



SIXTY YEARS
OF DISCOVERY
1947-2007

BROOKHAVEN
NATIONAL LABORATORY

BNL: Overview and Future Directions

Sam Aronson, Lab Director
RHIC & AGS Annual Users' Meeting
June 22, 2007

Aerial View of BNL



RHIC & AGS Users' Meeting - 2007

BROOKHAVEN
NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES

This talk

- Lab's portfolio – now and in the future
- Little about NPP – you've heard the vision from Peter Bond yesterday and the science all week
- I'll focus on what else goes on here and where it's going
- First, I need to tell you what I'm going to tell you...



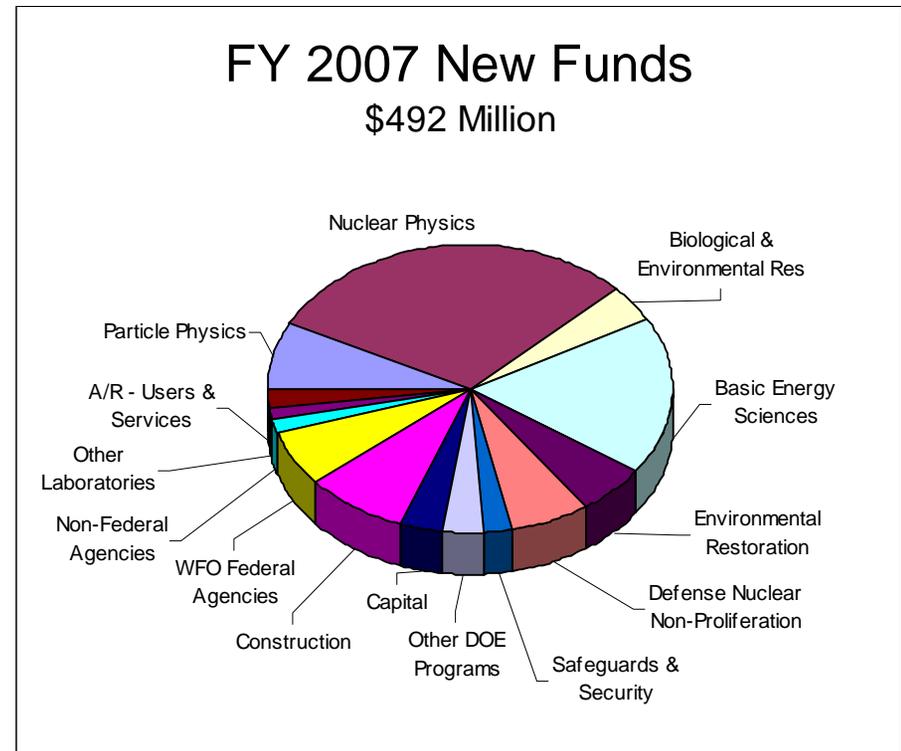
The Big Picture

- **The biggest piece of the science portfolio is NPP**
 - 40% of the Lab budget
 - RHIC, AGS, ATF → 1500 users annually
- **The next biggest piece is BES**
 - 20% of the Lab budget
 - NSLS, CFN → 2500 users annually
- **This balance will change over the next 5-10 years**
 - Some growth in NPP with the planned evolution of RHIC
 - Significant growth in BES (CFN + NSLS-II)
- **Approximate parity between NPP and BES**
 - **Good for BNL**
 - Growth, stability, maintain pure research, build up applied
 - Coupling to big initiatives (energy, nanoscience)



Snapshot

- BNL is celebrating its 60th anniversary
- Six Nobel Prizes garnered
 - Latest in 2002 and 2003
- ~2600 employees
- >4000 scientific facility users annually
- S&T Portfolio
 - Nuclear & Particle Physics
 - Basic Energy Sciences
 - Life Sciences
 - Energy
 - Environment
 - National Security
 - Computational Science



