NUCLEAR SCIENCE AND SECURITY CONSORTIUM
Summer 2020 Newsletter
Letter from the NSSC Director

The Nuclear Science and Security Consortium (NSSC) has completed another successful year in recruiting, educating, and training top students in relevant nuclear science and security topics, while at the same time demonstrating scientific excellence in cutting-edge research. At the end of its 9th year, the NSSC has proudly supported 521 people (undergraduate and graduate students, postdocs, specialists, and faculty) and placed 42% of students and postdocs completing the program into DOE national laboratories or other government positions.

The primary objective of NSSC from the beginning has been to connect students with a core set of disciplines that support the nonproliferation and nuclear security mission and to expand national laboratory collaboration to provide students the opportunity to engage deeply in research under the guidance of national laboratories staff scientists. All current NSSC Graduate Fellows have a laboratory mentor in addition to an academic mentor. Since 2016, 148 NSSC students and postdocs have conducted in-residence lab research, and 117 NSSC students are working on lab-led projects. The NSSC has graduated 111 B.S., 67 M.S., and 108 Ph.D. student fellows and affiliates and has supported 47 postdoctoral scholars through program completion.

In addition to 112 (42%) NSSC Fellows and Affiliates that have accepted positions in DOE national laboratories or other government, an additional 50 were hired into faculty and research positions at U.S. universities. These stellar NSSC Fellows and Affiliates represent the next generation of young scientists and researchers, with research skill sets and expertise required to support critical nuclear science and engineering disciplines needed in nuclear nonproliferation, nuclear arms control, nuclear incident response, nuclear intelligence activities, nuclear energy, and other nuclear-related fields.

The NSSC has demonstrated scientific excellence through the publication of numerous highly cited manuscripts in influential journals. The Consortium has produced 333 peer-reviewed publications and 1,264 oral and poster presentations on fundamental and applied research in nuclear and particle physics, nuclear engineering, radiation detection, radiochemistry and nuclear chemistry, and nuclear security policy supporting the nuclear security mission. The wide reach of the NSSC provides a unique infrastructure for recruitment, education and training, as well as human capital development, formidable for the quantity, quality, and diversity of fellows and a rich collaborative research environment between the university members, their students, faculty researchers, and the DOE National Laboratory scientists and staff.

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Prof. Jasmina Vujic, NSSC Director, with UC Berkeley students.
The Mission of NSSC

Train the next generation of nuclear scientists and engineers while engaging in research and development spanning basic aspects of new technology and methods to programmatic work directly supporting the nuclear security and nonproliferation mission.

The History of NSSC

The Nuclear Science and Security Consortium was established as the first NNSA academic consortium. The first phase of the NSSC included the partners: UC Berkeley, UC Davis, UC Irvine, UC San Diego, UN Las Vegas, Michigan State University, Washington University in St. Louis, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratory, and Los Alamos National Laboratory. During this phase, NSSC also worked with several Minority Serving Institutions, including Clark Atlanta, Fisk, Hampton, South Carolina State, and UT El Paso.

In 2016, the NSSC recompeted and was awarded funding for an additional five years of support. The NSSC added partners UT Knoxville, Texas A&M University, George Washington University, and Oak Ridge National Laboratory.

During the Summer of 2020, the NSSC will continue their work supporting top students during their academic studies and facilitating career connections at the national laboratories.
NSSC Partners & Leadership

EXECUTIVE TEAM

DR. JASMINA VUJIC
Director
UC Berkeley

DR. BETHANY GOLDBLUM
Executive Director
UC Berkeley

DR. JASON HAYWARD
Deputy Executive Director
UT Knoxville

DR. KAI VETTER
NNSA Liaison
UC Berkeley

DR. LEE BERNSTEIN
Director for Laboratories
UC Berkeley/LBNL

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Lawrence Livermore National Laboratory

ACADEMIC POINTS OF CONTACT

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UC Davis

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GWU

DR. JASON HAYWARD
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LAB POINTS OF CONTACT

DR. JOHN VALENTINE
LBNL

DR. VLADIMIR MOZIN
LLNL

MARGARET ROOT
LANL

DR. DAVE WILLIAMS
ORNL

DR. DAVID PETERS
SNL

NSSC STAFF

CHARLOTTE CARR
Program Manager

DEREK JOHNSON
Financial Analyst

NSSC Director Prof. Jamina Vujic presents at the NSSC Fall Workshop in 2019.

