VCU | Virginia Commonwealth University

Department of Mechanical & Nuclear Engineering

Nuclear Engineering Program at Virginia Commonwealth University

Dr. Supathorn Phongikaroon, P.E.
Engineering Foundation Professor and
Director of Nuclear Engineering Program

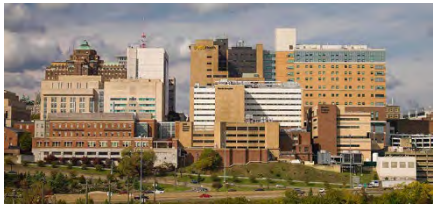
ANS Young Members Group
Spotlight on Universities
Thursday, March 3, 1:00 – 2:30 pm

Contact info: sphongikaroon@vcu.edu

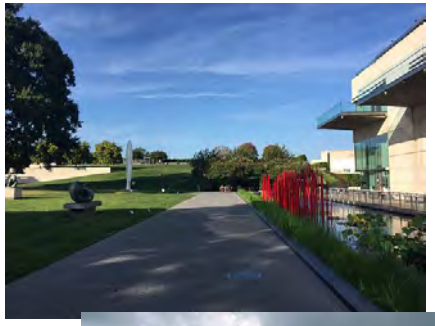
Outline

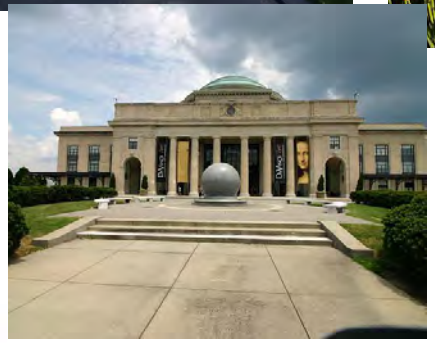
- Overview
- Nuclear Engineering Program
  - Highlights
- Faculty/Research programs
- Organizations and activities

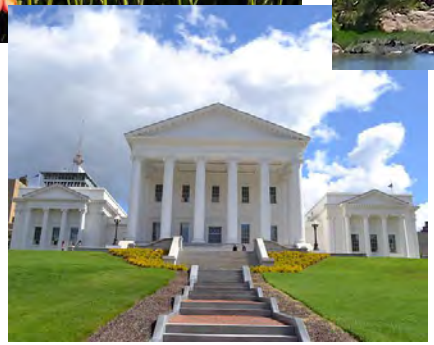
Where is VCU?

