

Connecting Students to Nuclear Data Projects at the National Laboratories

WANDA 2021

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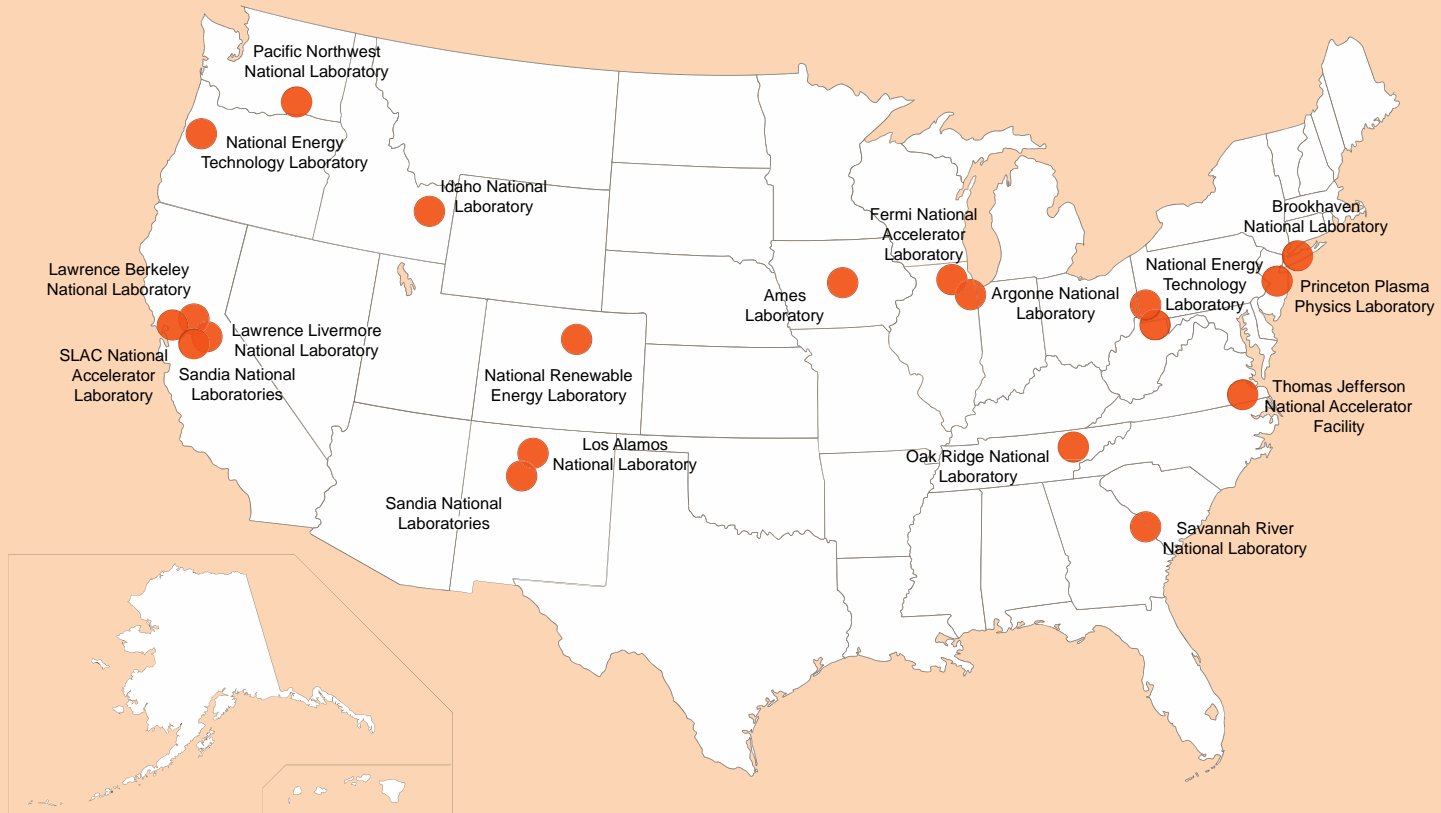
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The Department of Energy national laboratories are located across the nation and offer opportunities for students to engage in cutting edge research

