DOE National Laboratory Support to ETI Workshop
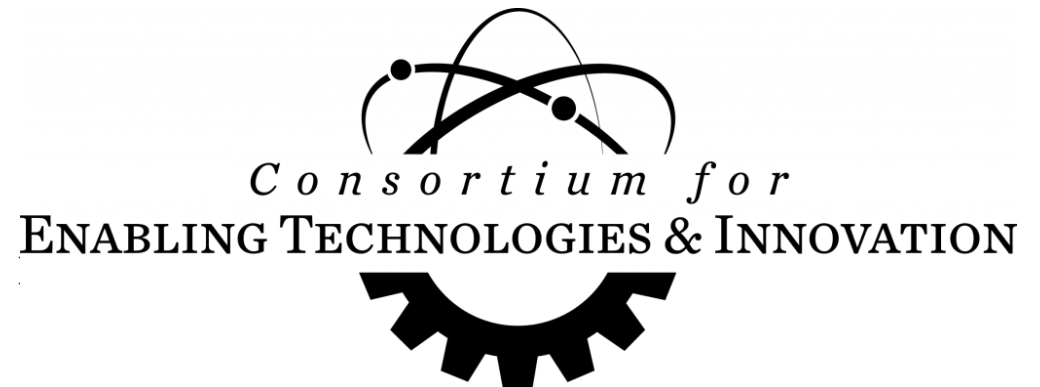
Geoff Fairchild (LANL) / Robert Brigantic (PNNL)

30 October 2019

Consortium for
ENABLING TECHNOLOGIES & INNOVATION

Agenda

- Introductions (10 min)

- Summarize each lab's focus/capability areas related to ETI activities (20 min)

- Discuss how to help students/faculty scope their research on some problems (30 min)

- Strategize about how to place students, working together to help students be placed at the best lab for them (15 min)

- Discuss how to collaborate together as national labs on ETI research (15 min)

ETI National Laboratory Partners

Lab Focus/Capability Areas

Argonne National Laboratory (ANL)

- Lead POC: …

- ETI Thrust Areas Leads
  - TA1: …
  - TA2: …
  - TA3: …

- Core capabilities relevant to ETI:
  - …
  - …
  - …
  - …
  - …

- Key facilities relevant to ETI
  - …
  - …
  - …

- Key ETI related programs
  - …
  - …
  - …
  - …

- Internships for graduate students
  - …
  - …
  - …

- Other relevant programs/information
  - …
  - Additional summer courses available
    - …
    - …
  - Joint faculty assignments
  - …

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Lawrence Berkeley National Lab (LBNL)

- Lead POC: John Valentine

- ETI Thrust Areas Leads
  - TA1: Brian Quiter (focus: data science, algorithm development, multi-sensor data collection and analysis)
  - TA3: Cameron Geddes (focus: nonproliferation applications of monoenergetic photon sources)
  - TA3: Paul Barton (focus: development of advanced photodetectors for scintillation based radiation detectors)

- Core capabilities relevant to ETI:
  - Nuclear sciences: radiation detector development
  - Accelerator –based monoenergetic photon sources
  - Multi-sensor data fusion & machine learning-based algorithm development
  - Data service: algorithm evaluation and testing

- Key facilities relevant to ETI
  - Berkeley Lab Laser Accelerator (BELLA) Center
  - Semiconductor Detector Laboratory (SDL)
  - Berkeley Data Cloud (BDC)

- Key ETI related programs
  - DNN R&D MINOS Venture
  - DNN R&D LPA MPS for Nonproliferation
  - DTRA/NA-24/NA-84 3D SDF project suite
  - DNN R&D Nuclear Data

- Internships for graduate students
  - LBNL can accommodate internships of any duration
  - It is in the LBNL staff's DNA to mentor students, so they are always welcome
  - Due to its proximity to and relationship with UC Berkeley, there are always 100s of students at LBNL – a great environment throughout the year

- Other relevant programs/information
  - AI for Science Initiative
  - Synthetic biology
  - Advanced Light Source (ALS)

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Brookhaven National Laboratory (BNL)

- Lead POC: …

- ETI Thrust Areas Leads
  - TA1: …
  - TA2: …
  - TA3: …

- Core capabilities relevant to ETI:
  - …
  - …
  - …
  - …
  - …

- Key facilities relevant to ETI
  - …
  - …
  - …

- Key ETI related programs
  - …
  - …
  - …
  - …

- Internships for graduate students
  - …
  - …
  - …

- Other relevant programs/information
  - …
  - Additional summer courses available
    - …
    - …
  - Joint faculty assignments
  - …

