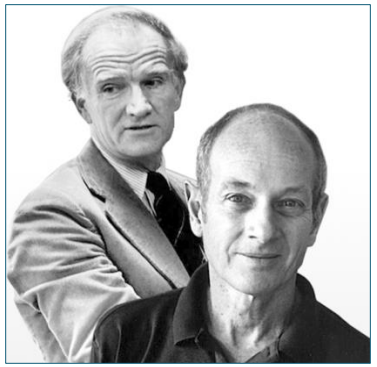
Nobel Prizes in Physics for discoveries at BNL



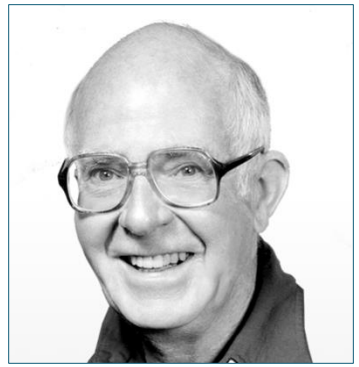
1957 Physics: Lee (Columbia) and Yang (BNL) for parity violation

1976 Physics: Ting (MIT) for discovery of the J/Psi particle



1980 Physics: Cronin and Fitch(Princeton) for CP Violation

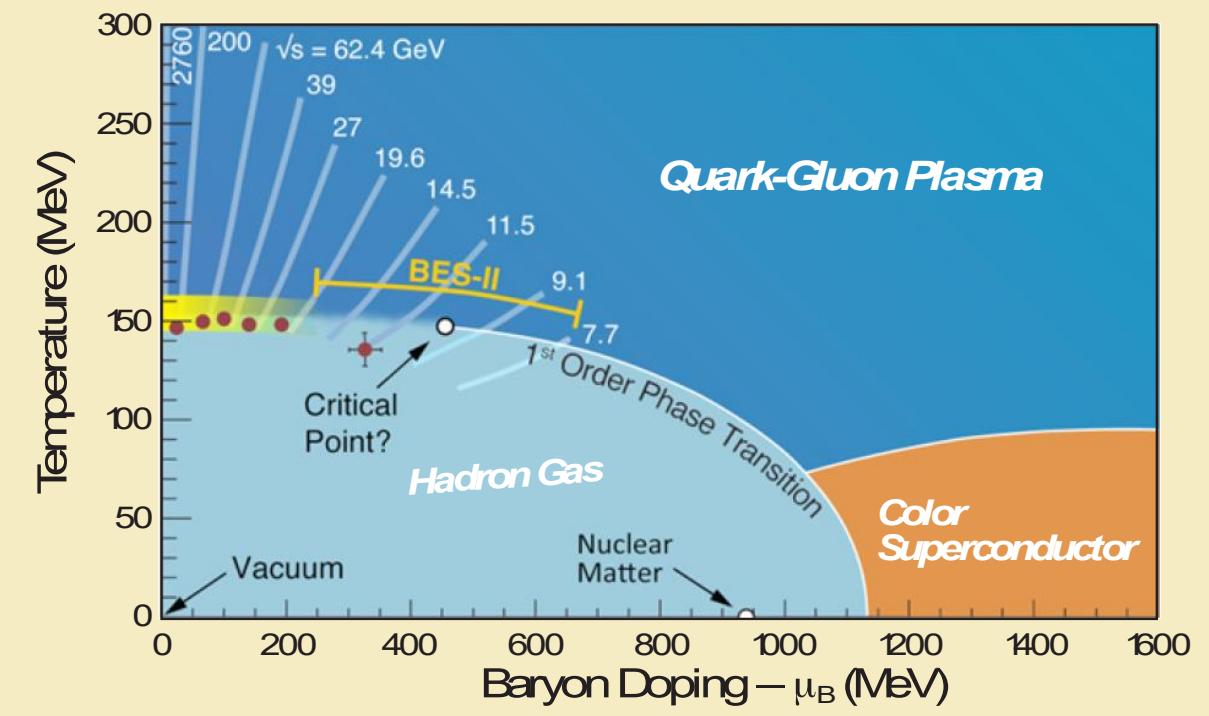
1988 Physics: Lederman, Schwartz, Steinberger (Columbia) for discovery of the muon-neutrino