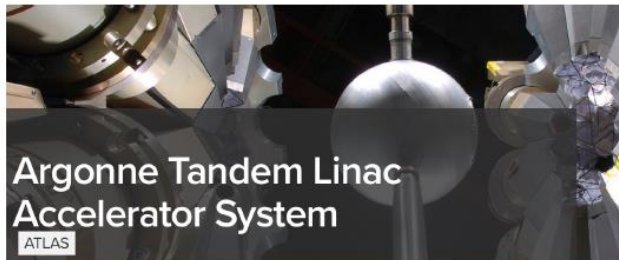


There are numerous programs at the federal level and at these laboratories to help create a pipeline of students in order to train the next generation of scientists

Federally sponsored programs allow for the most flexibility for students interested in working at a national laboratory

- There are numerous federal programs that help pay for students to spend the summer or longer at a national laboratory
- Programs exist for both undergrads and grads
- The total cost of the student may be fully covered by the federal program
 - “Free” students allows the labs to hire more students than they normally would
- Win-Win scenario
 - The laboratories get a student to help with a project and a potential future hire
 - The students get experience in a lab, make connections with other scientists in their field, and have a potential future job
- Federally sponsored fellowships
 - NSF
 - DOE
 - Computational Science Graduate Fellowship (CSGF)
 - Stewardship Science Graduate Fellowship (SSGF)
 - Laboratory Residency Graduate Fellowship (LRGF)
 - Nuclear Nonproliferation International Safeguards Fellowship (NNIS)
 - Nuclear Energy University Program (NEUP)
 - Science Graduate Student Research Program (SCGSR)
- Internships
 - Science Undergraduate Laboratory Internships (SULI)
 - Minority Serving Institutions Program (MSI)
 - Military Academy Collaboration (MAC)
- Other fellowships
 - National GEM Consortium (GEM)

Argonne National Laboratory (ANL) Nuclear Data Student Resources



Argonne Tandem Linac Accelerator System

ATLAS

Nuclear Data Program

ANL Physics Division opportunities

<https://www.anl.gov/atlas>

ATLAS is a U.S. Department of Energy User Facility that hosts roughly 200 to 300 users each year. It is supported by the Office of Nuclear Physics of the Department of Energy. ATLAS users come from U.S. universities and national laboratories as well as from foreign institutions. The facility is also accessible to industrial users.

<https://www.anl.gov/phy/nuclear-data-program>

POC: Dr. Filip G. Kondev (kondev@anl.gov)



EDUCATION AND OUTREACH PROGRAMS

Science Undergraduate Laboratory Internship

Community College Internship Graduate Programs

Maria Goeppert Mayer Fellowship

ANL Lab-wide opportunities

- temporary employment
- internships
- visiting student programs
- graduate training programs

<https://www.anl.gov/education>

very competitive

<https://www.anl.gov/hr/maria-goeppert-mayer-fellowship>

Argonne  NATIONAL LABORATORY

Brookhaven National Laboratory (BNL) University and College Programs

- **Department of Energy Programs at BNL**

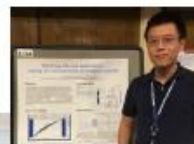
- Summer 10 weeks; semester 16 weeks - includes stipend, housing and round-trip travel depending upon location
- Science Undergraduate Laboratory Internship (SULI)
- Community College Internship (CCI)
- Visiting Faculty Program (VFP)
- Office of Science Graduate Research Fellowship (SCGSR)
- Nuclear Chemistry Summer School (NCSS)
- Nuclear and National Safeguards and Security (NNSS)
- Accelerator Science Programs

- **Partner based programs (examples)**

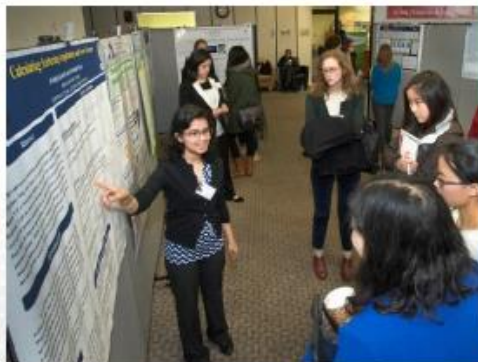
- NSF - Alliance for Graduate Education and the Professoriate
- NYS College Science Technology Entry Program (CSTEP)
- NSF Louis Stokes Alliance for Minority Participation (LSAMP)
- High School Research Program (HSRP)

www.bnl.gov/education

In the last ~5 years, **NNDC** has hosted more than 50 SULI/SERP interns.



