

# 10-Year Strategic Plan Update

*Doon Gibbs  
Community Advisory Council  
December 11, 2014*



U.S. DEPARTMENT OF  
**ENERGY**

Office of  
Science

# Outline

- 10-Year Strategic Plan
- 10-Year Infrastructure Plan Summary
- Recompete Summary
- Q&A

# Brookhaven National Laboratory – Next 10 Years

## Vision

To be the leading U.S. DOE, multi-program laboratory with recognized impact on national science needs

- Leadership in nuclear physics, photon sciences and selected areas of energy science
- Accelerate DOE missions in HEP, BER and national security
- Leadership in data-driven computational science

## Mission

Utilize our world-class facilities and expertise to:

- Advance energy and environment-related basic research and apply them to 21<sup>st</sup> Century problems of critical importance to the Nation
- Advance fundamental research in nuclear and particle physics to gain a deeper understanding of matter, energy, space, and time

## Strategy

Position our major user facilities (**NSLS-II**, **CFN** and **RHIC** → **eRHIC**) for continued leadership roles

- Integrate our programs and facilities, including outreach to universities, industry, and other National Laboratories to enable us to solve complex problems of national importance

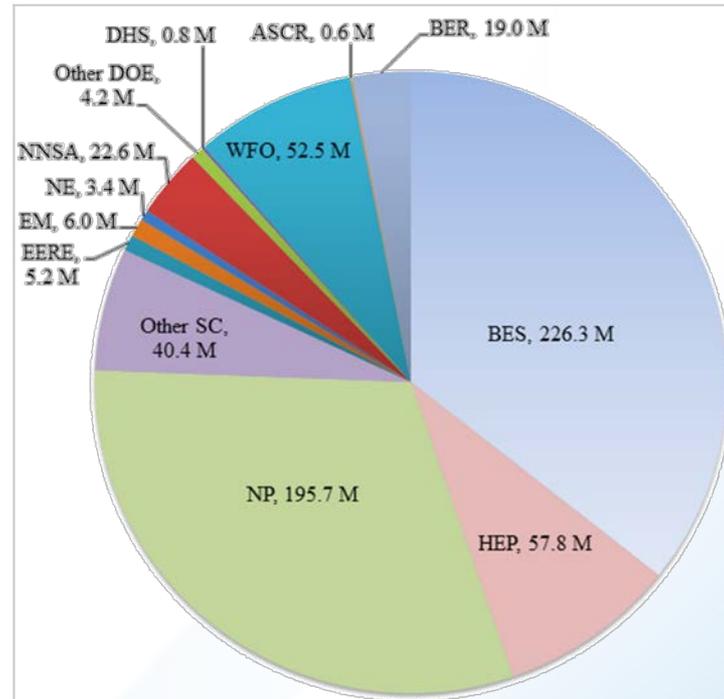
Enabled by renewed infrastructure and  
safe/efficient operations

# Brookhaven National Laboratory at a Glance: FY 2013

- Physical Assets
  - 5,322 acres
  - 310 SC buildings
- Human Capital
  - 2,882 FTEs (2987 heads)
  - Direct/indirect: 0.59/0.41
  - 480 undergrad/grad students (paid by Lab)
  - 4,134 facility users
  - 1,377 visiting scientists



## FY 2013 Funding by Source (\$M)



**FY 2013 Total Lab Operating Costs (excluding Recovery Act):** \$629.9 million

**FY 2013 Total DOE/NNSA Costs:** \$22.6 million

**FY 2013 WFO (Non-DOE/Non-DHS) Costs:** \$52.5 million

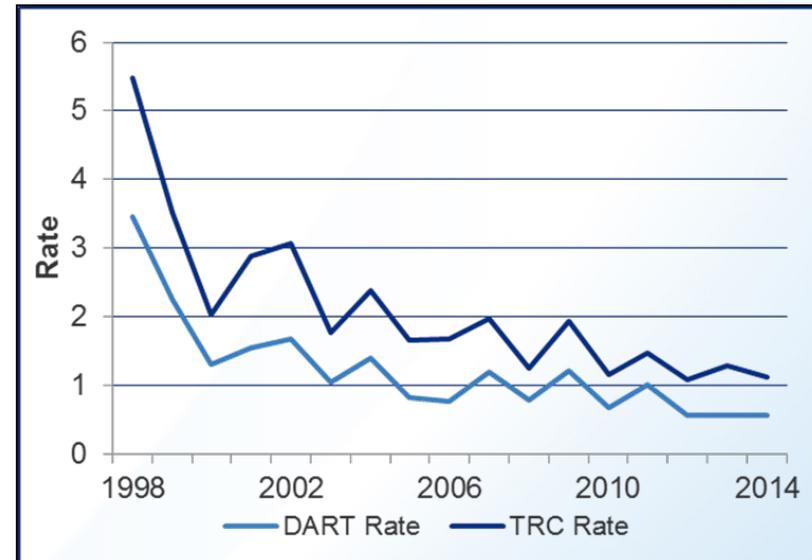
**FY 2013 WFO as % Total Lab Operating Costs:** 8.3%

**FY 2013 DHS Costs:** \$0.8 million

**Recovery Act Costed from DOE Sources in FY 2013:** \$4.7 million

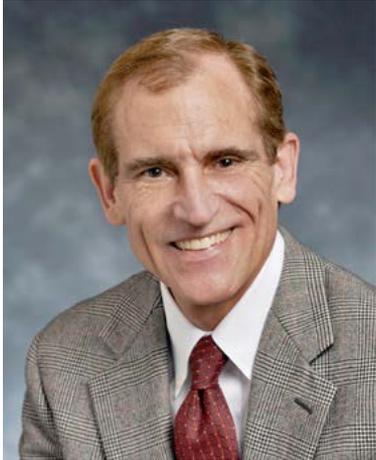
# We are Focused on Operational Excellence

- Overall improvement
  - Injury severity (as measured by days away) remains substantially down
  - Slips / trips / falls is #1 injury type
  - Traffic safety continues as a concern
- Engagement and accountability are a focus and showing results
  - Meeting this week with Opinion Leaders
  - Where we've been, where we're going
- Business environment is an emergent issue
- Investing in hazard identification, elimination, and mitigation
- Active governance by BSA via Board Committees and BSA peer reviews
- Project management oversight improvements
- New leadership in place



The motivation is to carry out the mission – inspiring staff to understand how their performance enables success