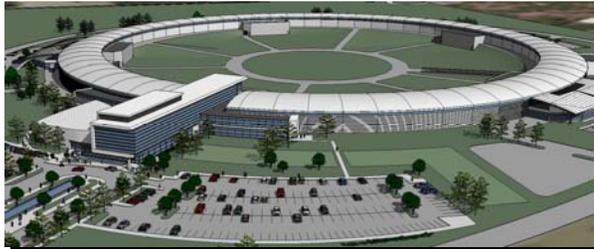
Some of BNL's Research Facilities



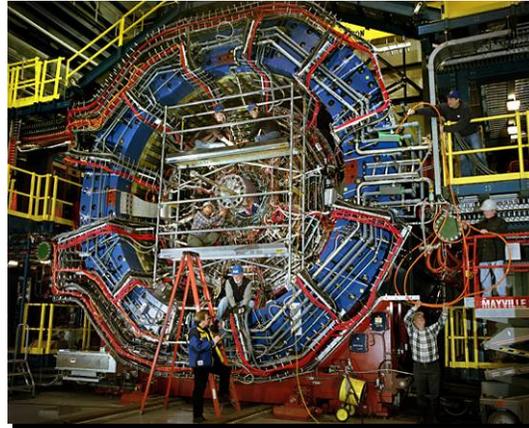
**Center for Functional Nanomaterials
(construction started in 2005)**



NASA Space Radiation Laboratory



National Synchrotron Light Source-II



STAR detector at RHIC



**Molecular Beam Epitaxy
oxide system**



**Positron Emission
Tomography Facility**

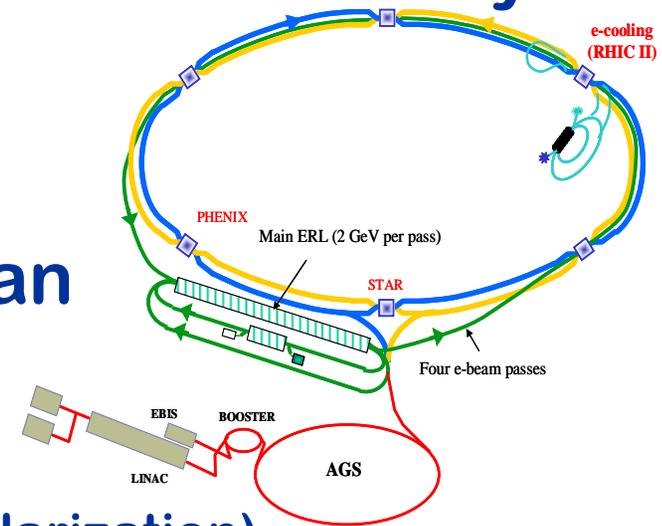


**Transmission Electron
Microscopy Facility**



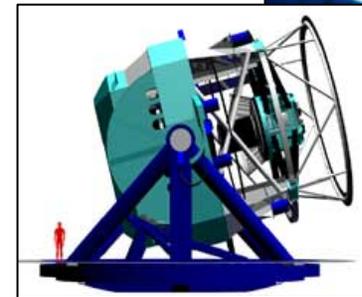
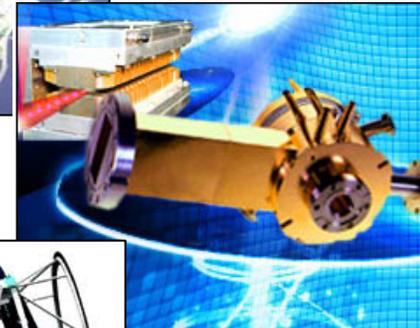
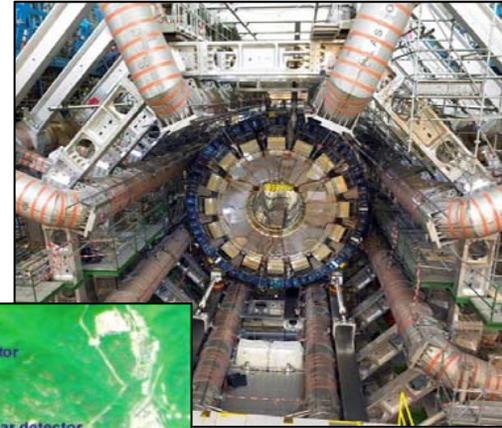
BNL's Plan to Upgrade RHIC

- Evolve the RHIC facility to address the key QCD questions
 - **A main BNL strategic thrust at the institutional level**
- Four key elements of the Plan
 - **Near-term upgrades to RHIC**
 - Detector upgrades, EBIS, enhanced accelerator performance (luminosity and polarization)
 - **RHIC-II**
 - e-Cooling $\rightarrow \times 10$ increase in average luminosity
 - **eRHIC**
 - Add electron beams to existing hadron beams at RHIC
 - **Theory and computational QCD**



