



Consortium for Monitoring, Technology, and Verification (MTV) Accomplishments

2023 MTV Workshop
March 21, 2023

Prof. Sara A. Pozzi
University Diversity and Social Transformation Professor
Director, Consortium for Monitoring, Technology, and Verification
Director, Diversity, Equity, and Inclusion, College of Engineering
University of Michigan



Motivation and Mission

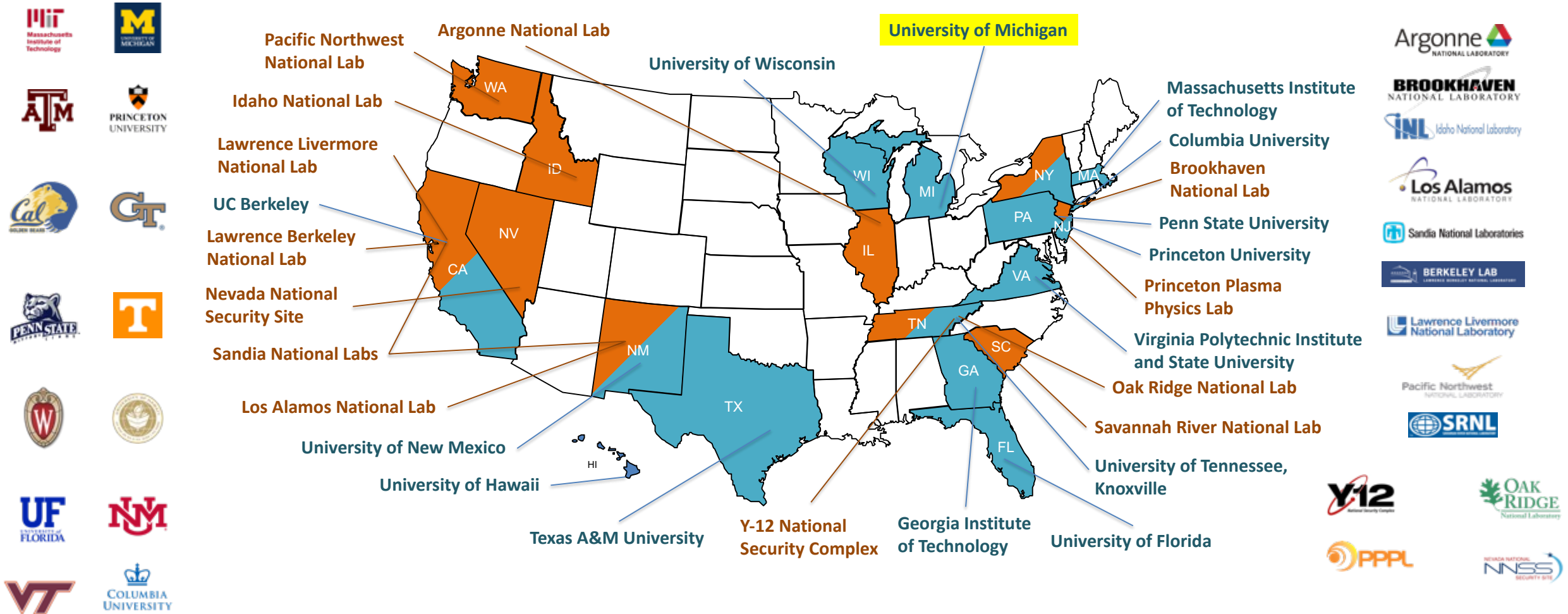
- Preventing the further spread of nuclear weapons and related technology is paramount to our national security
- Recent world events have significant impact on the nonproliferation landscape
 - North Korea nuclear weapons program and recent rocket tests
 - Possible revival of the Joint Comprehensive Plan of Action with Iran
 - Russia/Ukraine war putting nuclear facilities and nonproliferation at risk
- Timely detection of nuclear proliferation requires a deep understanding of the associated signatures and technology
- The NNSA Consortium mission is to develop new technologies that detect and deter nuclear proliferation activities and to train the next generation of nuclear professionals



Consortium for Monitoring, Technology, and Verification (MTV)

14 Universities

13 National Labs



MTV Timeline and Outcomes

Phase I: Startup

- Refined research directions
- Recruited talent for MTV fellowships
- Introduced fellows and associates to research activities
- Created collaborations with national laboratories

Year 1

Phase II: Develop

- Advanced nuclear nonproliferation technologies in 3 thrust areas
- Implemented student and faculty participating in research onsite at national laboratories

Year 2

Phase III: Apply

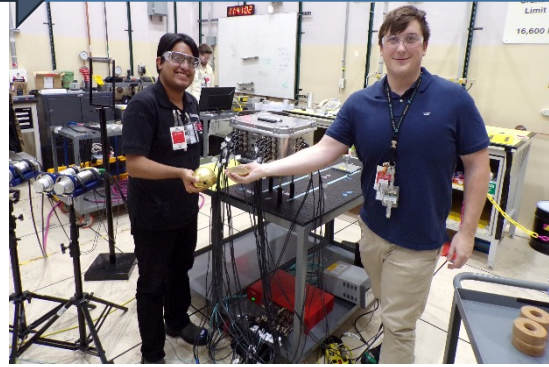
- Conducting experiments and simulations for each thrust area
- Implementing and awarding new fellowships
- Developing new and improving existing courses
- Hosting outreach and recruiting events

Year 4

Phase IV: Transition

- MTV graduates are transitioned into career positions
- Technology is transitioned to national labs, industry, and academia
- Results are published in peer-reviewed journal publications and at conferences

