Defense Nuclear Nonproliferation at Brookhaven National Laboratory

April 7, 2021

Presented to the NA-22 Enabling Technologies and Innovation and Monitoring Technologies and Verification Consortia

Susan Pepper, Chair

Nonproliferation and National Security Department

70 YEARS OF DISCOVERY

A CENTURY OF SERVICE

U.S. DEPARTMENT OF ENERGY

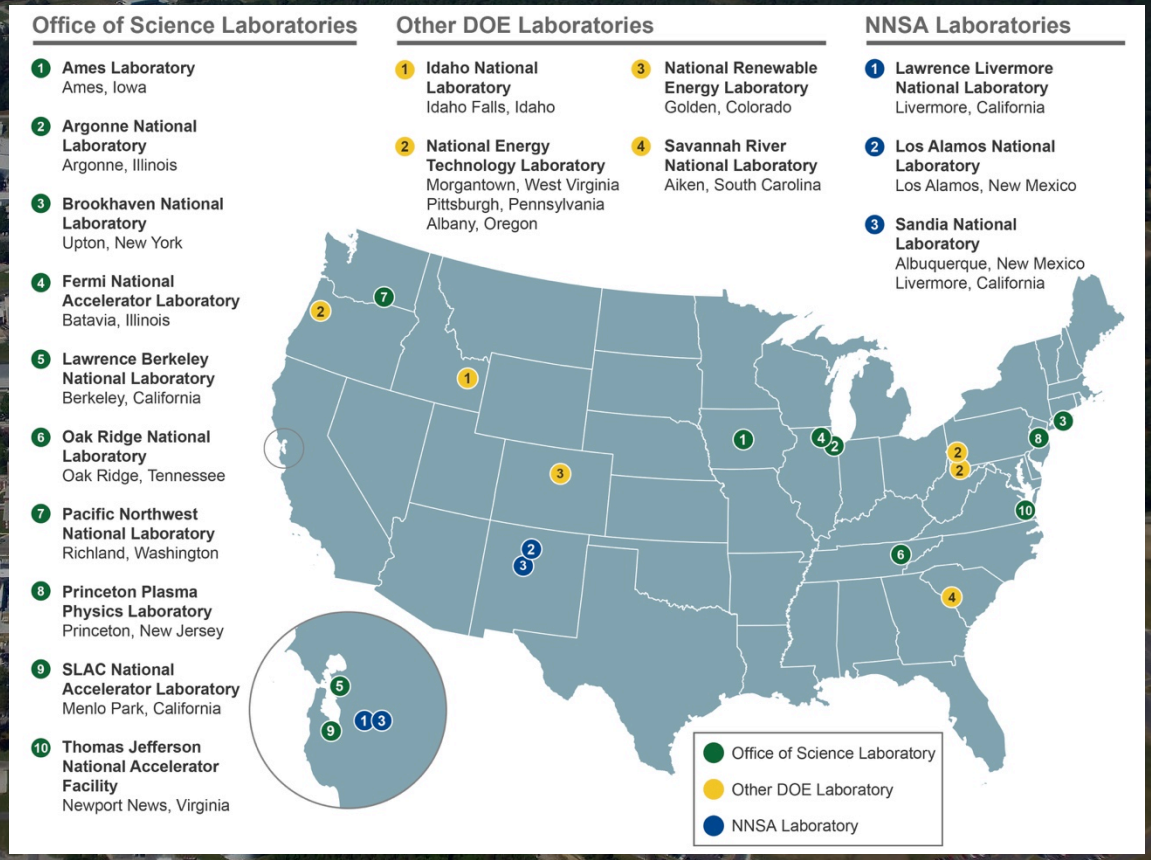
BROOKHAVEN NATIONAL LABORATORY


Long Island Sound
Atlantic Ocean
Brookhaven National Laboratory
Upton, N.Y.
LEGEND
0 5 10
miles
Airports
1 LaGuardia
2 Kennedy Int'l.
3 Long Island MacArthur
Approaches To Brookhaven National Laboratory
Best Route From New York City
Alternate Routes (Highways)