Wide range of topics: reaction evaluations, fission yields, gamma-ray spectroscopy, web programming, antineutrinos

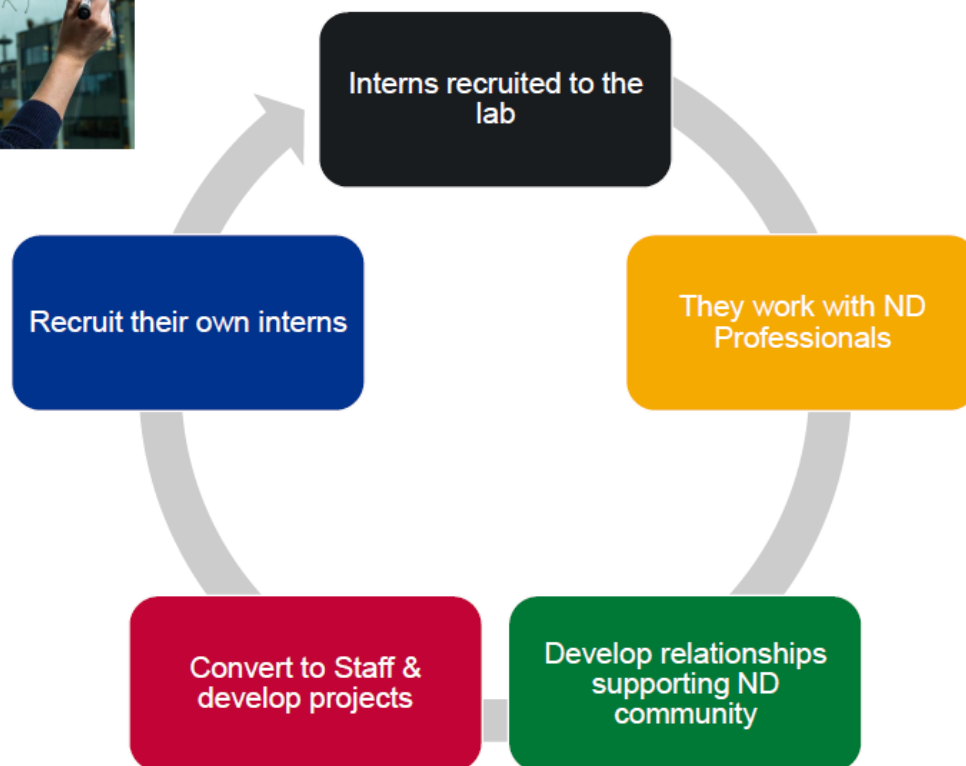


Pacific Northwest National Laboratory (PNNL) Pipeline

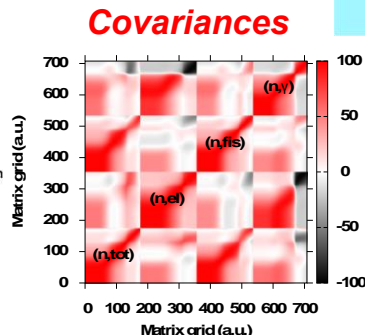
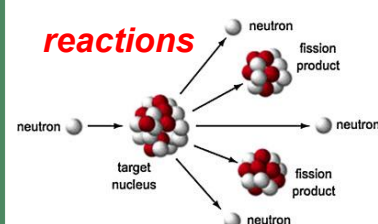
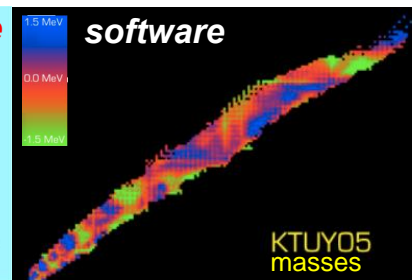
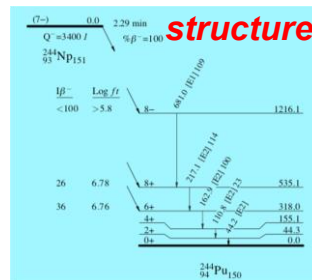
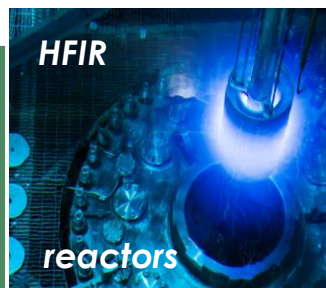