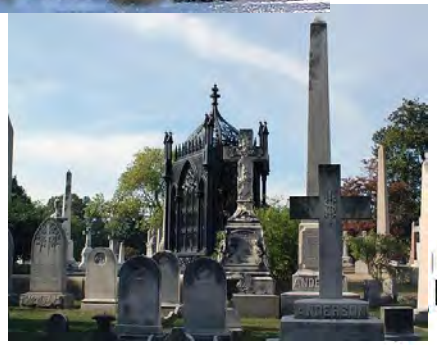


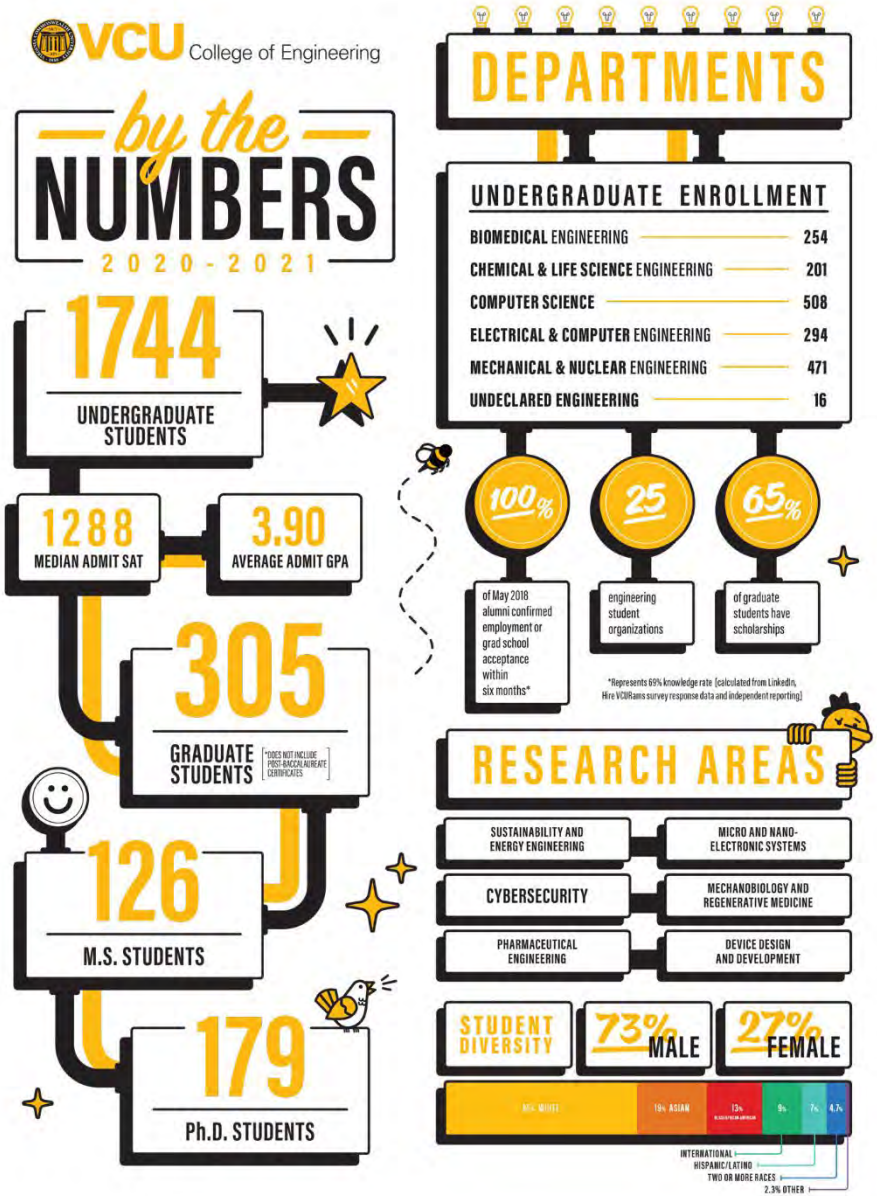

VIRGINIA
OHIO
WEST VIRGINIA
KENTUCKY
DISTRICT OF COLOMBIA
MARYLAND
Harpers Ferry NHP
Winchester
Leesburg
Skyline Drive
Alexandria
Warrenton
Harrisonburg
Luray
Geo. Washington MEM PKWY
Stafford
Shenandoah NP
Stanardsville
Geo. Washington NM
Charlottesville
Lake Anna
Warm Springs
Lake Monticello
Tappahannock
Warsaw
Covington
Lovingston
Palmyra
Hanover
King William
Heathsville
Amherst
Powhatan
Richmond
Chesapeake Bay
New Kent
Fincastle
Lynchburg
Amelia Court House
Mathews
Roanoke Civic Center
Salem
Roanoke
Rustburg
Jamestown Settlement
Williamsburg
Tazewell
Petersburg NB
Fort Monroe
Rocky Mount
Pulaski
Floyd
Charlotte Court House
Dinwiddie
Sussex
Hampton
Norfolk
Virginia Beach
Chatham
Gate City
Stuart
Martinsville
Emporia
Courtland
Norfolk Scope











MNE Overview (2021-2022)

Full Time Faculty:	28
Administrative Staff:	1 (2)
Technical Support Staff:	2
Undergraduate Students:	471
Nuclear Eng. Students:	60
Graduate Students:	103
Research Expenditures:	~$4 M/yr
Journal Papers:	~60/yr

Diversity and Inclusion

> *If you were a young woman in my office, I would say to you, 'The sky's the limit — get moving! Come to VCU, become an engineer.' As a woman dean, I look forward to the day when our female [engineering] population is 50 percent, and I am confident that we are on our way to making that dream a reality."*
>
> **— BARBARA D. BOYAN, PH.D.**
> *Alice T. and William H. Goodwin Jr. Dean*
> *VCU College of Engineering*

2019 ASEE Diversity Recognition Program

The VCU College of Engineering has been awarded **a Bronze award** by the American Society for Engineering Education (ASEE) Diversity Recognition Program. The Bronze award, the highest level awarded in 2019, acknowledges VCU Engineering's commitment to bringing women and underrepresented minorities into the field and places the college among the nation's leaders in inclusive excellence.

Partner Institutions

Virginia Union University

New dual degrees with Virginia Union University, Virginia's oldest historically black university.

John Tyler and J. Sargeant Reynolds community colleges

Partnership selected for funding by **Howard Hughes Medical Institute 2018 Inclusive Excellence initiative** to promote science for transfer students, especially those from underrepresented groups.

