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 21st 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 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
- Lab level initiative reporting to the DDST
- Partnerships: SBU, IBM, Intel, and Columbia

## National Security
- NRC, DOS, RAP, NNSA, DoD
- Support for diplomacy, treaties, and IAEA Safeguards

## National Security
- 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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Brookhaven Science Associates
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### Computational Science

#### Emerging Core Capability Essential for BNL Science
- Lab level initiative reporting to the DDST
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- Leveraging RACF, CSC, CFN to enable NSLS-II data management

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### 12 Core Capabilities Underpin All of Our Work
**Integrated Energy Team from Discovery to Deployment**

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

<table>
<thead>
<tr>
<th>Discovery</th>
<th>Development</th>
<th>Deployment</th>
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<tbody>
<tr>
<td>Complex Materials</td>
<td>SMES</td>
<td>Electric Grid</td>
</tr>
<tr>
<td>Catalysis</td>
<td>Superconducting Windmills</td>
<td>Energy Storage</td>
</tr>
<tr>
<td>Biology</td>
<td>Nano Catalyst Scale-up</td>
<td>Sustainable Fuels</td>
</tr>
<tr>
<td>Climate</td>
<td></td>
<td>Thermoelectric Applications</td>
</tr>
</tbody>
</table>

- 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

![Image of facilities and projects]

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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

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 Jingguang 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
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) SGRID³ 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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# The Next Decade

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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

A quark/gluon “sea”
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

<table>
<thead>
<tr>
<th>The P5 Recommendations</th>
<th>BNL's Leadership Roles</th>
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<tbody>
<tr>
<td>• Use Higgs boson as a new tool for discovery</td>
<td>• U.S. host lab for the ATLAS experiment at the LHC</td>
</tr>
<tr>
<td>• Pursue physics associated with neutrino mass</td>
<td>• Recognized expertise in neutrino physics and strong involvement in neutrino program</td>
</tr>
<tr>
<td>• Identify physics of dark matter, dark energy and inflation</td>
<td>• Significant contributions to LSST science and construction</td>
</tr>
<tr>
<td>• Explore the unknown: new particles, interactions, and physical principles</td>
<td>• Development of the theoretical framework that motivates these experiments</td>
</tr>
<tr>
<td>• Support enabling technologies in accelerators, detectors, and computing</td>
<td>• Essential research on AS&amp;T, detectors and computing</td>
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Absence of Higgs boson decay into “invisible particles”: no evidence of physics beyond standard model, puts new limits on dark matter models

Observation of a full oscillation cycle

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

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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 μm-sized aerosol particles at NSLS-II SRX beamline

Alistair Rogers in Alaska conducting NGEE-Arctic research

Fe(II)/(Fe(II)+Fe(III)) obtained using STXM/NEXAFS (LBNL-ALS)
Engaging Experts and Special Capabilities Across the Lab

<table>
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<tr>
<th>Partnerships</th>
<th>Resource Needs</th>
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<td>CSHL, SBU, Yale, U. Missouri, EMSL</td>
<td>Additional hires to build capability</td>
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<tr>
<td></td>
<td>Upgraded lab space</td>
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**Plant Biochemistry**
- Metabolic engineering

**Quantitative Physiology**
- Understand plant response to global change

**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

**Mesoscale Multi-Modal Imaging**
- NSLS-II, CFN

**KBase**
- Data-centric HPC and HTC
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
  - 1st 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 operations

**Critical Outcomes**

- Understanding the origins of matter and mass
- Transformational discovery through synchrotron science
- *In operando* and *in situ* energy science leadership
- Leadership in data-driven discovery
- Renewed research campus that enables BNL’s research mission
- Safe, efficient operations that ensure delivery of BNL’s research mission
The Laboratory Pillars

- Energy Sciences
  - NSLS-II
  - CFN
  - In Operando

- Nuclear and Particle Physics
  - RHIC
  - eRHIC

- Environment/Biology
- Nuclear Science
- Nonproliferation

Cross-cutting Computational Initiative

Mission Enabling

- Renewed Infrastructure
- Safe, efficient Operations
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