PNNL's Nuclear Data Pipeline

- PNNL does not have a formal Nuclear Data Program
- Nuclear data research is Application driven
- Students/Professors are encouraged to consider the National Security Internship Program



Nuclear Data Activities and Programs at Oak Ridge National Laboratory (ORNL)



Activities

- Neutron-induced reaction measurements (transmission, capture, thermal neutron scattering)
- Charged particle-induced reactions (transfer, capture)
- Reaction theory (direct & resonant capture)
- Data evaluations of nuclear reactions & structure
- Uncertainty quantification
- Online Software Systems for Basic & Applied Nuclear Science

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 Michael Smith (smithms@ornl.gov) Physics Division



Applications

- Criticality, Reactors, Nonproliferation, Safeguards
- Nuclear Astrophysics, Cosmology

Experimental facilities

- Spallation Neutron Source (SNS)
- High Flux Isotope Reactor (HFIR)
- Support facilities: RPI, UTK, Notre Dame University

Programs and sponsors

- Nuclear Criticality Safety Program (NCSP)
- Nuclear Regulatory Commission (NRC)
- United States Nuclear Data Program (USNDP)
- DOE Office of Nuclear Physics

Links : ncsp.llnl.gov, neutrons.ornl.gov, ornl.gov/scale/references, ornl.gov/division/pd, ornl.gov/directorate/nsed/educational-outreach/internships

Savannah River National Laboratory (SRNL) Human Pipeline

*At SRNL, experts in nuclear chemical manufacturing apply knowledge of **nuclear materials and processes** in technical areas ranging from nuclear waste cleanup to defense nonproliferation.*

Example of Recent Student Nuclear Data Research:
Study of long-term stability & reliability of radioactive standards

Opportunities for Undergraduate Students

- Office of Science – Science Undergraduate Laboratory Internships (SULI) Program <https://science.osti.gov/wdts/suli>
- DOE-Environmental Management Minority Serving Institutions Partnership Program (MSIPP) <https://orise.orau.gov/msipp/locations/savannah.html>

Opportunities for Graduate Students

- Office of Science – Science Graduate Student Research (SCGSR) Program <https://science.osti.gov/wdts/scgsr>

Opportunities for Post-Graduates

- SRNL Postdoctoral Researcher Program

Questions on SRNL Student Opportunities?

Contact Natalie Ferguson at (803)761-4965
Natalie.Ferguson@srnl.doe.gov



Underground Counting Facility

- Low background gamma counting facility located 48 ft underground.
- Detector background is approximately 300 times lower relative to the same detector at surface level.
- Minimum detectable activity of 600 femtocuries for 137-Cs in one liter of water.
- Accredited ISO 17025 gamma counting measurements.

SRNL-RP-2021-00015



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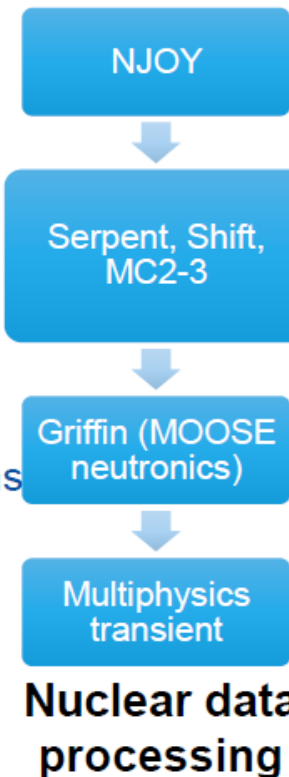
Idaho National Laboratory (INL) Human Pipeline

Human Pipeline and Data Needs for Advanced Reactors

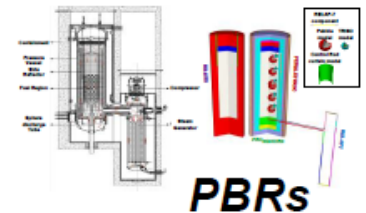
- Advanced reactors group is a consumer of nuclear data (NJOY to Serpent to Griffin)
- Data needs:
 - Graphite scattering for PBRs, FHRs, TREAT
 - Salt cross sections for MSR, FHR
 - Low temperature S(a,b) for space applications
 - Fundamental data for radiation damage
- Group ~10 members & usually hosts about 10 interns per year
- Applications:

