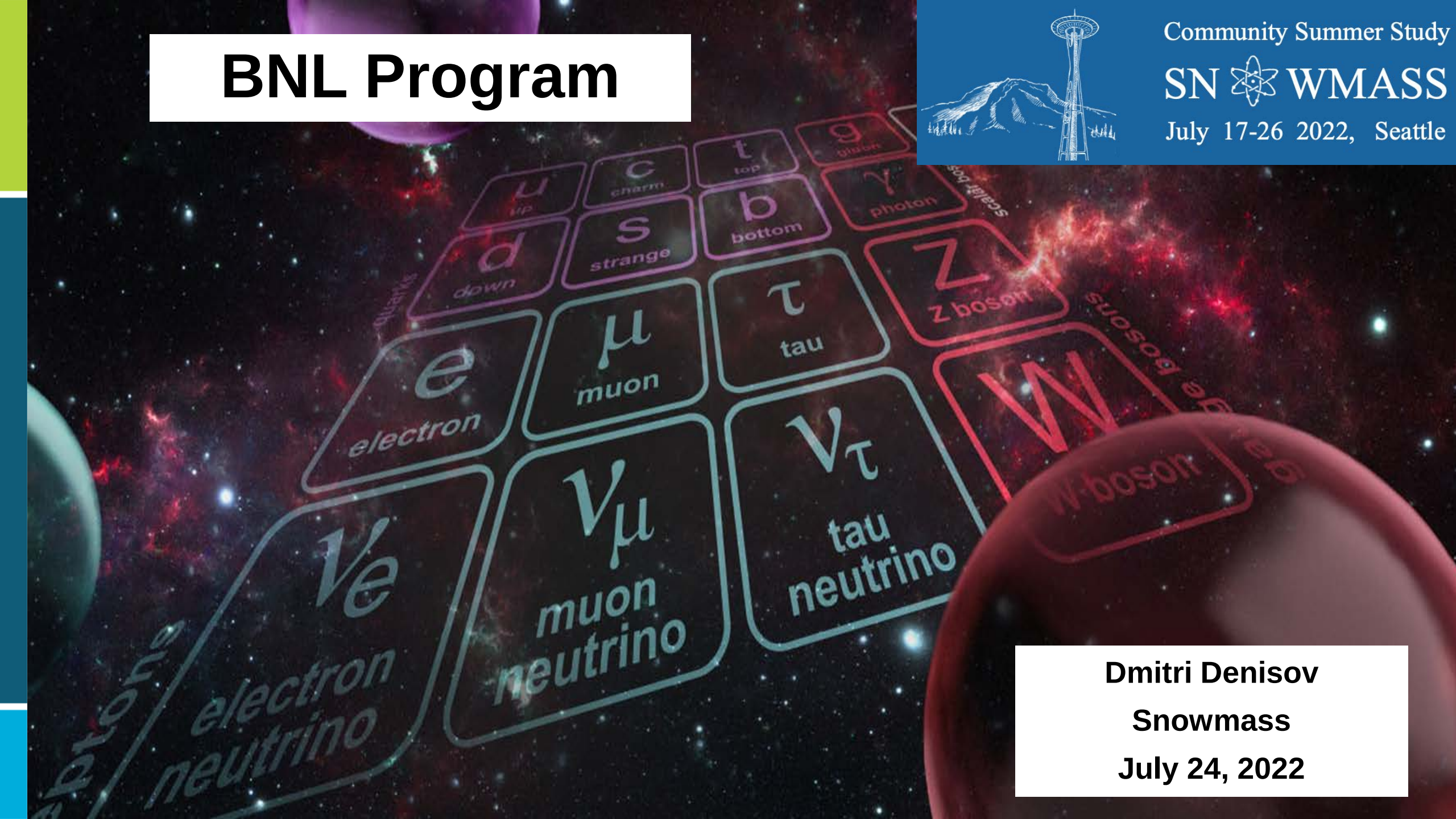
BNL Program



Dmitri Denisov

Snowmass

July 24, 2022

Brookhaven National Laboratory

- **Physical Assets**
  - 5,000 acres
  - 300 buildings
- **People**
  - 2,600 staff
  - Lab supported
    - 500 students
    - 4,400 guests/users, including remote
- **FY21 costs $672 million**
- **High energy physics is 3rd largest program at BNL**

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High Energy Physics - Understanding the Origin of Space and Time