By the Numbers

20%
women faculty

36%
increase in female undergrads since 2012

83%
more degrees awarded to female students since 2009

#1
Virginia engineering school for percentage of Hispanic graduates

55%
increase in Hispanic/Latinx undergraduate students since 2012

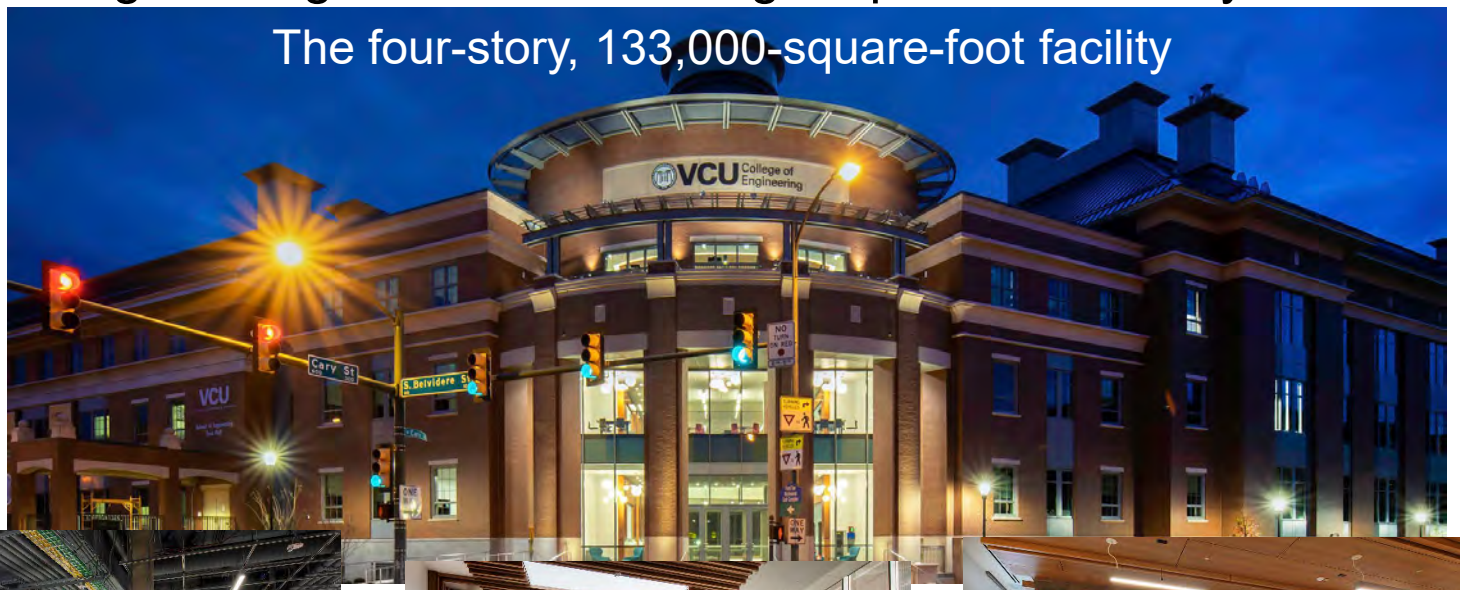
40%
increase in under-represented minority students since 2014

24
Countries represented (U.S. News & World Report)

College of Engineering

Engineering Research Building - Opened February of 2021

The four-story, 133,000-square-foot facility



Department of Mechanical & Nuclear Engineering

https://egr.vcu.edu/giving/engineering-research-building/

Brief History

1996– First class of students enrolls at the VCU School of Engineering

1996– Initiation of Mechanical Engineering Program

2000– ABET Accreditation of B.S. in Mechanical Engineering

2000– Establishment of M.S. and Ph.D. in Engineering

2007– Initiation of M.S. Track in Nuclear Engineering

2008– Establishment of M.S. in Mechanical and Nuclear Engineering (including online option)

