Consortium for Monitoring, Technology, and Verification Newsletter, 2022

PROF. SARA A. POZZI Director, Consortium for Monitoring, Technology, and Verification MTV.engin.umich.edu











MTV Leadership

MTV Motivation and Mission

- Preventing the spread of nuclear weapons and related technology is paramount to our national security
- Timely detection of nuclear proliferation requires a deep understanding of the associated signatures and technology to detect them
- The MTV's mission is to develop new technologies that detect and deter nuclear proliferation activities and to train the next generation of nuclear professionals

Executive Leadership



Prof. Sara Pozzi Director University of Michigan



Dr. Mona Dreicer Lawrence Livermore National Laboratory

External Advisory Board



Prof. David Wehe Chief Scientist University of Michigan



Dr. Richard Kouzes Pacific Northwest National Laboratory



Prof. Igor Jovanovic Assoc. Dir. for Natl. Labs University of Michigan



Dr. Nancy Jo Nicholas Los Alamos National Laboratory



Dr. Shaun Clarke Associate Director University of Michigan



Dr. Vladimir Protopopescu Oak Ridge National Laboratory



Ms. Courtney Wagoner Project Manager University of Michigan



Dr. James Tiedje Michigan State University

National Laboratory Partners



THRUST AREA 1 FUNDAMENTALS OF

NUCLEAR AND PARTICLE PHYSICS



Prof. Igor Jovanovic Thrust Area 1 Lead University of Michigan

Reaction Theory and Modeling S. Pozzi, U Michigan C. Perfetti, New Mexico

Novel Imaging Techniques Z. He, U Michigan D. Wehe, U Michigan A. Hecht, New Mexico

Antineutrino-Based Methods A. Erickson, Ga Tech P. Huber, Va Tech. J. Learned, Hawaii I. Jovanovic, U Michigan

THRUST AREA 2

SIGNALS AND SOURCE TERMS FOR NUCLEAR NONPROLIFERATION



Prof. Steven Biegalski Thrust Area 2 Lead Georgia Institute of Technology

Isotopic Science S. Biegalski, Ga Tech. A. Danagoulian, MIT M. Flaska, Penn St. U

Spatial/Temporal Spectroscopic Analysis I. Jovanovic, U Michigan

> In Situ Natural Monitoring (biota) T. Hazen, UTK E. Alm, MIT A. Arkin, Berkelev H. Dulai, Hawaii

Nuclear Fuel Cycle Process Modeling P. Wilson, Wisconsin S. Chirayath, TAMU A. Glaser, Princeton

B. Kiedrowski, U Michigan A Prinja, UNM

Radiation Transport

Infrasound M. Garces, Hawaii

> G. Ekstrom, Columbia P. Richards, Columbia W-Y. Kim, Columbia

Wide Area Environmental Sampling K. Hartig, Florida

University of Hawaii Radiation Background Monitoring

Seismology

THRUST AREA 3

NUCLEAR

EXPLOSION

MONITORING

Dr. Milton Garces

Thrust Area 3 Lead

Methodologies for

K. Kearfott, U Michigan

Environmental Fate and Transport of Radionuclides A. Enqvist, Florida

Radionuclide S. Pozzi, U Michigan

CROSS CUTTING THRUSTS

MODELING AND SIMULATION Prof. Brian Kiedrowski University of Michigan

NUCLEAR POLICY Prof. Paul Wilson University of Wisconsin EDUCATION AND OUTREACH Prof. Kimberlee Kearfott University of Michigan



Awards & Accomplishments

INMM Vincent J. DeVito Distinguished Service Award

Prof. Sara Pozzi, MTV Consortium Director and professor in the U-M Department of Nuclear Engineering & Radiological Sciences (NERS), was recently awarded the Vincent J. DeVito Distinguished Service Award during the Institute of Nuclear Materials Management (INMM) Annual Meeting. The award is named for the Institute's long-time Secretary.

Pozzi was recognized for her long-term and noteworthy contributions to nuclear materials measurement, monitoring and verification, training, and research in nuclear engineering and radiological sciences.