<https://inl.gov/inl-initiatives/education/internships/>

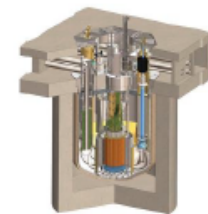
NEAMS
Nuclear Energy Advanced Modeling Simulation



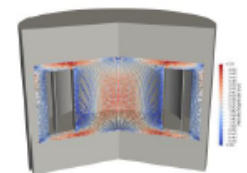
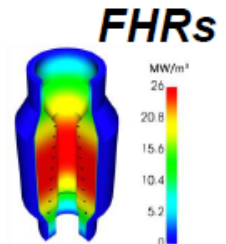
Advanced reactors



PBRs



LMFR



MSRs

IDAHO NATIONAL LABORATORY

Lawrence Berkeley National Laboratory (LBNL)

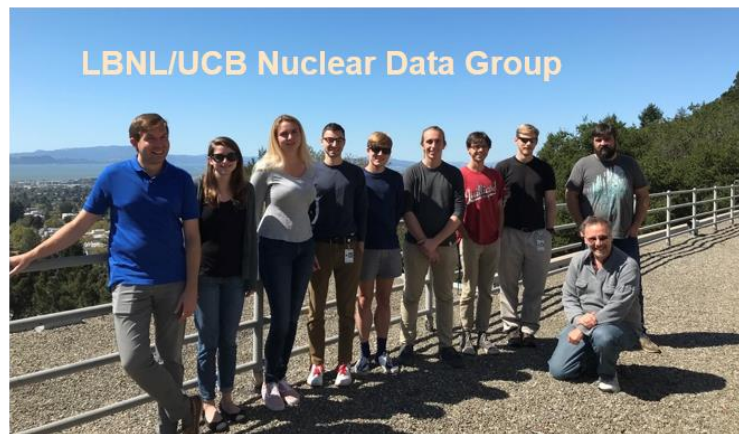
Nuclear Data Human Pipeline



BERKELEY LAB

Bringing Science Solutions to the World

LBNL works closely with the University of California campuses (especially UC Berkeley) to engage students and train the next generation of nuclear data experts



The **LBNL/UCB Nuclear Data Group** (led by Prof. Lee Bernstein) and the **Bay Area Neutron Group** (led by Dr. Bethany Goldblum) offer undergraduate apprenticeships, graduate student theses, and postdoctoral scholarships in nuclear data experiment and evaluation.



SULI

NSSC
NUCLEAR SCIENCE and SECURITY CONSORTIUM

berkeley
urap II
undergraduate research
apprentice program



Student Programs at Los Alamos National Laboratory (LANL)

- [Student Programs Office](#) *(several programs targeted to minority groups as well)*
- **DOE Programs**
 - NA22 Consortia (MTV, ETI, NSSC)
 - NNSA Stewardship Science Graduate Fellowship (SSGF)
 - Office of Science – Graduate Student Research Fellowship (SCGSR)
 - Predictive Science Academic Alliance Program (PSAAP)
- **Individual University Partnerships**
 - RPI, TUNL, FRIB/MSU, MIT, Central Michigan U., Texas A&M, UC Berkeley, U. Notre Dame, Ohio U., ... (and many more)
- **Schools**
 - [Computational Physics Summer Workshop](#)
 - [Parallel Computing Summer Research Internship](#)
 - [Keeping nonproliferation science summer program](#)
 - [Seaborg Institute](#)
 - *And many others not quite in nuclear data, but possibly related*

Questions? lanl-ndwg-committee@lanl.gov

Nuclear Data Pipeline at Sandia National Laboratories (SNL)