ATLAS experiment at CERN

Lead Lab for U.S. ATLAS collaboration of 800 US scientists

Leading US ATLAS Operations program and hosting Tier 1 computing center

Neutrino Program at Fermilab

Proto-DUNE detector with BNL-developed cold electronics

Studying properties of neutrinos with short-baseline experiments

Belle II experiment at KEK

Lead Lab for U.S. Belle II experiment in Japan

Rubin Observatory

Commissioning the experiment in Chile

Developing computing and software for data analysis

Theory

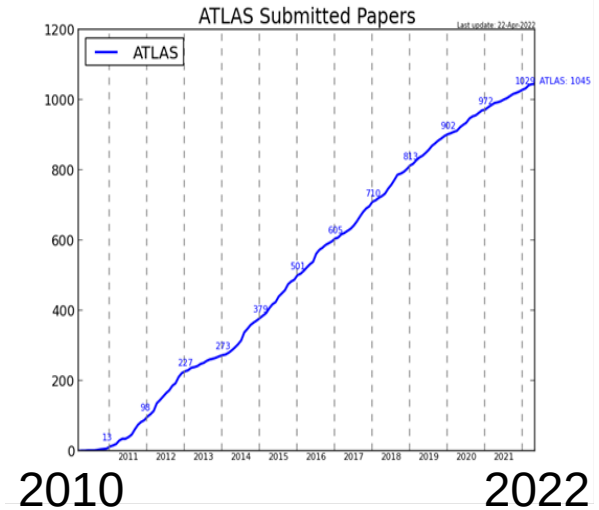
Fundamental progress on (g-2) value calculations

Exciting new developments in neutrino and colliders physics

Assembly of muon system at CERN

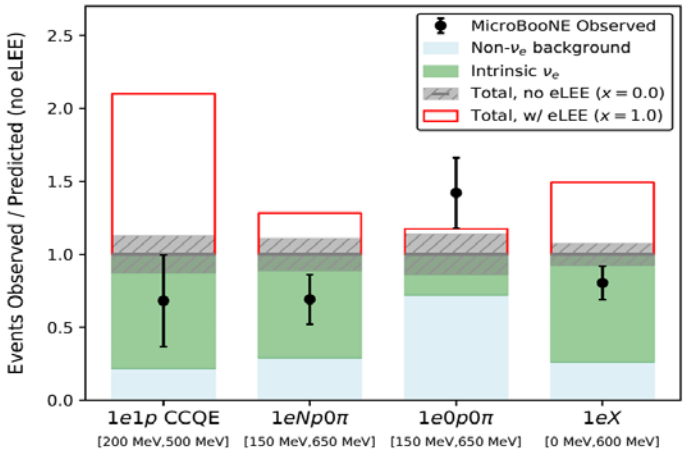
Tier 1 center in new building at BNL

ATLAS published over 1000 papers



2010 2022

Exclusion of sterile neutrinos



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High Energy Physics - Enabling Future of the Field

Energy Frontier

- Hosting project office for $250M high luminosity ATLAS upgrade
- Building magnets for the LHC upgrade
- Developing computing and software for effective HL-LHC data management

Intensity Frontier

- Strongly contributing to DUNE experiment
  - Studies of neutrinos, supernovas, and proton decay
  - Leading DUNE Module 2 activities
- Studying CP violation with Belle II experiment

Cosmic Frontier

- Soon to analyze unique Rubin Observatory LSST Camera data
  - Understanding Universe expansion
- Building LuSEE-Night mission to the far side of the moon
  - To detect, for the first time, “Dark Ages” signal from the early Universe

Leading Technologies Developments for Particle Physics

- Computing and software
- Detectors and electronics
- Accelerators R&D including superconducting magnets

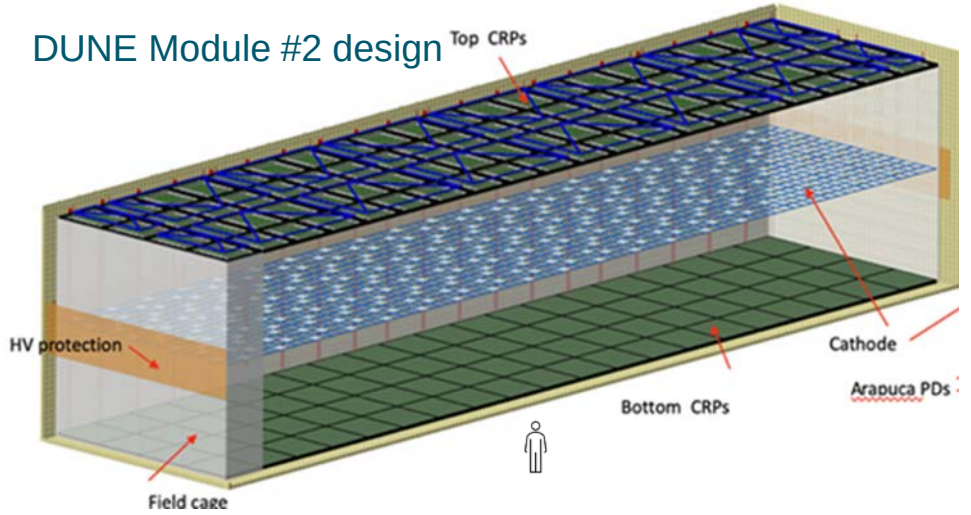
Actively participating in the field long term future planning aka Snowmass