Prof. Kai Vetter with students. (photo courtesy of LBNL)
Research Focus Areas and Crosscutting Areas

- **Nuclear & Particle Physics**
  Lead: Barbara Jacak, UCB

- **Radiochemistry & Forensics**
  Lead: Ken Czerwinski, UNLV

- **Nuclear Engineering**
  Lead: Max Fratoni, UCB

- **Radiation Detection**
  Lead: Kai Vetter, UCB

- **Nuclear Data**
  Lead: Lee Bernstein (UCB)

- **Modeling & Simulation**
  Lead: Jasmina Vujic (UCB)

- **Nuclear Security Policy**
  Lead: Michael Nacht (UCB)

- **Education**
  Lead: Bethany Goldblum (UCB)
Mariah Ramirez's research focuses on a technical study with the main objective of supporting nuclear safeguards approaches for neptunium present in spent fuel. The main premises of this work are to support the reduction of global nuclear security threats and improve safeguard measures currently in place by the IAEA. This project utilizes benchtop radiochemical experimental methods and computational radiation transport simulations to analyze neptunium present in irradiated spent fuel or high-level radioactive waste.

Mariah's advisor at TAMU is Prof. Charles Folden. Mariah's lab mentors are Alex McSpaden and Rene Sanchez, from the Advanced Nuclear Technologies group (NEN-2) at Los Alamos National Laboratory.
Joseph Gordon works on the Gamma-Energy Neutron-Energy Spectrometer for Inelastic Scattering (GENESIS), a new experimental platform at the 88” Cyclotron at Lawrence Berkeley National Laboratory that combines high-resolution gamma ray detectors with fast neutron detectors to measure double differential neutron spectra in coincidence with gamma ray production following inelastic scattering. Initial experiments with Fe-56, under the guidance of Dr. Darren Bleuel from LLNL, and U-238, under the guidance of Dr. Lee Bernstein from UC Berkeley, will improve understanding of reaction product correlations which are crucial aspects in the design of nuclear technologies, from advanced reactors to improved active interrogation set-ups.

James is pursuing a Ph.D. degree in Radiochemistry at the University of Nevada Las Vegas (UNLV) while working full-time at Los Alamos National Laboratory (LANL). At UNLV and LANL, his work focuses on the preparation, analysis, and characterization of nuclear materials. This includes fundamental and applied studies of the uranium fuel cycle and specific fission products such as technetium (Tc) and samarium (Sm). With his contribution, the clean chemistry team at LANL has developed a novel method to measure the isotopic ratios from a nanoscopic amount of Sm. This improvement expands on the capability of using thermal ionization mass spectrometer (TIMS) in the realm of nuclear forensic analysis. James’ advisor at UNLV is Prof. Frederic Poineau, and his lab mentor at LANL is Dr. Jeremy Inglis.
Vincent Fischer
UC Davis

Vincent is working on the Accelerator Neutrino Neutron Interaction Experiment (ANNIE), a gadolinium-loaded water Cherenkov detector located on a neutrino beam at Fermilab. ANNIE aims to measure the neutron multiplicity of neutrino interactions and demonstrate the use of new technologies in the field of fast photosensors and new detection media. Vincent designed, developed, and built the water circulation and purification system of the experiment, a one-of-its-kind apparatus capable of efficiently purifying gadolinium-loaded water at a fraction of the cost and space of existing systems. He also performed laboratory tests and simulations on Water-based Liquid Scintillator (WbLS), a novel detection medium combining the advantages of water and liquid scintillator. Both technologies are of the highest interest of the Advanced Instrumentation Testbed (AIT) and the WATCHMAN experiment, a 1000-ton detector dedicated to nuclear non-proliferation through the detection of neutrinos from nuclear reactors. Vincent’s academic advisor is Prof. Robert Svoboda, UCD, and his lab mentor is Steven Dazeley, LLNL.

