Brookhaven National Laboratory

U.S. DEPARTMENT OF ENERGY

Physics Department

Early Career and Research Associate Retreat

Hong Ma

Chair, Physics Department

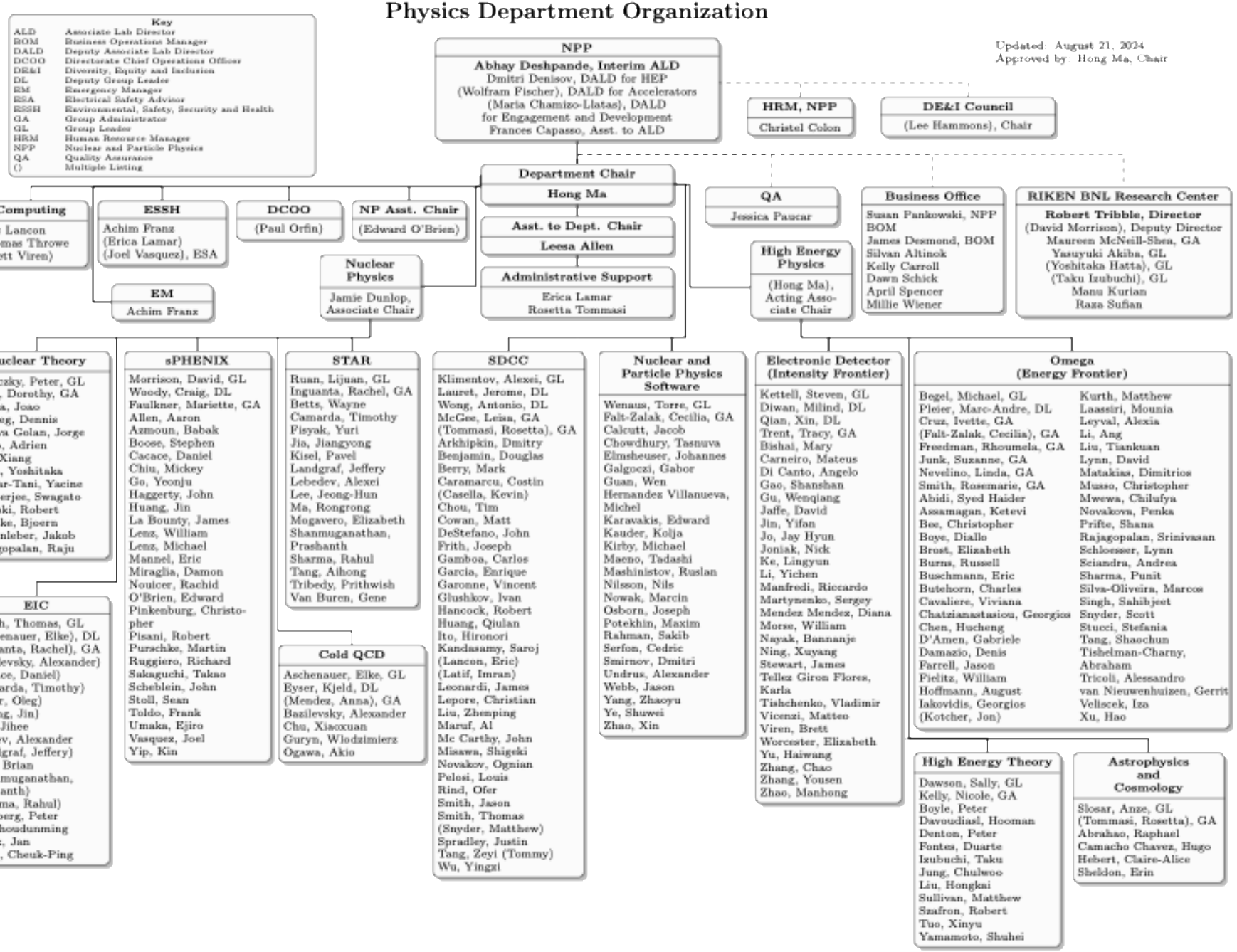
Sept 19, 2024

@BrookhavenLab

BNL Physics Department

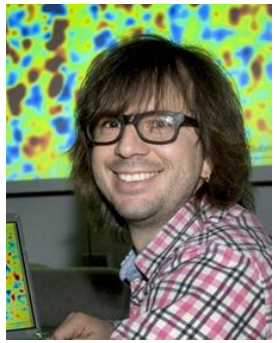
- The Department has ~ 250 staff members
  - including ~40 postdocs, ~100 research staff, plus IT, technical, engineering and administrative support staff
- Leading roles in large international collaborations for nuclear and particle physics experiments
- Theoretical physics programs that guide and support the experimental programs
- Hosting large user communities for our program
- **Nuclear Physics Program**
  - RHIC experiments: PHENIX, STAR, sPHENIX
  - Future EIC Experiments: EIC physics and detector R&D, ePIC, EIC detector project and operations
  - BNL has a strong research effort on heavy ion, spin physics and theory, and is responsible for the detector operation and upgrades.
- **High Energy Physics Program**
  - Host lab for US ATLAS Operations Program and Upgrade Project
  - Host lab for US Belle II Operations Program
  - BNL is a leading contributor to Fermilab neutrino programs
  - Astrophysics and Cosmology at the Rubin Observatory (LSST), and LuSEE-Night operation and science
  - Strong research programs in energy, intensity, cosmic frontiers and theory
- **Software and Computing**
  - RHIC Computing Facility, US ATLAS Tier-1 and US Belle II Tier-1 are part of Scientific Data and Computing Center(SDCC)
  - A common software group that supports all experimental programs

Physics Department Organization



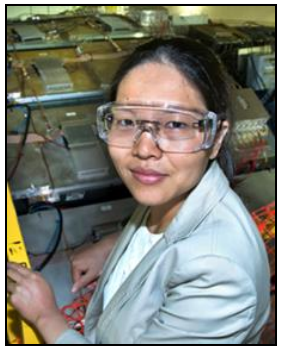
DOE Early Career Awards in Physics Department