- ~130 white papers with proposals submitted by BNL scientists to Snowmass

HL-LHC magnet testing at BNL

ATLAS silicon assembly at BNL

DUNE Module #2 design



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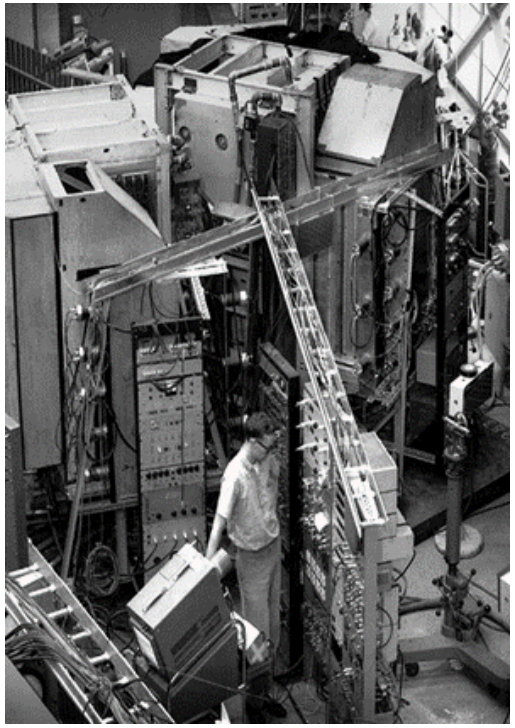
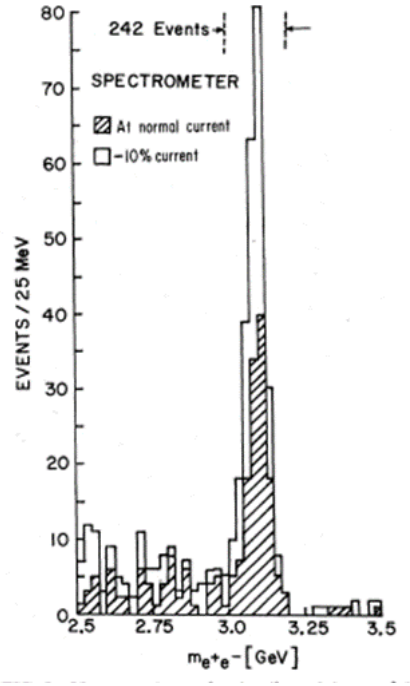
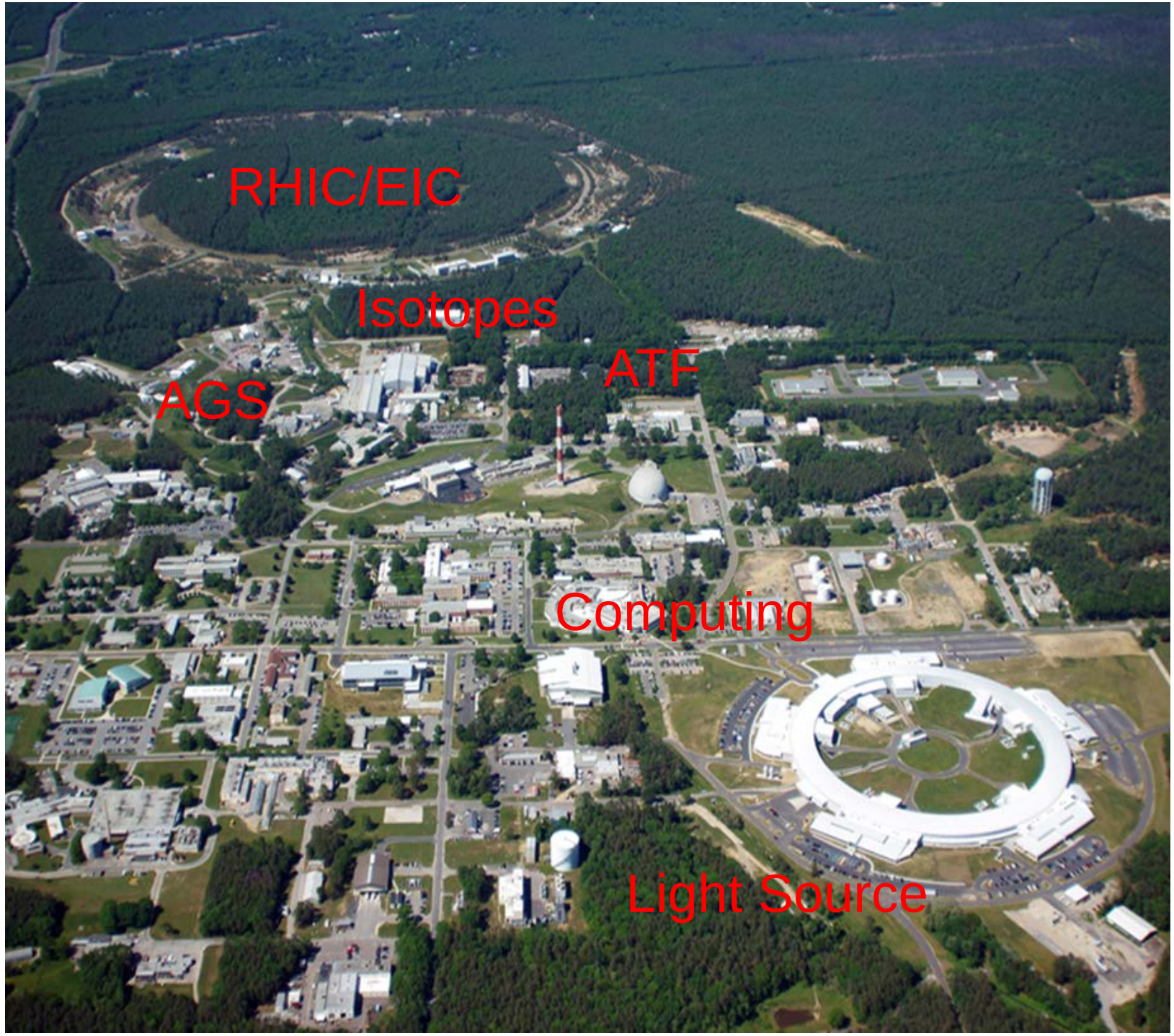
Five BNL HEP Nobel Prizes and Strong Contributions to Many More