Year 5 and on

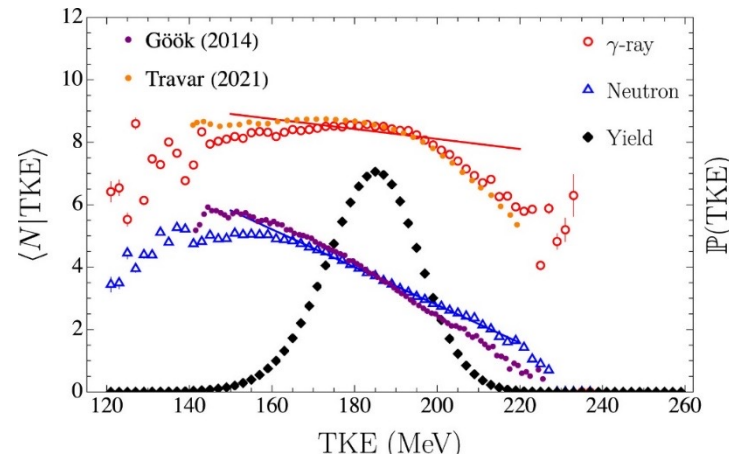
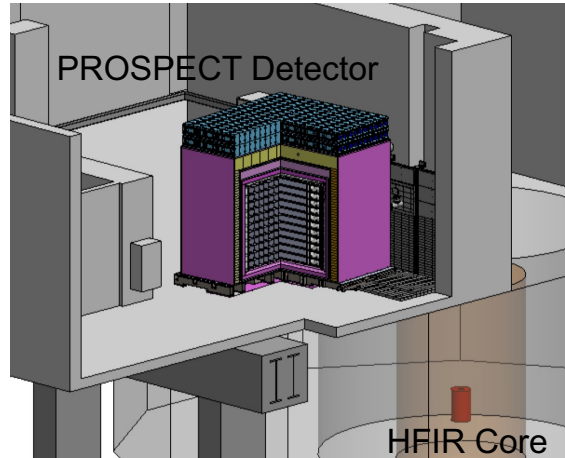
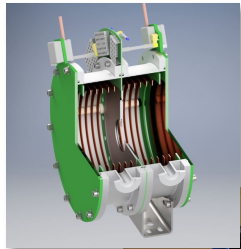


Research Highlight: Neutrino and Fission Physics

- We are measuring the dependence of the fragments' angular momenta on the excitation energy of the fissioning system
- Collaboration with Argonne National Laboratory
- The results of these experiments will be used to improve models of fission



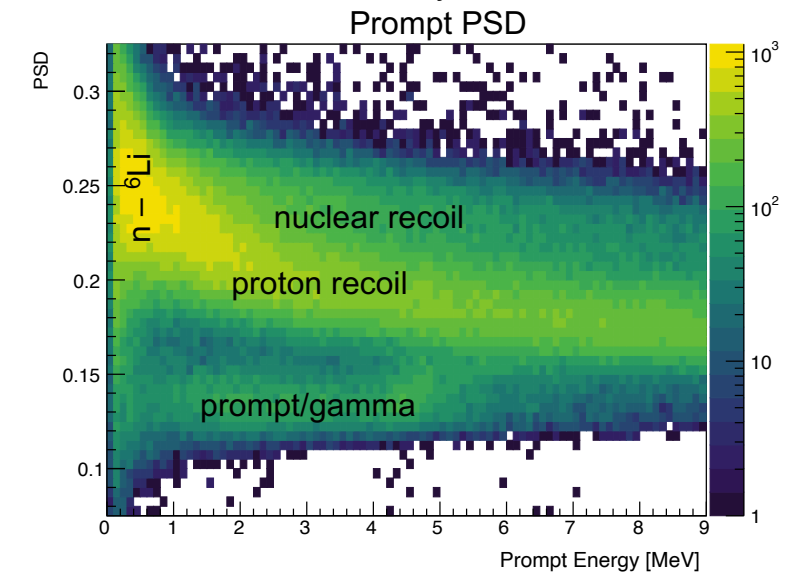
Stefano Marin, Nathan Giha, Sara Pozzi
University of Michigan



- We are analyzing antineutrino data from the PROSPECT detector at the High Flux Isotope Reactor
- Precise measurement of reactor flux will demonstrate this technology towards commercial reactor monitoring