2009– Initiation of B.S. Major Concentration in Nuclear Engineering

2010– Department name changed to Mechanical and Nuclear Engineering

2012– ABET Accreditation of B.S. Major Concentration in Nuclear Engineering

2012– Establishment of Ph.D. in Mechanical and Nuclear Engineering

Nuclear Related Industries

Nuclear Medicine Tech

Lightbridge Corporation

Mitsubishi Nuclear Energy

NuSource, LLC

US Department of Defense

Framatome

Dominion Energy

Jefferson Lab

Mega-Tech Services

Newport News

Norfolk Naval Shipyard

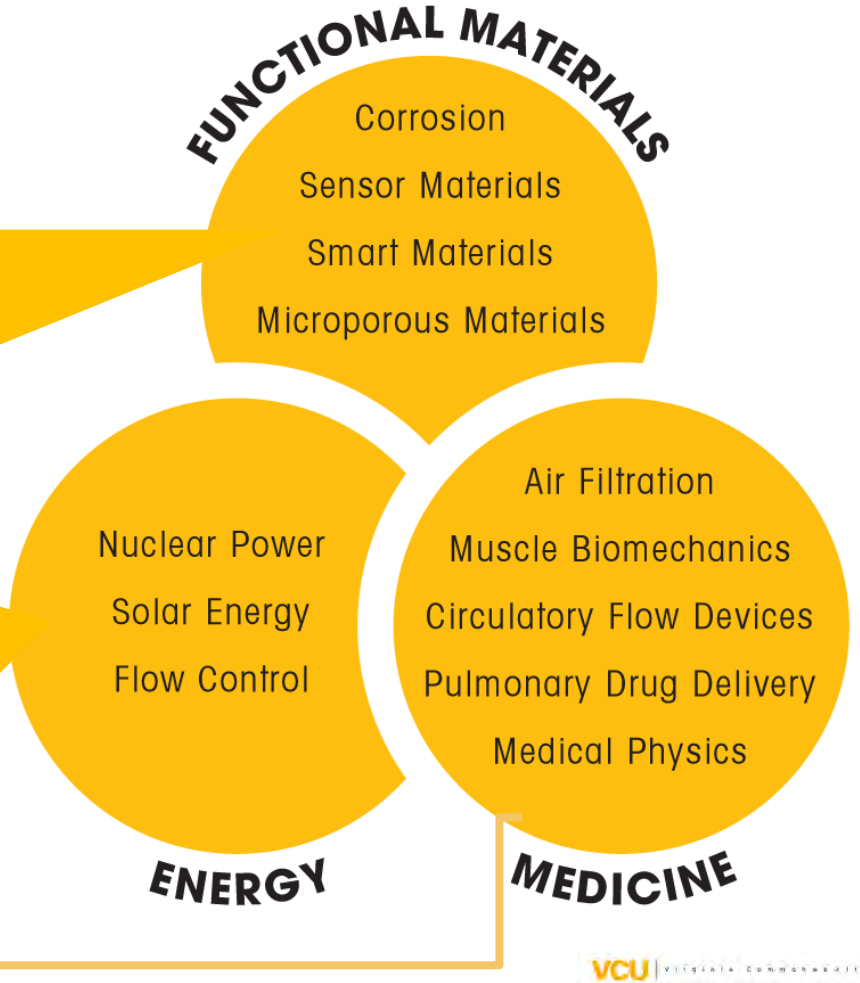
Nova Tech

BWXT Nuclear Energy

Mechanical and Nuclear Engineering Research

Nuclear Engineering Programs

- ❑ Plasma physics for space exploration,
- ❑ Nano-radioisotope for medical applications,
- ❑ Neutron transports,
- ❑ Thermal fluid science and molten salt chemistry for advanced reactor and nuclear fuel cycle, and
- ❑ Nuclear safeguards for protecting our future safe and clean energy

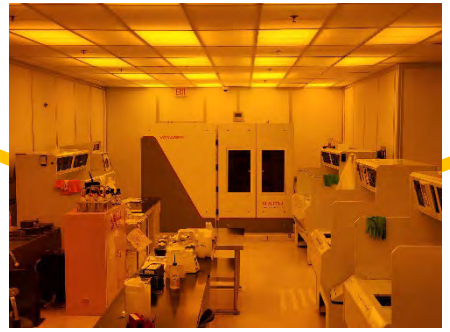


Center for Pharmaceutical Engineering and Sciences

Makerspaces – MNE Innovation Lab

VCU Cybersecurity Center

Wright Virginia Microelectronics Center



Nanomaterials Core Characterization Facility

2020-2021 NE Highlights

- US News & World Report
  - Rank 22nd in the nation – 2020/2021
  - Rank 18th in the nation – 2019/2020
  - Rank 20th in the nation – 2018/2019
  - Rank 24th in the nation – 2017/2018

Nuclear Engineering Faculty

Dr. Supathorn Phongikaroon (Engineering Foundation Professor, Director of Nuclear Engineering Program)

- PhD, Chemical Engineering, University of Maryland, College Park
- *Radiochemical engineering, Spectroelectrochemical techniques (electrochemistry & optical spectroscopy) of molten salt systems and nuclear fuel cycle*

Dr. Lane Carasik (Assistant Professor)

- PhD, Nuclear Engineering, Texas A&M
- *Advanced Reactor Design and Simulation, Computational Fluid Dynamics using HPC, Scaling of Experiments for MSR and Fusion Design*

Dr. Braden Goddard (Assistant Professor)

- PhD, Nuclear Engineering, Texas A&M
- *Security, Safeguards and Non-proliferation*

Mr. James Miller (Professor of Practice)

- MS, Nuclear Engineering, Pennsylvania State University
- *Reactor Theory, Nuclear Safety*

Dr. Gennady Miloshevsky (Associate Professor)

- PhD, Physics, Heat and Mass Transfer Institute, Minsk
- *Computational Physics, Shielding of Space Radiation, Fission SNM Sources, Plasma Physics and Atomic Spectra, CFD, Two-Fluid Liquid Metal-Plasma Flows, Warm Dense Matter*

Dr. Jessika Rojas (Assistant Professor)

- PhD, Nuclear Engineering, University of Missouri, Rolla
- *Radiation Detection and Measurement, Medical Applications*

Dr. Gary Tepper (Professor and Department Chair)