HEP

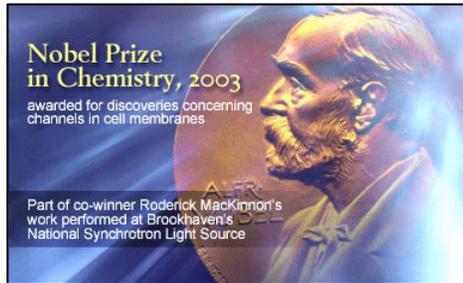
- Focus on core strengths of BNL
 - Experiments @ the energy & precision frontiers
 - Theory
 - Accelerator development
 - Instrumentation
- Long term projects
 - Mostly off-site
 - Stable component of the big picture



National Synchrotron Light Source

- **Crucial resource for the Northeast**

- **2300 Users/year**
- **> 400 institutions**
 - academic, industrial, government
- **~ 800 publications per year**
- **~ 130 in premier journals**

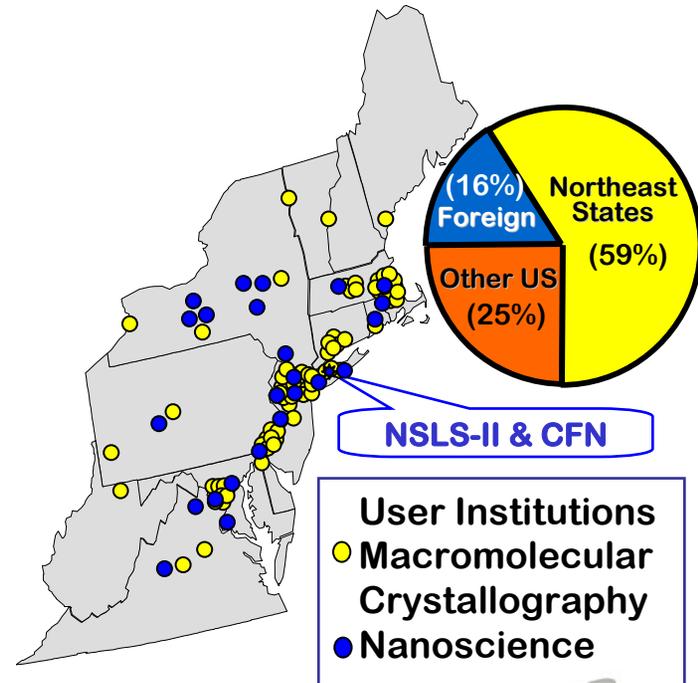


- **Vital for BNL programs:**

- **CFN, Catalysis Center, Structural Biology, Environment**

- **What's next: NSLS-II**

- **NSLS ~25 years old**



Center for Functional Nanomaterials

Themes

- **Electronic Nanomaterials**
- **Soft/Bio Nanomaterials**
- **Nanocatalysis/Interfaces**



Develop
and
Share

Materials,
Processes,
and Tools

at the Nanoscale

for the Country's
Critical Needs

User-oriented

Emphasis on Energy

Preparation

Characterization

Understanding

New Techniques

User facility, fully operational 5/08



RHIC & AGS Users' Meeting - 2007



NSLS-II

- **World-leading performance**
 - 10,000 brighter than NSLS
 - 1 nm spatial resolution
 - 0.1 meV energy resolution
 - Synergy with the CFN
 - Dynamical characterization of new materials, reactions, processes
- **CD-1 today!?**
 - \$750-925M TPC
 - Full operations in FY2015
 - Comparable in scope to RHIC operations



Energy Strategy

- **Institutional initiative**
 - Involves multiple departments in several directorates
- **The vision**
 - Develop new programs across the spectrum from discovery to applied research to technology development
 - Aimed at breakthroughs in the effective use of renewable energy through improved conversion, transmission, and storage