Among Pozzi's many contributions to safeguards, she developed new techniques for neutron measurements that are being adopted by the International Atomic Energy Agency (IAEA) for nuclear safeguards applications. She is a co-developer of the MCNPX-PoliMi, a Monte-Carlo code for correlation measurements, now being used in over 50 institutions worldwide.

Nuclear Nonproliferation International Safeguards Fellowship

Londrea Garrett, Ph. D. student at the University of Michigan, was awarded the Nuclear Nonproliferation International Safeguards Fellowship. This fellowship is given to graduate students whose dissertation work is relevant to the field of international safeguards and could be used to promote the IAEA's initiatives. The fellowhsip will allow Garrett to partner directly with an external facility, such as one of the national laboratories to help foster a working relationship with current experts in the field and provide additional resources.



Garrett was offered the fellowship based on her proposal to study how optical spectroscopy techniques like laser-induced breakdown spectroscopy could be used to characterize powder samples such as what would be found in reprocessed nuclear fuels.

Fellow of the American Nuclear Society

Igor Jovanovic, a professor within the U-M Department of Nuclear Engineering and Radiological Sciences (NERS) and the Applied Physics Program, has been named a Fellow of the American Nuclear Society (ANS).

The honored membership grade of Fellow is awarded to ANS members for outstanding accomplishment in any one of the areas of nuclear science and engineering. The honor of receiving the highest membership grade of the Society is reserved for senior members of good reputation who have compiled a professional record of experience marked by significant contribution to the advancement of one or more of the various disciplines served by the society.



Jovanovic was recognized by the ANS for contributions made to the advancement of nuclear science and technology through notable original research or invention in the nuclear field.

Winner of MedPhysSlam Preliminary Competition of the Great Lakes Chapter of American Association of Physicist in Medicine

Congratulations to recent Ph. D. graduate, Noora Ba Sunbul, for winning the MedPhysSlam Preliminary Competition of the Great Lakes Chapter of American Association of Physicists in Medicine! She will be presenting at the upcoming AAPM Conference, and we are very excited for all the progress she has made on characterizing dose fields for radiation therapy.

Noora enrolled as a fellow in 2018. Since then she has participated and attended the MTV annual workshops. Her research studies includes full commissioning and characterization of a research linac





for its implementation as an animal

research irradiator in addition to its active interrogation applicability for nonproliferation and detection of special nuclear materials. The other part of Noora's work involves the investigation of a 3D real time detection techniques known as ionizing radiation acoustic imaging and 3D gel dosimetry for implementation in radiation therapy dosimetry.

Awards & Accomplishments 2022 MTV Hybrid Workshop: March 22-23, 2022

The Consortium for Monitoring, Technology, and Verification (MTV) held a successful hybrid annual workshop on March 22–23, 2022 in Ann Arbor, MI. Activities included presentations consisting of 26 oral presentations and 39 posters. The workshop was hosted in-person at the Michigan League on the University of Michigan's campus and via Zoom; this hybrid format allowed for 157 attendees from 18 universities, 10 national laboratories, and the government.

Full meeting details, including an interactive agenda and links to presenter materials, can be found on the event link at: <u>https://mtv.engin.umich.edu/events/2022-mtv-workshop/</u>





Three panels were held during the two-day event: Consortium Alumni, Consortium Fellows, and National Lab Partnerships. During these panels, a total of 15 panelists from academia and the national laboratories shared their experiences within the MTV consortium and fielded questions from the audience, both virtual and in-person.

Consortium Alumni Panel

Cameron Miller, Department of Homeland Security; Jason Nattress, Oak Ridge National Lab; Valerie Nwadeyi, Savannah River National Lab; Ciara Sivels, Johns Hopkins University Applied Physics Lab; Felicia Sutanto, Lawrence Livermore National Lab

Consortium Fellows Panel

Lauren Finney, University of Michigan; Isabel Hernandez, University of Michigan; Tyler Johnson, Duke University; Kris Ogren, Los Alamos National Laboratory/University of Michigan; Kelly Truax, University of Hawaiʻi

National Lab Partnership Panel

Milton Garces, University of Hawaiʻi; Adam Hecht, University of New Mexico; Jesson Hutchinson, Los Alamos National Lab; Meghan McGarry, Lawrence Livermore National Lab; Scott Thompson, Idaho National Lab.