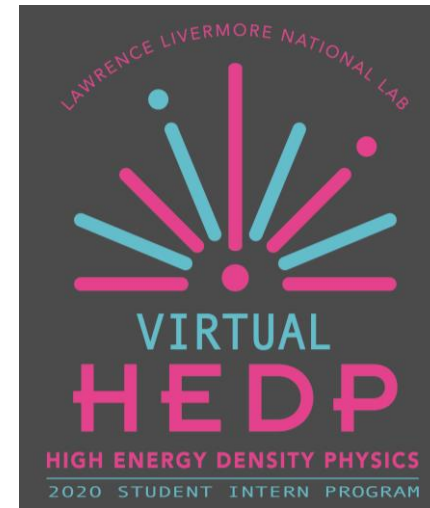
- University Engagement
 - **Sandia-supported Student Interns** ➔ **Fellowships & Post-Doc. appointments:**
 - **Fulltime & Summer Internship**
 - **Truman** Fellowship – named after President Harry S. Truman who created Sandia Labs
 - **Jill Hruby** Fellowship – named after a previous Lab Director and aimed to develop women in engineering and science fields who are interested in technical leadership careers in national security.
 - **New** REHEDS/ASAP Fellowship in radiation and electrical sciences – yet to be approved and named
 - **Academic Alliance Program** – on-campus managers to facilitate the universities' institutional partnerships with Sandia, serving as the universities' local interface to Sandia staff and leadership
 - **University Research Association** – 90+ university consortium
 - **S.T.A.R.T. HBCU program:** historically black colleges and universities
 - **Collaborations**, e.g.
 - Interaction of Ionizing Radiation with Matter University Research Alliance (**IIRM-URA**) – DTRA funded effort, led by Pennsylvania State University with thrust lead by Brigham Young University (BYU)
 - **COHERENT collaboration** on coherent elastic neutrino-nucleus scattering at SNS (80 members, 18 institutes in 4 countries)
- Funding for Research
 - **LDRD**, Laboratory Directed Research and Development
 - **Research Foundations** (\$59M/yr.)
 - **Mission Foundations** (\$61M/yr.)
 - **Strategic Initiatives** (\$66M/yr.)
 - **Programmatic** sources
 - **Product-specific** funding
- Examples of Programs that Support Research into Nuclear Data
 - LDRD: Research Foundation: Radiation, Electrical, and High Energy Density Science (REHEDS)
 - LDRD: Grand Challenges, e.g., **Light Speed GC** on explosive optical emissions
 - ~\$5M/yr. project Involving 4 universities; 10 FTE/yr. and \$900k/yr. of university support,
 - LDRD: Mission Campaigns, e.g., **ASAP** - Assured Survivability and Agility with Pulsed Power
 - ~\$25M-\$40M over 5-7 yr.
 - Programmatic: Radiation Effects Sciences, Nuclear Survivability Engineering Campaign (C7), NA-115
 - Programmatic: Z-pinch pulsed power approach to inertial confinement fusion (ICF)



Lawrence Livermore National Laboratory (LLNL) offers numerous internally sponsored programs to bring in students interested in nuclear science



- Students work in all areas related to nuclear data
 - Experiments, theory, evaluation, applications
- LLNL participates in all the previously mentioned federally sponsored programs
- Academic Cooperation Program (ACP)
 - Student is funded externally, but works closely with a lab mentor on a project
- Scholarships/Fellowships
 - Graduate Research Scholars Program
 - High Energy Density Physics Fellowship
 - Lawrence Fellowship
 - LLNL's distinguished postdoc
- Internships
 - High Energy Density Physics Summer Internship (HEDP)
 - Seaborg Nuclear Forensics Summer Internship
 - ROTC/MARA Internships
 - STAR
- Other ways to bring students to the lab
 - ACT-UP
 - Academic collaboration between LLNL scientists and a university
 - University Centers
 - Predictive Science Academic Alliance Program (PSAAP)
 - Stockpile Stewardship Academic Alliance program (SSAA)
 - Nuclear Science and Security Consortium (NSSC)
 - Direct funding from a project



<https://st.llnl.gov/opportunities/student-opportunities>



There are many improvements that can be made to the student pipeline into the laboratories

- Better tracking of students
 - Maintaining student connections after their internships
 - Potential future hires
 - Potential university connections
- Provide funding to the lab mentors
 - Many programs fund only the students and do not fund the mentor's time
 - Limits number of people willing to be mentors
- Mentor training
 - Improve the student's experience at the labs
 - Internships are more than just a research project
 - Students should be exposed to other work at the labs
 - General advice on being a scientist and obtaining positions in science
- Outreach
 - Get students interested in nuclear science
 - Community college events
 - K-12 science fairs, classroom visits, after school activities



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