[ambitious] Science Goals

- **Bio-fuels**: Develop sustainable, cost-effective alternative-fuels using biological systems with tailored end use properties
- **Solar Fuels**: Science breakthroughs to lower cost and enable effective energy storage for solar energy utilization → a viable man-made solar-to-fuels process
- **Electronic Nano-materials (Solar PV, Solid State Lighting)**: Create nano-structured materials and assemblies for higher efficiency, cost-effective photovoltaic devices and solid state lighting applications
- **Electrochemistry (Fuel Cells, Batteries)**: Develop novel nano-catalysts to improve efficiency and reliability of fuel cells and storage devices
- **In-situ Nano-catalysis**: Understand and control the state of nano-catalysts at the atomic level in real time and under operating condition
- **High Tc**: Improve our understanding of strong electronic correlations to enable new and better superconductors, and ultimately, a room temperature superconductor

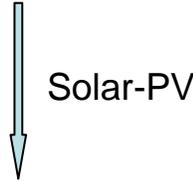


RHIC & AGS Users' Meeting - 2007

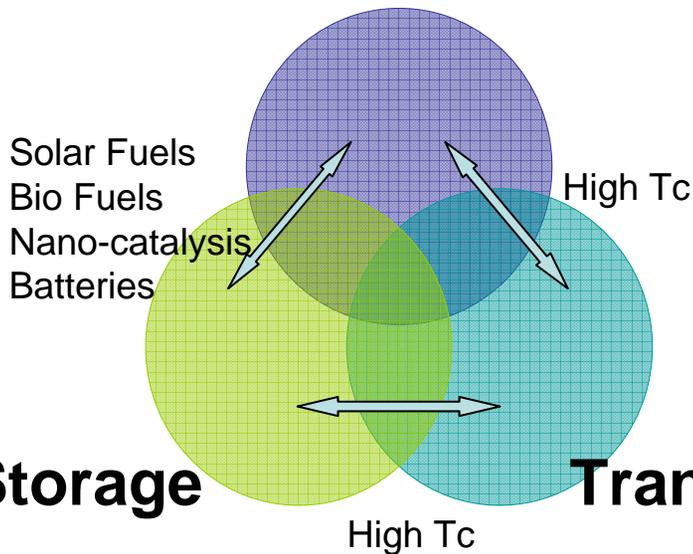


Examples of Research Initiatives

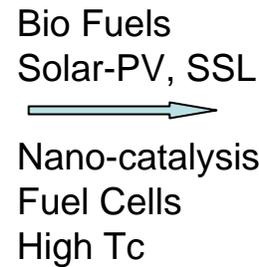
Solar Pathways



Conversion/Production



End Use



Energy Strategy

- Strategy is science-based, focused on long-ranged R&D with strong nanoscience component
- Driven by BNL growth areas/strengths in science and user facilities
- Aims to increase connections among directorates, especially “basic-applied”
- Poised to take advantage of areas of growing emphasis at DOE, both inside the Office of Science and outside
- Alignment with national needs → a growth area



RHIC & AGS Users' Meeting - 2007



Translational Biomedical Imaging

Three core elements

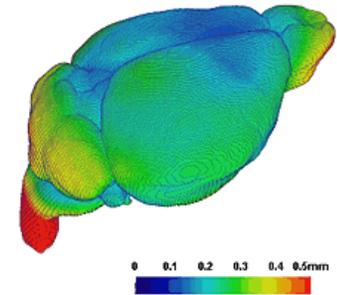
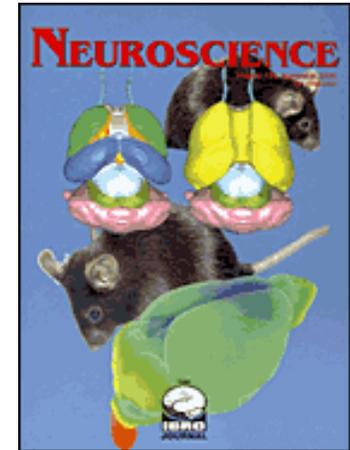
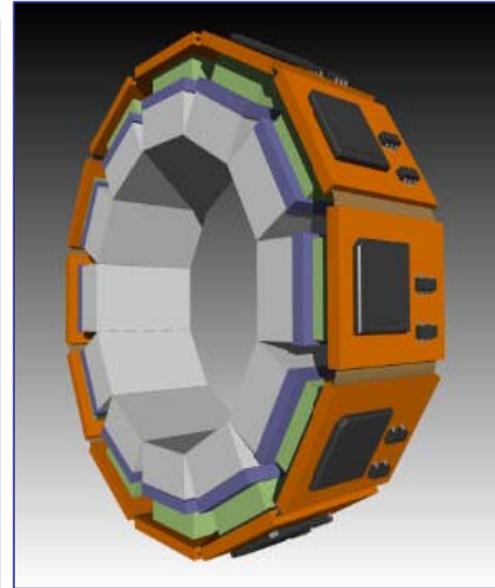
- Radiotracers (developed at BNL)
- Physical sciences, and Clinical and Preclinical Neuroscience
- Instrumentation (with Instrumentation Div., Physics,...)