# Notable Appointments



**Bob Tribble**  
Deputy Director  
Science & Technology



**Jack Anderson**  
Deputy Director  
Operations



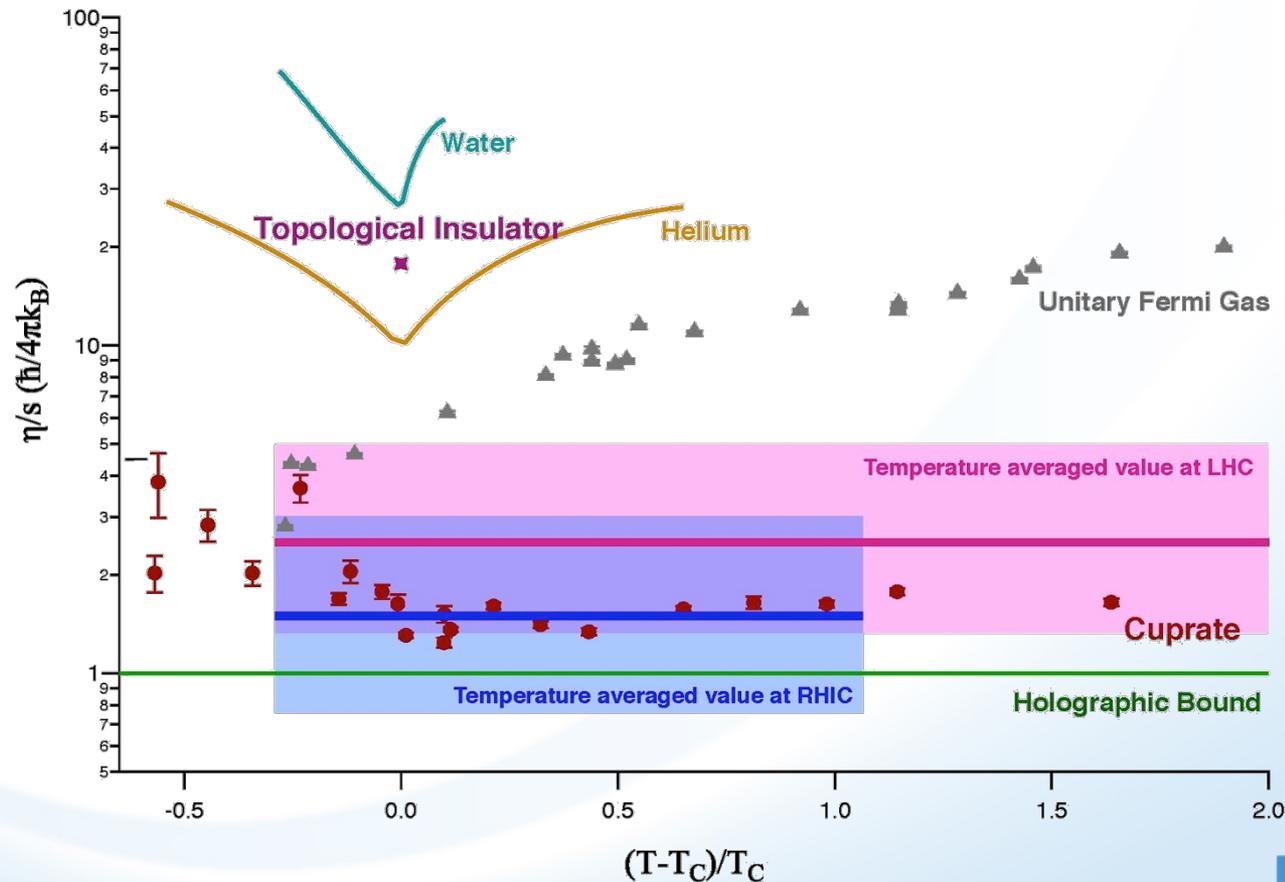
**Gail Mattson**  
ALD  
ES&H



**Martin Schoonen**  
ALD  
EBNN

# The Multi-Program Nature of BNL Enables Scientific Discoveries in Diverse Fields

- Following the discovery of nearly perfect fluidity in quark-gluon plasmas, similar behavior in high  $T_c$  superconductors was observed
- Co-location of research groups promotes the sharing of ideas and approaches that lead to unexpected connections



# The Next Decade

## Energy S&T

- Unprecedented capabilities of NSLS-II and CFN drive the science program
- BES, BER core program leadership
- Integrated Centers for Energy Science (ICES) starting w/ catalysis and grid/storage
- *In operando* experimentation
- Regionally focused grid research

## Origins of Matter & Mass

- Complete RHIC NP mission
- Design, construct, and commission eRHIC
- Leadership roles within HEP priorities
- ATF--user facility supporting HEP stewardship mission
- Capabilities for related work e.g., BLIP, NSRL, hadron therapy

## Computational Science

Emerging Core Capability Essential for BNL Science

- Lab level initiative reporting to the DDST
- Partnerships: SBU, IBM, Intel, and Columbia
- Leveraging RACF, CSC, CFN to enable NSLS-II data management

## National Security

- NRC, DOS, RAP, NNSA, DoD
- Support for diplomacy, treaties, and IAEA Safeguards
- Radiation detector development
- Strong coupling to Northeast Region security and emergency response needs

12 Core Capabilities Underpin All of Our Work

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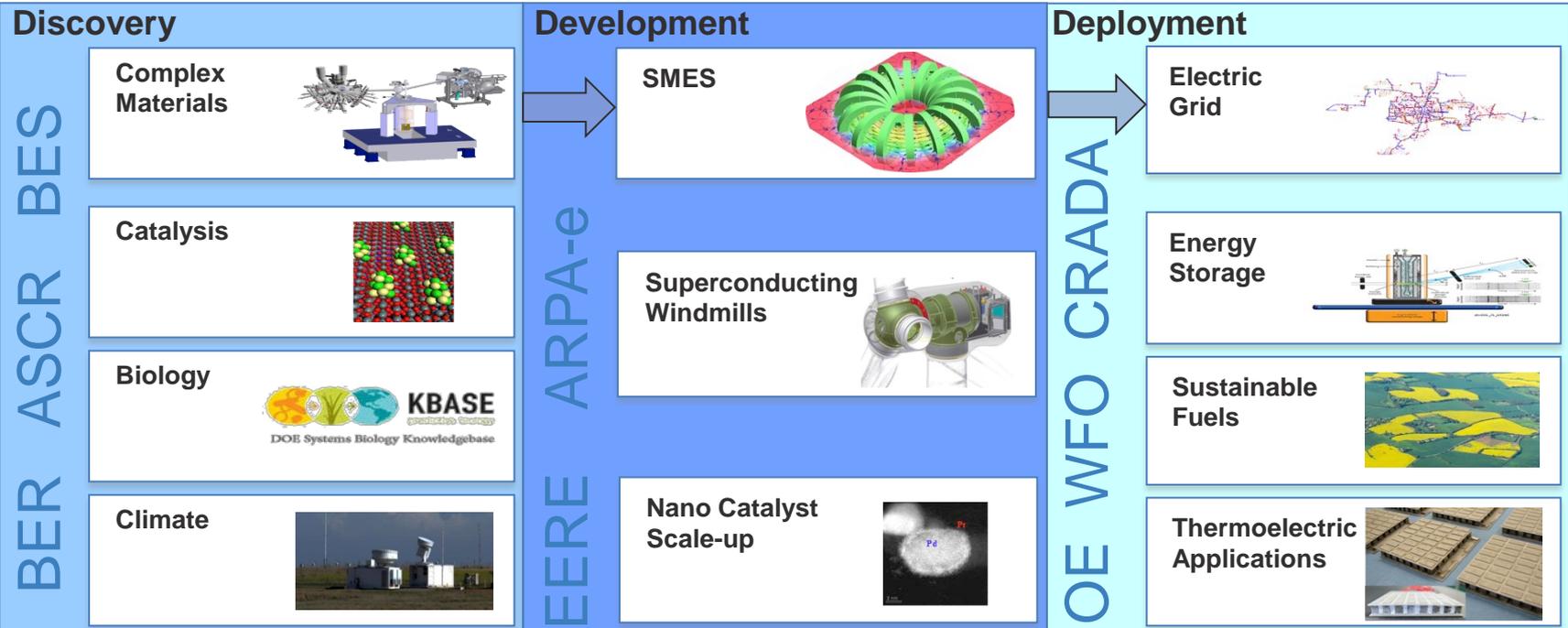
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# Integrated Energy Team from Discovery to Deployment