Brookhaven Lab Today

The 17 national labs are unique, helping address DOE's mission by:

- Building, operating big machines a university or company could never build on its own—these facilities require national support
- Forming teams, both within labs and across the DOE complex
- Complementing, competing, and collaborating
- Fundamental, noncommercial research
- Technology transfer



U.S. Department of Energy, via Wikimedia Commons

Brookhaven Lab Today

Managed by Brookhaven Science Associates

Numbers

- Employees: 2,500
- Jobs in NY State: approx. 5,400
- Users: 4,000 per year
- Grad/Undergrad students on payroll: 400
- Total funding for FY 2019: $650 million
  - $580 million from the U.S. Department of Energy
  - $70 million from other agencies

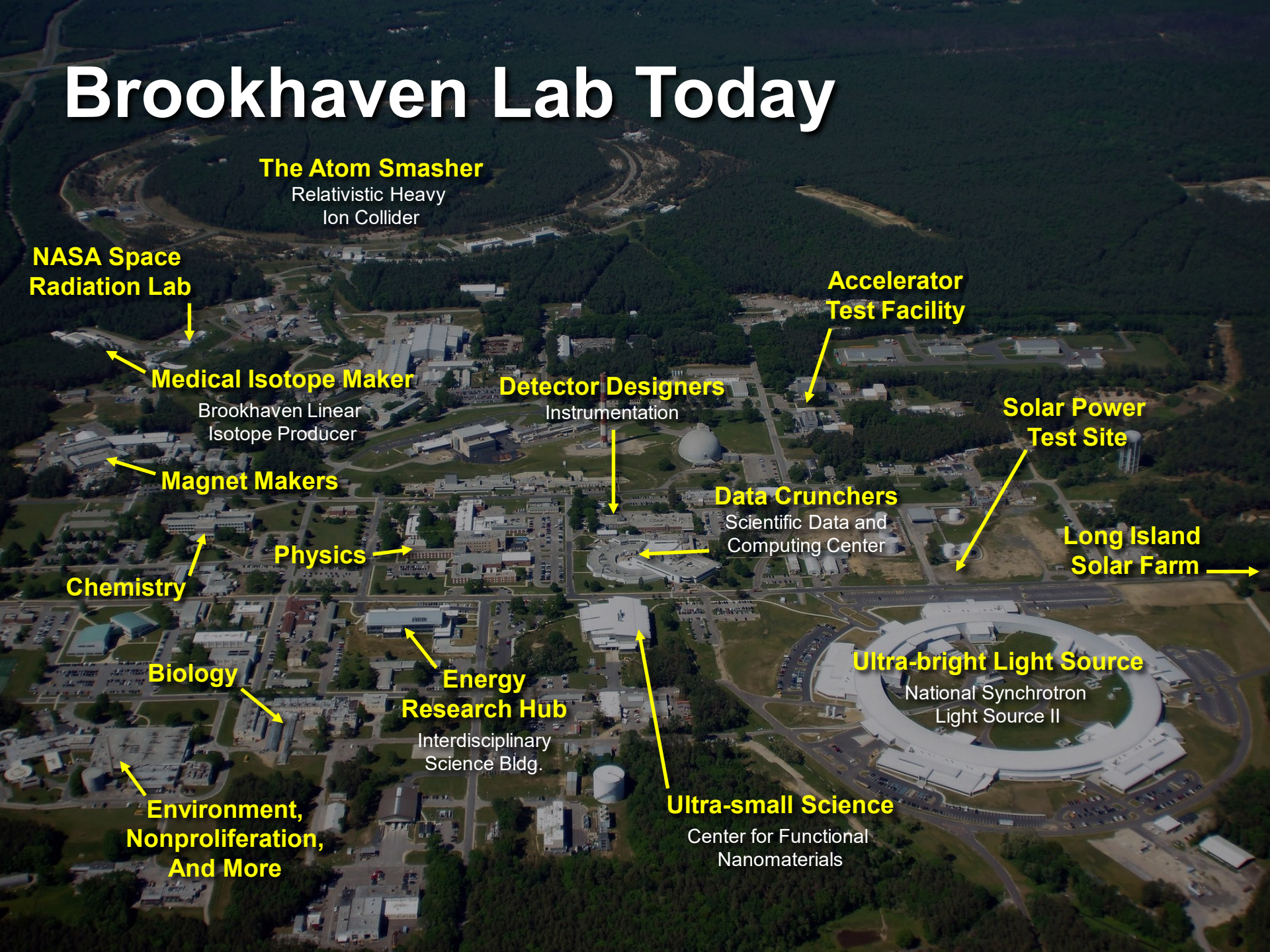
Key partnerships

- New York State
- Stony Brook University
- Battelle

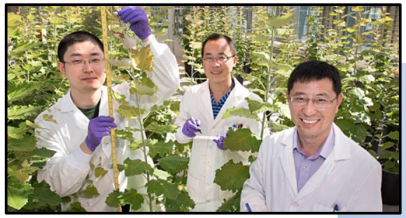
Doon Gibbs
BSA President,
Brookhaven Lab
Director

Robert Tribble
Deputy Director
For Science &
Technology

Jack Anderson,
Deputy Director
For Operations


Brookhaven Lab Today
The Atom Smasher
Relativistic Heavy Ion Collider
NASA Space Radiation Lab
Medical Isotope Maker
Brookhaven Linear Isotope Producer
Magnet Makers
Chemistry
Physics
Biology
Environment, Nonproliferation, And More
Energy Research Hub
Interdisciplinary Science Bldg.
Detector Designers
Instrumentation
Data Crunchers