Paige Kunkle, David Campbell
Boston University

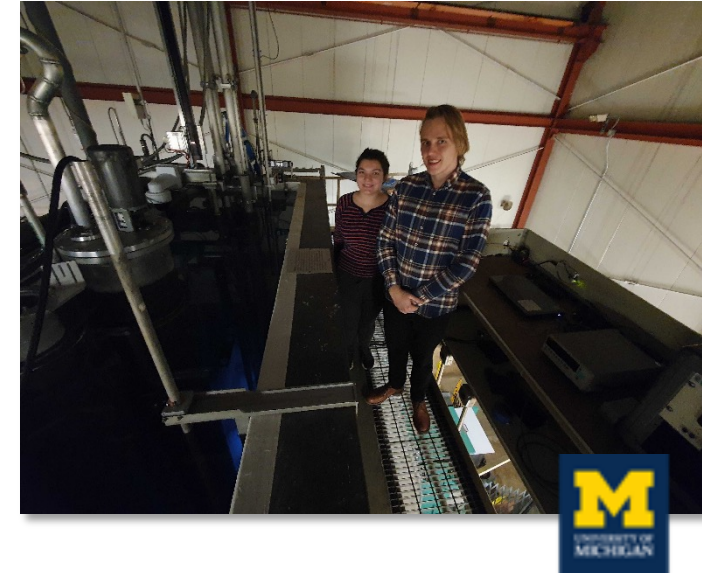


Research Highlight: Reactor Experiments

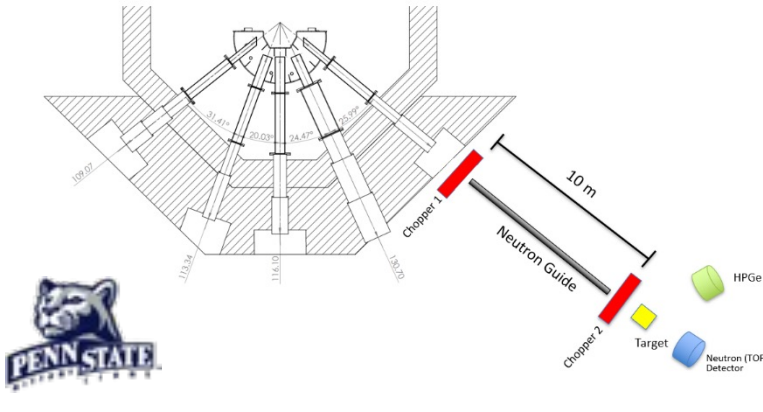
- Conducted new experiments for nuclear reactor monitoring and forensics signature discovery
 - beam characterization at the OSU Reactor Measurements
 - UM neutron noise measurements at the CROCUS Reactor at EPFL, Switzerland
 - Sample irradiation at Missouri University Research Reactor for MCNP6.2 model validation
 - Epithermal neutron chopper designed for the Breazeale Reactor at PSU to perform neutron activation analysis
- We are developing better ways to monitor the power levels of a nuclear reactor, analyze materials in the fuel cycle, and detect radioactive emissions



UF
UNIVERSITY OF
FLORIDA



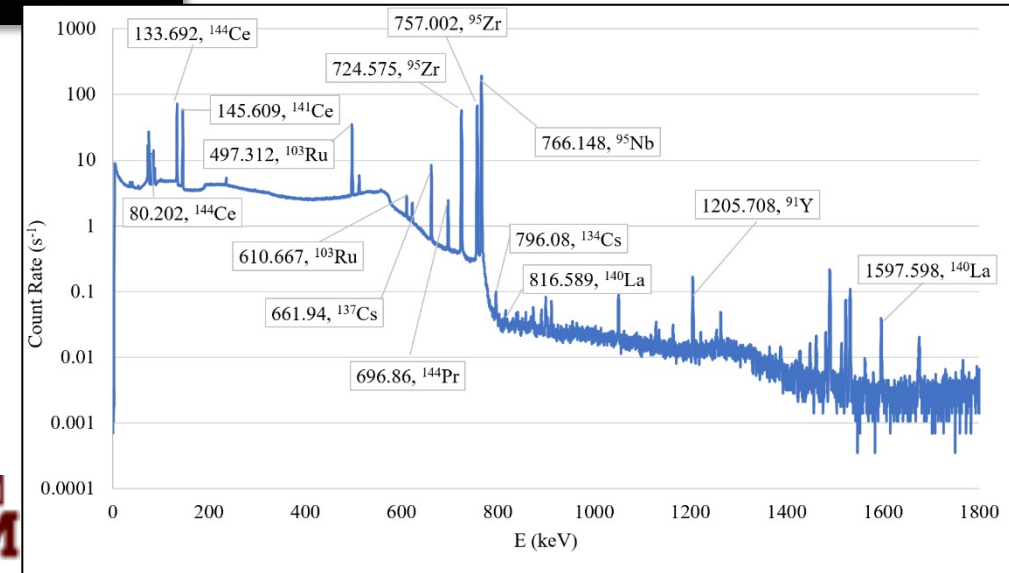
M
UNIVERSITY OF
MICHIGAN



PENN STATE
UNIVERSITY



ATM

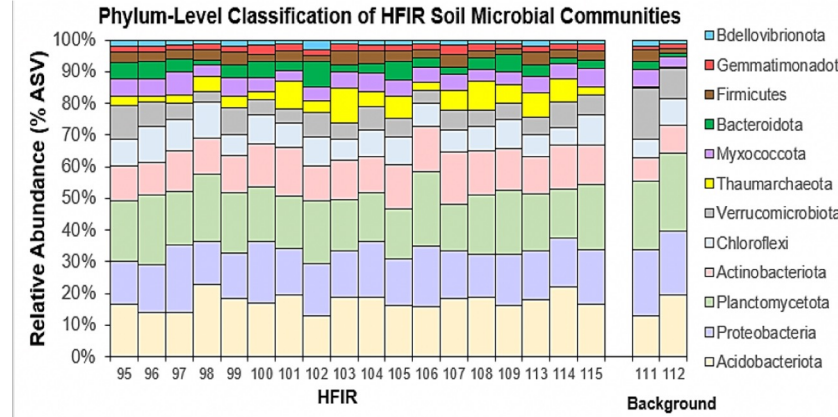


NNSA
National Nuclear Security Administration

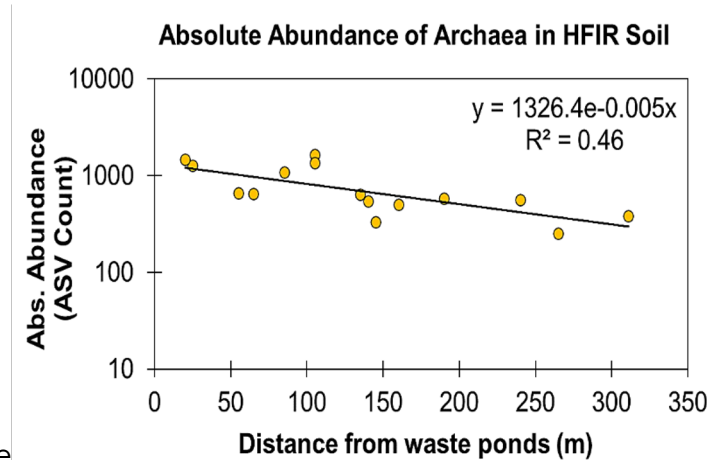
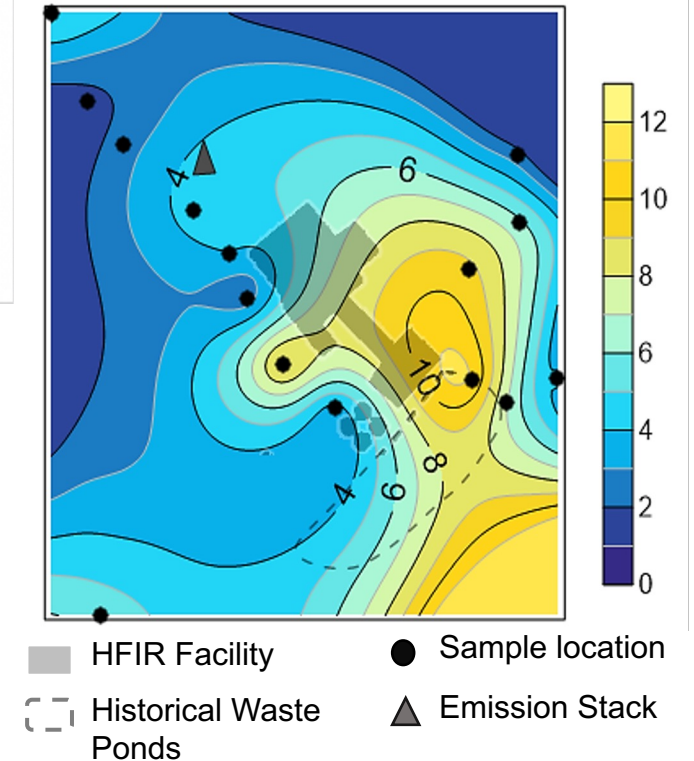
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Research Highlight: Microbial biosensors for detection of nuclear proliferation