- PhD, Engineering Physics, University of California at San Diego
- *Radiation Detection and Measurement, Instrumentation Design*

Dr. Zeyun Wu (Assistant Professor)

- PhD, Nuclear Engineering, Texas A&M
- *Reactor Physics, Neutronics, Multi-physics Modeling, Computational Methods on Particle Transport*

Active Nuclear Engineering Affiliate Faculty

Ms. Devon Gallagher (Dominion Energy)

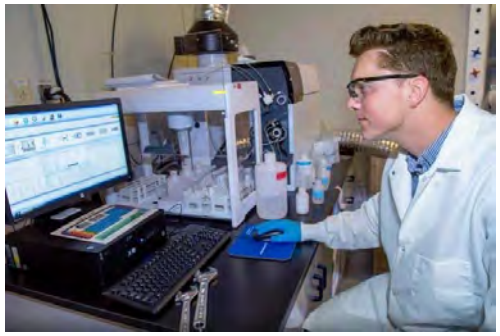
- Principal Engineer
- Probabilistic Risk Analysis (Spring 2019, Spring 2020)

Teaching and Research Equipment

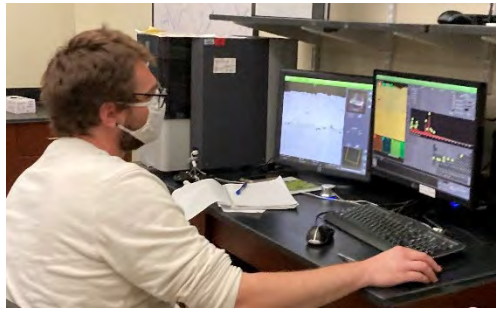
HPGe Detector

GM and NaI Detectors

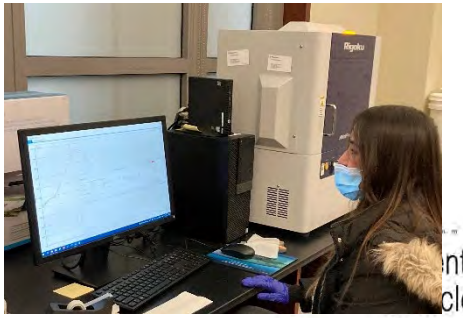
ICP-MS from NRC Res.



SEM from DOE-Infrastruc.



High Temperature XRD from DOE-Infrastruc.

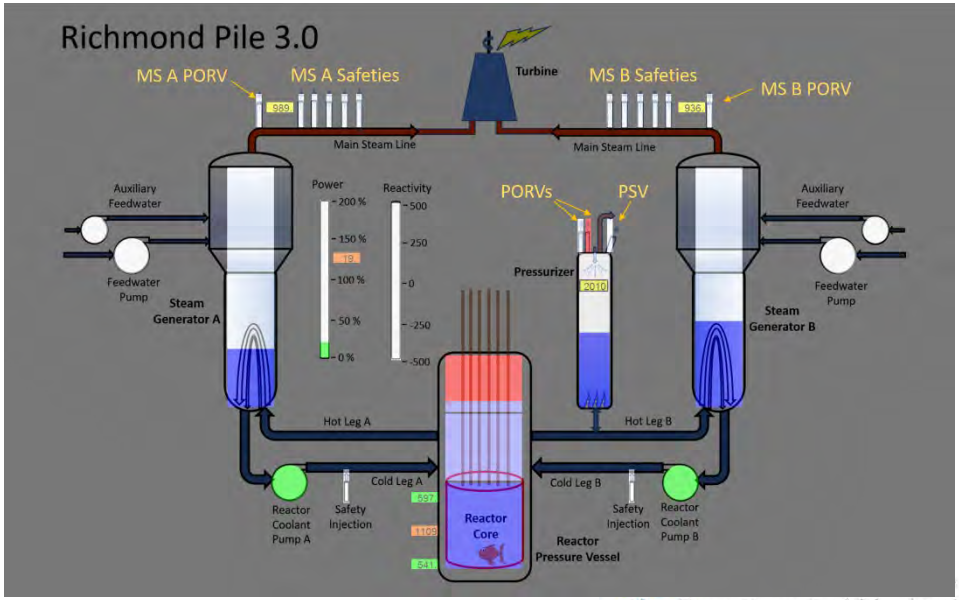


Portable HPGe Detector

A radiation area monitor for radioactive materials smuggling teaching/research

Richmond Pile 3

The VCU nuclear reactor simulator is an integral part of MNE's nuclear engineering program. In addition to classroom use, the simulator is used to showcase the program to prospective students and for community outreach such as the annual Science Teachers Workshop.