Focus our efforts, build on BNL strengths, align internally and with stakeholders, achieve real-world impact



- Integration of facilities and expertise for greater value for DOE investment
- Core Capabilities + Computational Science underpin all work
- Communication & Interaction with stakeholders to accelerate translation

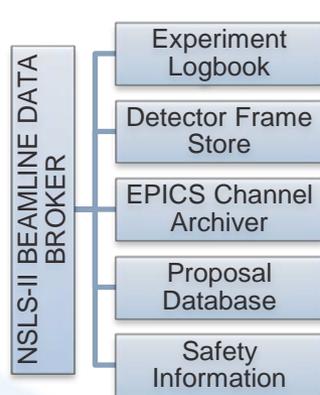


# Ramp Up of NSLS-II User Science

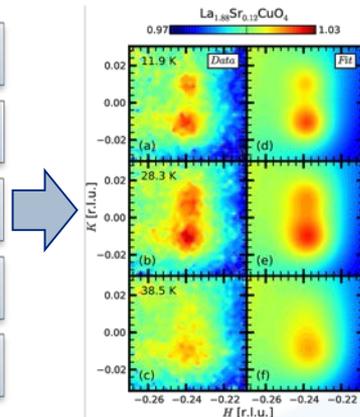
- First Experiments Workshop took place Aug 12-13, 2013
  - More than a dozen user workshops in FY13
- 61 Proposals received for User Assisted Science Commissioning Experiments
  - Beamtime oversubscribed by a factor of 3
  - Working closely with user community
- Using LDRD to accelerate first experiment development



Sample Cells, Stages, Detectors

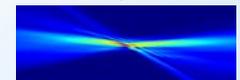


Next Generation Data Collection/Analysis



Robotic Sample Changers

— Simulation



→ ← 11nm

World leading nano-focusing optics

We will have key experiments ready for beam at beginning of beamline science commissioning

# *In Operando* Science is a Differentiating Capability for BNL

*Definition:* The study of materials under real-world, operating conditions (pressure, temperature, chemical environment, voltage...)

## Vision:

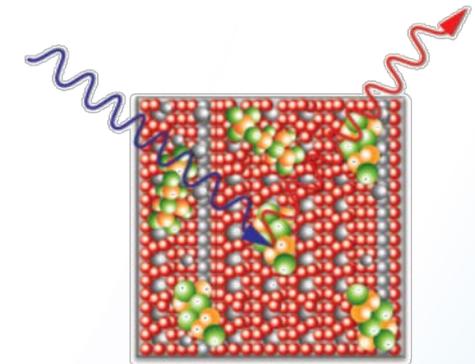
Develop a suite of *in operando* photon- and electron-based probes at **NSLS-II** and **CFN** to deliver solutions to pressing energy challenges

## Integrated Centers for Energy Science (ICES)

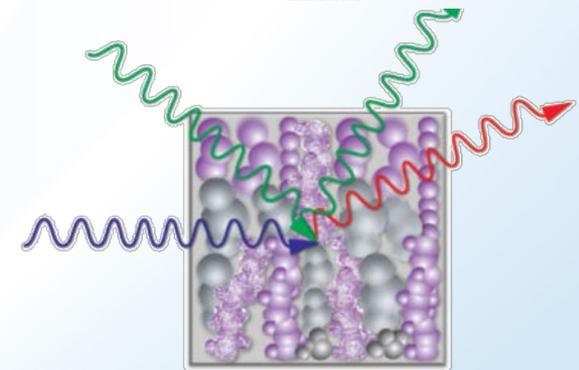
- Modeled after the successful Synchrotron Catalysis Consortium
- Combines:
  - Core-program expertise
  - Access to world-leading facilities
  - State-of-the-art integrated tools
  - External experts

## ICES examples:

- **Catalysis Science**, led by Jinguang Chen, will reveal atomic level structure and function in actual reaction environments
- **Energy Storage**, led by Esther Takeuchi, leverages many of the catalysis tools for use in energy storage problems



**TODAY**   
 Single probe  
 Model surfaces  
 Vacuum



**VISION**   
 Multiple probes  
 Complex surface  
 Real world conditions

# Electric Grid Technology and Commercialization

- Northeast Solar Energy Research Center (NSERC)
  - Test/evaluation facility to enable development and integration of reliable/resilient solar, storage and grid technologies in the NE
  - Partner with NYSSGC, utilities, and industry
    - Integrate PV and energy storage (plus load management) into electrical distribution system
    - Design/control micro-grid architectures
    - Test smart-grid technologies, e.g. inverters, sensors, control systems
    - Modeling
  - \$1 M NYSESDC funding for NSERC build-out
- Use BNL micro-grid as a distribution lab (AEGIS)
  - Partner with NYSSGC/SBU; engaged OE
  - NYS support for grid projects – e.g. \$5 M (BNL/SBU) SGRID<sup>3</sup> award
- Acceleration of commercialization
  - Partner with Columbia, SBU, and Cornell on Proof-of-Concept Center—NYSERDA \$5 M



**First Experiments**

- NYSERDA-funded study of smart-grid inverters (\$2 M proposed)
- Collaboration with EPRI, NYS Utilities
- Engineering Studies - FY14
- First Field Tests at BNL - FY15