FY 2011



Anže Slosar
Cosmic Frontier

FY 2013

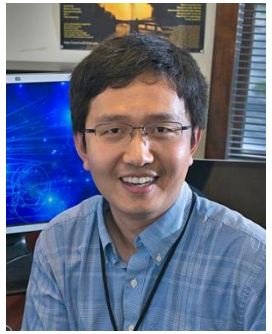


Lijuan Ruan
STAR

FY 2014

Bjoern Schenke
Nuclear Theory

FY 2014



Xin Qian
Intensity Frontier

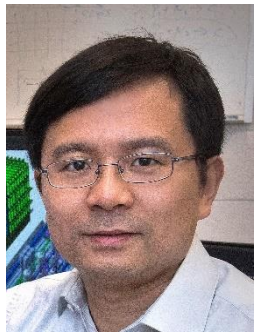
FY 2016

Christoph Lehner
High Energy Theory

FY 2017

Alessandro Tricoli
Energy Frontier

FY 2017

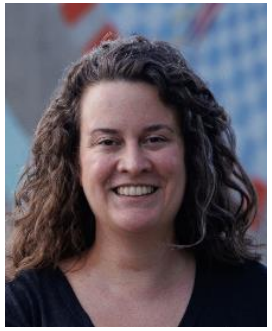


Chao Zhang
Intensity Frontier

FY 2019

Viviana Cavaliere
Energy Frontier

FY 2023



Elizabeth Brost
Energy Frontier

Former Physics Department Postdocs with ECAs after BNL

Name	Group	Institute	Year
Lisa Whitehead	EDG	Univ of Houston	2012
Stephanie Majewski	Omega	Univ of Oregon	2014
Dennis Perepelitsa	PHENIX	Univ of Colorado	2017
Michael Mooney	EDG	Colorado State	2020
Luchang Jin	Nculear Theory	UConn	2020
Chun Shen	Nuclear Theory	Wayne State	2021
Daniel Brandenburg	STAR	Ohio State	2023

Goldhaber Fellows

Name	Group	Year
Peter Petreczky	Nuclear Theory	2002
Kyle Cranmer	Omega	2005
Paul Sorensen	STAR	2005
Lijuan Ruan	STAR	2005
Ruth S. Van De Water	High Energy Theory	2008
Thomas Gadfort	Omega	2010
Bjoern Schenke	Nuclear Theory	2012
Dennis Perepelitsa	PHENIX	2012
Rongrong Ma	STAR	2014
Chun Shen	Nuclear Theory	2016
Christopher Sheehy	Cosmology	2016
Zhoudunming Tu	STAR/EIC	2018
Hanyu Wei	EDG	2018
Daniel Brandenburg	STAR	2010
Syed Haider Abidi	Omega	2021
Adrien Florio	Nuclear Theory	2022
Jennifer Roloff	Omega	2023
Diallo Boye	Omega	2023
Yeonju Go	sPHENIX	2023

Blue: Currently BNL Scientific Staff
Red: Current fellows

Brookhaven Postdoc Adrien Florio Explores the Next Phase of the Quantum Revolution

Florio brings his unique perspective and experience to C^2QA's Theory and Applications subthrust

January 5, 2023

Brookhaven's Brandenburg Named 2022 Blavatnik Regional Awards Finalist

Award recognizes physicist's notable experimental achievements at the frontier of nuclear physics

September 21, 2022

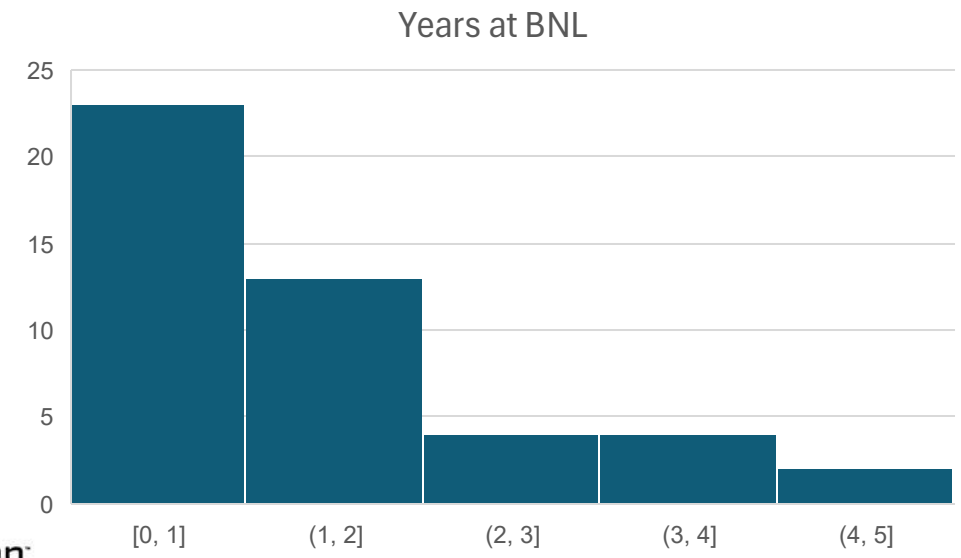
Recruiting and Retention

Continuous recruitment of postdocs throughout the year

- 23 postdocs joined in FY24

8 of the 17 current RS3/4 staff members were BNL postdocs

- Most through open searches



Current postdocs
including Goldhaber Fellows

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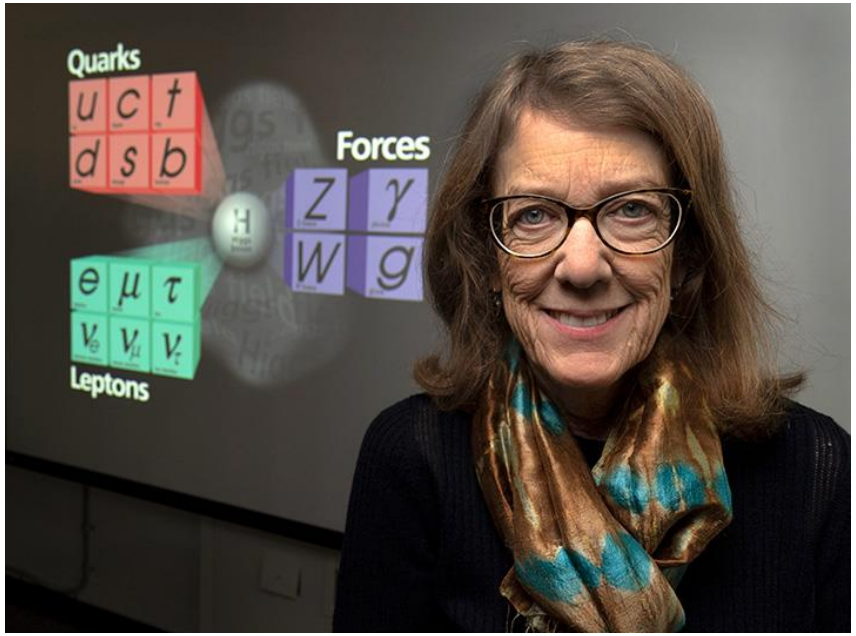
Office of Science Distinguished Scientist Fellows