Alicia Palmisano
Michigan State University

Alicia performs direct cross section measurements on proton-rich nuclei for the astrophysical p process. She has developed and validated a new experimental and analysis technique for these direct measurements and successfully measured the $^{82,84}$Kr$(p,\gamma)^{83,85}$Rb cross section from 2.7 MeV - 3.7 MeV. This technique can be applied to other $(p,\gamma)$ and $(\alpha,\gamma)$ reactions.

Alicia’s advisor is Prof. Artemis Spyrou and she works with lab mentor Aaron Couture, LANL.
Sandra Bogetic has just completed her Ph.D. at UC Berkeley. Her thesis research was performed within the Nuclear Science and Radiochemistry group at the National Ignition Facility (NIF) at LLNL. The Ph.D. thesis was performed under the mentorship of Professor Jasmina Vujic, and lab mentorship of Dr. Lucile Dauffy and Dr. Dawn Shaughnessy. Sandra's Ph.D. work dealt with the further development, validation, and applications of a novel, cross-cutting modeling capability for tailoring neutron energy for nuclear security and nonproliferation related applications. The specific focus was initially on the generalization of a metaheuristic optimization software package (Gnowee/COEUS), as a part of an ongoing collaboration between UC Berkeley, NIF/LLNL, and the Air Force Institute of Technology (with Prof. James Bevins). This new capability enables the development of optimal designs of neutron spectra tuning assemblies at a fraction of the cost in terms of manpower and research effort, thereby greatly accelerating efforts in many areas of nuclear science and engineering that need neutron spectra with specific desired characteristics. As part of Sandra's Ph.D. thesis and work at LLNL, she had the exciting opportunity to work at NIF in planning and designing several integral validation experiments for materials of interest, during four NIF shot campaigns. The experiments have generated important data that have been used for comparison and validation of the computational design models. Her work presented several examples of the application of the optimization package to design energy tuning assemblies at the NIF to cover specific national security applications of neutrons. This experience broadened her knowledge of the concepts of validation, uncertainties, and the use of different spectroscopic methodologies to measure neutron flux and reaction rates.

Julie He is a graduate student currently working on developing firmware for the novel Large-Area Picosecond Photodetector (LAPPD), which will be used in neutrino detectors and other nuclear security applications. Julie also conducts material compatibility studies for detectors that use gadolinium-doped water and water-based liquid scintillator as their detection medium. Julie's academic advisor is Prof. Bob Svoboda at UC Davis, and her lab mentors are Adam Bernstein and Steven Dazeley from LLNL.
Mara Grinder  
MSU

Mara is currently working on a Doppler shift attenuation lifetime measurement of excited states in 36 and 38Si along with an implementation of an active diamond target to further improve the method under the direction of her advisor Hironori Iwasaki. During her practicum, Mara worked on a project determining how diamond detectors behave in high radiation environments at Los Alamos National Laboratory with her Laboratory mentor Hye Young Lee. She also had the opportunity to attend the Joint ICTP-IAEA workshop on Nuclear Decay Data: Theory, Experiment, and Evaluation that was held in Trieste, Italy acquiring hands-on experience learning how nuclear data are evaluated. These projects further the NNSA’s mission by improving detection systems and deepening understanding of nuclear structure data to improve models.

Mairead Montague  
UT Knoxville

Mairead first joined the NSSC as an undergraduate fellow at UC Berkeley working at LBNL. As an undergraduate, she worked with lab mentor Darren Bleuel (LLNL) and academic advisor Bethany Goldblum to perform a feasibility study on a carbon backscatter time-of-flight detector for use at LLNL’s neutron imaging facility. Mairead is now an NSSC graduate student fellow at UTK. At present, she is working with Paul Hausladen at ORNL on a Fast Neutron Imager for spent fuel verification. Her team is designing and prototyping a neutron detector with a modified parallel slit collimator to be used to determine the location and age of individual fuel pins in a fuel assembly. Using a number of boron-coated straw detectors, fission product neutrons from Cm-244 can be detected after making it through the stainless steel and high-density polyethylene collimator. Using the calculated fields-of-view for each slit in the collimator, analytic models are being developed which can localize the neutron source. Mairead is working with MCNP6.1 to simulate the detection response for the full collimator. Ultimately she will create a neutron response model that will generate the response functions suggested by physical principles with empirical fit parameters. Various components of the response include detector straw efficiency, collimator penetration, inter-detector scattering, and edge transmission. Ensuring that these components are correctly accounted for and that their output matches a detector response simulated in MCNP6.1 is her current work.
Eric Matthews
UC Berkeley