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Idaho National Laboratory (INL)

- Lead POC: David Chichester, david.chichester@inl.gov

- Core capabilities relevant to ETI:
  - Nuclear engineering, all areas
  - Fuel cycle sciences
  - Data analytics and machine learning
  - Advanced manufacturing focused on nuclear fuel production
  - Field work

- Key facilities relevant to ETI
  - Materials and Fuels Complex (traditional and advanced manufacturing of nuclear fuel; fresh and irradiated nuclear fuel handling; special nuclear material access; glove boxes; hot cells; nuclear reactor operations)
  - Advanced Test Reactor Complex (reactor operations)
  - INL Site (890 square miles; nuclear fuel cycle pattern-of-life, high-explosives testing; UAV operations; access to shrub-steppe biota)

- Key ETI related programs
  - Multi-Informatics for Nuclear Operations Scenarios (MINOS): use of real-time infrasound and low-frequency acoustic observations to support nonproliferation assessment
  - Ecosystem for Open Science (eOS): cloud-hosted architecture to support research projects for both data warehousing and on-line collaboration, data analytics, and machine learning development
  - Advanced Design and Manufacturing (ADM): an INL Initiative exploring new methods to make nuclear fuels, nuclear materials, and other materials for use in harsh environments

- Student opportunities
  - ETI-supported, on-site student measurement campaigns at INL

 - Internships (https://inl.gov/inl-initiatives/education/internships/)

Lawrence Livermore National Laboratory (LLNL)

- Lead POC: Vincenzo Lordi, lordi2@llnl.gov, 925-423-2755

- Core capabilities relevant to ETI:
  - Data sciences / analytics / machine learning
  - Radiation detectors and materials (scint's, semi's)
  - Additive manufacturing
  - Fuel cycle modeling
  - Autonomous vehicles / swarms
  - Materials modeling
  - Nuclear (bio)forensics
  - Safeguards
  - Remote sensing, hyperspectral imaging, sensor data fusion

- Key facilities relevant to ETI
  - Advanced Manufacturing Laboratory
  - Livermore Computing HPC Center
  - Data Science Institute
  - Nano Fabrication Facility
  - Center for Engineered Materials and Manufacturing

- Key ETI related programs
  - ADAPD (Advanced Data Analytics for Proliferation Detection)
  - MINOS (Multi-Informatics for Nuclear Operations Scenarios)
  - Persistent DyNAMICS
  - Vulcan
  - WATCHMAN

- Internships for graduate students
  - Glenn T. Seaborg Institute (GTSI) Nuclear Forensics Summer Internship
  - Data Science Summer Institute (DSSI)
  - Computational Chemistry and Materials Science (CCMS) Summer Institute
  - Materials and Chemistry Institute (MaCI)
  - NucOps internships

- Other relevant programs/information
  - Livermore Graduate Scholars
  - Summer courses:
    - Nuclear Safeguards VTC Lecture Series
    - International Nuclear Safeguards Policy and Information Analysis Course (joint with Middlebury Institute)
  - Joint faculty assignments / Mini Faculty Sabbatical Program
  - Website with links to active PIs, projects, and logistics for working at LLNL: https://dnn-consortia.llnl.gov/eti/

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Los Alamos National Laboratory (LANL)

- Lead POC: Geoffrey Fairchild – gfairchild@lanl.gov

- ETI Thrust Areas Leads
  - TA1: Jim Smith (ADAPD)
  - TA2: Deniece Korzekwa (additive/micro manufacturing)
  - TA3: James Miller

- Core capabilities relevant to ETI:
  - Remote sensing – entire pipeline: design → build → analyze
  - High-performance computing
  - Build and field experiments using SNM
  - AM with metals, polymers, and ceramics
  - Micro-manufacturing
  - Pre-/post-rad biological analysis (microbiome, genetic, etc.)
  - Quantum computing (D-Wave, IBM, etc.)

- Key facilities relevant to ETI
  - CINT (Center for Integrated Nanotechnologies)
  - Sigma Complex
  - DARHT (Dual-Axis Radiographic Hydrodynamic Test Facility)
  - LANSCE (Los Alamos Neutron Science Center)
  - National Criticality Experiments Research Center (NCERC)

- Key ETI-related programs
  - MINOS
  - ADAPD
  - PD

NSSC-LANL
Dr. G. Robert Keepin
Nonproliferation Science
Summer Program

June 22 – August 14, 2020

- Internships for graduate students
  - Keepin Summer School
  - Codesign School
  - Parallel Computing Summer School
  - Supercomputer Institute
  - Data Science at Scale School
  - Cyber Security School
  - Applied Machine Learning Research Internship
  - Quantum Computing School
  - Computational Physics Workshop