Two Brookhaven Lab Scientists Named DOE Office of Science Distinguished Fellows

October 16, 2019



Sally Dawson, 2019

Mary Bishai Named Distinguished Scientist Fellow

Department of Energy Office of Science recognizes Brookhaven physicist for her leadership in neutrino studies and for mentoring young scientists

August 12, 2024

Mary Bishai, 2024

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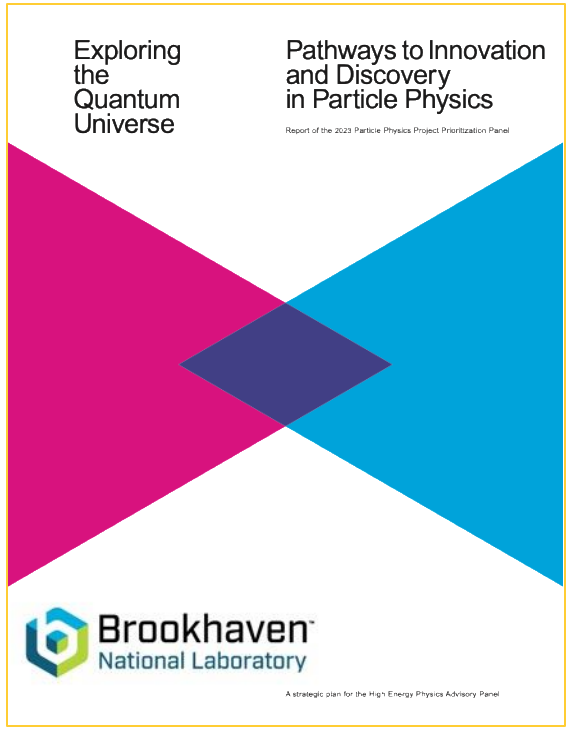
Planning for the future

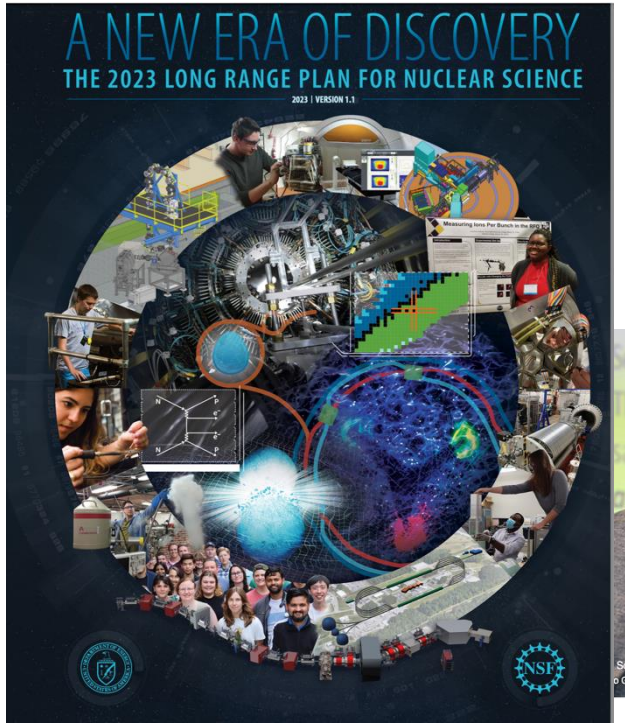
Snowmass/ P5 Planning Process

To identify the most compelling scientific opportunities at the Energy, Intensity and Cosmic Frontiers, and to identify those technologies require for frontier research