AWARDS

Best Oral Presentations

Emily Kwapis, University of Florida, Ph. D. Advisor: Kyle Hartig, "Spatial structure and expansion dynamics of laser-produced cerium plasmas"

Eric Lepowsky, Princeton University, Ph. D. Advisor: Alexander Glaser, "N-SpecDir Bot: A neutron-detecting, spectrally- and directionally-sensitive robot for nuclear verification"



Best Poster Presentations

Tyler Johnson, Duke University, Ph. D. Advisor: Phillip Barbeau, "Neutrino-induced nuclear reactions at the spallation neutron source"

Oskar Searfus, University of Michigan, Ph. D. Advisor: Igor Jovanovic, "Detection of prompt photofission neutrons from U-238 with a He-4 scintillation detector"



Awards & Accomplishments

INMM/ESARDA J.D. Williams Student Paper Award from the Cyber & Emerging Threats Committee

In 2003 the Student Award was officially named the J. D. Williams Student Paper Award to honor the memory of James D. Williams, INMM President in 2001-2002, for his energetic backing of young professionals and tireless support of the INMM to stimulate interest in, respect for, and proliferation of nuclear materials management principles. Tracking of Individual TRISO-fueled Pebbles through the Application of X-ray Imaging with Deep Metric Learning by Emily Kwapis, University of Florida

Society for Applied Spectroscopy (SAS) Atomic Section Student Award

The 2022 SAS Atomic Section Student Award, recognizes undergraduate and graduate student members who have excelled in the area of Atomic Spectroscopy. These students will present their work as part of the Atomic Section program at SciX 2022. University of Florida Ph. D. student Emily Kwapis was awarded for her research and will be presenting her talk "Spectroscopic Signatures and Ovidation Characteristics of Lagar produced Carium Diagnas" in Octob



Oxidation Characteristics of Laser-produced Cerium Plasmas" in October at SciX 2022.

Emily Kwapis is a Ph. D. student in Nuclear Engineering at the University of Florida where her research focuses on improving nuclear forensic capabilities and preventing the proliferation of nuclear weapons. She works in the Optical Science and Nonproliferation Laboratory studying the physical and chemical properties of plutonium nuclear fireballs through the use of laser-produced plasma surrogates. The work consists of experimental and computational components including optical spectroscopy methods, Multiphysics codes, and machine learning techniques. Ms. Kwapis earned her B.S.E in Nuclear Engineering from the University of Michigan in 2019 along with a minor in Electrical Engineering.

Patent Awarded!

Inventors: Sara Pozzi, Shaun Clarke, Marek Flaska, Angela Di Fulvio Patent No. 11,181,648, scintellator-based neutron and gamma-ray dosimeter, Issued on November 23, 2021.



IEEE NPSS Glenn F. Knoll Graduate Education Award

Stefano Marin, a Ph. D candidate at the University of Michigan received the IEEE NPSS Glenn F. Knoll Graduate Education award for outstanding graduate students in the field of nuclear science instrumentation, medical instrumentation, or instrumentation for security applications. The grant is intended to support travel and attendance to conferences, workshops or summer schools, or special research projects.

Stefano collaborates with other students and researchers at the University of Michigan and at national laboratories on advancing



knowledge of the nuclear fission process. Specifically, he focuses on the correlations between the neutrons and gamma rays emitted immediately following fission, which are of great importance to nonproliferation applications and can reveal previously unknown physics of the fission process.

INL's University Nuclear Leadership Program (UNLP) Scholarship



Andrew Panter, an undergraduate student in the U-M Department of Nuclear Engineering & Radiological Sciences has been awarded a scholarship of \$10,000 through the University Nuclear Leadership Program (UNLP). The scholarship through UNLP is to empower and support the next generation of leaders whose innovative nuclear research would help achieve the President's ambitious climate goals of 100% clean electricity by 2035, and net-zero carbon emissions by 2050. "I feel incredibly honored to receive this award. The NERS program has been a whirlwind for the past three years," Panter said, "with all the opportunities I have been afforded and wonderful peers and faculty I have met. I am proud to represent the University of

Michigan's commitment to academic excellence through this program."