- Environmental sampling is important for monitoring and detecting proliferation-sensitive nuclear activities
- This work explores microbial community dynamics in environments exposed to proliferation-sensitive fuel cycle activities to inform remote detection and monitoring technologies



Thaumarchaeota Relative Abundance (%)



Isis Fukai



Kurt Ash

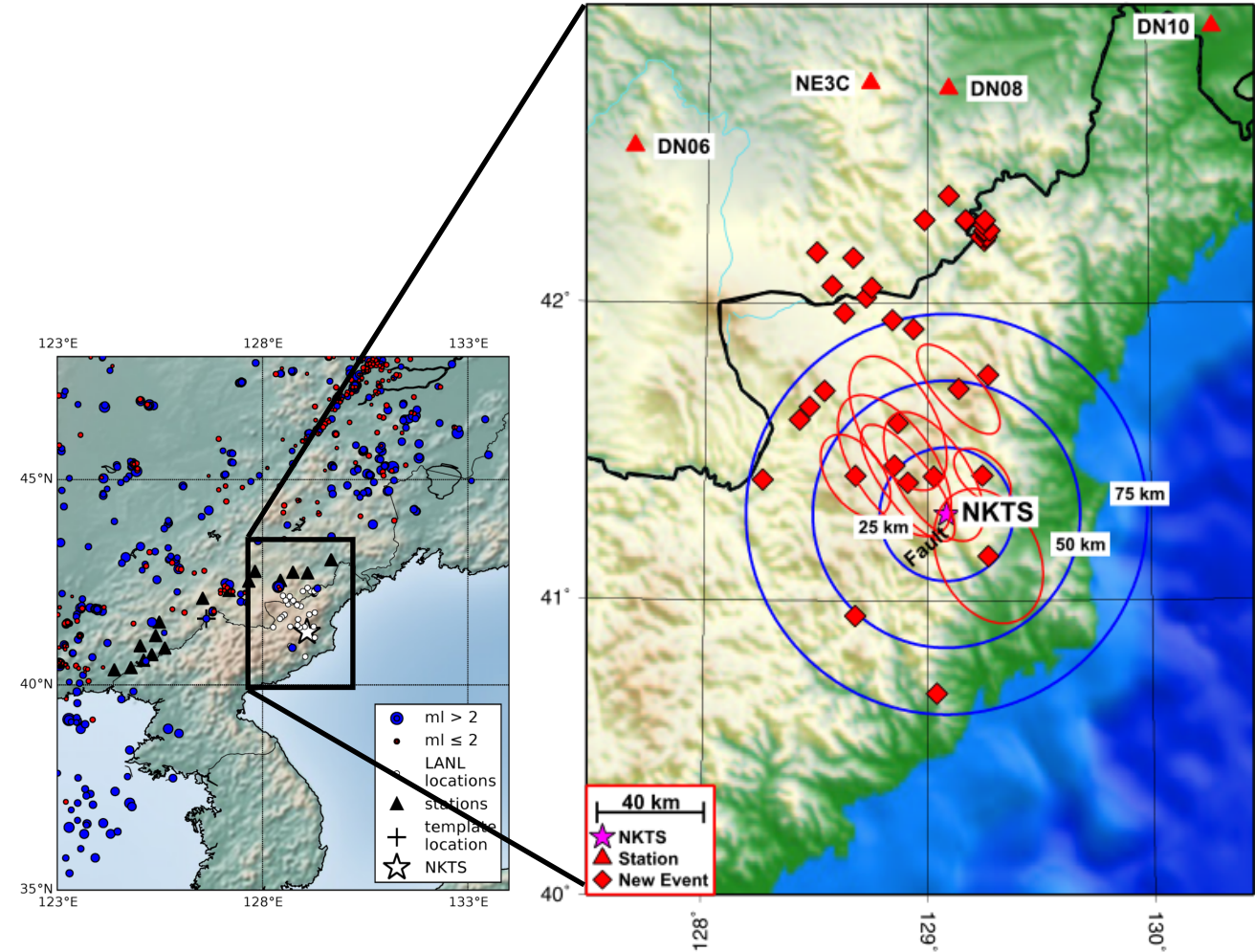
University of Tennessee, Knoxville