Eric’s Ph.D. thesis research focuses on fission and the improvement of nuclear data related to that process. He has worked on the development of the Fast Loading User Facility for Fission Yields (FLUFFY), which is a pneumatic system that rapidly transports actinide samples between a neutron beam and an HPGe detection array. FLUFFY is being used to measure fission yields for short-lived products (~1-second half-lives). In addition to this, Eric has developed a Monte Carlo method for model-independent fission yield covariance matrix generation. Finally, Eric is working with Dr. Denise Neudecker at LANL to write a template of expected uncertainties for fission yield measurements. Eric’s academic advisor is Prof. Lee Bernstein.

August Ridenour
George Washington University

August’s research duties and aspirations at The George Washington University are two-fold as he completes his Ph.D. in Chemistry with Dr. Christopher Cahill. His efforts in the lab focus on a fundamental exploration of f-element bearing materials, the determination of their molecular structure through X-ray diffraction, and their characteristic spectroscopic signatures to better understand their properties under environmental and security relevant conditions. This is highlighted most acutely by a scientific collaboration between August’s lab and Dr. Ken Czerwinski’s lab at the University of Nevada – Las Vegas, that synthesized and characterized the structure and spectroscopic signatures of the first americium-containing metal-organic framework. August spent the summer of 2018 as a Keepin Nonproliferation Fellow at Los Alamos National Laboratory working with Dr. Robert Rundberg on a project to detect and identify X-ray signatures from nonproliferation-relevant actinides. Concurrently, August serves as the teaching assistant for “The Science of Nuclear Materials” – a course in GW’s Elliot School of International Affairs aimed at introducing nuclear chemistry and physics to nuclear science and technology policy graduate students. August has assisted with both the lecture and lab-practical portions of the course, providing equipment demonstrations for weekly lab practical experiments in radiation detection with lab-based and “in-the-field” analytical techniques.
NSSC Recent Events

Fall Engagement Workshop and External Advisory Board Meeting 2019 - Hosted by LLNL
The 2019 NSSC annual workshop and advisory board meeting was held Oct. 8 - 9. The event was jointly organized by LLNL with Dr. Vladimir Mozin as host and the University of California, Berkeley, and was attended by more than 60 university students, postdocs, faculty, and over 50 national lab scientists from several laboratories. The event featured oral and poster presentations from students. The workshop concluded with tour offerings from LLNL including visits to the National Ignition Facility Tour (NIF), High Performance Computing Lab, and the Nuclear Forensics Lab.

University Program Review 2019
The NSSC participated in the annual Department of Energy (DOE) National Nuclear Security Administration (NNSA) Defense Nuclear Nonproliferation Research and Development (DNN R&D) University Program Review (UPR) meeting from June 4 - 6, 2019 in Raleigh, North Carolina, hosted by North Carolina State University. The event was attended by students, faculty, national laboratory scientists, and DOE NNSA program officials. Students presented on their research and contributions to the NNSA mission. NSSC Student Fellows and Affiliates presented 18 oral presentations and 30 poster presentations.

Attendees of the 2019 NSSC Fall Engagement Workshop hosted by LLNL.

Students tour the NIF as part of the NSSC Fall Engagement Workshop at LLNL.

During UPR 2019 Rebecca Krentz-Wee (UCB) was awarded best oral presentation from NSSC. Eric Matthews (UCB) was awarded best national laboratory collaboration from NSSC.
NSSC Sponsors new course on Radiation Detection for undergraduates at UC Berkeley

NSSC Specialist Dr. Ali Hanks developed and taught the undergraduate level course, A Hands-On Introduction to Radiation Detection, during the Fall 2019 semester. Freshman and Sophomore engineering students received an introduction to radiation detection and radiation in the environment. As part of the course, students built their own nuclear radiation detectors.