IEEE NPSS Graduate Scholarship Award

The IEEE NPSS Graduate Scholarship award recognizes contributions to the fields of nuclear and plasma science by a graduate student. The award comes with a check for \$1500, a certificate, and one year's paid membership in NPSS.

Abbas earned his M.S. in Nuclear Engineering from Purdue University in 2018. He is currently pursuing his Ph. D. in the Department of Nuclear Engineering and Radiological Sciences at the University of Michigan. His research interest includes active interrogation techniques for nuclear nonproliferation applications, radiography, neutron die-away techniques, applications of linear accelerators and machine learning techniques for nuclear muclear material detections.



Doctoral Fellowships in Applied Antineutrino Physics

The Consortium for Monitoring, Technology, and Verification (MTV) supports emerging research needs in the area of antineutrino physics applied to nuclear nonproliferation. The emission of antineutrinos from beta decay is a signature that may be harnessed to enable significant new capabilities for nonproliferation. Antineutrino emission rates are directly proportional to reactor power and methods have been developed showing promise for reactor monitoring and discovery. Similar methods could benefit applications such as spent fuel monitoring and even nuclear explosion detection. We are exploring advanced antineutrino detection technology and applications that present opportunities for transformational advances in our ability to detect proliferation activities.

To support these efforts, doctoral student fellowships are being awarded through a competitive process. US citizens or permanent resident students from academic institutions, both inside and outside of the MTV, may apply. Fellows are selected for continuous funding, renewable each year, pending satisfactory performance.

For more information, visit the MTV website at: https://mtv.engin.umich.edu/doctoral-fellowships-in-applied-antineutrino-physics/



Past and Current OVS Antineutrino Fellows



Connor Awe Duke University Fellow: 2019 - 2021 Experimental Physicist, SRI International: 2021 - Present



Edward Callaghan UC, Berkeley Fellow: 2019 - Present



Tyler Johnson Duke University Fellow: 2019 - Present



Paige Kunkle Boston University Fellow: 2022 - Present



Matthew Lee Texas A&M University Fellow: 2021 - Present



Kristofer Ogren University of Michigan Fellow: 2019 - 2021 Postdoc, Los Alamos National Laboratory: 2021- Present



Garrett Wendel Penn State University Fellow: 2021 - Present

MTV is currently accepting applications for 2022 fellowships!

Visit us online at MTV.engin.umich.edu to submit your application.

RESEARCH Experimental Activities during Year 3



Highly-enriched uranium experiments at the Device Assembly Facility, Nevada National Security Site, Feb 16 – 25, 2021



Experiments at the Device Assembly Facility, Los Alamos National Laboratory, Jul 19 – 22, 2021











Cf-252 studies and experiements with a custom fission chamber, Argonne National Lab, Feb – April 2022



- **GHLGHTS** 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. New course for Fall 2022
- Texas A&M University, Prof. Chirayath, NUEN-651: Nuclear Fuel Cycles and Nuclear Material Safeguards. Students: 22
- University of Michigan, Prof. Kearfott: E100-900: DIY Geiger Muller Counter. Students: 40
- 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). New course for Fall 2022





MTV NEWSLETTER, 2022

Research Highlights

Research Highlight: Decoding DNA Sequences to Infer Radiation Exposure

- Need for development of methodology to identify DNA signature associated with ionizing radiation and specific reactor pools (SFPs)
- Performed 16S sequencing on SFP bacteria to identify biomarkers of ionizing radiation resistance; determined most reactor microbes are transient and rare
- Next steps: Identify the genomic signatures associated with exposure to ionizing radiation using microbial GWAS



Eric Alm Massachusetts Institute of Technology



Gordon Kohse MIT Nuclear Reactor Laboratory (in collaboration)



Research Highlight: Organic Glass Scintillators for Radiation Detection

- Investigation of novel organic glass scintillators for improved radioxenon detection
- In-house casting of various scintillator shapes
- Experiments: time and energy resolutions, optical wrapping, efficiencies, and pulse shape discrimination capabilities