Research Highlight: Background Seismicity near the DPRK Test Site

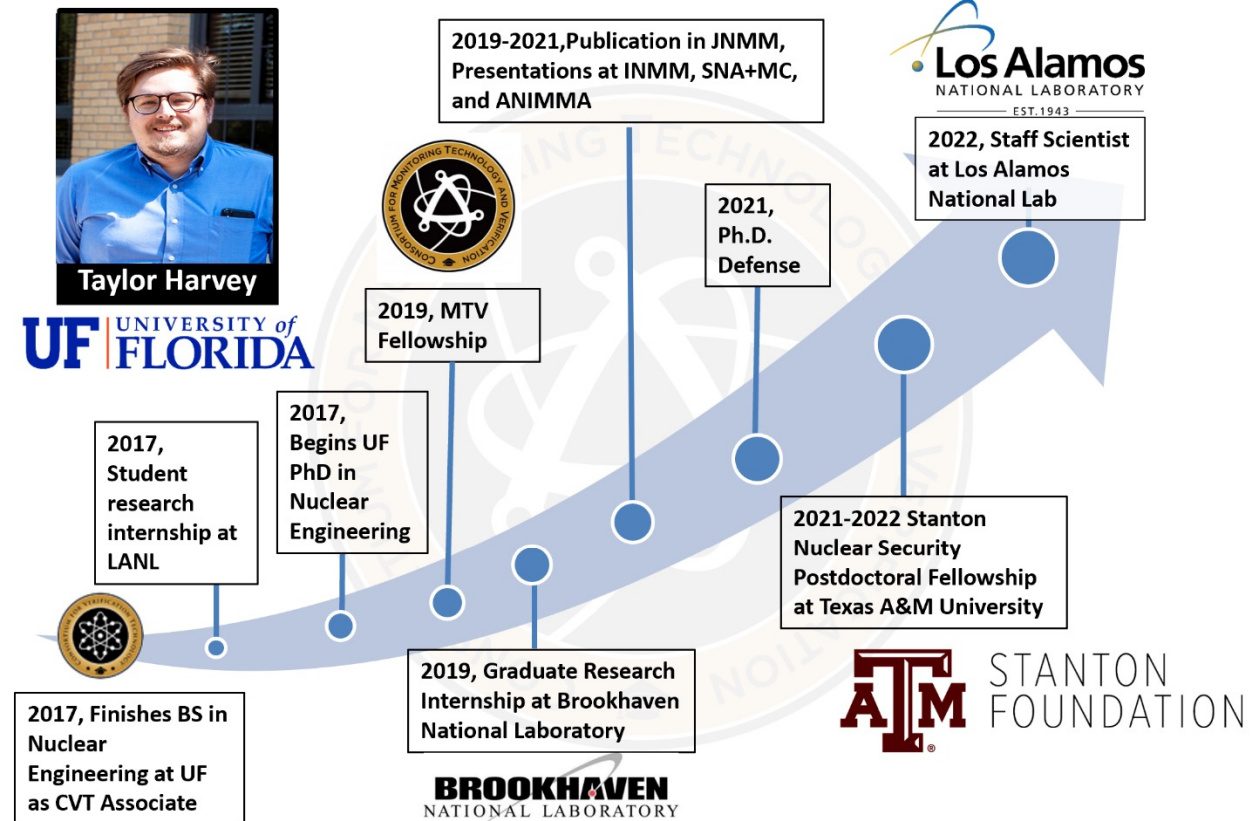
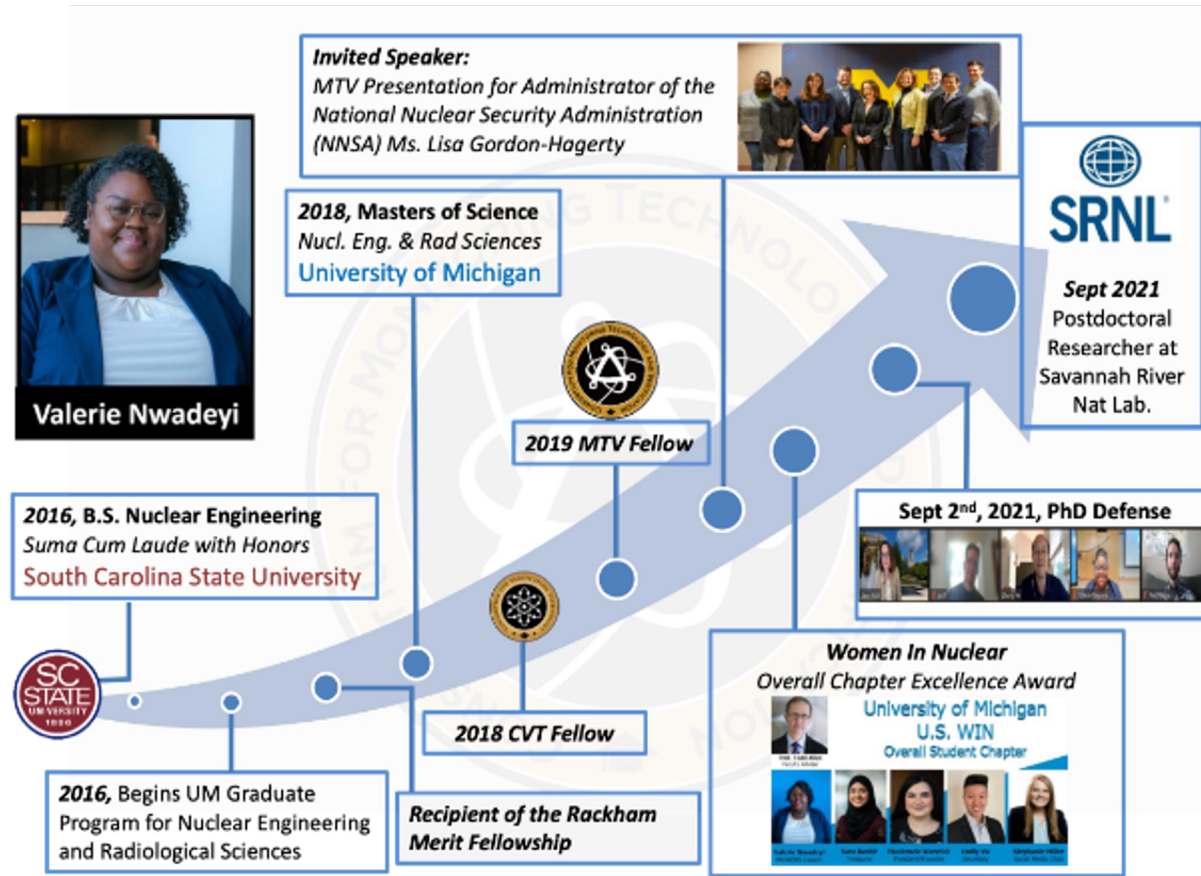
- Use of historic Dongbei sensor network data to better understand background seismicity around the North Korea test site
- Background characterization improves our capability to monitor, understand, detect, locate, and characterize an explosion