Scientific Data and Computing Center
Accelerator Test Facility
Solar Power Test Site
Long Island Solar Farm
Ultra-bright Light Source
National Synchrotron Light Source II
Ultra-small Science
Center for Functional Nanomaterials

Nonproliferation and Nuclear Science



BNL/DOE Facilities

Programs and Capabilities

- National Nuclear Data Center
- Engineering for national security
- Non-destructive particle characterization and forensics using NSLS-II
- Detector design testing
- Data analytics, machine learning, artificial intelligence
- Accelerator Test Facility – training for IAEA

Partners/Joint Appointments

University

Stony Brook University

Yale

The City College of New York

National Lab

Argonne National Laboratory

Pacific Northwest National Laboratory

INL Idaho National Laboratory

Oak Ridge National Laboratory
Managed by UT-Battelle for the Department of Energy

Industry

GE

REDLEN TECHNOLOGIES

Westinghouse

FLIR

New York State

nyserda
Energy Innovation Solutions

Raytheon

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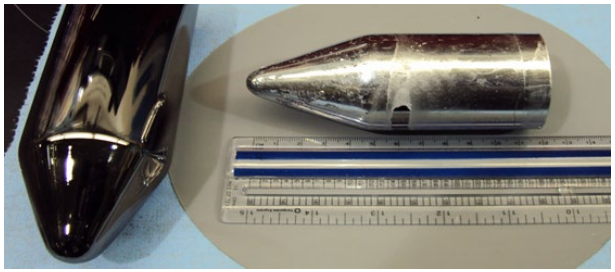
BROOKHAVEN NATIONAL LABORATORY

Defense Nuclear Nonproliferation-Related Activities

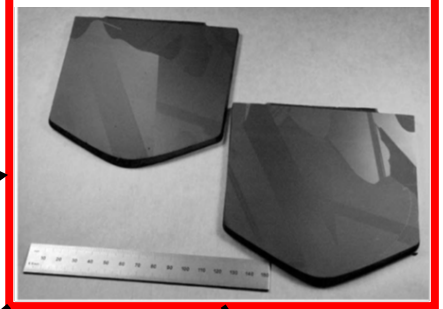
- Radiological Response Programs
- International Safeguards Support to the IAEA
- Data Driven Intelligence and Security
- Instrumentation
- Environment and Climate Science