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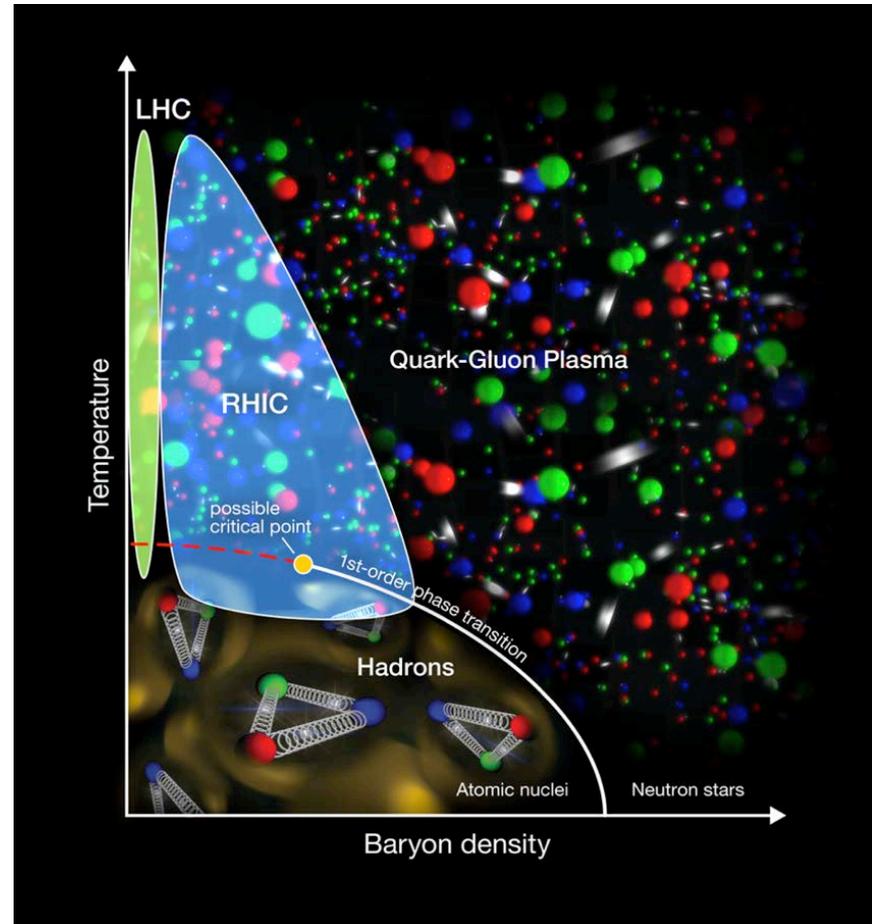
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12 Core Capabilities Underpin All of Our Work

# RHIC is the Perfect Facility to Explore the Phases of Nuclear Matter

- QCD matter turns from a nucleon superfluid into a nucleon/hadron gas at approximately 100 billion degrees
- When heated to 2 trillion degrees at RHIC, nuclear matter suddenly turns into a liquid again
  - The most perfect liquid ever observed
- **Only RHIC has the energy range to observe where the transition occurs**



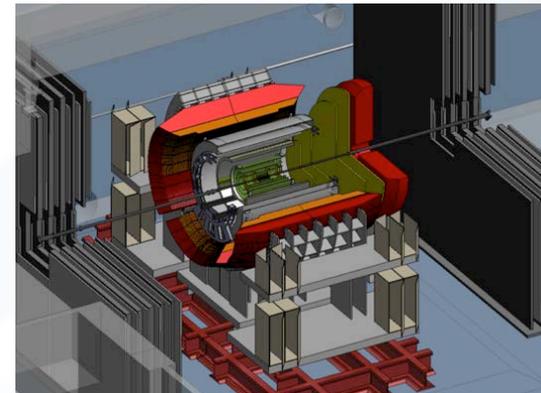
# Completing the RHIC Mission

## Status:

- RHIC-II configuration is now complete
  - 3D stochastic cooling
  - Vertex detectors in STAR (HFT) and PHENIX
- RHIC Run 14 – Integrated Au+Au luminosity exceeds all previous Au+Au runs combined

## Plan: Complete the RHIC Mission in 3 campaigns:

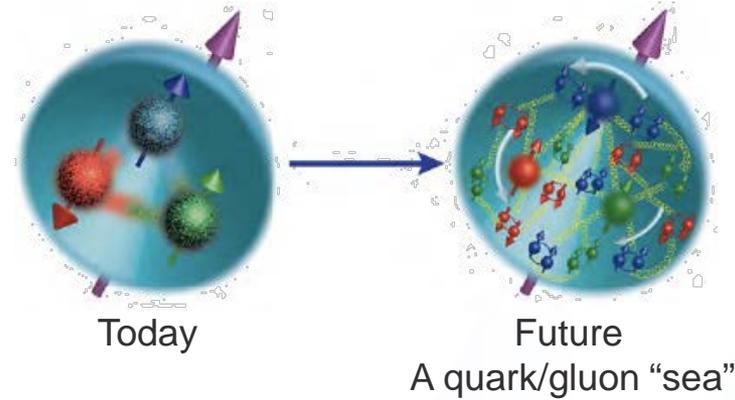
- **2014/15/16:** Understand the properties of the quark gluon plasma using heavy quark spectroscopy
- 2017: Install low energy e-cooling
- **2018/19:** High precision scan of the QCD phase diagram
- 2020: Install superPHENIX upgrade
- **2021/22:** What makes the QGP a perfect fluid: Elucidate the fluid correlations using jets
- 2023/2024: RHIC shutdown and transition to eRHIC



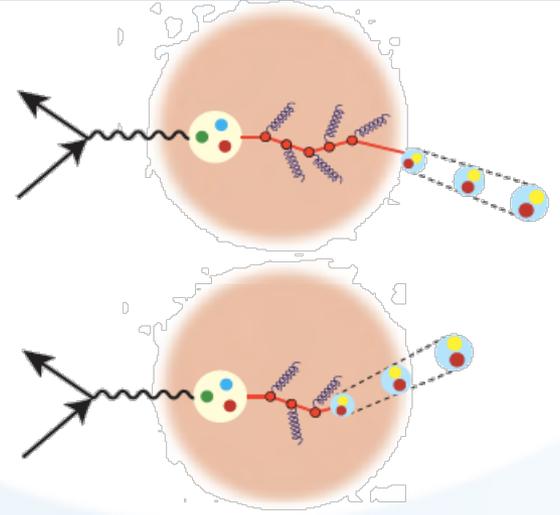
RHIC remains a unique discovery facility:  
~3,000 citations/year, ~30 PhDs per year

# EIC: QCD Laboratory of the Future

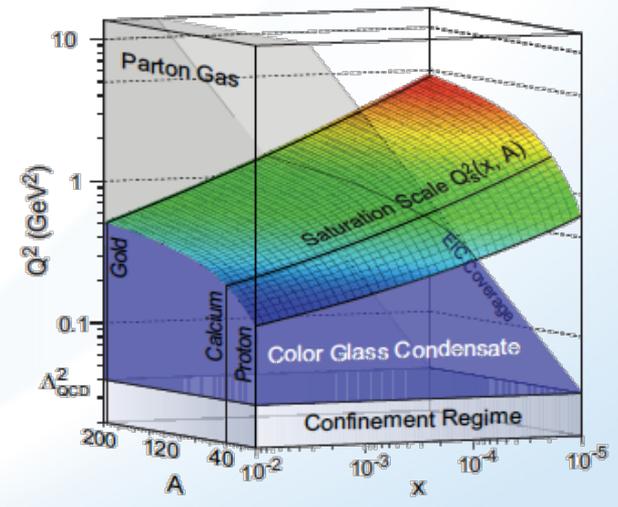
Gluon structure of the “cold” proton:  
How is the proton’s mass generated and what carries its spin?