Research Highlights

FAST Research Group

https://fastresearchgroup.weebly.com/

Lane B. Carasik, Ph.D.
Assistant Professor
Associate Editor,
Fusion Sci. Tech Journal

Graduate (PhD) Students

Arturo Cabral

James Vulcanoff

Meryem Murphy

Aristidis Loumis-Demetrakopoulos

Connor Donlan

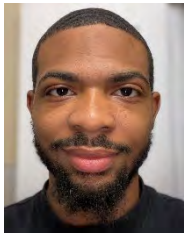
Theodore Chu

Undergraduate Students

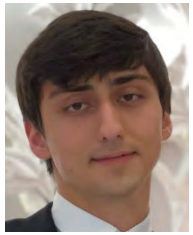
Sierra Tutwiler

Ryan McGuire

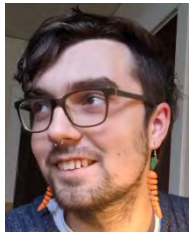
Candler Langston



Jerel Houston



Adam Mafi



Jake Holweger

Fluids in Advanced Systems and Technology (FAST) Research Group:

- Advanced Reactor Design
- Computational and Experimental Thermal Hydraulics
- Additive Manufacturing
- Scaled Experiments for MSRs and Fusion

Current Funding Sources:

- Jeffress Trust Grant – FY20-22
- NRC Faculty Dev. Grant – FY21-24
- NRC Research Grant – FY21-24
- DOE STTR Phase 1 – FY21-22
- DOE SBIR Phase 1 – FY22

Current Collaborators:

- Luna Innovations Inc.
- Kansas State University
- Argonne National Laboratory
- Idaho National Laboratory
- Cinco Research
- Uni. of California-Irvine

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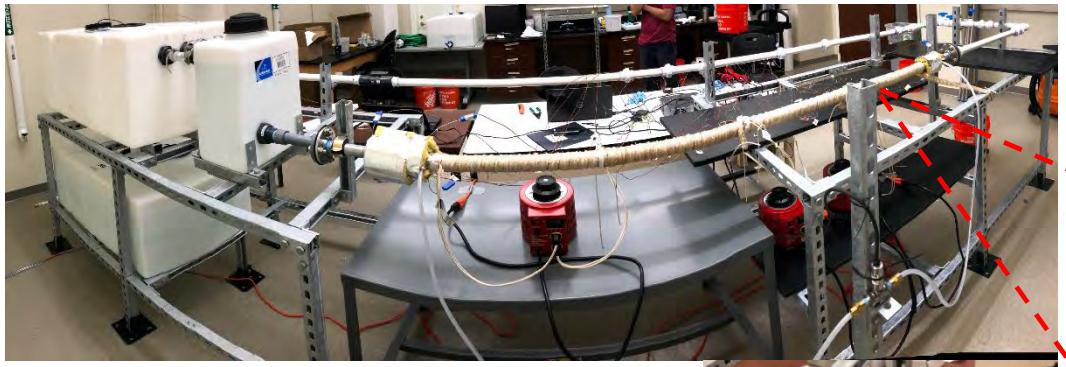
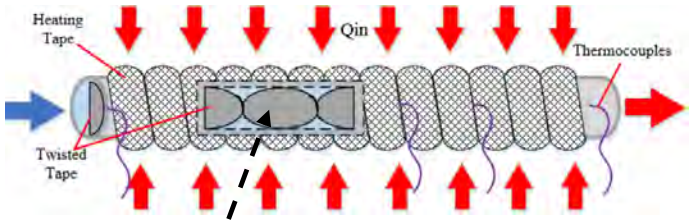
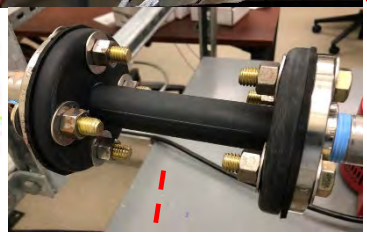
FAST RG Experimental Activities

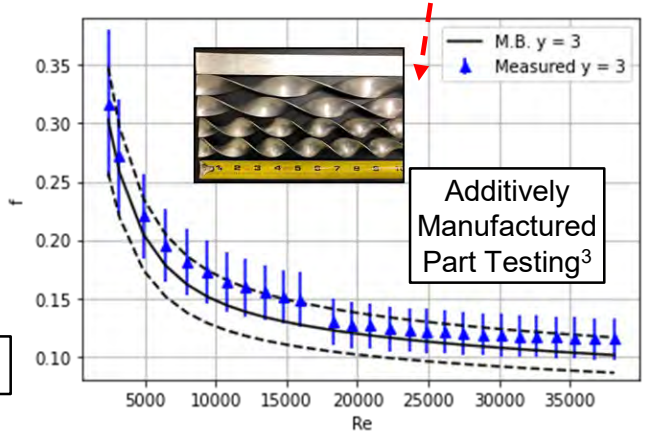
Modular Separate Effects Testing Facility 1st Loop (MSETF-1)