Notable accomplishments

- Imaging the Awake Animal
- Clinical trials of GVG
- 3-D Atlas of Mouse Brain

Important part of the portfolio

- Needs broader support base



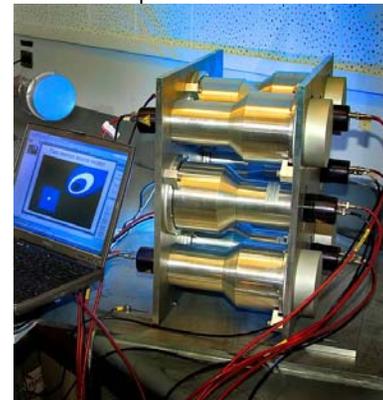
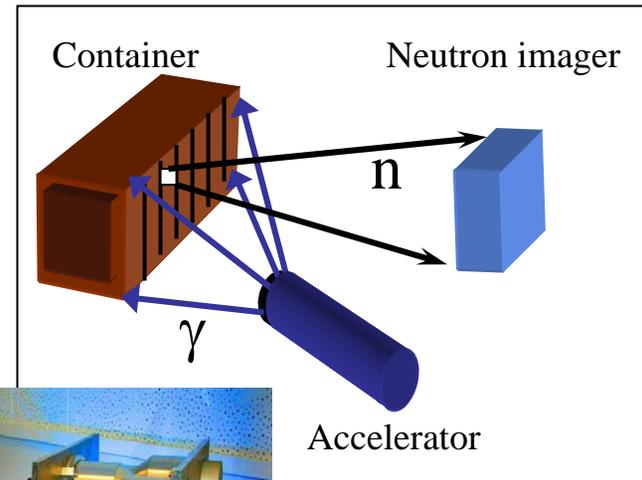
GVG
BNL Drug may
Fight Addiction:
LI Business
News (3/17/2006)

Digital rendering
of genetically-
engineered
mouse brain



Homeland Security

- Using BNL's competency in advanced detector development to detect trace amounts of :
 - Nuclear materials
 - Chemical agents
 - Biological agents
 - Explosives
- More DHS involvement



Computational Science

Existing

- RHIC and ATLAS Computing Facilities
- Two QCDOC Computers – 20Tflops

New

- 100 teraflop IBM BlueGene/L
 - 28Tflops of BG/P coming later
- SBU/BNL collaboration \$26M grant from NYS
- On-site, installed, benchmarked last week
 - Reached 84.8 Tflops/s
 - #4 on the Top 500 List (after LLNL, SNL, IBM)
- Operations starting soon
- NY Center for Computational Science (NYCCS)
- Immediate Research
 - QCD – lattice gauge theory
 - Astrophysics/fluid dynamics
 - Nanoscience/Materials Science
- Future Research
 - Computational biology/drug design
 - Climate modeling/energy modeling