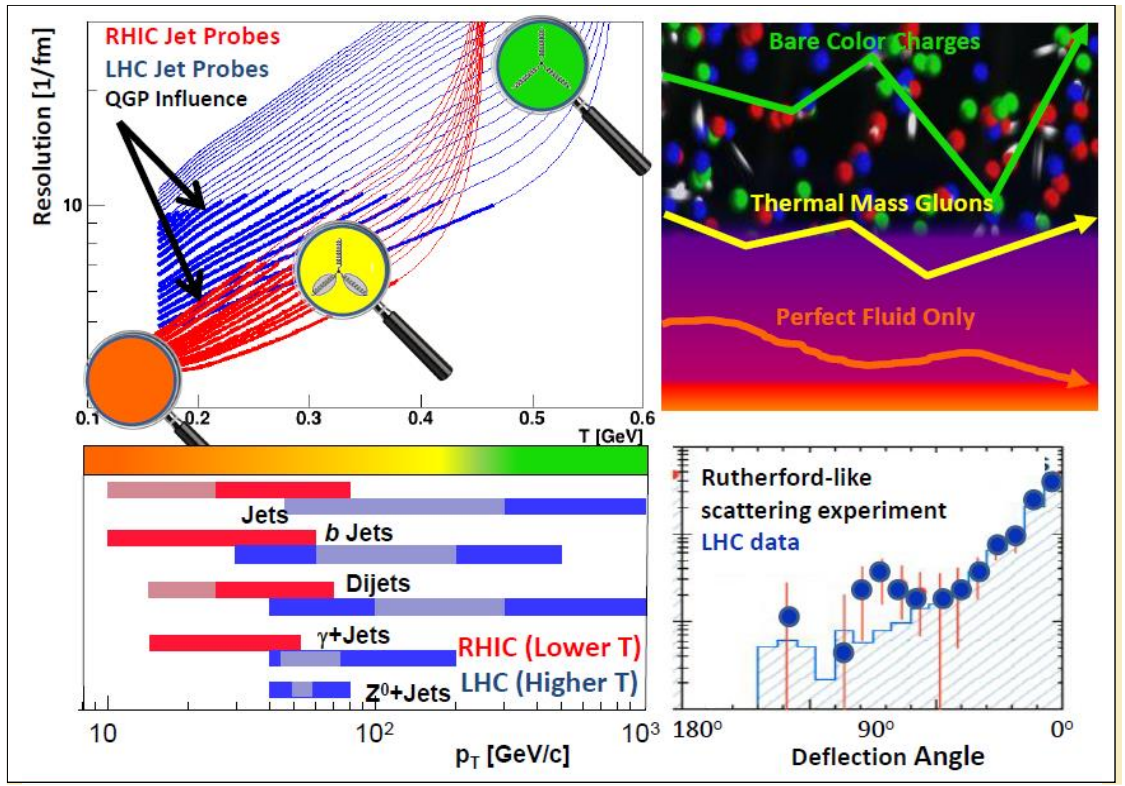


2002 Physics: Davis (BNL) for detection of solar neutrino and its deficit

Completing the RHIC Mission

- Study of the properties of Quark Gluon Plasma and its phase transition
- Understanding of the origin of proton spin





Analysis of Runs 2019-2021 from STAR Exploring the phase diagram of QCD matter; polarized proton run in 2022