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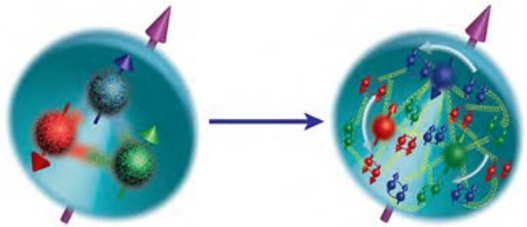
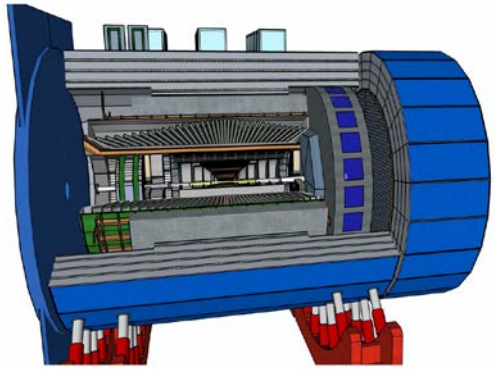
Relativistic Heavy Ion Collider
Electron Ion Collider

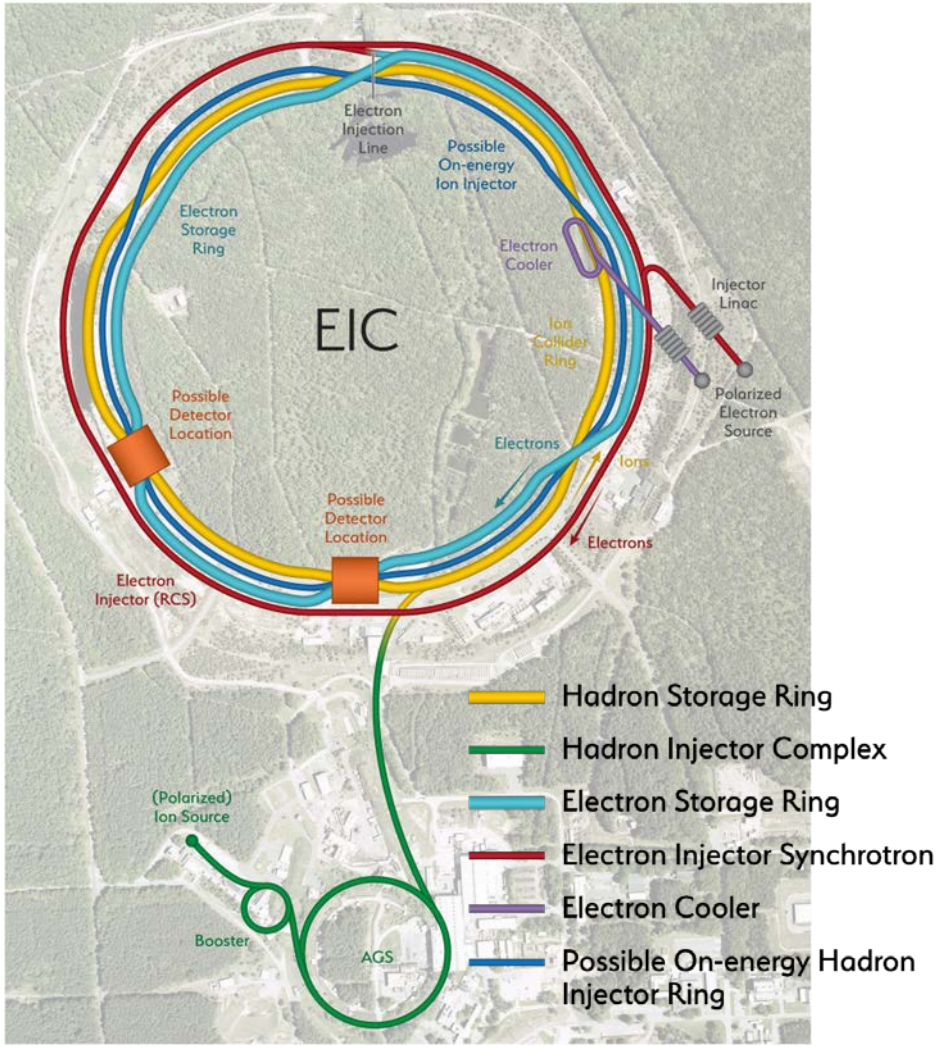
RHIC operation with sPHENIX and STAR experiments till 2025

