Summary of PNNL Visit Project-X and Nuclear Energy

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Steve Holmes
Bob Tschirhart
Pat Hurh

Pacific Northwest National Laboratory Participants

► Mike Thompson, Deputy Director, Fundamental & Computation Sciences

► Mary Peterson, Program Manager, Energy an Environment Directorate

► David Asner, Scientist, Radiation Detection & Nuclear Sciences

► Dave Senor, Engineer, Engineering Mechanics and Structural Materials Group

► David Wootan, Engineer, Nuclear Safety

► Gertrude Patello, Manager, Radiological and Nuclear S&T

► Charles (Chuck) Henager, Scientist, Materials and Structures Performance

► Clark Carlson, Project Manager, Radiochemical Science & Engineering Group

► Craig Aalseth, Scientist, Detector Development

► Marty Keillor, Scientist, Radiation Detection and Nuclear Sciences

► Daniel Stephens, Manager, Radiation Detection and Nuclear Sciences

► Sean Stave, Engineer, Simulations and Analysis

► Lynn Wood, Scientist, Integrated Systems for Sensing

► Brent VanDevender, Engineer, Detector Development

► Clark Carlson, Project Manager, Radiochemical Science & Engineering Group

► Theva Thevuthasan, Scientist, TL, Scientific Resources Division

► Shuttha Shutthanandan, Scientist, Interface Spec/Diffraction

► Kevin Regimbal, Deputy Director, Computational Science and Mathematics Division

Pacific Northwest National Laboratory
and
Office Of Science Programs

MICHAEL THOMPSON, PHD
DEPUTY ASSOCIATE LABORATORY DIRECTOR

Fundamental & Computational Sciences Directorate

February 13 , 2012

Pacific Northwest National Laboratory:
Battelle-managed and mission-driven

Pacific Northwest
NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

FY11 Facts

- ► *$1.1B in R&D expenditures*
- ► *More than 4,800 staff*
- ► *2000 users & visiting scientists*
- ► *994 peer-reviewed publications*
- ► *49 patents & 252 inventions*
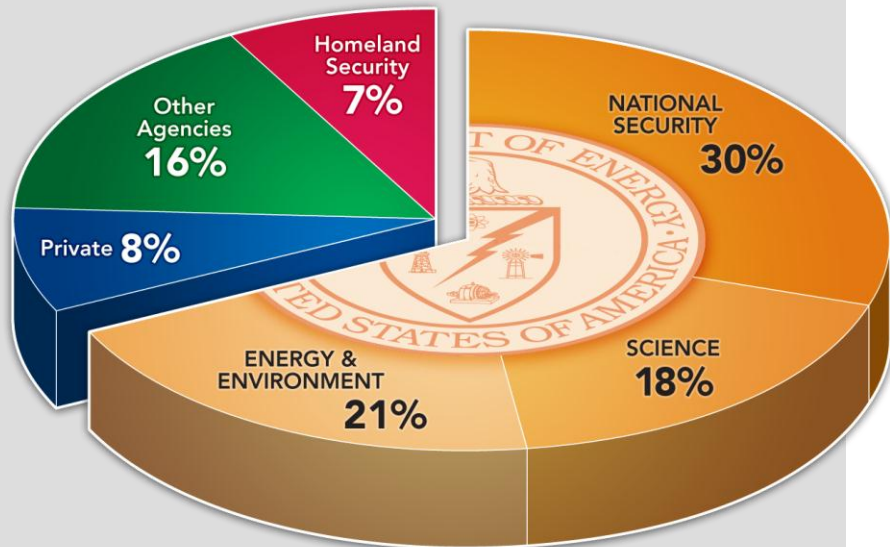
► Mission-driven collaborations with government, industry, academia

► Operated by Battelle since 1965

► Top-performing lab for 5 years

Homeland Security 7%
Other Agencies 16%
Private 8%
NATIONAL SECURITY 30%
ENERGY & ENVIRONMENT 21%
SCIENCE 18%

Sequim
Seattle
Portland, OR
Richland
MAIN CAMPUS

PNNL nurtures 10 Core Capabilities for long-term success

Systems Engineering and Integration

Advanced Computer Science, Visualization, and Data

User Facilities and Advanced Instrumentation

APPLIED

BASIC

Chemical and Molecular Sciences

Biological Systems Science

Climate Change Science

Subsurface Science

Chemical Engineering

Applied Materials S&E

Applied Nuclear S&T

- World-class technical staff
- State-of-the-art equipment
- Mission-ready facilities

5

Current PNNL S&T Computing Infrastructure

Simulation Capabilities

Standard Architecture → → → Alternative Architecture

Midrange (40 clusters) ~65 TF	Evergreen ~ 30 TF	Chinook 163 TF	Superdome 1.6 TF (institutional)	Barracuda 17 TF