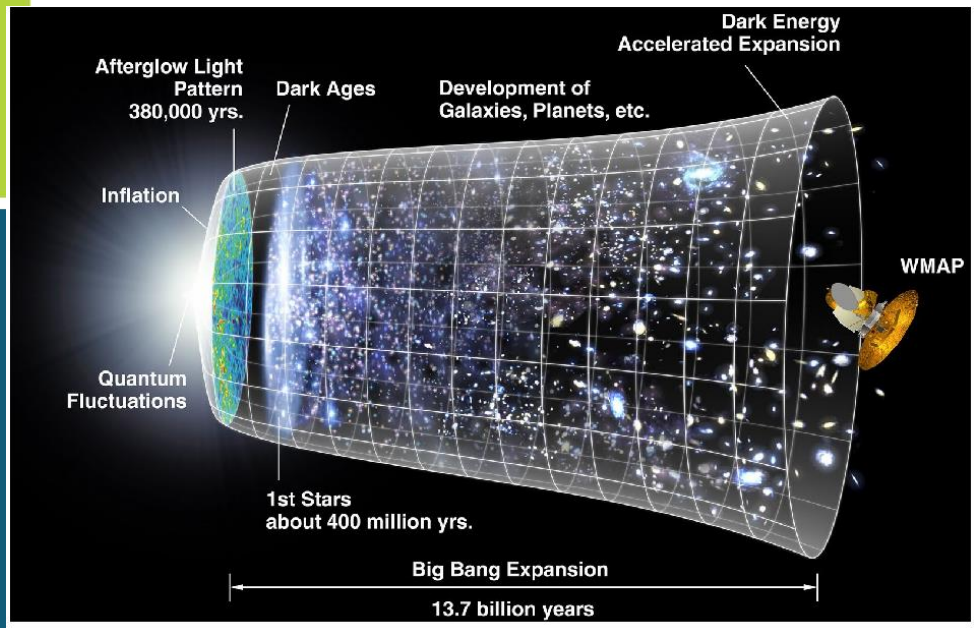
NSAC Long Range Plan

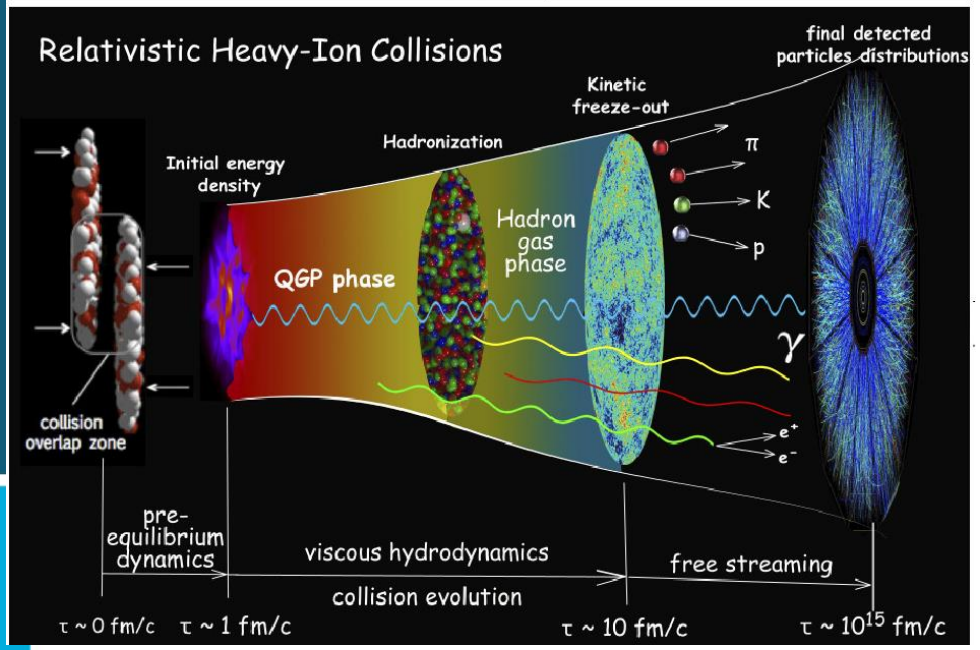
To identify and prioritize the most compelling scientific opportunities for the U.S. nuclear physics program to pursue over the next decade, and articulate its potential scientific impact



BNL LRP writing committee members:
Haiyan Gao
Lijuan Ruan
Bjoern Schenke

Current nuclear physics program: RHIC



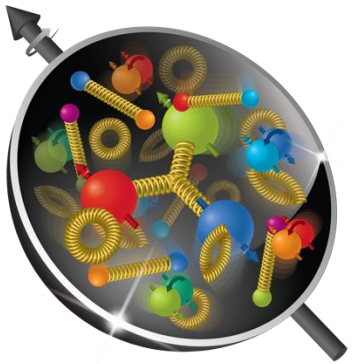


Relativistic Heavy Ion Collider: Recreates the universe as it existed a few microseconds after the big bang

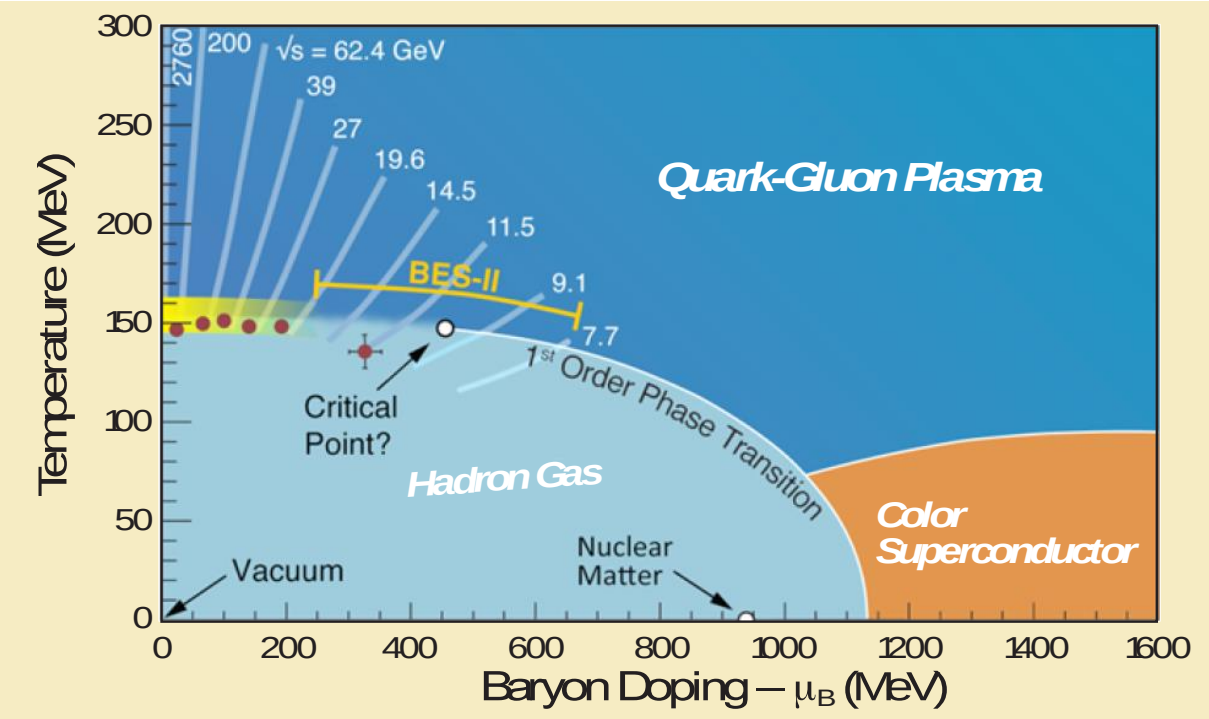
Discovered that matter at a few Trillion degrees behaves as a nearly perfect fluid