EIC Parameters

- High Luminosity: L= 10^{33}–10^{34}cm^{-2}sec^{-1}, 10–100 fb^{-1}/year
- Highly Polarized Beams: ~70%
- Large Center of Mass Energy Range: E_{cm} = 20–140 GeV
- Large Ion Species Range: protons – Uranium

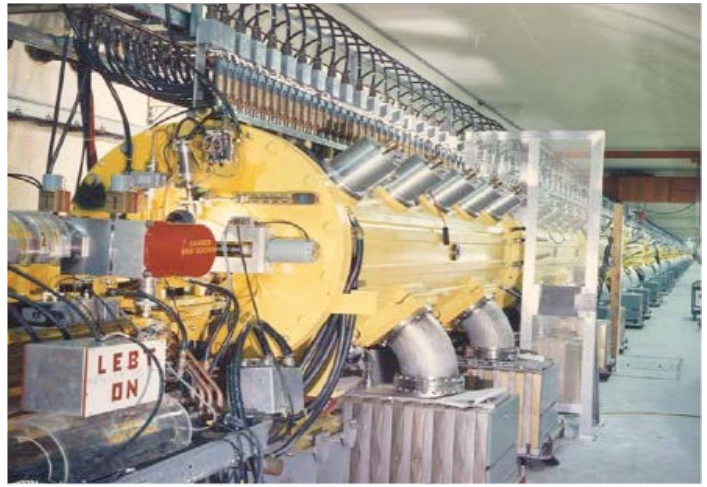




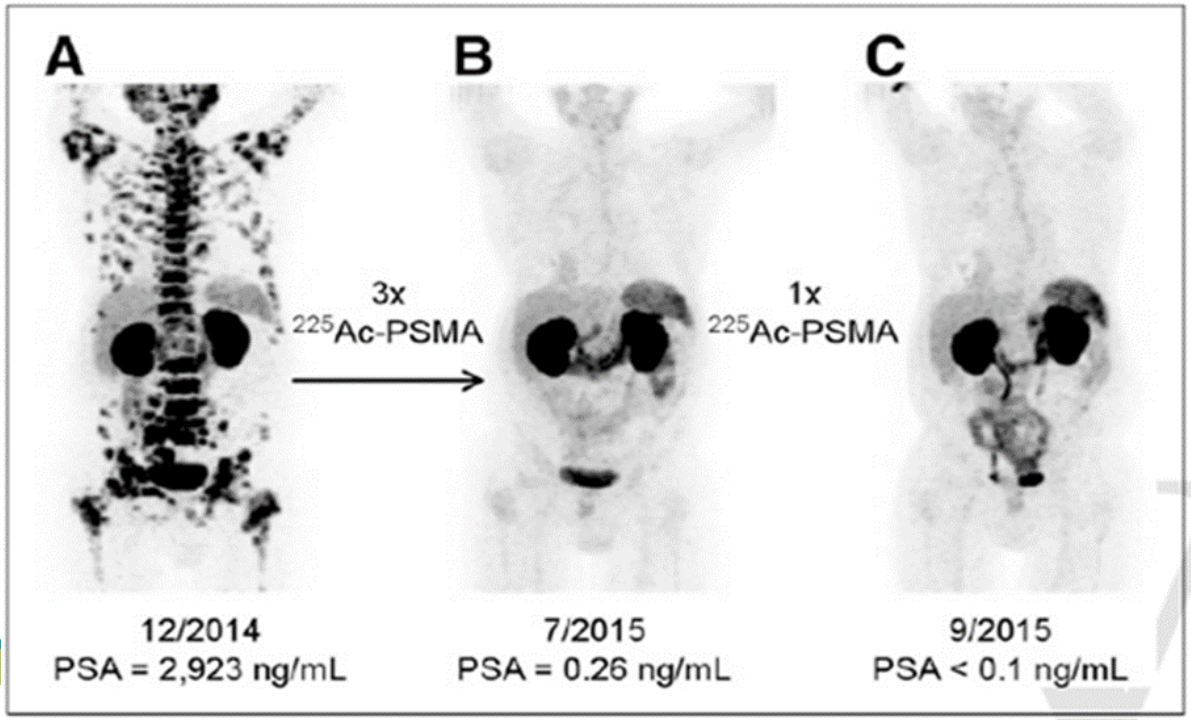


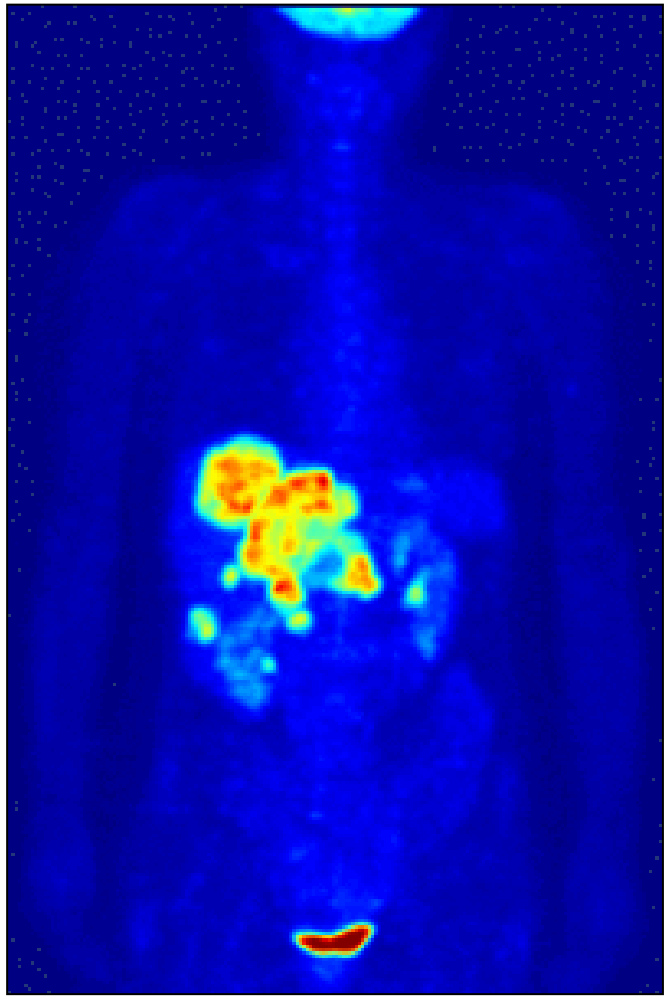
Many exciting joint opportunities with the office of nuclear physics

Medical Isotope Program



- Targets irradiation with 200 MeV proton beam
- Many interesting synergies with HEP