Visualization Capabilities

MURAL
Interactive Power wall

Herald/Paul T. Erickson
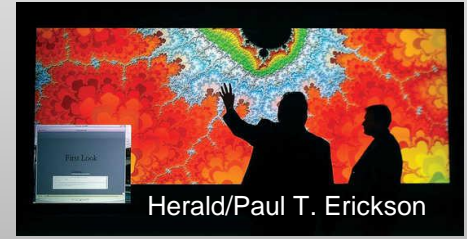
Seattle: 10 Gbps to ESnet, 10 Gbps to Pacific Northwest GigaPOP

Boise :10 Gbps to ESnet

Network – Resilient 20 Gbps core

38 λ for growth

39 λ for growth

Data Transfer Node

Data Intensive Computing Capabilities
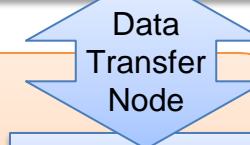
Processing	Query / Analysis	Storage

ARM Data Mgmt Facility	Bio Data Pipeline	Cougar XMT	XSI: FusionIO GPU	Fandango (CPP Data Mgmt)	Nemesis	RPMP	Aurora (EMSL Archive)

Testbed

Facilities

New CSF:
- 10,000 Square feet
- Up to 10 MegaWatts
- Geothermal Cooling

6

Enable development and testing of irradiation-insensitive, low-activation materials

▶ **Objective**: develop a fundamental understanding of radiation effects in materials

▶ **Required to** provide a sound basis for development of materials for fusion reactors

▶ **Aligns** with DOE FES, DOE-BES research directions, DOE NE, U.S. Fusion Materials Science Programs, and Japan/European Union atomic energy agency agreements

▶ **PNNL expertise**: materials science including alloy and composite development; performance of irradiation experiments, post-irradiation examination of mechanical properties and microstructure and their correlation, computer simulation and modeling; coordination

MA957 - 500C

20nm

Eurofer97 - 500C

20nm
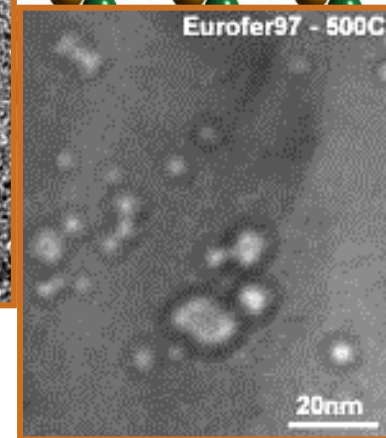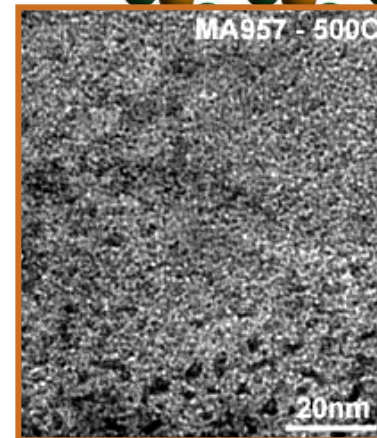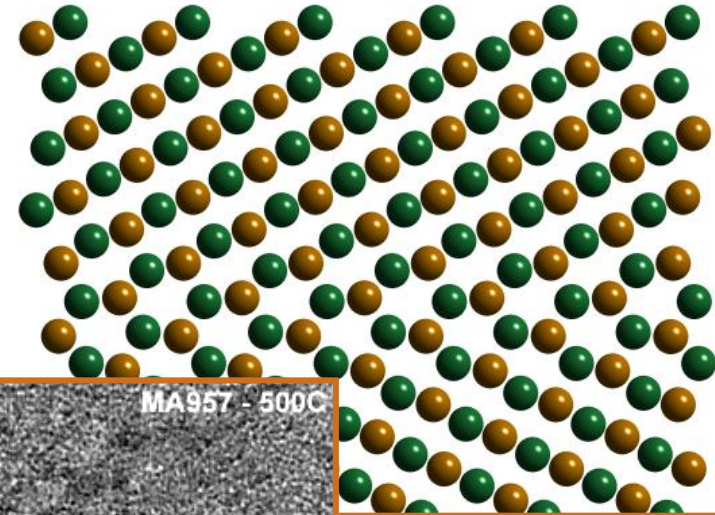
Nuclear and Particle Physics Research at PNNL

▶ **Neutrino Science**

- ■ PNNL staff history of forefront ⬜ research in solar neutrinos and 0⬜⬜⬜
- ■ MAJORANA DEMONSTRATOR 0⬜⬜⬜ decay 76Ge Experiment