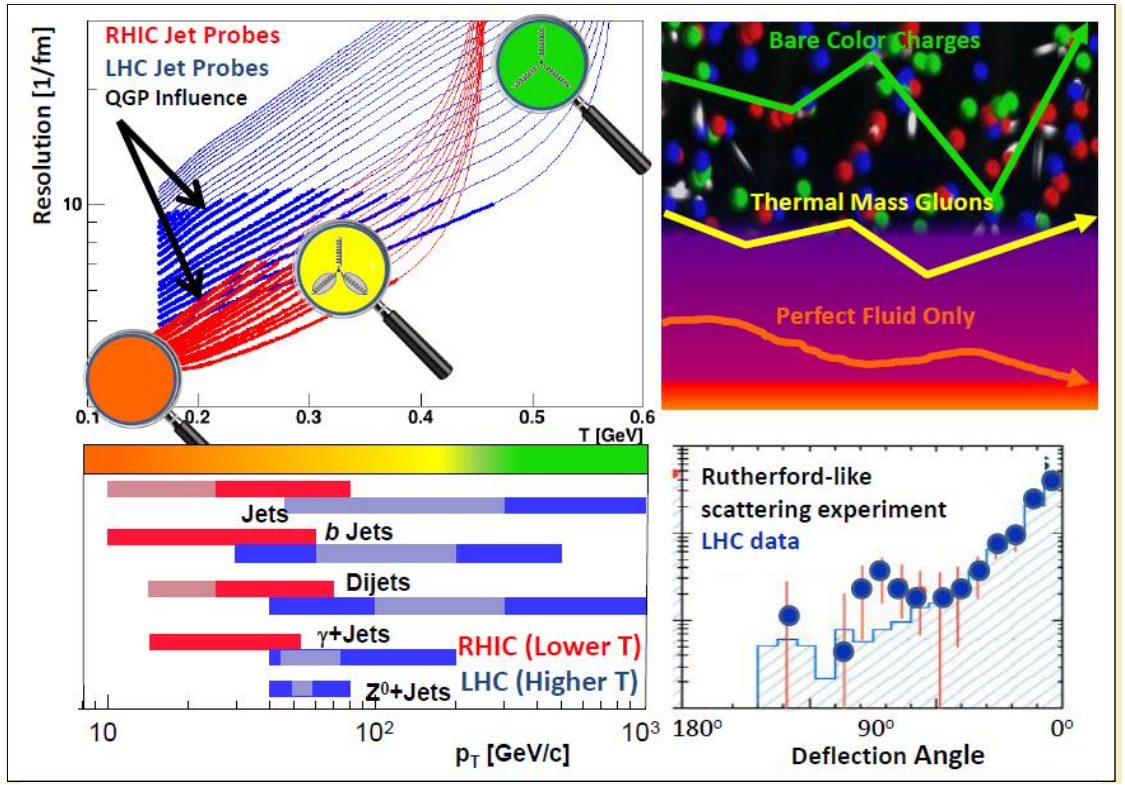
Also the only Polarized Proton collider

Discovered that gluons carry a substantial fraction of the proton spin



Completing the RHIC Mission





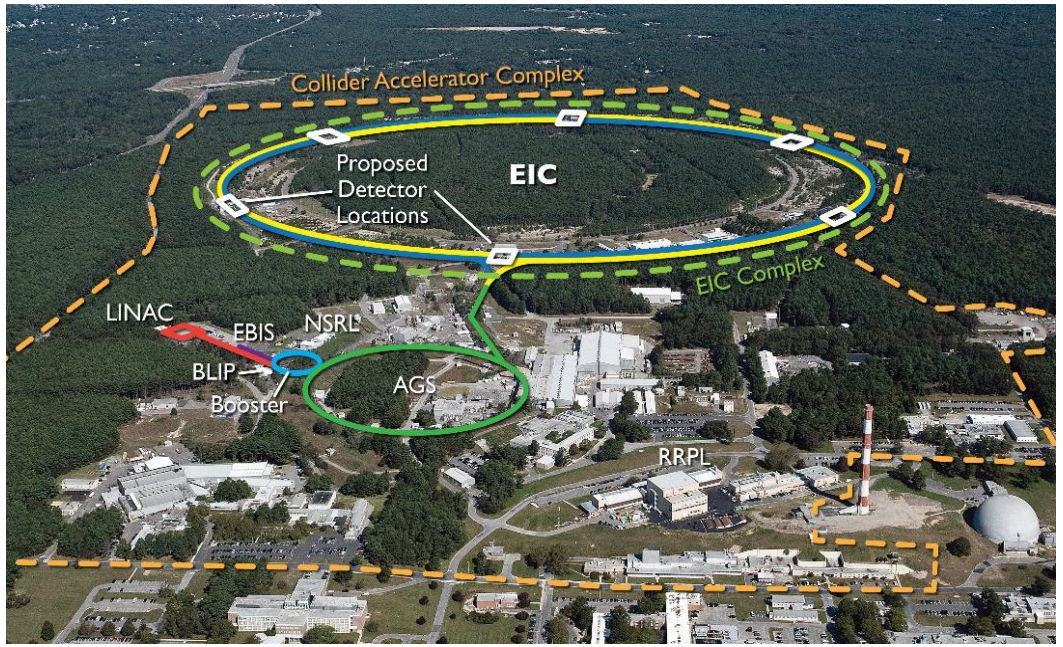
Analysis of Runs 2019-2021 from STAR Exploring the phase diagram of QCD matter, polarized proton run in 2022

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

The Electron-Ion Collider

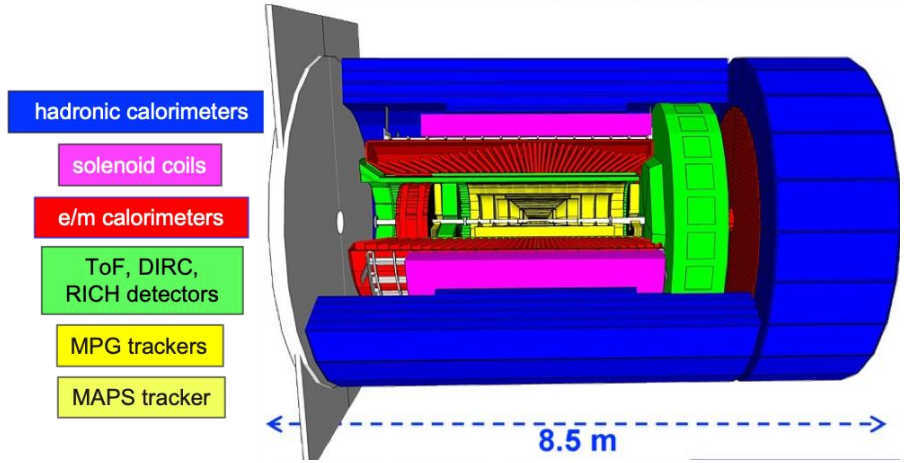
An EIC can uniquely address three profound questions about nucleons and how they are assembled to form the nuclei of atoms:

- 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?