RHIC & AGS Users' Meeting - 2007

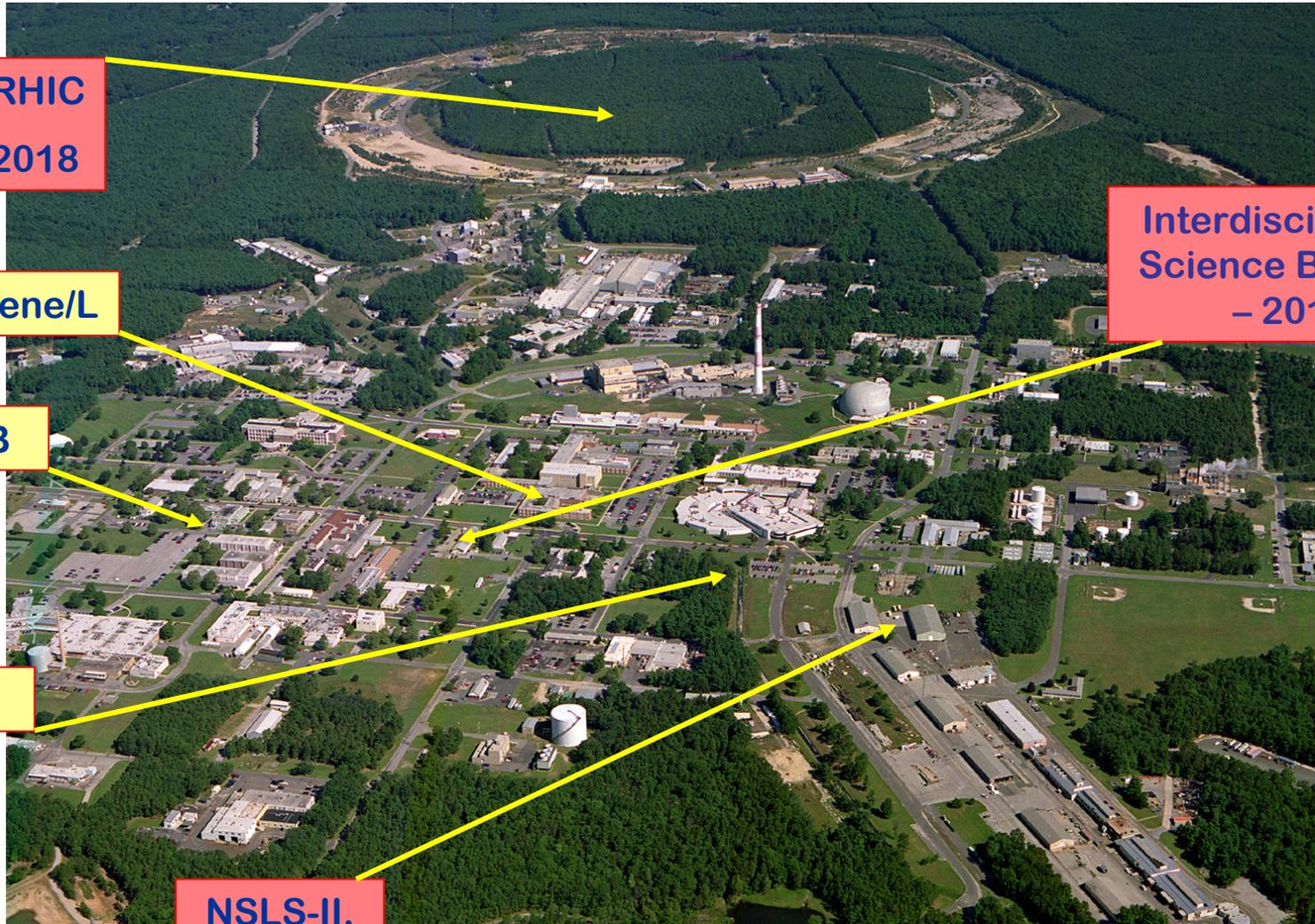


Plans for The Future

- Build and operate NSLS-II
 - Transition NSLS → NSLS-II
- Evolve RHIC to a QCD lab @ RHIC
 - RHIC-II and eRHIC
- Install full nanoscience capability @ CFN
- Pursue Laboratory-wide Energy Strategy
- Build computational science capability
- Expand translational biomedical imaging
- Grow advanced detector development



Aerial View of BNL: 2007→2020



eRHIC
- 2018

BlueGene/L

RSB

CFN

Interdisciplinary
Science Building
- 2012

NSLS-II,
JPSI
- 2014



RHIC & AGS Users' Meeting - 2007



The Big Picture

- The biggest piece of the science portfolio is NPP
 - 40% of the Lab budget
 - RHIC, AGS, ATF → 1500 users annually
- The next biggest piece is BES
 - 20% of the Lab Budget
 - NSLS, CFN → 2500 users annually
- This balance will change over the next 5-10 years
 - Some growth in NPP with the planned evolution of RHIC
 - Significant growth in BES (CFN + NSLS-II)
- Approximate parity between NPP and BES
 - Good for BNL
 - Growth, stability, maintain pure research, build up applied
 - Coupling to big initiatives (energy, nanoscience)