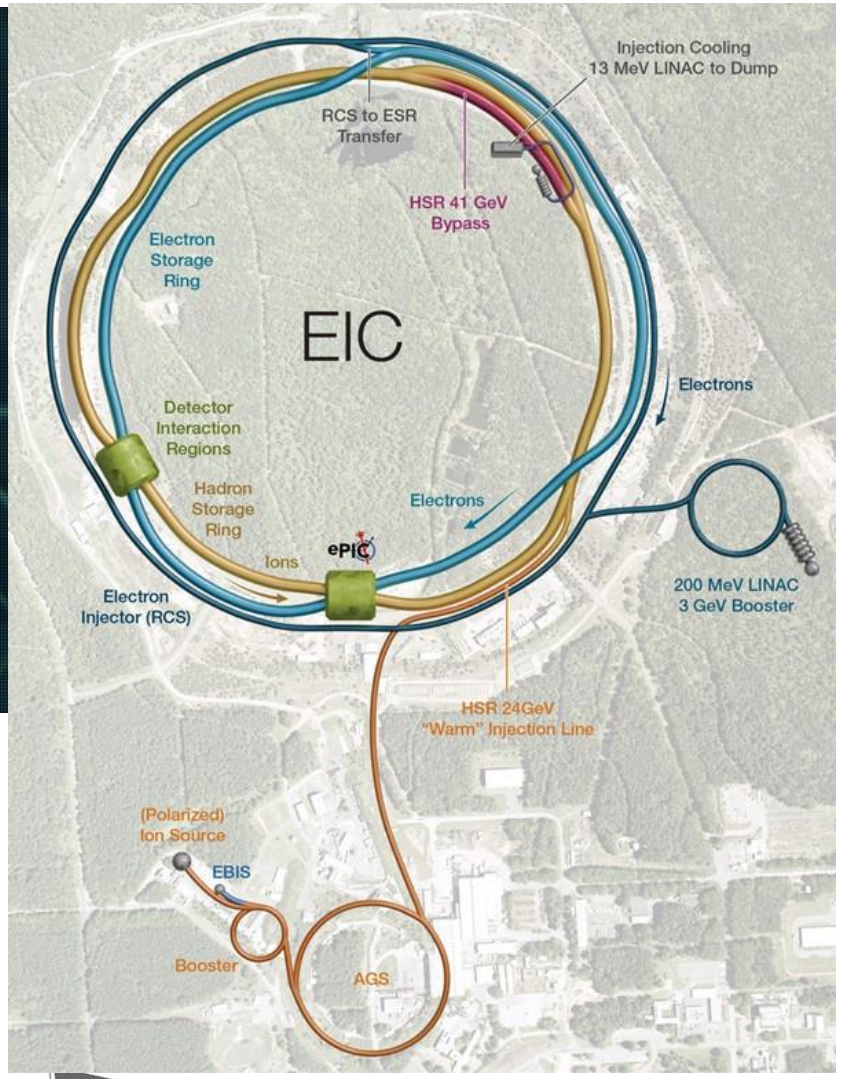
Runs 2023-2025 with sPHENIX and STAR: how does the perfect fluid emerge from quarks and gluons?

https://www.bnl.gov/eic/

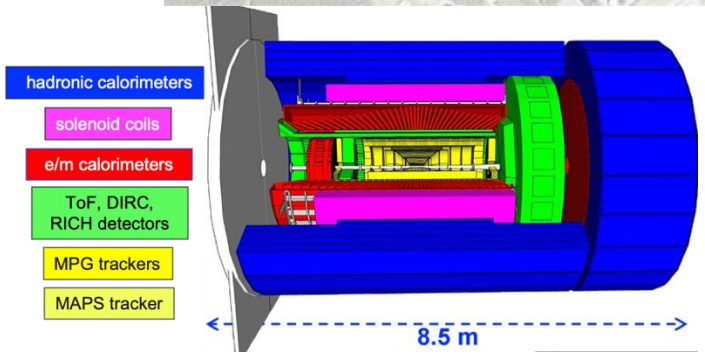
The Electron-Ion Collider

A machine that will unlock the secrets of the strongest force in Nature

- Discovery machine will allow scientists to look inside protons and neutrons and unlock mysteries of the strong force that binds nature's building blocks: quarks and gluons
- Research and development for the EIC will lead to advanced technology and useful applications
- The EIC is being built through a partnership with DOE, Brookhaven, and Thomas Jefferson National Accelerator Facility with additional support from New York State
- The EIC also benefits from participation among international collaborators



- How does the **mass** of the nucleon arise?
- How does the **spin** of the nucleon arise?
- What are the emergent properties of dense systems of gluons?