Major milestones: CD-0 December 2019; DOE EIC site (BNL) selection Jan 2020; CD-1 June 2021; EIC project detector selected in March 2022; ePIC collaboration formed in July 2022; CD-3A in March 2024, CD-3B planned for March 2025, further project planning in progress

Physics Department focuses on EIC physics, software and computing, participation in ePIC collaboration and EIC detector project, operations support, and R&D for the 2nd detector



ePIC

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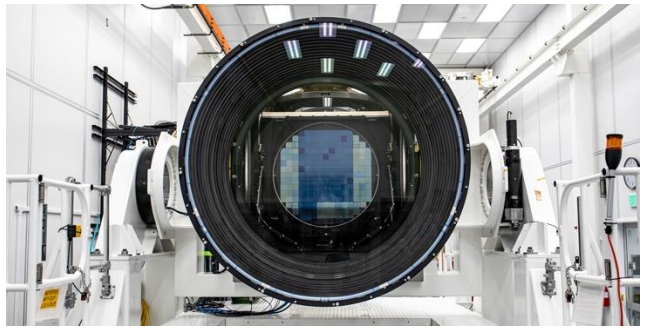
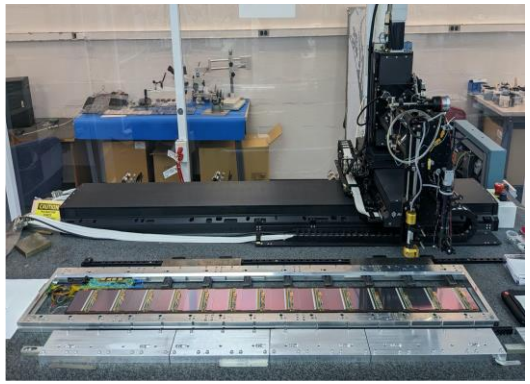
Implementing 2023 P5 Vision for Ongoing Program

- **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**
  - Snowmass, P5 and P5 follow up