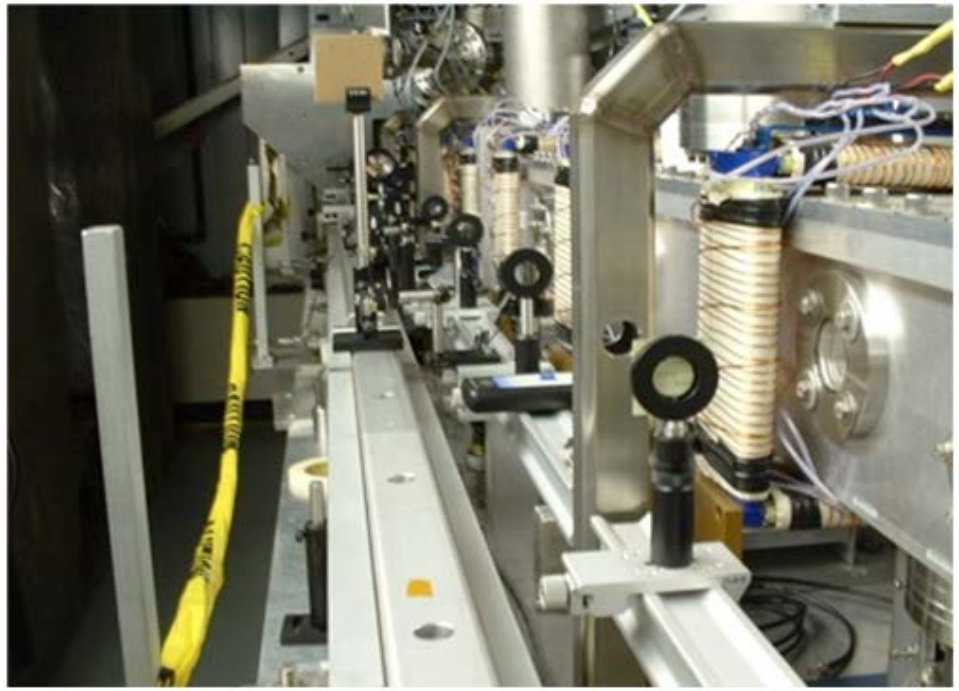


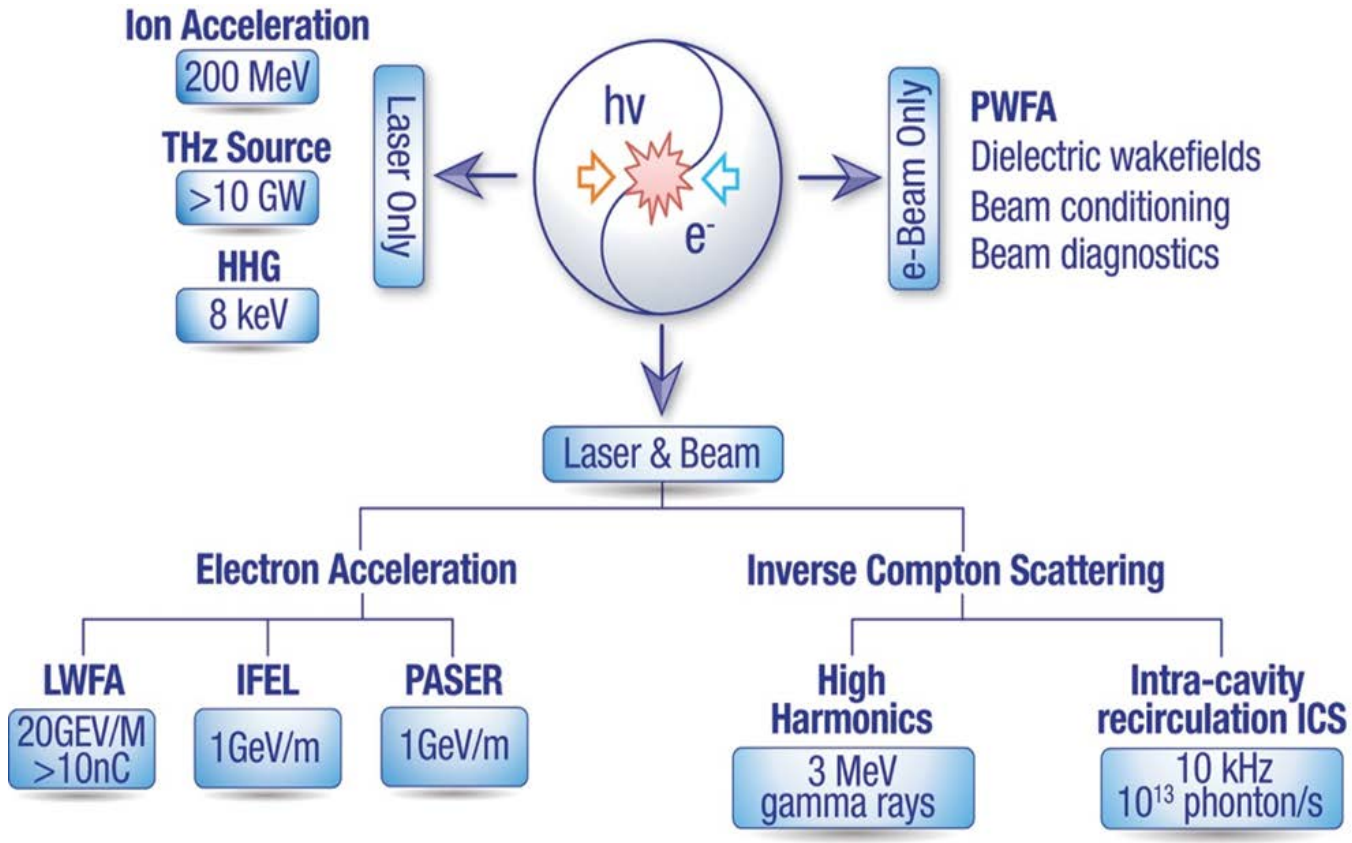


Accelerator Test Facility: A unique electron – laser facility

The ATF has been serving accelerator users for the past 25+ years

Now part of ARDAP Office
Accelerators Research and Development and Production





Computing and Data Sciences

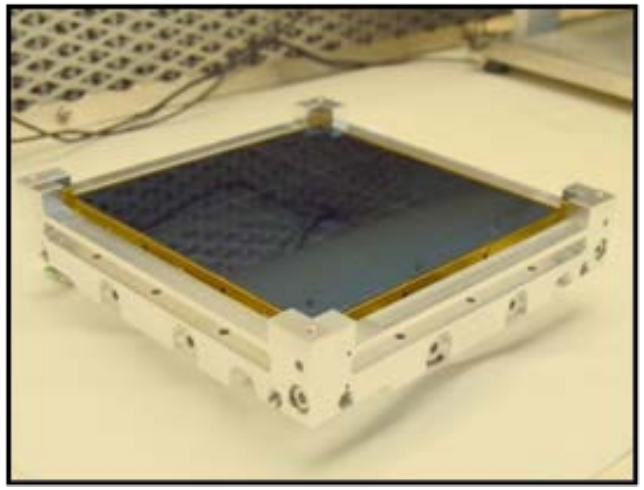