Leah Clark Ph.D. Student University of Michigan



Tessa Maurer Ph.D. Student University of Michigan



Shaun Clarke University of Michigan







Research Highlight: Towards an Improved LIF Imaging Technique in Pursuit of a Portable System

- Goal is to develop technology to detect contamination/ radionuclides
- Capture and analyze images for positive identification of contaminants qualitive and quantitative, able to detect and identify multiple metals at the nmol/cm2
- Still evaluating effects of environmental conditions and testing new laser wavelengths



Kelly Truax Ph.D. Student University Hawaiʻi at Mānoa



Henrietta Dulai University Hawaiʻi at Mānoa







Research Highlight: Tonga Eruption on Smartphones

- Largest atmospheric explosion since 1883 Krakatoa blast
- Yield derived from CVT/ MTV R&D



Milton Garces University Hawaiʻi at Mānoa



Education AT ON and Outreach 2022 MCNP/MCNPX-PoliMi Training Workshop



Prof. Brian Kiedrowski Associate Professor U. Michigan



Dr. Shaun Clarke Associate Research Scientist U. Michigan

Prof. Brian Kiedrowski (far left) and Dr. Shaun Clarke at the University of Michigan, Nuclear Engineering and Radiological Sciences department, served as instructors at the 2022 MCNP/MCNPX-PoliMi Training Workshop.

This year's hybrid workshop, held on May 10 and May 11, welcomed 11 participants interested in learning and developing their skill with this unique code.

UNM/UM Undergraduate Research Experience -Summer 2022

On June 20-24, the Consortium for Monitoring, Technology, and Verification (MTV) and University of Michigan (UM) will be hosting undergraduate students from the University of New Mexico in a new weeklong program at the UM Ann Arbor campus, the MTV Summer Experience. During the MTV Summer Experience, UNM undergraduate students will engage in hands-on laboratory experiments, participate in experimental activities/demonstrations, learn about Ph.D. research, and hear lectures by radiation detection and nuclear nonproliferation experts.

The following Nuclear Engineering and Radiological Science labs will be participating in the MTV Summer Experience:

- Position-Sensing Semiconductor Radiation Detector Laboratory (Prof. Zhong He)
- Applied Nuclear Science Instrumentation Laboratory (Prof. Igor Jovanovic)
- Radiological Health Engineering Laboratory (Prof. Kim Kearfott)
- Detection for Nuclear Nonproliferation Laboratory (Prof. Sara Pozzi)
- Radiation Detection and Measurement Group (Prof. David Wehe)



MTV Nuclear Engineering Summer School

Classes will be taught in-person and virtually by MTV faculty, national lab collaborators, and senior PhD students: June 14 - August 11, 2022.

Lectures are designed to benefit students interested in strengthening their research capabilities. This program covers a range of topics and techniques that benefit student researchers at all academic levels. There is no cost to participate and a completion certificate will be awarded to participants who attend 80% of lectures! Course details, topics, and recorded presentations can be found online:

https://mtv.engin.umich.edu/2022-mtv-nuclear-engineering-summer-school/

Course topics include:

- Nuclear Engineering Background
- Gamma-ray Detection
- Neutron Detection
- Active Interrogation
- Monte Carlo Methods
- Radiation Imaging
- Fission
- Special Applications

Guest Lecturers

- Aditi Verma, Assistant Professor, University of Michigan
- Alan Carr, Senior Historian/Project Manager, Los Alamos National Laboratory
- Azaree Lintereur, Assistant Professor, Penn State University
- Nicholas Thompson, R&D Engineer, Los Alamos National Laboratory





- Cameron Miller, Program/Technical Analyst, Dept. Homeland Security/CWMD
- Peter Marleau, Staff Physicist, Sandia National Laboratory
- Zhong He, Professor, University of Michigan
- Matthew Devlin, Instrument Scientist, Los Alamos National Laboratory
- **Ciara Sivels**, Nuclear Engineer, Johns Hopkins University Applied Physics Laboratory