- Other relevant programs/information
  - Guest scientist/student agreements
  - Serve on dissertation committees and as adjunct faculty
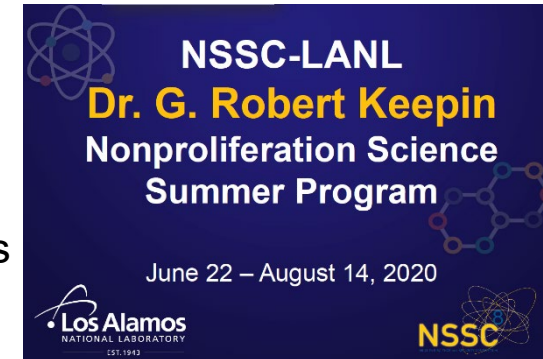
Nevada National Security Site (NNSS)

- Lead POC: Alex Plionis
- ETI Thrust Areas Leads
  - TA1: Michael Howard (focus: Bioindicators and remote sensing)
  - TA2: Dan Champion (focus: Patterns of Life ADAPD)
  - TA3: Cleat Zeiler (focus: Geophysics and data wrangling)
- Core capabilities relevant to ETI:
  - Nuclear sciences
  - Data analytics and machine learning / data visualization
  - Operations research
  - Spectral remote sensing as it relates to biophysical and biochemical vegetation characterization
  - Emergency Management/Response/Training
- Key facilities relevant to ETI
  - Remote Sensing Laboratory (RSL)
  - Cloud services
  - Additional Scientific Facilities

- Key ETI related programs
  - Advanced Data Analytics for Proliferation Defense (ADAPD)
  - LYNM -- PE1
  - SPE
  - Bioindicators

- Internships for graduate students
  - MSTS Student Programs
    - NNSS funded summer and co-op internships

- Other relevant programs/information
  - Joint faculty assignments

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Oak Ridge National Laboratory (ORNL)

David F. Williams is a PhD chemical engineer with 40 years of professional experience and publications in nuclear fuel cycle R&D spanning upstream chemistry and enrichment, reprocessing, fuel fabrication, isotope production, and advanced reactor concepts. Dave has led or managed projects/programs in each of these areas for the DOE Office of Science, Office of Nuclear Energy, Office of Environmental Management and multiple offices within NNSA. Dave served as a technical advisor to the Office of Proliferation Detection from 2007-2010 and served as the ORNL Point-of-Contact for the DOE/NNSA Office of Defense Nuclear Nonproliferation R&D (NA-22) from 2010-2019.

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703-244-9992 (mobile)
865-231-1445 (pager)

ORNL DNN R&D Consortia PPOC/PM

Philip R. Bingham is Group Leader for the Imaging, Signals & Machine Learning Group at the ORNL. He has applied image processing for applications in industrial inspection and national security. He received an early career award from DOE to develop high resolution neutron radiography capabilities using coded source imaging, and has gained experience in development of systems and algorithms for radiography and computed tomography with both x-ray and neutron sources and development of holographic imaging systems and algorithms with applications in semiconductor mask defect detection, mask inspection, ballistic matching, and cellular imaging. His ideal research combines image/signal processing techniques with unique sensor systems to develop new measurement capabilities.

ORNL ETI PI/POC

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703-244-9992 (mobile)

https://www.ornl.gov/staff-profile/philip-r-bingham

Kenneth J. Dayman works in nuclear security modeling and forensics at ORNL. His interests include inverse problem theory, applied Bayesian statistics, machine learning applied to nuclear forensics, and data analysis for passive and active gamma-ray spectrometry. Ken has developed novel analysis methods for post-detonation fallout debris and inverse analysis methods for advanced neutron coincidence counting data, inverse depletion problems, and material provenance assessment. Presently he is developing a rapid analysis method for complex gamma-ray spectra for DTRA's Basic Research Program. He received an Innovations in Fuel Cycle Research Award under the MPC&A section, and was a DHS Nuclear Forensics Fellow from 2011 to 2015.

Thrust Area 1 & 2 Coordination

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972-824-5831 (mobile)

https://www.ornl.gov/staff-profile/ken-j-dayman

N. Dianne Bull Ezell works in the Nuclear Experiments and Irradiation Testing Group at ORNL with a recent focus on signal processing of EMI rejection for Johnson Noise Thermometry measurements. Her research interests are electrical system architecture and integration as well as low-noise mixed-signal electronic design for nuclear instrumentation. A few of her on-going projects and roles at ORNL are systems engineer for A Large Ion Collider (ALICE) at CERN, control software design for ITER sub systems, and system engineer of nuclear instruments design for advanced reactors. Dianne has been an active member of IEEE since 2005 and was nominated for senior membership in 2017.