- Reusing light source building to host modern computing center
- Computing Science Initiative developing scientific computing methods, including AI/ML

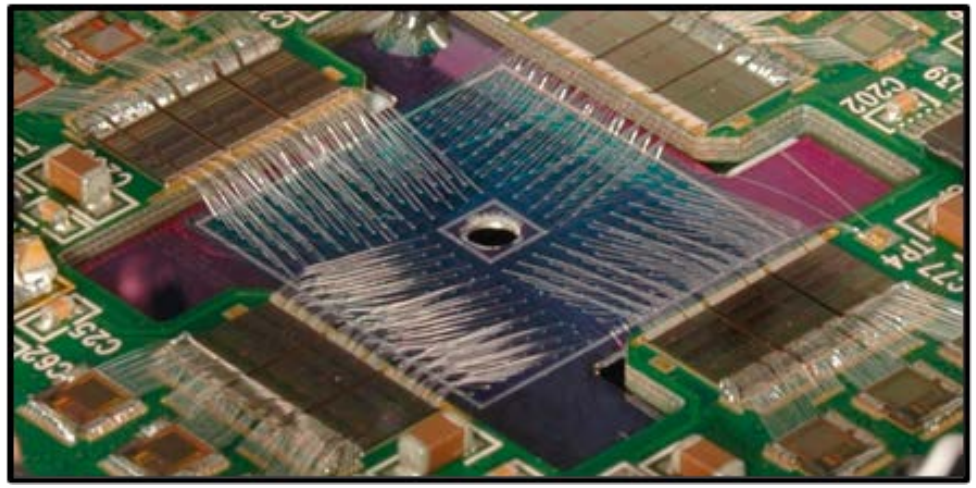
Superconducting Magnets Division

- Experience in designing and construction superconducting magnets
- Strong research program, connection to other programs in nuclear physics and fusion