Host Lecturers

- Shaun Clarke, Associate Research Assistant, University of Michigan
- **Oskari Pakari,** MTV Postdoc Research Fellow, University of Michigan
- Noora Ba Sunbul, Recent Ph.D. Grad, University of Michigan
- Stefano Marin, Ph.D Student, University of Michigan
- Abbas Jinia, Ph.D. Student, University of Michigan
- Christopher Meert, Ph.D. Student, University of Michigan
- Nathan Giha, Ph.D. Student, University of Michigan
- Leah Clark Ph.D. Student, University of Michigan
- Juliann Lamproe, Ph.D. Student, University of Michigan
- Ricardo Lopez, Ph.D. Student, University of Michigan
- Flynn Darby, Ph.D. Student, University of Michigan

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Apply now for the MTV Doctoral Fellowship in Applied Antineutrino Physics!

Overview
2022 MTV Nuclear Engineering
Summer School
2022 MTV Nuclear Engineering
Workshop
2022 MTV Workshop
2021 MTV Nuclear Engineering
Summer School
2021 MTV Virtual Workshop
2021 US-UK Workshop
2021 US-UK Workshop
2021 US-UK Workshop
2021 MCNP / MCNPX PoliMil
Workshop

EVENTS

Events

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2022 MTV Nuclear Engineering Summer School

The 2022 MTV Nuclear Engineering Summer School is an 8-week program that will cover a range of topics and techniques that benefit student researchers at all academic levels. Students interested in strengthening their research capabilities are invited to register for the upcoming summer school. Classes will be taught in a hybrid format (UM's campus and...

Continue Reading

The MTV website serves as a web domain to provide public information on MTV news, activities, and personnel. MTV team members can find information on opportunities within the research field, national laboratories, and universities: https://mtv.engin.umich.edu/

The reporting period of 9/01/21 – 4/30/22 has shown 5,403 sessions by 3,586 users (Google Analytics). The session average per quarter is 1,495 sessions Year 1 (2020) and 1,792 sessions in Year 2 (2021); the current average through Year 3 is 1,801 (Q1-Q3). The MTV website has welcomed over 10,000 users in Years 1-3!

In addition to the MTV website, the MTV social media platforms generate thousands of views:

- LinkedIn: https://www.linkedin. com/in/sara-pozzi-a98ab813/
- Twitter: @NNSA_MTV
- Facebook: @NNSA.MTV
- YouTube: MTV Consortium, 133 videos available
- Blog posts: Graduate-studentsuccess.com

Post

l am so proud of my students conducting research throughou...



CCO 190 6 comments

Post

CC C 81

Search

Excited to host our first in-person lab tour in a while, with Profess...



8 comments

Training and PMENT Development

237 Current Students and Postdocs engaged in MTV Research





MTV Publications

- 1. A. Bernstein, N. Bowden, B. L. Goldblum, P. Huber, I. Jovanovic, and J. Mattingly, "Colloquium: Neutrino Detectors as Tools for Nuclear Security", Reviews of Modern Physics, https://doi.org/10.1103/RevModPhys.92.011003
- 2. Moritz Kütt and Alexander Glaser, "Vintage Electronics for Trusted Radiation Measurements and Verified Dismantlement of Nuclear Weapons," PLOS ONE, October 30, 2019. https://doi.org/10.1371/journal.pone.0224149
- 3. Noah McFerran, Bonnie Canion, Benjamin McDonald, Jonathan Kulisek, Jonathan Dreyer, Simon Labov, Andreas Enqvist, "Gamma-ray spectrum variations for surface measurements of uranium hexafluoride cylinders", Nuclear Instruments and Methods A, Vol. 961, p. 163675, 2020, https://doi.org/10.1016/j.nima.2020.163675
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- 18. J. Nattress, F. Sutanto, P.-W. Fang, Y.-Z. Chen, A. Cheng, K.-Y. Chu, T.-S. Duh, H.-Y. Tsai, M.-W. Lin, and I. Jovanovic, "Characterization of the 12C(p,p')12C Reaction (Ep=19.5–30 MeV) for Active Interrogation", Physical Review Applied 14, 034043 (2020). DOI: 10.1103/PhysRevApplied.14.034043
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