Thrust Area 3 Coordination

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865-574-4368 (office)
972-824-5831 (mobile)

https://www.ornl.gov/staff-profile/n-dianne-d-ezell

OAK RIDGE National Laboratory

25 DNN R&D Projects ripe for Collaboration

DNN R&D Project Title	Ending FY	ORNL PI
Analytics and Data Science		
Ecosystem for Open Science	2024	Philip Bingham
Advanced Data Analytics for Proliferation Detection	2023	Philip Bingham
Persistent Dynamics	2021	Jeff Johnson
Data Analytics Methods for Verifying Nuclear Facility Operations	2021	Scott Stewart
Multi-Informatics for Nuclear Operations Scenarios	2020	Jared Johnson
Radiation Detection & Analysis		
Associated-Particle Imaging Algorithms for Material Identification	2022	Paul Hausladen
Fast TOF Correlation	2021	Jason Newby
Single Volume Scatter Camera Development	2021	Paul Hausladen
Silicon Alpha Detector for DARPA ICONS neutron generator	2020	Seth McConchie
Safeguards		
Accurate Quantification of U-235 in LEU Holdup Deposits using Gamma and Neutron Imaging	2022	Ram Venkataram
Distributed multi-modal fiber optic sensing for containment verification	2022	Will Ray
Embeddable Fiber Bragg Grating UID	2021	Klaus-Peter Ziock
Evaluation of Safeguards Measurement Performances against the International Target Values	2020	Philip Gibbs
Improving HEU Detection - OPRA	2020	Bradley Patton
Signal and Sample Transport/Analysis		
Conductive Propagation of Signals	2022	Kellie Baldwin
Unconventional Signal Processing of Source Term Signals	2021	Will Ray
Sensor Networks Powered by Trees	2021	Cathy Romano
Focused Experiments and Analytics for Research in Detection	2021	Thomas Karnowski
Experimental and Computational Investigation of Uranium Particle Formation and Dynamic Behavior	2020	Mengdawn Cheng
Analog Signal Processing for Deployable Sensor Systems	2020	Milton Ericson
Capabilities of Connected COTS Power Instruments	2020	Thomas Karnowski
Nuclear Modeling and Simulation		
Modeling of historic events for independent validation of GPS/DSP performance	2021	Vince Jodoin
Water-Surface-Burst Fallout Model	2021	Vince Jodoin
Geophysical Signatures for Underground Structures Detection	2020	Monica Maciera
Detection and Characterization of Undeclared Irradiation Activities	2020	Brian Ade

ORNL Internships

Primary websites:

ORNL: https://www.ornl.gov/directorate/nsed/educational-outreach/internships
ORAU/ORISE: https://orise.orau.gov/ornl/applicants/default.html
Housing Guide: https://orise.orau.gov/ornl/current-participants/preparing-for-the-appointment/housing.html

internhousing.com

Preferred Vehicles listed in primary websites:
- NESLS (most rewarding !)...*Feb.28 deadline*
- ASTRO (also rewarding, most flexible, Grad-students only)
- AISI (rewarding Artificial Intelligence summer school)
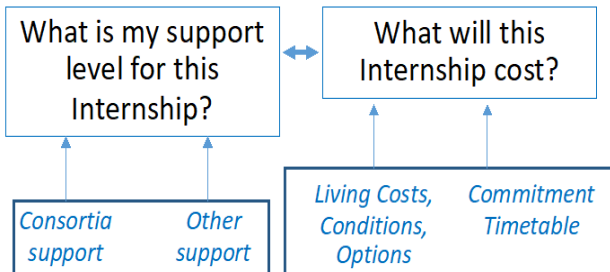- SULI and HERE (Undergrads)

Riding with Smokey

A few programs provide their own support:
- Dec.1 deadline for Jan. Mini-semester: https://www.zintellect.com/Opportunity/Details/2019_ORNL_Mini-Semester
- DOE Visiting Faculty program: https://orise.orau.gov/ornl/faculty/vfp/default.html

| What is my support level for this Internship? | ↔ | What will this Internship cost? |

UTK/PSCC ←→ ORNL Buses
https://ridethet.utk.edu/wp-content/uploads/sites/51/2019/07/ORNL-PSCC-Route-Info-2019-20.pdf

UTK Summer dorms available May 17- Aug. 1.
https://ugresearch.utk.edu/students/summerhousing/

Consortia support   Other support

Living Costs, Conditions, Options   Commitment Timetable

This area has a low cost of living, but there is a surge of students in the summer – ID your housing early.