How do confined hadrons emerge from isolated quarks? (“ARPES”)

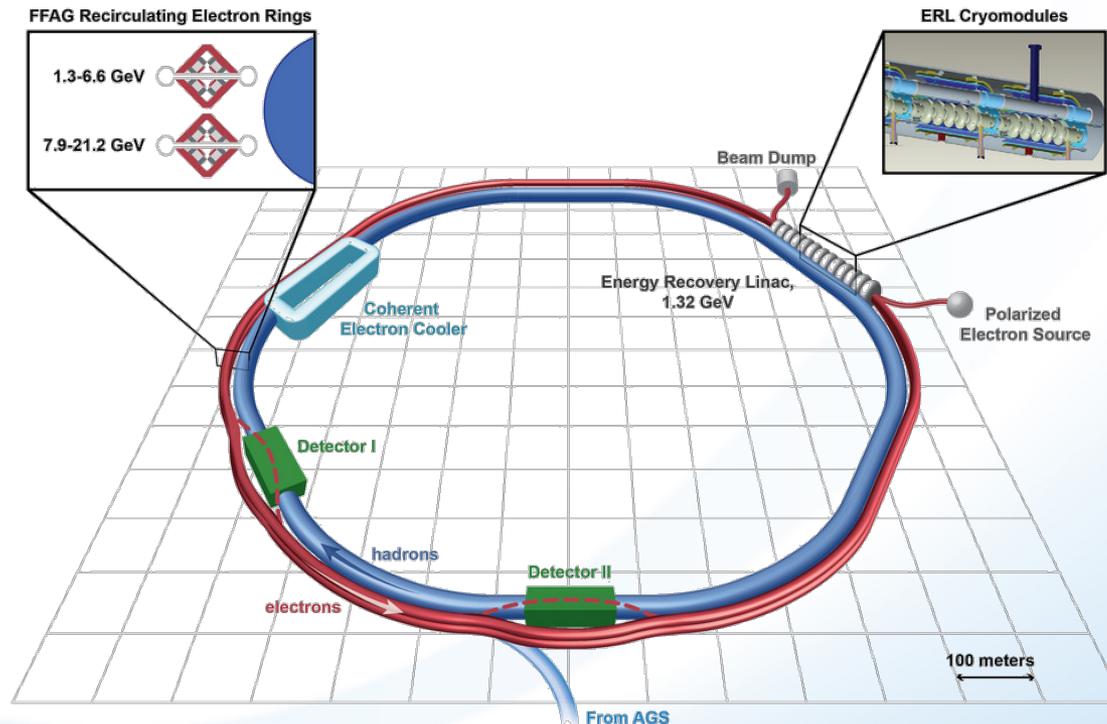


High density phase of low energy gluon matter



# eRHIC Design: Innovative and Cost-Effective

- World's first Linac-ring collider
- Energy Recovery Linac (ERL) reduces power consumption from 1 GW to 20 MW
- Coherent electron cooling for record high beam brightness
- Fixed field alternating gradient (FFAG) recirculating arcs propagate beams with multiple energies



When complete, eRHIC will be the most advanced and energy-efficient accelerator in the world

# BNL's HEP Program is Well Aligned With the P5 Recommendations

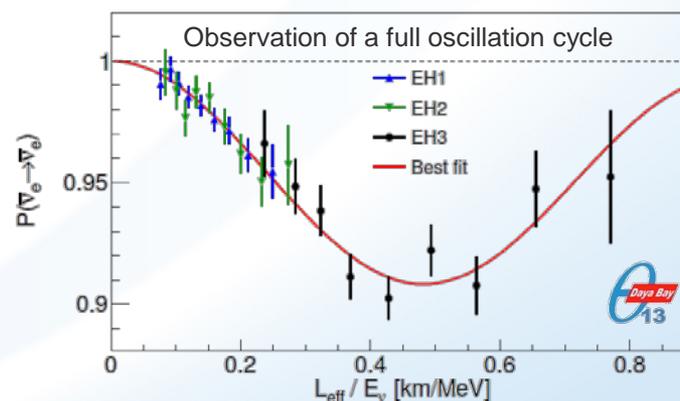
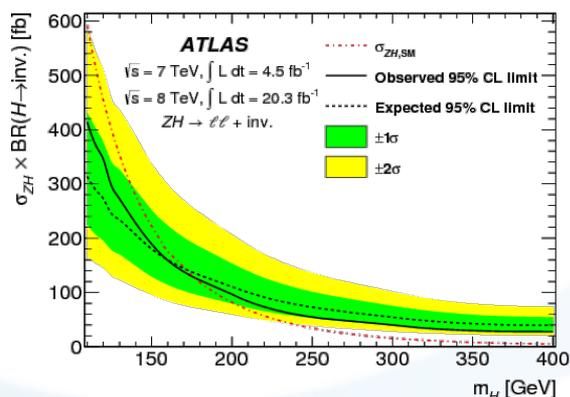
## The P5 Recommendations

- Use Higgs boson as a new tool for discovery
- Pursue physics associated with neutrino mass
- Identify physics of dark matter, dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles
- Support enabling technologies in accelerators, detectors, and computing

## BNL's Leadership Roles

- U.S. host lab for the ATLAS experiment at the LHC
- Recognized expertise in neutrino physics and strong involvement in neutrino program
- Significant contributions to LSST science and construction
- Development of the theoretical framework that motivates these experiments
- Essential research on AS&T, detectors and computing

Absence of Higgs boson decay into "invisible particles": no evidence of physics beyond standard model, puts new limits on dark matter models



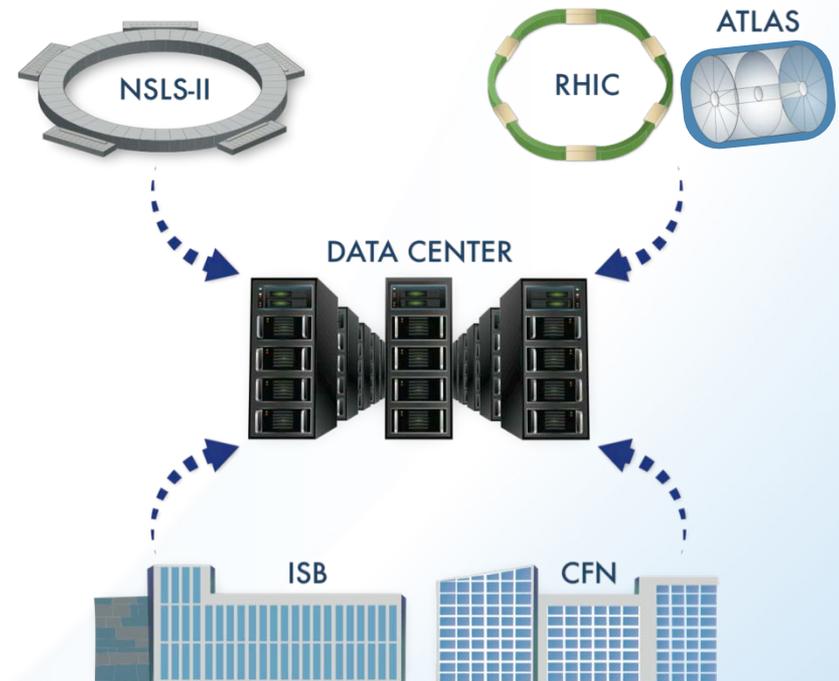
First measurement of mass splitting in electron channel  $\Delta m^2_{ee}$  agrees with muon channel  $\Delta m^2_{\mu\mu}$  - important confirmation of neutrino oscillation picture