Nuclear Security: The Nexus Between Technology and Policy Graduate Level Course Held for the Ninth Year

The only nuclear security policy focused course held at UC Berkeley was co-taught by Prof. Michael Nacht of the Goldman School of Public Policy and Prof. van Bibber of the Department of Nuclear Engineering for the ninth year during the Spring 2020 semester. Guest speakers for the course included Scott Kemp (MIT), Brad Roberts (LLNL), Sheryl Hingorani (LLNL), and George Moore (MIIS). All classes were broadcast live for all partners and recordings are hosted on the NSSC website.

Webinar Series brings lab scientists and former U.S. Secretary of Energy to Berkeley

A few highlights from the past year’s webinars include Yana Feldman, Nonproliferation and International Safeguards Analyst, LLNL discussing, “A Multimodal-Deep Learning System for Monitoring Nuclear Proliferation Activities Using Open Sources”, and Mark Chadwick, Chief Scientist and Chief Operating Officer, ALDX, LANL, on “Nuclear Science, Engineering & Deterrence. A Career that Matters at Los Alamos”. NSSC also partnered with NTI and NPWG to host a panel discussion on, “How Close to Doomsday? Nuclear Dangers and Stopping a New Nuclear Arms Race.” The panel consisted of former California Governor Jerry Brown, former U.S. Secretary of Energy and Nuclear Threat Initiative (NTI) Co-chair and CEO, Dr. Ernest J. Moniz, and Dr. Bethany Goldblum, NSSC Executive Director. Events were attended by an in-person audience in Berkeley, and broadcast live to all partners.

NSSC and the Project on Nuclear Gaming host the “The Largest Online Wargaming Event Ever!”

NSSC hosted a SIGNAL play festival at UC Berkeley in November 2019. Gamers worldwide participated in playing SIGNAL, a video game focused on understanding the issues surrounding nuclear deterrence and strategic stability. SIGNAL was developed by the Project on Nuclear Gaming, which includes some NSSC personnel and lab staff working together to study deterrence through experimental wargaming.
NSSC Summer Programs

NSSC has supported **39** Summer Programs since 2011.

The NSSC LANL Summer Program debuted in the summer of 2017. NSSC Graduate Fellows attend the summer program to learn how game-changing science, engineering, and technology are applied to reduce the dynamic threats of nuclear nonproliferation. The NSSC LANL Summer Program is an eight-week extended research internship hosted by the Nuclear Science and Security Consortium and Los Alamos National Laboratory.

The program provides a survey of the national laboratory activities and mission space, focused research projects with a strong connection to nonproliferation science and technology, and a companion symposium series linking nuclear security science, technology, and policy.

Students in the program have broad exposure to LANL, access to mentors from LANL and SNL, and opportunities for lab-directed research.

During Summer 2020, the NSSC-LANL Keepin program will be held online due to COVID-19 related travel restrictions. Students will be working remotely with lab mentors at LANL or SNL. Enrichment activities will be broadcast live.

**Two days of lectures from LANL now available to audit**

Due to the unique setup of this year’s summer program for the first time, two days of Keepin program lectures will be available to be audited online for non-program participants, including members of other NA22 consortia.

Many planned programs for Summer 2020 have been cancelled due to COVID-19 travel restrictions.

NSSC LANL Keepin Nonproliferation Science Summer Program

Above left: NSSC LANL Keepin Summer Program participants in 2019.

Above right: Tyler Jordan working on LANL directed research.
NSSC GW Boot Camp on Nuclear Security Policy
The boot camp features an intensive introduction to nuclear security for the prevention of nuclear weapons proliferation and nuclear terrorism. This two-week course explores the implications of scientific and technological developments on government function and policy issues as well as international norms, treaties, and diplomacy. Specific topics include technical policy issues associated with nuclear weapons, nuclear energy, forensics, and missile defense, as well as regional issues such as the Iran Nuclear Deal, the North Korean nuclear situation, the Russian and Chinese arsenals, and more. The Boot Camp leverages GW's unique location two blocks from the White House and across the street from the State Department featuring high level personnel from government agencies and nuclear arena NGOs, as well as field trips to NNSA/DOE, Capitol Hill, and other government agencies.