▶ **Dark Matter**

- ■ CoGeNT and C4
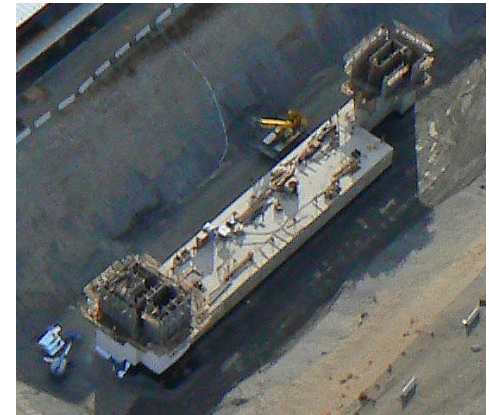
▶ **Flavor Physics**

- ■ Belle and Belle II

▶ **Isotope Program**

- ■ R&D for medicine, industrial use and science
- ■ Compact Systems Research and Development

▶ **Applications in National Security and Nuclear Energy**

▶ **PNNL expertise**: detector systems, complex electronics systems, analysis of HEP data, data intensive computing, modeling and simulation

PNNL Underground Laboratory

PNNL'S
Nuclear Energy Business

MARY PETERSON

Acting, Nuclear Energy Sector Manager

Energy and Environment Directorate

Key Partnerships

Idaho National Laboratory
- Waste Form/Separations Campaign
- In-Core Sensors/Materials Degradation Detection
- Fuel Development
- Life Extension
- Modeling and Simulation
- ATR NSUF
- Long Term Fuel Storage

Oak Ridge National Laboratory
- Materials Research
- CASL Modeling and Simulation Hub

Fermilab
- Project X

NEUP — Nuclear Energy University Programs
U.S. Department of Energy

Texas A&M University
Fuel
Cladding

The University of Tennessee
Prognostics
Algorithms

Penn State
Test Article Irradiation
Waste Forms

University of Michigan
Waste
Forms

Washington State University
Radiochemistry

Iowa State University — CNDE
NDE & Structural
Health Monitoring

The Ohio State University
Passive Component
Reliability

University of Wisconsin
Separations
Materials

Internal Investments in Nuclear Capabilities

Sustainable Nuclear Power Initiative
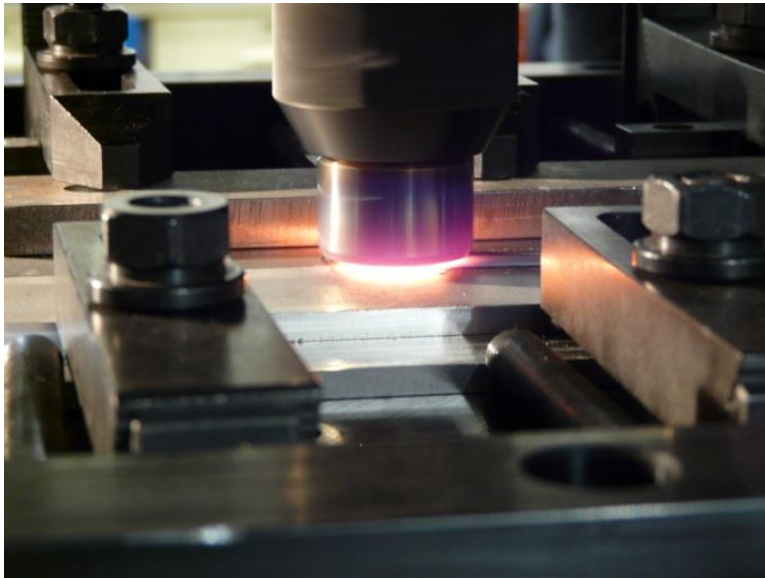
▶ Accelerated Fuel Qualification

▶ Reactor Aging Management

▶ Safeguards & Proliferation Detection

▶ Transuranic Recycle Technology

Materials Degradation Detection

▶ Microstructural Science for Precursor Identification

▶ Behavior Detection in Harsh Environments

▶ Demonstrate In-Situ Monitoring of Material Degradation

Summary

- Fermilab would like to invite PNNL to join Project-X accelerator area(s) and physics program that matches with your strength and interest.

- Fermilab would specially like PNNL to join the new Nuclear Energy initiative at a co-leader and work with us in developing this program as the US National Program as a demonstration project.

- Fermilab would like PNNL to initiate discussions with the US-DOE-NE in supporting Project-X jointly through US-DOE.
  - Fermilab would work with PNNL

🜲 **Fermilab**

Notes from PNNL

- Fermilab offered support to develop the energy station concept from a white paper into a full proposal.
  - Need to get started on this ASAP. It is important to complete in time to influence FY14 budgets.
  - Action item: PNNL to work with Fermilab on SOW and initial funding.
  - Action Item: Shekhar Mishra to organize a meeting of the interested parties in mid March.
- PNNL will join the Project-X Nuclear Energy Application development as co-leader with Fermilab and ANL to develop the demonstration project proposal.
  - Action Item: Fermilab to inform US-DOE-HEP
    - Shekhar will work with Pier, Stuart and Steve on this.
  - Action Item: PNNL to initiate discussions with US-DOE-NE to jointly support Project-X with US-DOE-OS.
    - Fermilab will participate in this discussion

🎔 **Fermilab**