# Computational Science Initiative

**Vision:** Leader in the analysis and processing of large volume, heterogeneous data sets for high-impact science programs and facilities

To achieve this vision BNL will:

- Create a Lab-level computational science initiative reporting to DDST
- Build out from RACF, CFN, ISB, CSC/NYCCS, and NSLS-II to deploy a Laboratory-wide sustainable infrastructure for data-management, real-time analysis and complex analysis
  - Initial focus: NSLS-II (with IBM)
- Grow programs and enhance competencies in applied mathematics and computer science aligned with the missions of ASCR and other SC programs
- Establish and grow partnerships with SBU, the Core Universities, IBM, Intel, and other National Laboratories

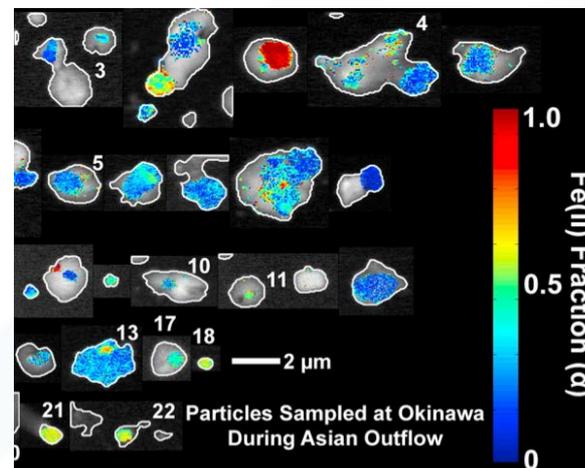


# Environmental and Climate Sciences: Contributions to ARM and ASR

- Expand contribution to DOE-Terrestrial Ecosystem Science through increased involvement in Next Generation Ecosystem Experiment (NGEE) – Arctic and proposed involvement in NGEE – Tropics
- Leverage NSLS-II (first light experiment) and TEM facilities at CFN
- Perform XRF imaging and XANES with sub-100nm spatial resolution spectroscopy on  $\mu\text{m}$ -sized aerosol particles at NSLS-II SRX beamline



Alistair Rogers in Alaska  
conducting NGEE-Arctic research



$\text{Fe(II)}/(\text{Fe(II)}+\text{Fe(III)})$  obtained using  
STXM/NEXAFS (LBNL-ALS)

# Engaging Experts and Special Capabilities Across the Lab

## Plant Biochemistry

Metabolic engineering



## Mesoscale Multi-Modal Imaging

NSLS-II, CFN

## Quantitative Physiology

Understand plant response to global change



## KBase

Data-centric HPC and HTC

## Center for Quantitative Plant Science

- Multi-scale modeling of plant physiology and interactions with the environment
- Start with simple model organisms and move to more complex systems
- A unique resource for DOE enabling a path from plant bioscience to bioengineering and applications

## Partnerships

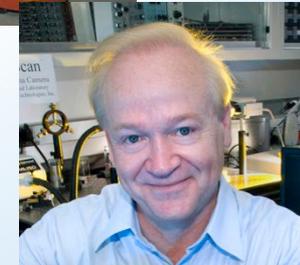
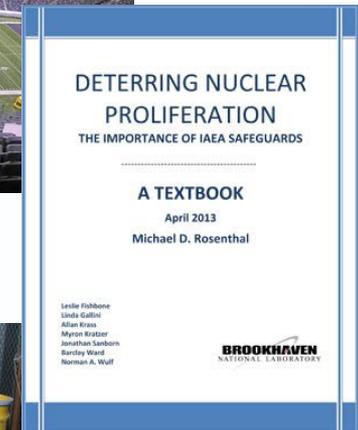
CSHL, SBU, Yale,  
U. Missouri, EMSL

## Resource Needs

Additional hires to build capability  
Upgraded lab space

# National Security Is An Important Effort At BNL

- Support DOE/NNSA and State Department
  - Policy and technical analysis to support diplomacy and treaties
  - Training programs for growing a sustainable nuclear/chemical security
- Strengthen IAEA safeguards
  - Manage the International Safeguards Project Office
  - Train IAEA and member state officials
- Respond to potential domestic threats to prevent terrorists from using WMD in U.S. – Radiological Assistance Program
- Develop and deploy radiation detectors to support national and homeland security missions
- Aspiration: Develop regional capability to train
  - 1<sup>st</sup> responders on rad/nuclear response
  - Utilities on new FEMA requirements



Ralph James Named Materials Research Society Fellow

# Ten-Year Campus Plan

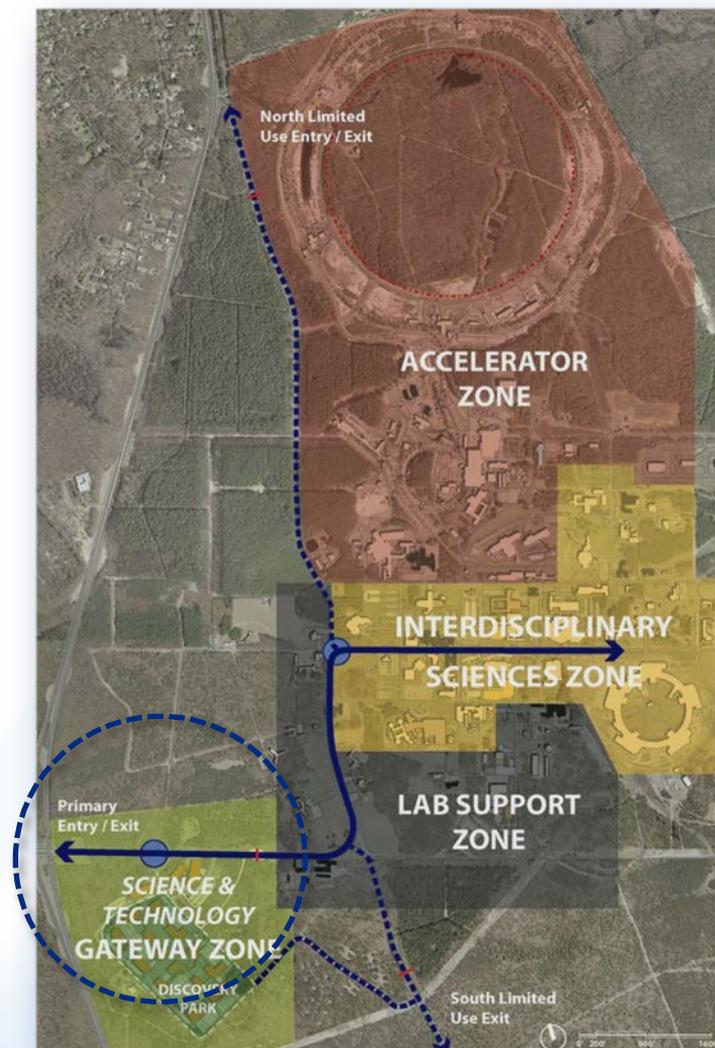
*BSA has a plan to deliver the next decade of science while transforming the Laboratory Campus with substantially reduced DOE-direct investment*