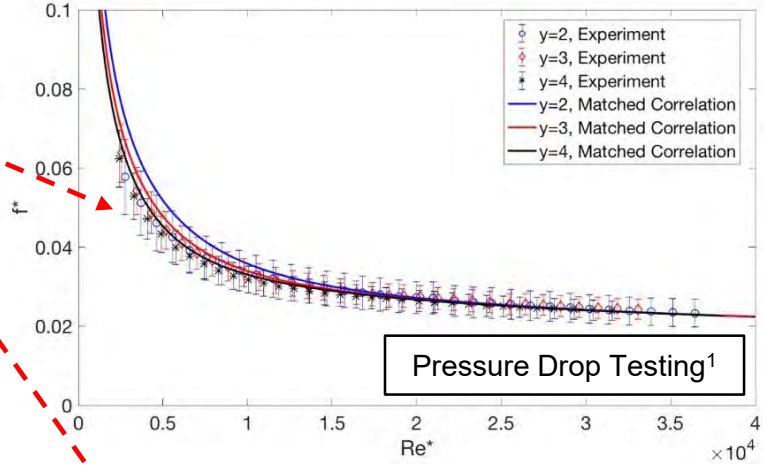


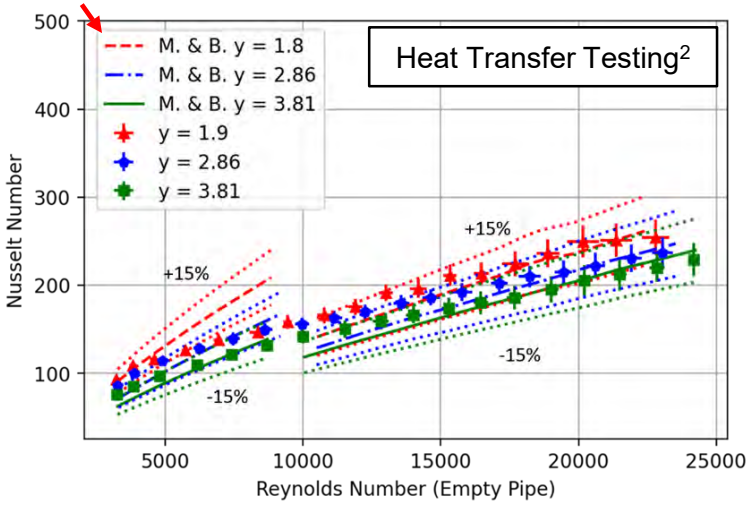




Heat Transfer Enhancements







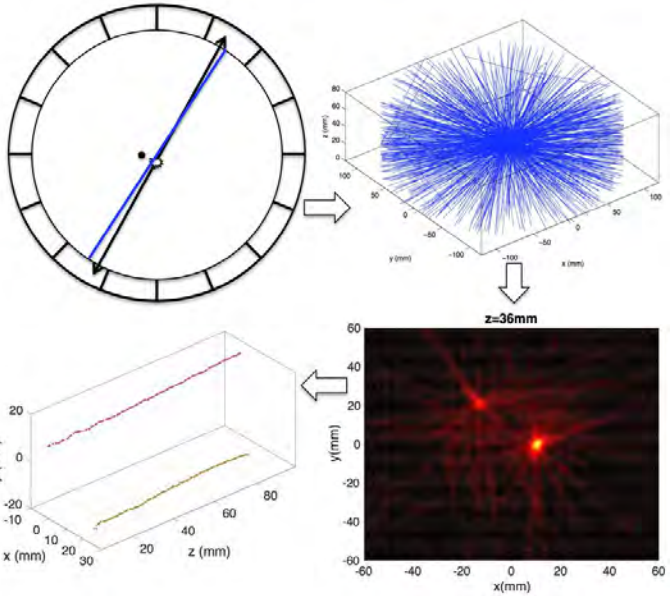
[1]Wiggins, C., Cabral, A., Carasik, L., 2021, "Experimental Investigation of Pressure Loss Calculation for Pipe Flow with Loose-Fitting Twisted Tape Inserts Using Channel Flow Correlations," Fusion Sci. Technol., vol. 77 (7-8), 710-715, 2021

[2]Cabral, A, Wiggins, C., Carasik, L. "Heat Transfer Investigation of Twisted Tape Swirl Tubes by Conventional Channel Flow Correlations with Molten Salt Reactor and Fusion Applications.'' In-Prep (2022)

[3]Cabral, A., McGuire, R., Murphy. M., Wiggins, C., Carasik, L., "Experimental Investigation of Twisted Tape Heat Transfer using Additive Manufacturing," Adv. In Thermal Hydraulics, 2022 (Submitted)

