Pacific Northwest
NATIONAL LABORATORY

Opportunities for MTV Students at PNNL

TA1: Nuclear physics research at PNNL spans the spectrum of basic and applied science. Basic science topics are focused on basic neutrino properties and their implications for the origins of matter and structure in the universe. Applied nuclear physics supports a broad range of applications in nonproliferation, including:

- Measuring fission fragment atomic mass, A, and Z with high precision using a fission Time Projection Chamber and new analyses of the Bragg energy loss curves.
- Production of radiopure materials for ultra-sensitive radionuclide measurements in PNNL's ultra-low-background facility.
- Quantitative radiography with X-rays and neutrons, developing advanced material discrimination methods and algorithms.
- Developing noninvasive methods to detect fissile material and isotopic content with moderated neutron sources.

TA2: Efforts at PNNL related to Signals and Source Terms span the research landscape from optical spectroscopy to the study of biota for environmental monitoring to nuclear fuel cycle modeling (see CT1). PNNL is currently working on optical spectroscopic tools for pre- and post- detonation isotopic science, methods to characterize SNM from a standoff distance, remote detection using laser-based techniques, and environmental monitoring. Some of the current potential opportunities include:

- Isotopic analysis of actinides and light elements (H, D, T, Li, etc.): Develop optical spectroscopic tools (emission, absorption and fluorescence) for rapid and standoff isotopic analysis.
- Actinide gas-phase chemistry: Monitoring actinide (U, Pu, etc.) gas phase chemistry in high-temperature environment, emission and absorption spectroscopy of actinide fireballs, developing state of the art optical spectroscopic tools for explosion monitoring, generation physics of particulates in high explosion and nuclear explosion events.

TA3: The ability to measure both the telltale radionuclide and seismic signatures from nuclear explosions relies on a network of international monitoring sensors. PNNL is a leader in the development of the sensors and the methods and techniques used to analyze the data from them. We have opportunities related to this effort in the following areas:

- Development of more sensitive particulate and noble gas systems to detect radioactive isotopes.
- Development and implementation of algorithms and advanced analytic methods to improve analysis of radionuclide signals.
- Investigations of the radionuclide signatures of molten salt reactors.
- Development of instrumentation and modeling suites, coupled with advanced data analysis, to improve understanding of seismic source signatures and geology.

CT1: In support of its broad spectrum of projects creating innovative technologies for the detection of nuclear and radiological materials, PNNL has developed and applied a range of mathematical models, numerical and analytical methods, and statistical techniques. Current opportunities at PNNL in this area include:

- Develop and demonstrate computational methodology to integrate multiple remote sensing technologies to support nuclear nonproliferation.
- Development of 1) computational models of a fuel cycle and 2) sensor observations of multiple characteristics from multiple sensors.
- Using natural language processing and machine learning, determine candidate nuclear signatures and activities from open-source data, such as local news and social media.

General skillset needs: Nuclear engineering, physics, reactor modeling, radiochemistry, radiation detection, atmospheric modeling, materials science, electrical engineering, inverse algorithms, data analytics, mechanical engineering, machine learning, seismology, geophysics, gamma spectroscopy, X-ray and neutron radiography.

If interested in any of these opportunities, or to discuss potential collaborations in related areas, please contact:
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