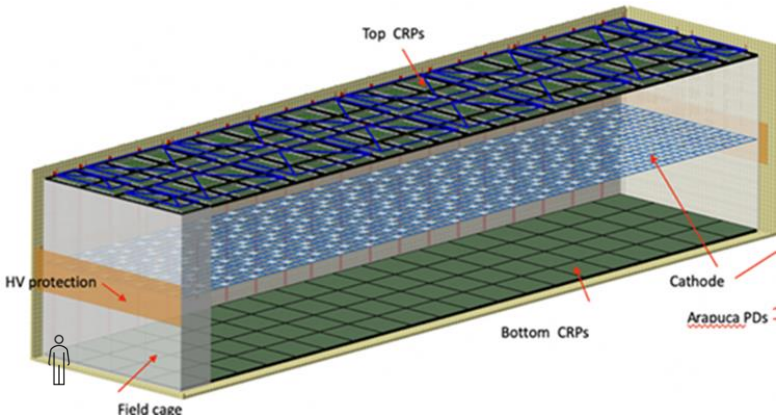
ATLAS silicon assembly at BNL

LSST Camera

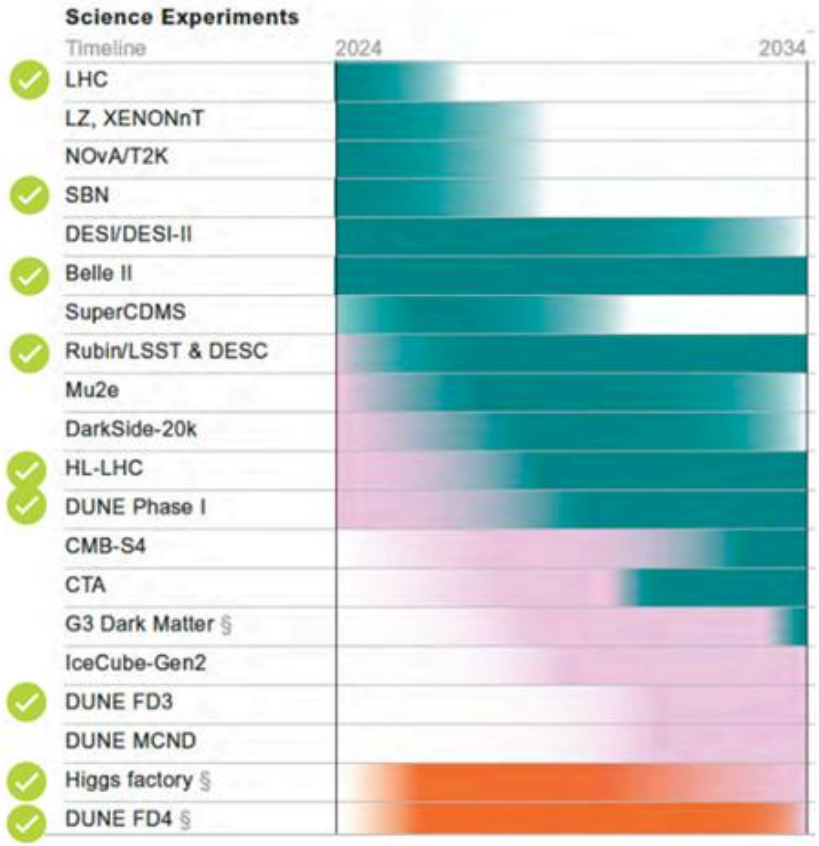


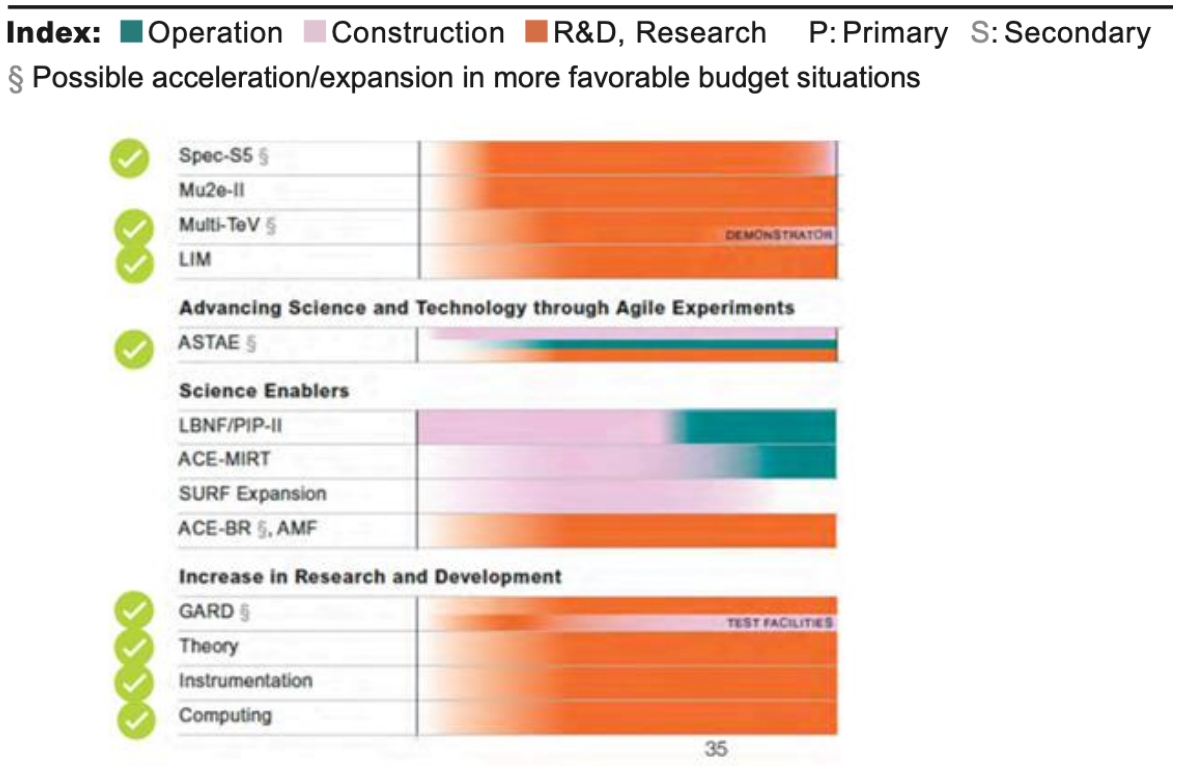


DUNE Module 2 design



BNL Response to P5 Report





- BNL has an exciting and realistic vision for implementing 2023 P5 report
- Beyond the on-going programs, we are pursuing **Higgs Factory, DUNE upgrade, future cosmology experiments**, and possible small experiments

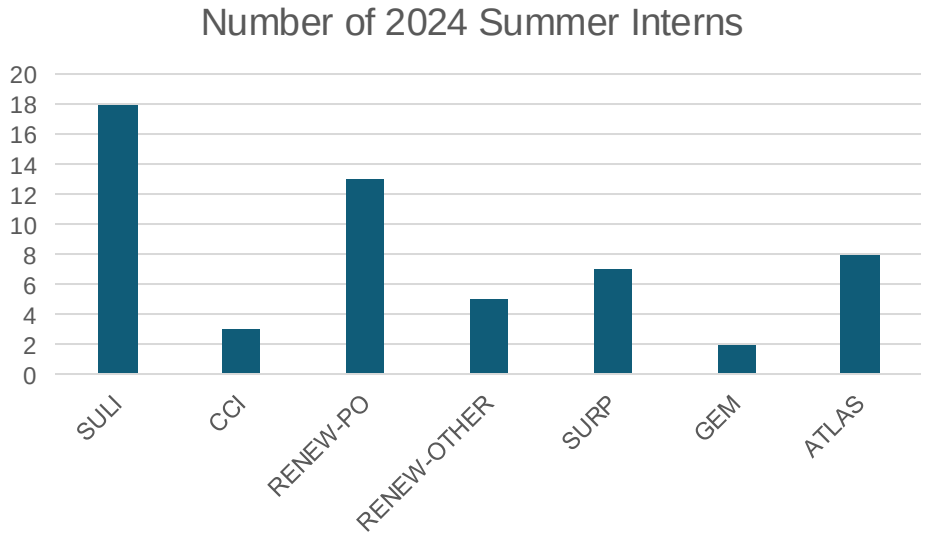
Towards a more diverse workforce

Working with DOE and wider NP and HEP community to build a more diverse workforce

- Established close working relationship with minority serving institutions
- 6 current RENEW programs supported by DOE Office of Science
- 7 new RENEW+FAIR proposals submitted for the 2024 call
- Leading African School of Physics program
  - Biennial school in Africa, alumni internship program at BNL, 5 interns this fall
- Summer lecture series for all students
- Exploring joint appointments with MSIs

Coding boot camp

Dinner with RENEW students



Over 50 summer interns

Investment for the future

LDRD https://www.bnl.gov/ldrd/

- Type A: aimed at larger projects in areas of strategic interest.
- Type B: smaller, short to medium-term projects, with allocation specific for potential Early Career Award applicants.
- Type C: limited funding to cover short-term R&D costs

Great opportunities for early career scientists to propose new ideas

NPP has an internal review process for proposals.

LDRDs provide significant fraction of support for postdoc positions

LDRD#	PI	TITLE	FY 2024	FY 2025	FY 2026	FY 2027
23-013 B	M. Diwan	Physics & Simulations very high energy neutrino fluxes & events-LHC	200000			
23-019 B	V. Tishchenko	R&D for Pioneer: Next generationRare Pion Decay Experiment	200000			
23-014 B	Q. Huang	Data Popularity, PlacementOptimization & Storage	200000			
23-016 B	Y. Mehtar-Tani	3 D Structureof the Proton: from partons to strong fields	300000			
23-049 A	M.A. Pleier	Capturing Leadership at future Higgs Factory for BNL	500000	500000		
23-050 A	T. Ullrich	Second EIC Detector: Physics case and Conceptual Design	498000	496000		
23-051 A	D Morrison	RBRC research from RHIC to EIC	675000	1325000	367000	
23-058 A	S.Rescia/S. Gao	Dual Calorimetry and 6-D Tracking with LAr TPC for Physics Discovery	500000	500000		
24-016 B	A. Slozar	Enabling Neutrino-triggered Rubin observations	200000	200000		
24-047 A	K. Kauder	EIC Simulation Infrastructure	500000	500000	500000	
24-C	V. Cavaliere	Quantum Entanglement in diboson processes	32000			
24-C	X. Chu	Universality from RHIC to EIC	110000			
24-C	D'Amen	Understanding Single Event Burnout to empower future silicon detectors	100000			
24-C	M. Diwan	Measurement of Scintilation	125000			
24-C	M. Kirby	DUNE Detector data	100000			
24-C	P. Petreczky	QCD Phase Diagram	83000			
24-C	S. Stucci	Radiation damage of SiC sensors	174000			
24-C	G. D'Amen	Impact of LGAD design and material on Single Event Burnout events	98000			
24-C	P. Steinberg	Vector meson production at the LHC (on the way to the EIC)	10000			
25-026 B	H. Abidi	Real time learning on heterogeneous devices for detector calibration		250000	250000	
25-030 B	H. Davoudiasl	Uncovering New Laws of Nature at the EIC	26000	250000	224000	
25-029 B	X. Chu	Exploring Gluon Saturation from pp/pA and ep/eA		250000	250000	
25-033 B	S. Mukherjee	Currents Across Time: Quantum Computing for EIC and Muon g-2		250000	250000	
25-040 A	H. Chen	Advancement of Noble Liquid Detectors R&D for 2023 P5 Report		600000	600000	600000