Won-Young Kim, Paul Richards
Columbia University



University of Michigan Consortia Student Advancement Models



MTV Students: 133 Degrees Earned as of December 2022



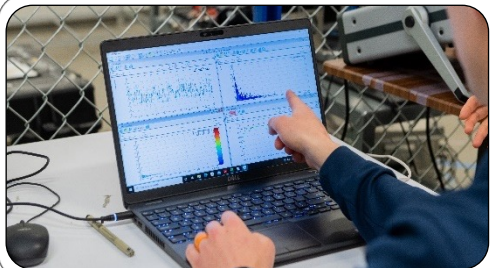
Ph. D. and Postdoc

27



Masters Degrees

35



Undergraduate Degrees

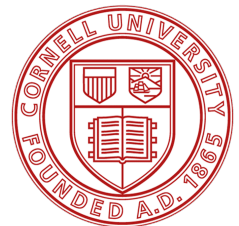
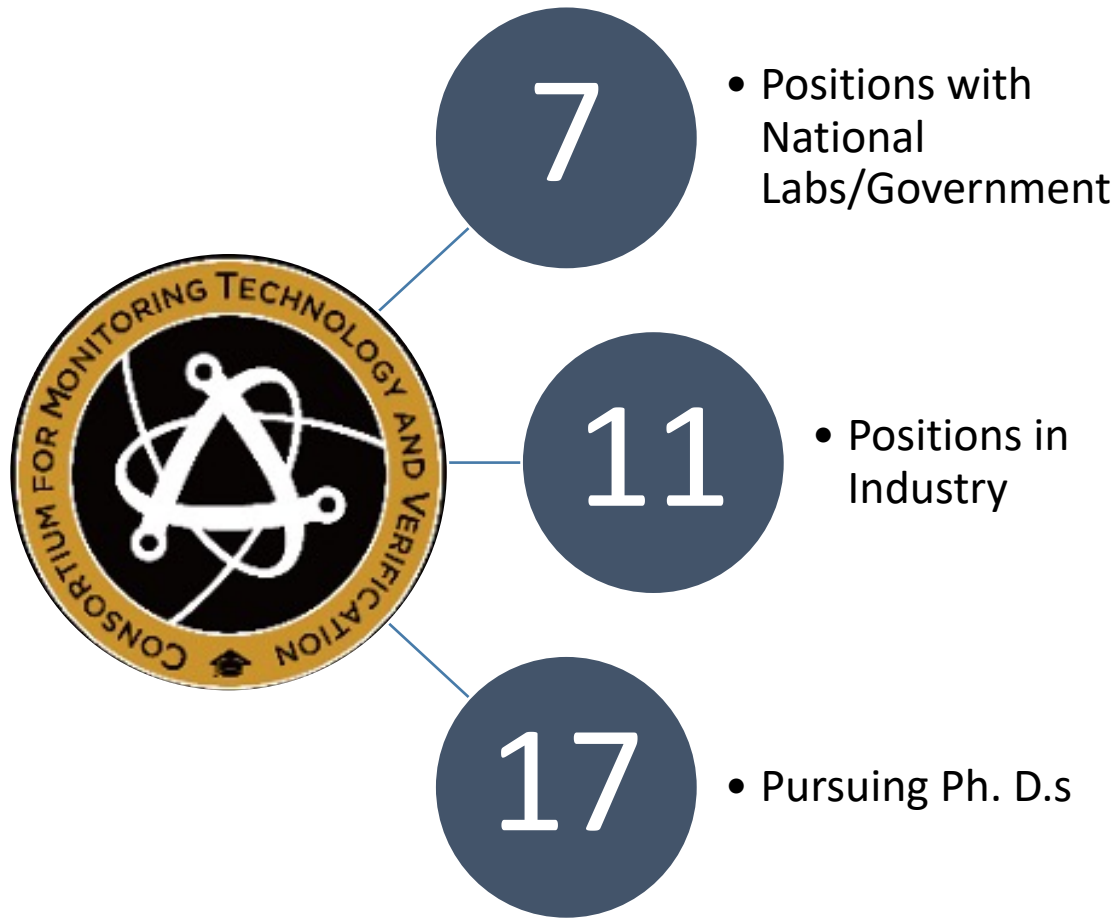
71

Consortium for Monitoring, Technology, and Verification (MTV)

Launching Careers: 28 Ph. D.s and Postdocs Graduated and Transitioned



35 MTV Masters Students: Graduated and Transitioned



MTV-Developed Courses

- Penn State University, Prof. Flaska, NucE450: Radiation Detection and Measurement. Students: 45
- Princeton University, Prof. Glaser, MAE 518: Virtual and Augmented Reality (VR/AR) for Scientists, Engineers, and Architects. Students: 36
- Texas A&M University, Prof. Chirayath, NUEN-651: Nuclear Fuel Cycles and Nuclear Material Safeguards. Students: 22
- University of Michigan, Prof. Pozzi, NERS 532: Nuclear Safeguards (collaboration with Oak Ridge National Laboratory). Students: 13
- University of Michigan, Prof. Pozzi, NERS 590-3: New Scintillators (collaboration with Oak Ridge National Laboratory). Students: 9