Gamma Spectroscopy - CdZnTe

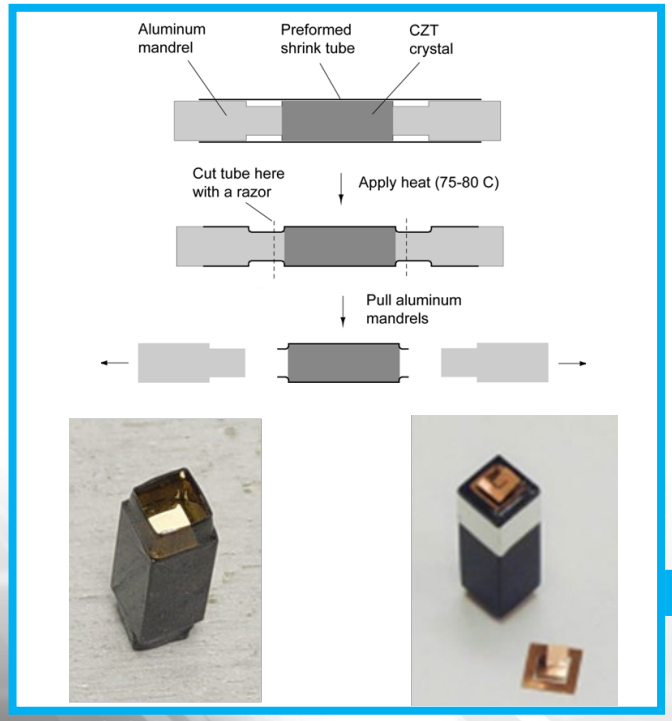
Crystal growth



Processing



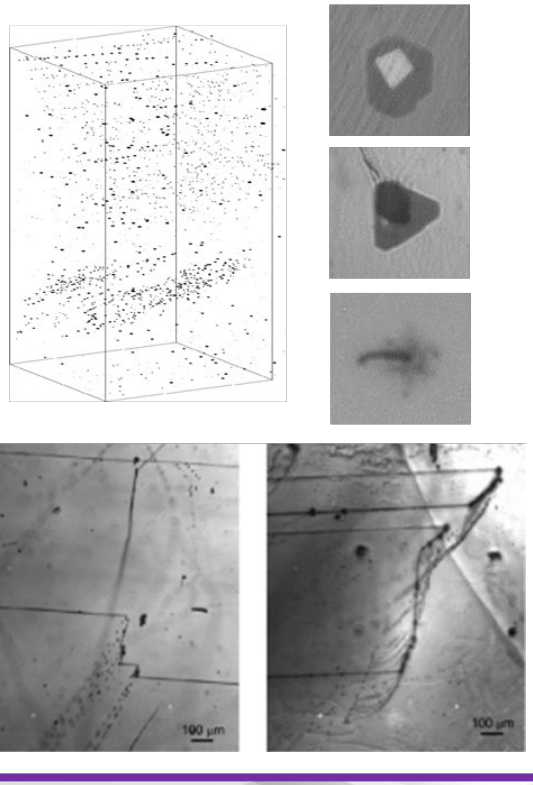
Detector Fabrication



Radiation Detection Device

Improved Radiation Detection Material

Material Characterization



Radiological Response

- Region 1 Radiological Assistance Program (RAP) (Northeast)
- Disaster Assistance Response Team (DART)
- Developing Radiological Dispersion Device (RDD) response tactics
- Testing and evaluating radiation detectors (handheld, backpack, and vehicle portal monitors)
- Training local and regional first responders for nuclear/radiological emergencies