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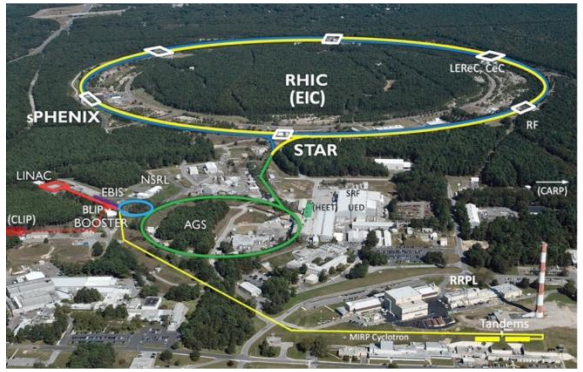
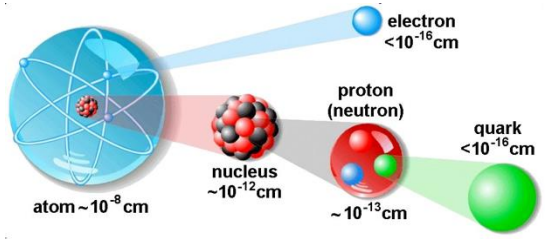
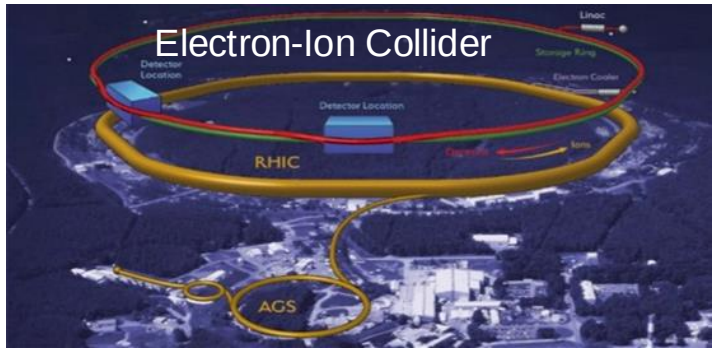
Red: Early Career scientists as lead PIs

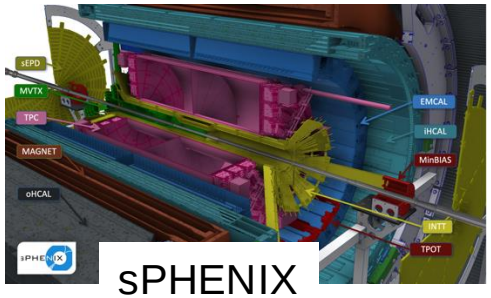
Frontier Science Programs in nuclear and particle physics, for decades to come.



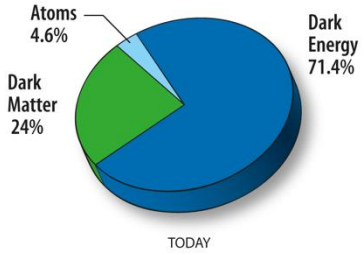
To understand sub-atomic world deeper and deeper

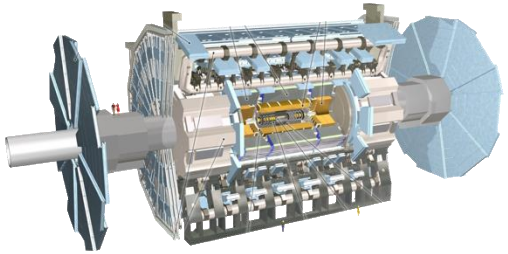




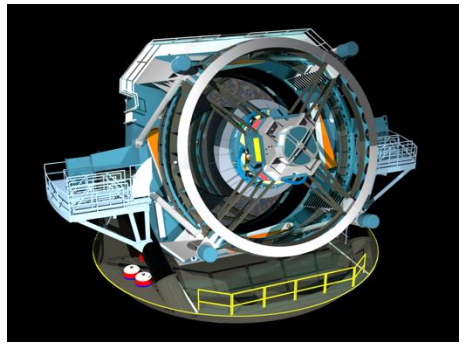


sPHENIX

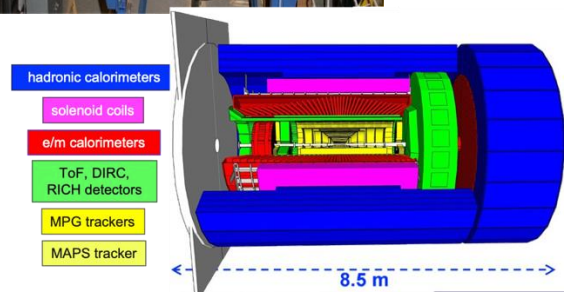




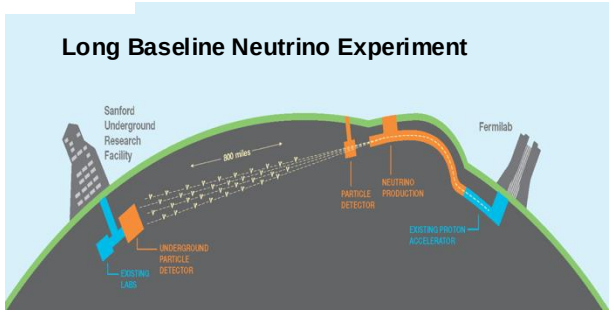
ATLAS @ LHC



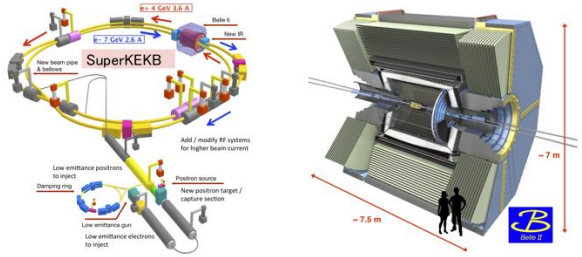
Rubin Observatory



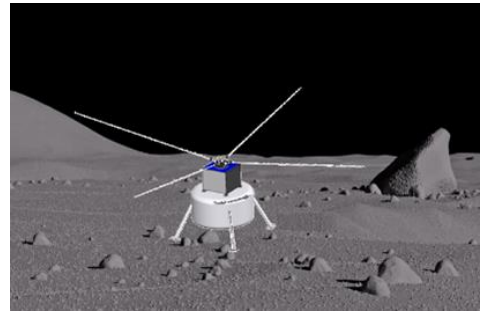
ePIC



DUNE at FNAL



Belle II at SuperKEKB



LuSEE-Night mission

Brookhaven National Laboratory

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