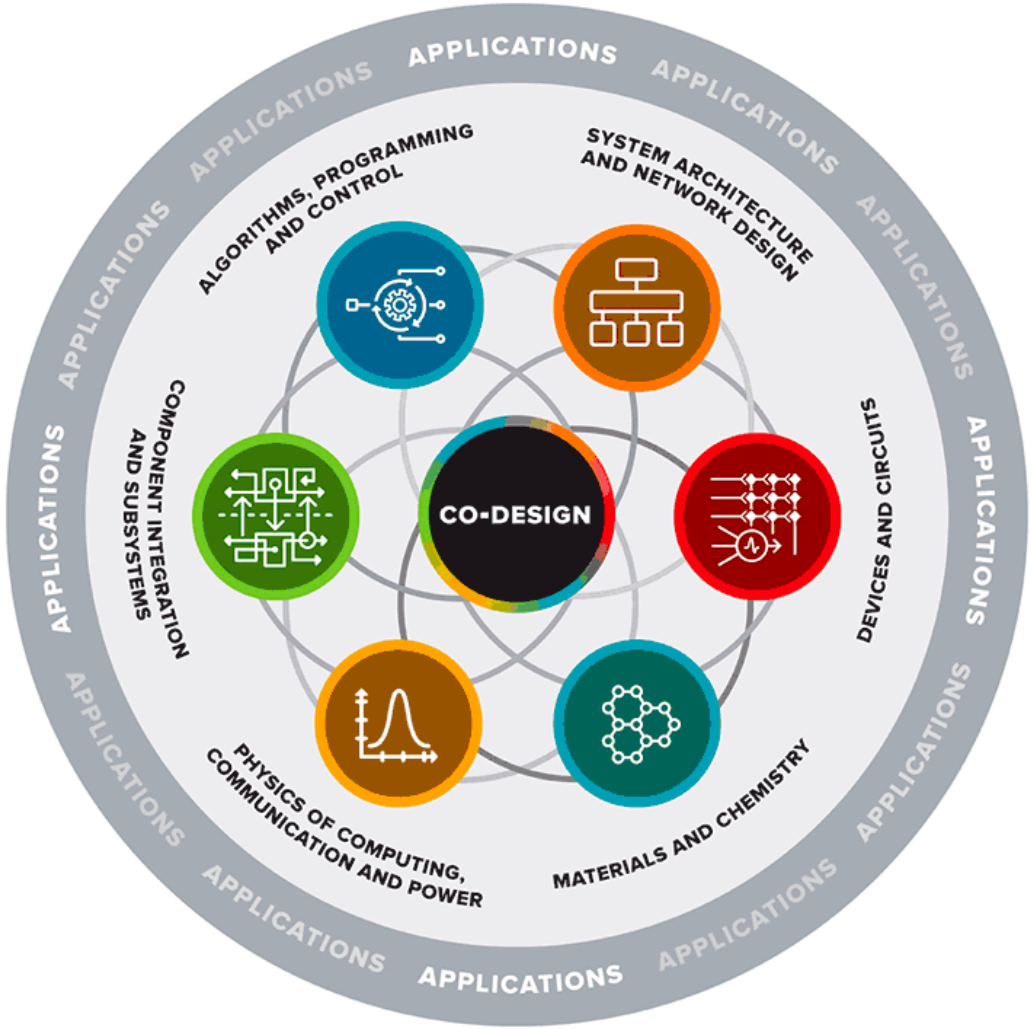
Instrumentation Division

- Provides key capabilities for science programs at RHIC, light source, SLAC, FNAL, CERN, and many other centers
- Excellent set of infrastructure, including recently added QIS lab





Light Source and QIS



C²QA
Co-design Center for Quantum Advantage

- BNL Quantum Center
  - Leads diverse science and engineering team
  - Developing approach to quantum computing from solid state physics new materials to “end users”
  - HEP, mainly lattice calculations for now, are playing a role of end users helping to develop quantum computers and their specifications

Brookhaven National Laboratory

BNL Questions and Answers

- Strong HEP, nuclear physics, basic energy sciences and other programs
- Excellent local facilities
- Strong experience in international cooperation
  - Welcoming everyone to BNL and interested to discuss opportunities abroad
  - Start from scientist's interactions
- Snowmass vision “ask”
  - Balance/stability between research, operations and projects
  - Prioritized vision for the future program, large experiments
  - Support of medium and small experiments
  - Support for theory, computing and R&D on accelerators and detectors
  - Education and support of junior scientists