International Safeguards Project Office

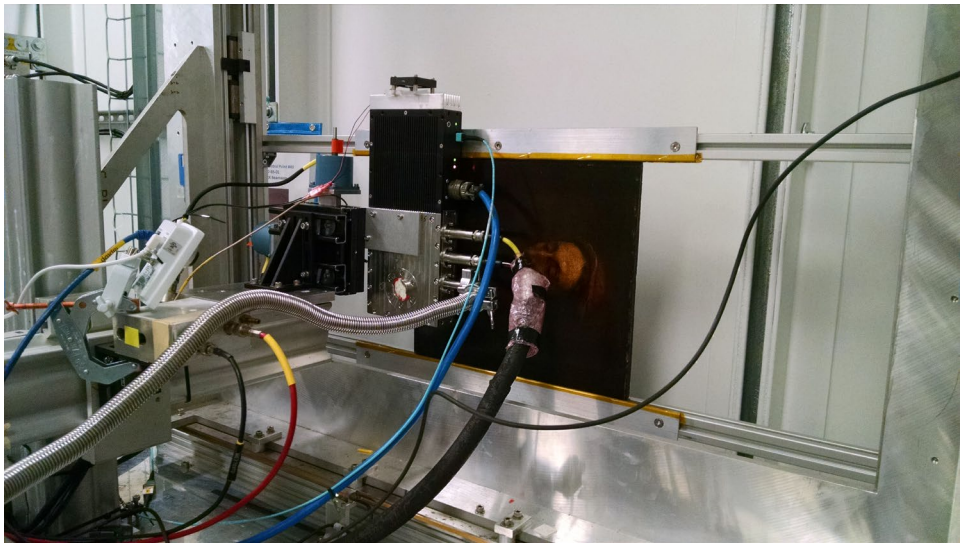
- Technical and administrative management of the U.S. Support Program to IAEA Safeguards
  - The USSP transfers technology and services that are available in the United States to improve the effectiveness and efficiency of IAEA Safeguards
- Sponsored by the State Department
- Project management
- Recruitment
- At BNL for 40+ years

www.bnl.gov/ispo

Deep Learning Applied to IAEA Surveillance

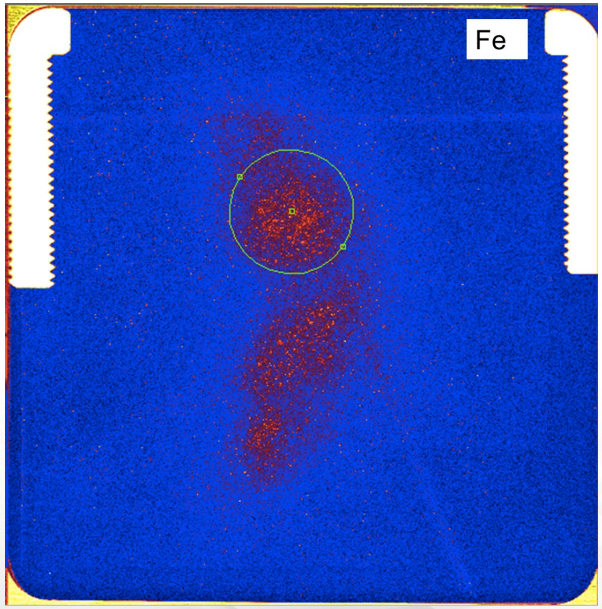
- Improve automated review of surveillance images by decreasing the number of false positives
- Applies an open-source algorithm – You Only Look Once (YOLO)
- We have trained the algorithm to “recognize” items that are likely to be found in a nuclear facility
- Next phase is tracking items between cameras as they move through a facility
- Working jointly with Sandia National Laboratories

Transformative capability: Fast Large Area Scanning



Original

Hg – Fe – As



10x10 cm swipe sample Loaded with NIST # 2584, indoor dust sample with added U particles.

Contained in plastic ziplock bag, held in place by frame.

Materials in Radiation Environment Facility

External facility for synchrotron imaging, spectroscopy and diffraction of radioactive materials

- *In situ* characterization capabilities (P, T, stress, ion irradiation, electric field)
- High-throughput and remote access (robotics)
- Radioactive samples: fuel, dispersible transuranics
- Nondestructive, minimal sample preparation, bulk samples for real interfaces
- Ability to create secure area for sensitive research (forensics)
- Building on expertise and methods developed at NSLS and NSLS-II

Questions


International Safeguards
Nuclear Security
Data Driven Intelligence and Security
Data Analytics