- Focus limited DOE investment in critical core buildings to enable the scientific agenda
- Make research safe and cost effective by downsizing the campus and demolishing old buildings
- Ensure scientific reliability through targeted utility infrastructure investments
- Support the growing population of scientific users through an innovative concept of Discovery Park

# Discovery Park: *A Transformative Opportunity*

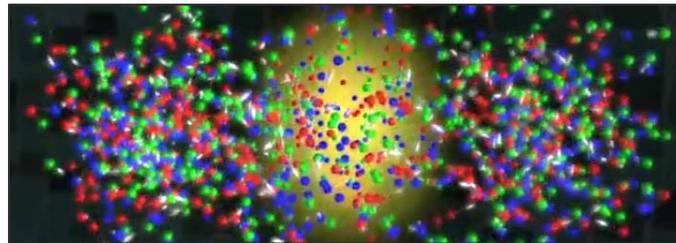
- Conceptualized as a joint partnership with external public/private resources through a land transfer
- Discovery Park could enhance the DOE's investment, assets, and needs and position the Laboratory as a valued and visible community partner
- Discovery Park has opportunity to bring valuable capability in several mission and support areas
  - Infrastructure Revitalization
  - Guest and User Services Portal
  - Research capabilities in Energy Science and Computing
  - Next Generation Workforce Development
  - Discovery to Deployment Partnerships



# Recompete Summary

# BSA Is Delighted to Manage BNL for the Next 5 Years (with Extensions up to 20)!

- BSA: Deep and experienced partners with a strong commitment to the Lab
  - Fiduciary: Stony Brook University and Battelle
  - Distinguished Core universities: Columbia, Cornell, Princeton, Harvard, Yale and MIT
- Impressive track record over 15 years: established excellent community relations, successful RHIC ops and the perfect fluid, successful NSLS ops: 2500 users per year, CFN, NSLS-II, significant improvements to safety record and infrastructure
- Exciting vision for the future that takes advantage of BNL's strengths and will have recognizable impact on DOE's mission
- Deep, proven and passionate management team, committed to the vision, to BNL and to each other



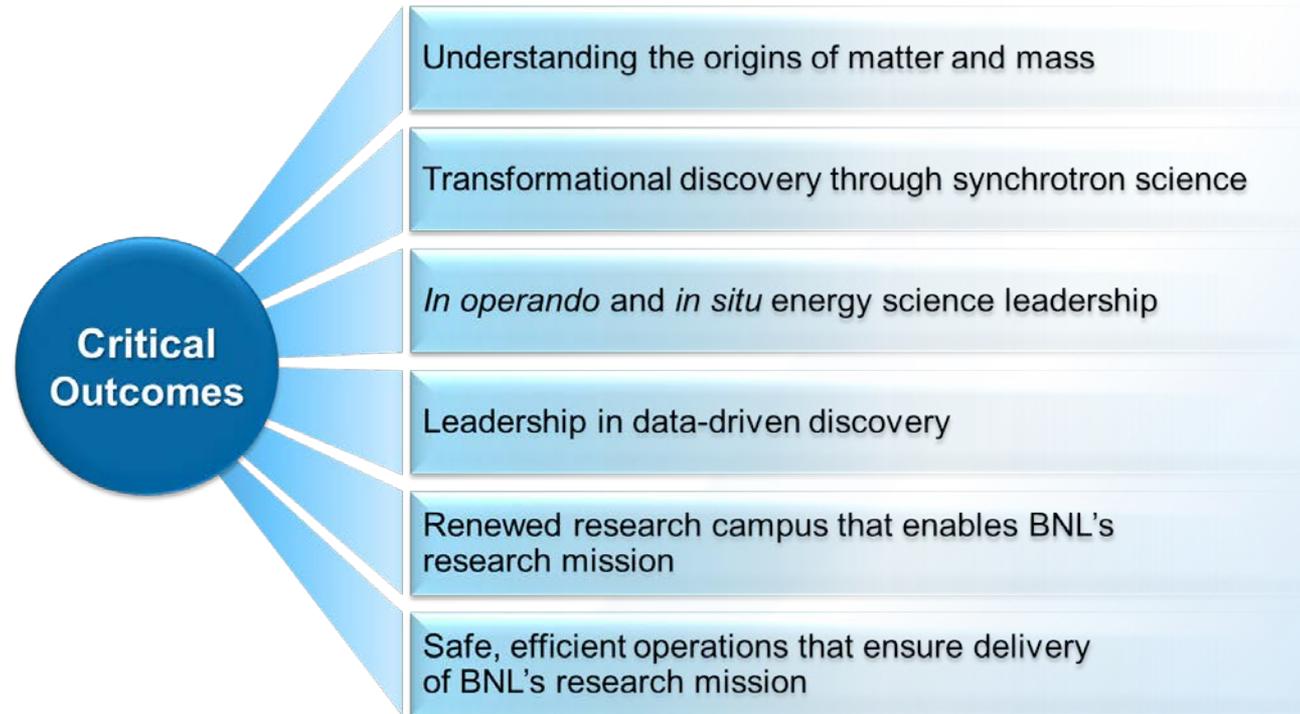
# BSA's Vision in 2025

- **Vision:** Brookhaven is among the world's few pre-eminent science laboratories. BNL provides broad leadership in nuclear, photon, and energy sciences; conceives, builds and operates premier user facilities serving highly productive user communities; leads in the application of data sciences to enable discovery at those facilities; and accelerates DOE's mission in high energy physics, applied energy sciences, environmental/biological sciences and nonproliferation through focused, distinctive programs. The Laboratory operates at the highest levels of safety and efficiency, on a fully modernized campus.
- **Culture of Excellence:** This vision is based on BSA's core philosophy of simultaneous excellence in science, laboratory operations, and in community service.