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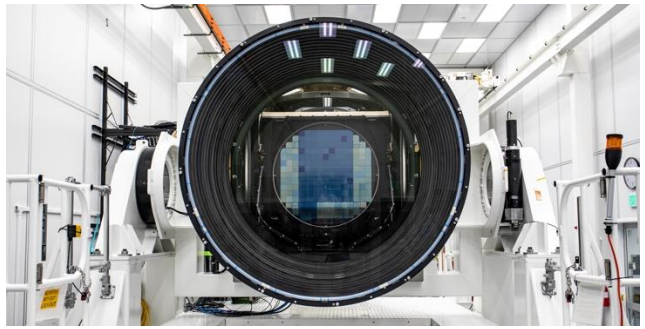
ePIC

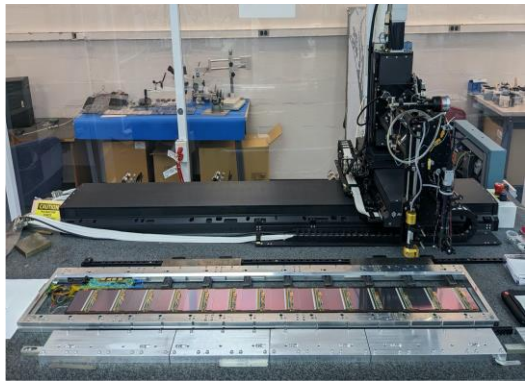
High Energy Physics Program in Physics Department

- **Energy Frontier**
  - Hosting project for $300M HL-LHC ATLAS upgrade
  - Building magnets for the HL-LHC
  - Developing HL-LHC computing and software
- **Intensity Frontier**
  - Contributing to DUNE experiment
    - Leading DUNE far detector Module 2 activities
  - Belle II detector operations during Run II
- **Cosmic Frontier**
  - Getting ready to analyze Rubin Observatory data
  - Building LuSEE-Night mission to the far side of the moon
- **Leading Technologies Developments for Particle Physics**
  - Computing and software
  - Detectors and electronics
  - AI/ML and Quantum Information Science
- **Actively participating in developing long term future**
  - Higgs Factory, DUNE Phase 2 upgrade, Muon collider

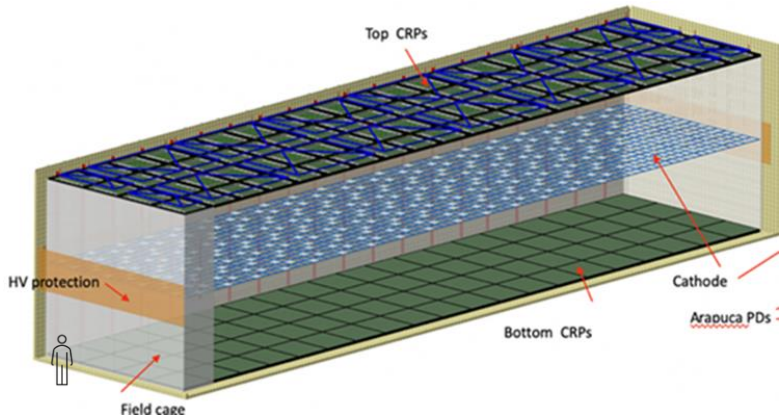
LSST Camera
At Rubin Observatory



ATLAS silicon assembly at BNL



DUNE Module 2 design



Training the next generation scientists

NuSTEAM and NuPUMAS lectures introduce the latest research in nuclear and particle physics being pursued at Brookhaven Lab

There are many internship opportunities at BNL for undergraduate students. We work closely with graduate students from universities

Great future for young scientists at BNL

Enjoy the traineeship programs at BNL!