ETI Relevant ORNL Initiatives

ETI
- Manufacturing Demonstration Facility
  - https://web.ornl.gov/sci/manufacturing/mdf/
- Transformational Challenge Reactor
  - https://tcr.ornl.gov/
- Artificial Intelligence Summer Institute
  - https://www.zintellect.com/Opportunity/Details/ORNL-HERE-AISI-Summer_2020

ORNL ETI contacts:

PI, TA1 & TA2: Philip Bingham
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TA1 & TA2: Ken Dayman
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TA3: Dianne Ezell
- bullnd@ornl.gov, 865-574-4368

Contact any ORNL staff about potential collaboration, but keep Dave Williams or one of these folks in the loop when something develops/needs support.

See also ORNL April 30, 2019 ETI Kickoff presentation (ORNL PubID 125495)

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Pacific Northwest National Laboratory (PNNL)

- Lead POC: Robert Brigantic

- ETI Thrust Areas Leads
  - TA1: Paul Whitney (focus: modeling fuel cycle for remote sensing)
  - TA2: Amanda Lines (focus: optical spectroscopy combined with modeling to understand molten salt systems)
  - TA3: George Bonheyo (biological sensors for stable isotope labelling)

- Core capabilities relevant to ETI:
  - Nuclear sciences
  - Data analytics and machine learning / data visualization
  - Operations research
  - Biological / chemical sciences

- Key facilities relevant to ETI
  - Radiochemical Processing Laboratory's (RPL)
  - Cloud services / GPU clusters
  - Additional Scientific Facilities

- Key ETI related projects and programs
  - Advanced Data Analytics for Proliferation Detection (ADAPD)
  - Persistent Dynamics
  - Laboratory Directed Research and Development (LDRD)
    - MARS – Mathematics for Artificial Reasoning in Science

- Internships for graduate students
  - National Security Internship Program (NSIP)
    - PNNL funded summer and co-op internships
  - Alternate Sponsored Fellows (ASF)
    - Mechanism for externally funded internships such as ETI student fellows

- Other relevant programs/information
  - NNSA Graduate Fellowship Program (NGFP)
  - Additional summer courses available
    - Data Science for Safeguards Practitioners (every other summer)
    - Radiation Detection for Nuclear Security
    - Nonproliferation and International Safeguards Summer Course
  - Joint faculty assignments

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Princeton Plasma Physics Laboratory (PPPL)

- Lead POC: Rob Goldston, goldston@pppl.gov

14 MeV neutron moderator / collimator, for producing variable neutron spectra. Can be pulsed, can irradiate depleted uranium blocks, working to acquire HALEU blocks. Bring your neutron and γ imaging sensors.

First robotic neutron detector of growing swarm, with Cf-252 cask. Recently calibrated, showing designed angular and neutron energy resolution. Bring your search algorithm and play hide-and-seek with neutrons and γ's.

Large shielded hall, held at negative pressure, with air replacement time in the few hour range. Environment similar to gas centrifuge enrichment plants. Bring your puffer and sniffer for detecting off-normal GCEP operation (or use ours).

Science Undergraduate Laboratories Internships: https://orise.orau.gov/ornl/undergraduates/suli/default.html

Sandia National Laboratory (SNL)

- Lead POC: David Peters

- ETI Thrust Areas Leads
  - Sandia/CA: Erik Brubaker

- Core capabilities relevant to ETI:
  - Additive/advanced manufacturing
  - Rad hard microelectronics
  - Data science/machine learning/deep learning

- Key facilities relevant to ETI
  - MESA: silicon and other semiconductor clean room complex
  - HERMES: Gamma ray testing facility
  - Robotic testing complex
  - Annular core reactor

- Key ETI related programs
  - NA-22 funded programs in data science, scintillator materials, scintillator read-out electronics, image analysis, gas isotope detection, photovoltaics for nuclear detection
  - Hyperspectral imaging data analysis, deep learning, data science, from other sponsors

- Internships for graduate students
  - Monitoring Systems and Technology Intern Center (MSTIC): http://www.sandia.gov/careers/students_postdocs/internships/institutes/mstic.html
  - Internships: http://www.sandia.gov/careers/students_postdocs/internships/institutes/mstic.html
  - Hruby and Truman fellowships for post-docs

- Other relevant programs/information
  - Lab-Directed Research and Development (LDRD) program with Georgia Tech, UIUC, UNM, UT-Austin, Purdue

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Scoping Student/Faculty Research

Strategize in Placing Students

Collaborating as National Labs