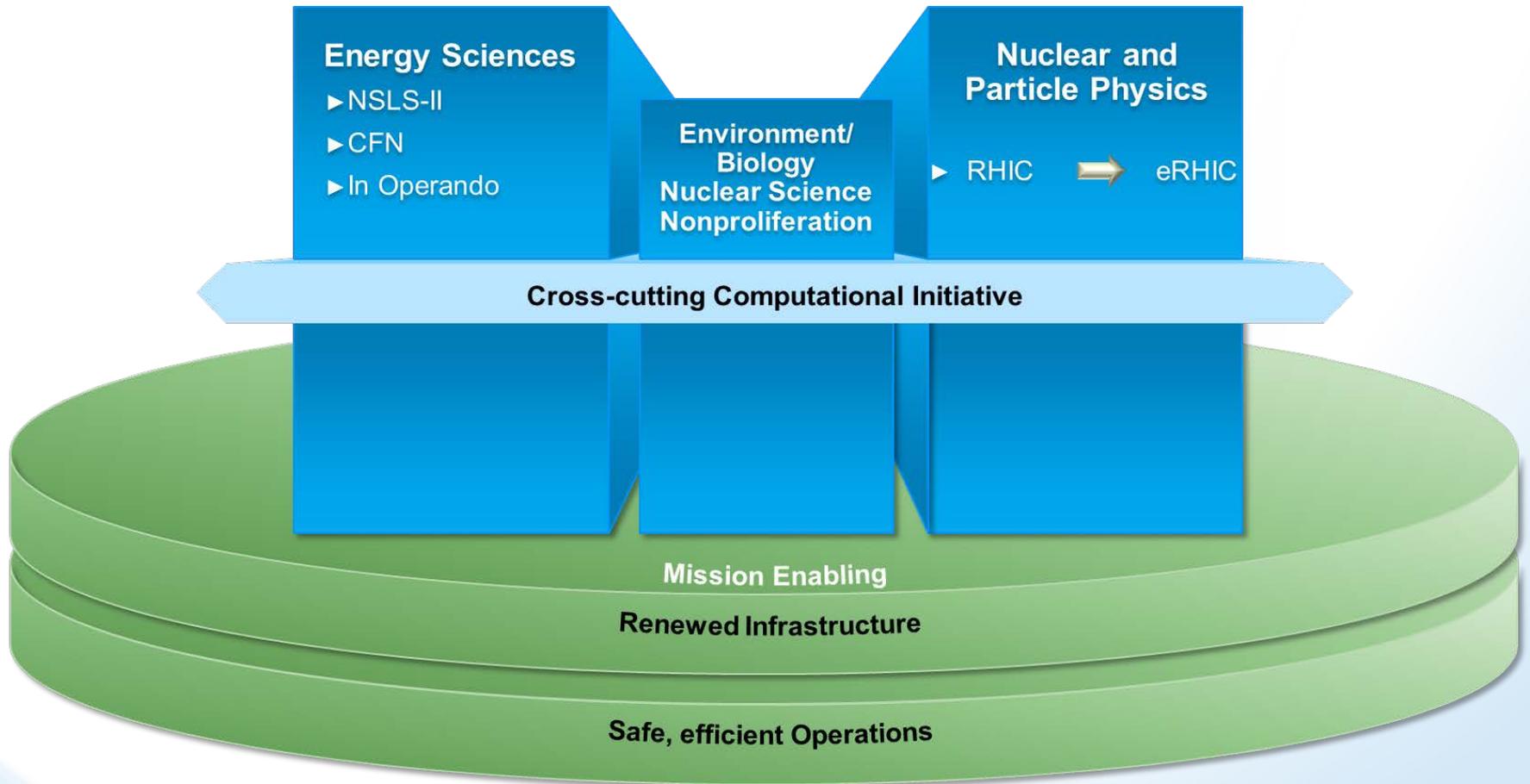


# BSA's Vision: Building a World-leading, Preeminent DOE Science Lab for the Future

- Leadership in nuclear physics, photon sciences and energy sciences
- Premier user facilities
- Accelerated BER, HEP, nonproliferation and applied energy missions
- Leadership in big data
- Enabled by renewed campus and safe/efficient



# The Laboratory Pillars

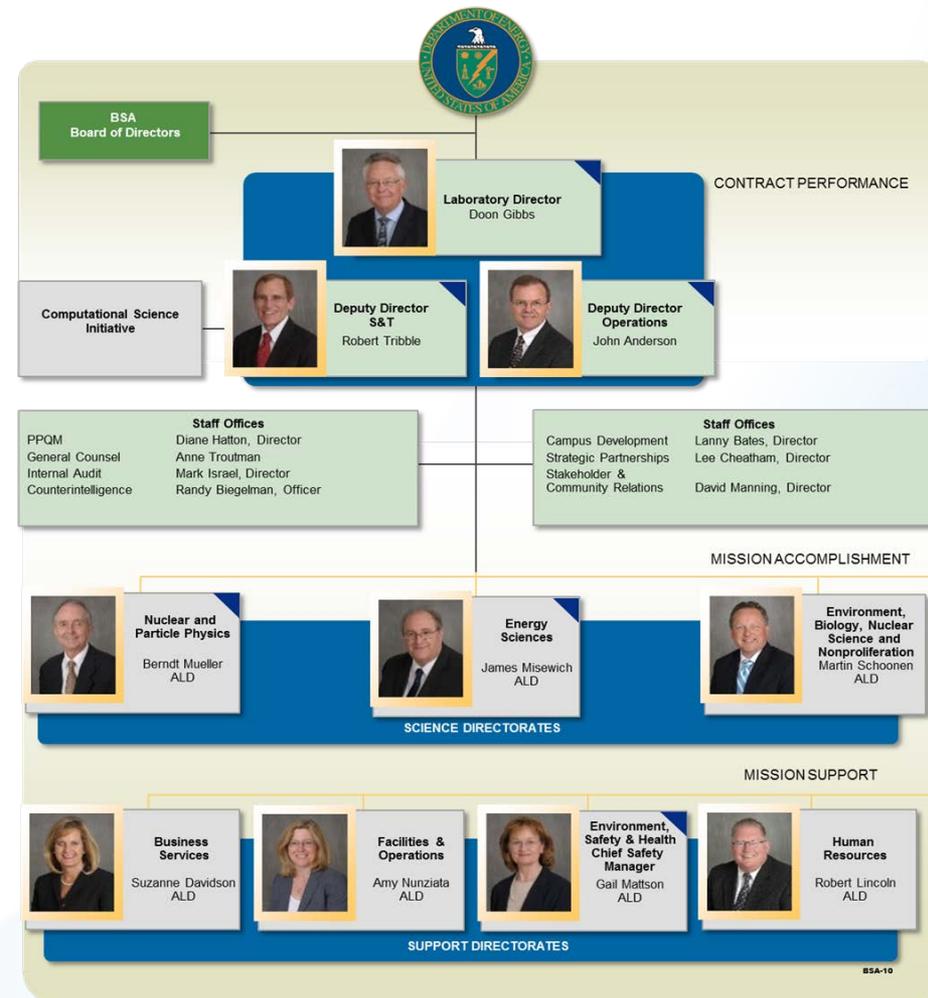


# Our Organization Is Redesigned to Achieve Our Vision

- Integrated Energy Sciences Directorate (Feb. 1)
  - NSLS-II
  - CFN
  - Basic Energy Sciences
  - Applied Energy Sciences
- Environment, Biology, Nuclear Science and Nonproliferation (as this summer)
- Created Lab-level initiative in Computational Science: Big Data
- Consolidate Business Services and ITD
- Established three new staff offices
  - Campus Development
  - Strategic Partnerships
  - Planning, Performance and Quality Management

## Benefits

- Clear leadership for each Critical Outcome
- Greater impact through consolidation
- New functionality without greater complexity



# Questions