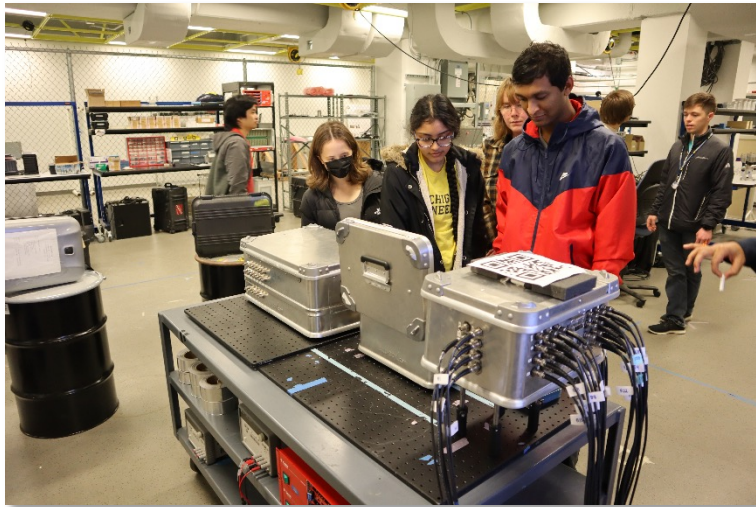
Education and Workshops

- MTV Annual Workshops: 525+ attendees since 2020
- MCNP / MCNPX-PoliMi Workshop: 63 participants since 2020
- UK-US Academic Network in Nuclear Security and Nonproliferation Skills Workshop 2021 (virtual): 27 lectures from 3 Consortia
- Nuclear Engineering Summer School (NESS): 700+ Attendees in 3 Years and lecturers from MTV students, faculty, and national lab affiliates



Early Engagement and Outreach

- Lab tours for elementary, junior high, and high school students
- Undergraduate research fellowships
- Do-it-yourself Geiger counter for radiation detection with high-school students
- UM-UNM Summer Research Experience



MTV Diversity and Excellence Fellows

The Consortium for Monitoring, Technology, and Verification (MTV) and Michigan Engineering (ME) recently created the MTV-ME Fellowship for Excellence and Diversity for undergraduate and graduate students.



Prabhjot Kaur



Ricardo Lopez



Tessa Maurer

MTV Diversity and Excellence Fellows awarded in Fall 2022

Current call for MTV Diversity and Excellence Fellows:



MTV Doctoral Fellows in Applied Antineutrino Physics

Graduated Fellows

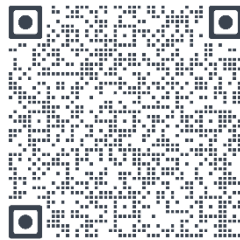


Connor Awe
Duke University
2019 Fellow
Experimental Physicist,
SRI International



Kristofer Ogren
University of Michigan
2019 Fellow
Postdoc,
Los Alamos National Lab

Current MTV Doctoral
Fellow in Applied
Antineutrino Physics Call:



Current Fellows



Edward Callaghan
UC, Berkeley
2019 Fellow



Matthew Lee
Texas A&M
University
2021 Fellow



Paige Kunkle
Boston University
2022 Fellow



Tyler Johnson
Duke University
2019 Fellow

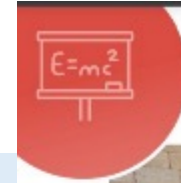


Garrett Wendel
Penn State
University
2021 Fellow



Ryan Bouabid
Duke University
2022 Fellow

Publications: September 2019 - December 2022



Education



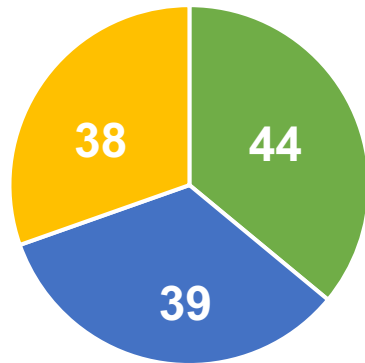
Professor Sara Pozzi with students and researchers in the UM Detection for Nuclear Nonproliferation Group lab. (Photo: Daryl Marshke, University of Michigan)

The MTV at the cutting edge of nonproliferation technology

NuclearNews Article, ANS, July 2022:

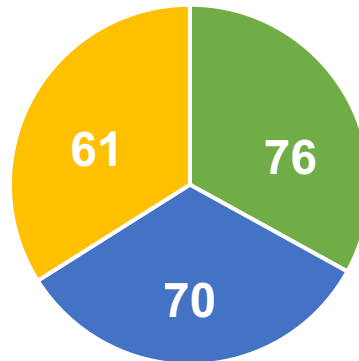


121
Peer-reviewed Journals



■ TA1 ■ TA2 ■ TA3

207
Conference Papers



■ TA1 ■ TA2 ■ TA3



NNSA
National Nuclear Security Administration



Website, Social Media, and Engagement with Public

MTV Website:

www.mtv.engin@umich.edu

- a. Website Traffic: over 34,000 sessions by 19,500 users since 2019

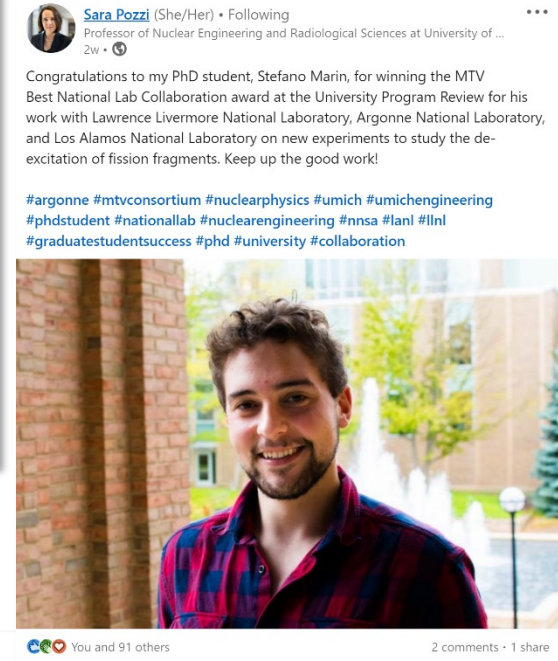
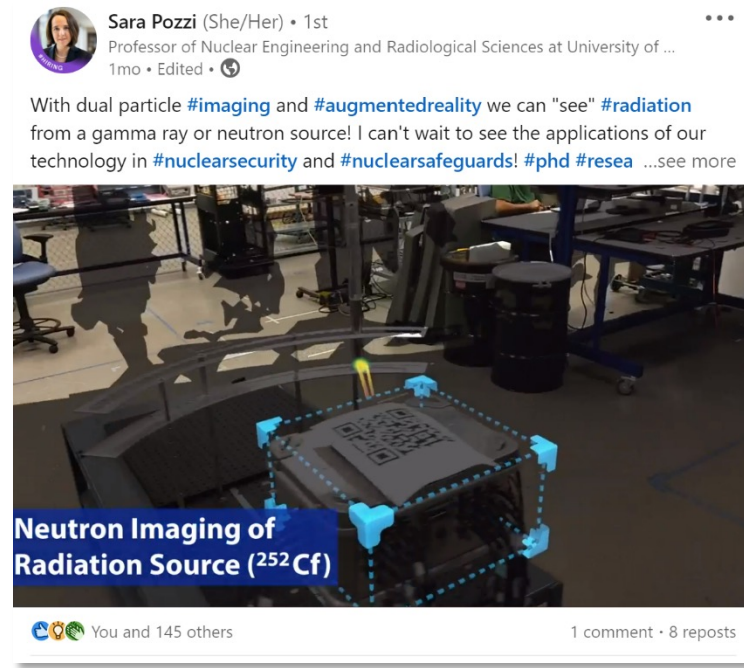
Thousands of views generated by social media:

- LinkedIn: <https://www.linkedin.com/in/sara-pozzi-a98ab813/>
- Twitter: @NNSA_MTV
- Facebook: @NNSA.MTV
- YouTube: [MTV Consortium, 133 videos available](#)

Invited talks: 129

Interactions with press: 28

Interactions with public: 118



MTV Consortium @NNSA_MTV · Dec 16, 2022

2023 is just around the corner. With the new year comes new opportunities. Be sure to check out current positions and fellowships offered at MTV schools and our national lab collaborators: mtv.engin.umich.edu/opportunities/ ✓ #ners #glowblue #nuclearsecurity



NNSA
National Nuclear Security Administration



MTV Hosted University Program Review (UPR) in June 2022

- UPR hosted in-person meeting June 7-9, 2022, in Ann Arbor, MI
- Three DNN R&D-funded consortia welcomed
- 273 participants
- 54 oral research presentations
- 70 posters
- Three MTV students awarded best presentation awards:
 - Best National Lab Collaboration: Stefano Marin, University of Michigan
 - Best Oral Talk: Kelly Truax, University of Hawai'i at Manoa
 - Best Poster Presentation: Eric Lepowsky, Princeton University



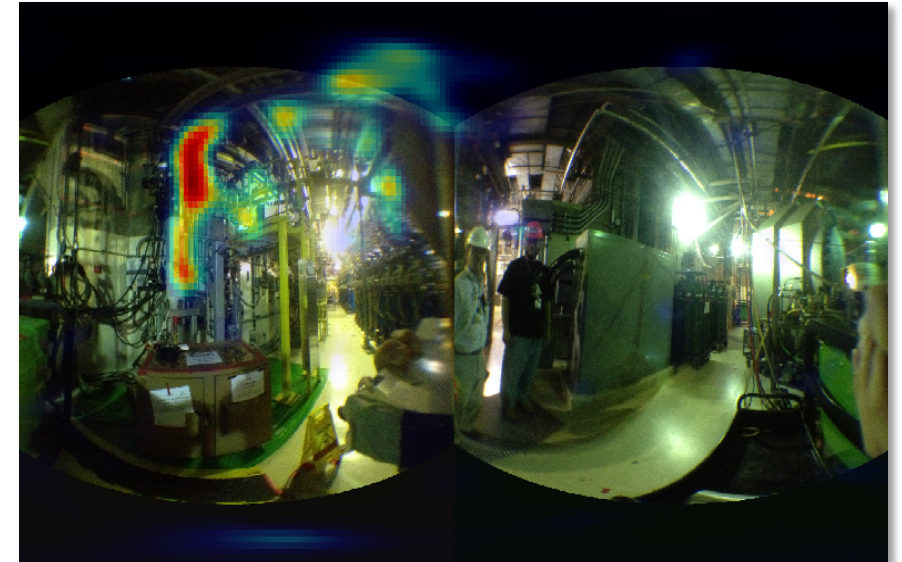
MTV Welcomed Administrator Hruby

- Under Secretary for Nuclear Security and NNSA Administrator Jill Hruby visited the University of Michigan (UM) September 2022
- Presented "U.S. Nuclear Security: The Need to be Responsive and Responsible"
- Awarded the Nuclear Science Week 2022 Nuclear Lifetime Achievement Award
- Visited UM Nuclear Engineering and Radiological Sciences Labs



MTV Impact

- Trained next-generation workforce
- Extended the understanding of ^{252}Cf spontaneous fission to improve fission codes
- Improved reliability of nuclear reactor monitoring for existing and proposed reactors through reactor experiments at several sites
- Refined our ability to detect fuel cycles via analysis of biological samples
- Improved our capability to detect, locate, and characterize nuclear explosions through analysis of seismic data from the Dongbei sensor network





The Consortium for Monitoring, Technology, and Verification would like to thank the DOE-NNSA for the continued support of these research activities.

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