Nuclear Analytical Techniques Summer Program at UC Davis
The Nuclear Analytical Techniques Summer School consists of some lectures, but mostly hands-on activities involving nuclear analytical techniques. Students perform Neutron Activation Analysis using the McClellan Nuclear Research Center, study proton elastic scattering at the Crocker cyclotron facility, gain experience and skills in counting with NaI and HPGe crystals, and learn about detectors and analysis techniques important across a broad range of science and industry.

Remote Learning Experience at LLNL
In response to the need for additional online educational opportunities, LLNL is developing a remote learning experience for Summer 2020. The program is designed to support the educational process, provide data from laboratory demonstrations, and conduct experiments to benefit university research projects. Experimental activities will be broadcast for university participants. The first planned activity is an evaluation of prompt gamma-ray emissions from neutron interrogation of meteorites.
NSSC by the numbers 2011 - 2020

NSSSC has supported 521 people since 2011

Former NSSC Fellows, Sarah Laderman (UCB, now IAEA), Daniel Hellfeld (UCB, now LBNL), and Tomi Akindele (UCB, now LLNL)

Prof. Lee Bernstein, Prof. Jasmina Vujic with Dr. Thibault Laplace, a UCB graduate and now current NSSC Assistant Research Engineer.

NSSC Cumulative Pipeline

42% of NSSC alumni go on to careers in the National Laboratories or other Gov. positions

Lab Engagement Metrics since September 2016

117 Students or Postdocs worked on Lab Directed Projects

100% of Graduate Fellows have a mentor at a National Laboratory

141 Lab Mentors at National Laboratories have worked one on one with a NSSC Fellow or Affiliate

Metrics of Success

333 Publications

756 Oral Presentations

508 Poster Presentations

176 Awards

Degrees Awarded

111 Bachelors

67 Masters

108 Ph.D
112 NSSC Alumni
working in the National Labs or other Government Positions

Sherry Fay
PhD UNLV
Postdoc UCB
Postdoc | LLNL
Dec 2015

Joseph Curtis
MS, UCB
Staff | LBNL
Dec 2014

Ross Barnowski
PhD UCB
Postdoc | LBNL
Spring 2016

Jonathan Pfau
PhD UNLV
DNFSB LANL
Fall 2012

Brian Daub
Postdoc UCB
Staff | LNL
Weapons & Complex Integration Directorate
Fall 2013

Deepa Khatri
BS, UCB
NNSA/LFO
Summer 2014

Victor Negut
B.A. UCB
Staff, NSD | LBNL
Applied Nuclear Physics
Spring 2014

Quinn Looker
PhD UCB
Staff | SNL
Fall 2013

Anthony Lubbers
BS, UCB
Staff Engineer | LLNL
Safety Bus division
Summer 2014

Ross Meyer
B.S. UCB
Staff, NSD | LBNL
Applied Nuclear Physics
Spring 2015

Andrew Haefner
PhD UCB
Staff, NSD | LBNL
Applied Nuclear Physics
Spring 2015

Kareem Hammerton
PhD MSU
Staff | Savannah River
Spring 2016

Joe Belarge
Postdoc MSU
MIT Lincoln Lab
Spring 2017

Steven Gardner
PhD UCD
Fermi National Accelerator Lab | Postdoc
2018

Alexander Dixon
Bachelors UCB
US Navy
Spring 2012

Jeff Rolies
M.S. UNLV
DTRA | Postdoc
Spring 2017

Tomi Akindele
PhD UCB
LLNL | Postdoc
2018

Joseph Labrum
B.S. UCB
Intelligence
Spring 2017

Thomas Halverson
Masters UCB
West Point
Spring 2016

Jon Balazhy
PhD UCD
SNL
Spring 2020

Sarah Laderman
Dual Masters | UCB
IAEA
Spring 2018

Bradley Childs
PhD UNLV
LLNL
Spring 2019

Ardelia Clarke
PhD Fisk
PNNL
Spring 2019

Athena Gallardo
PhD UNLV
LANL
Spring 2020

Nicole Apadula
Postdoc UCB
LLNL
Fall 2018

Max Wallace
Bachelors UCB
LLNL
Spring 2020

Sandra Bogetic
PhD UCB
Postdoc | LLNL
Spring 2020