FAST RG Experimental Activities

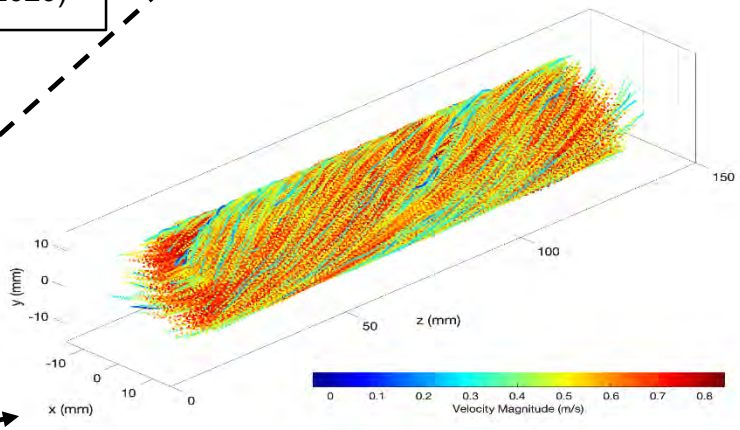
PEPT Imaging Facility for Measurements in Heat Transfer Components



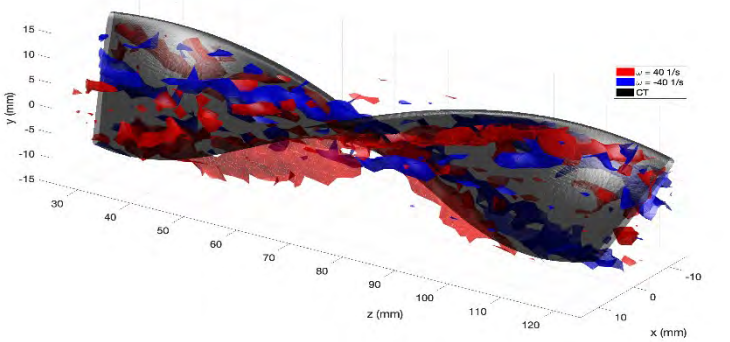
Positron Emission Particle Tracking (PEPT) & CT uses radiotracers to map flow fields

Agreement with VCU BARC facility for usage of existing PET Scanner (Completed Fall 2020)

Design and Construction of PEPT Flow Loop (Completed Spring 2021)

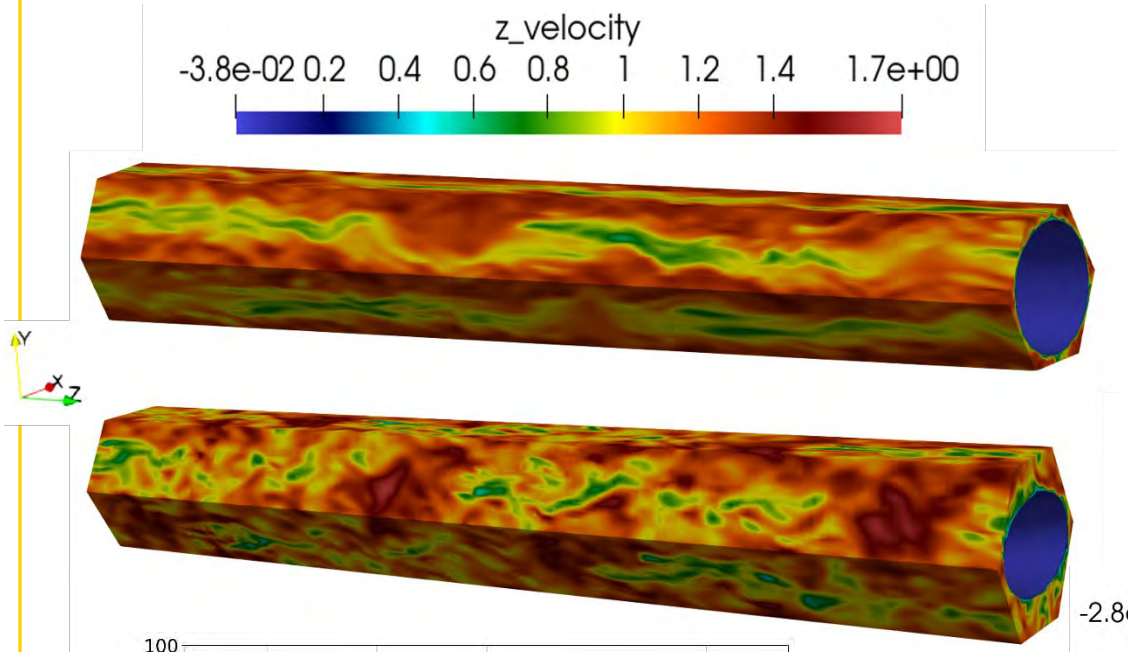


Flow visualization yields velocity fields and flow structures due to twisted tape insert (Fall 2021)

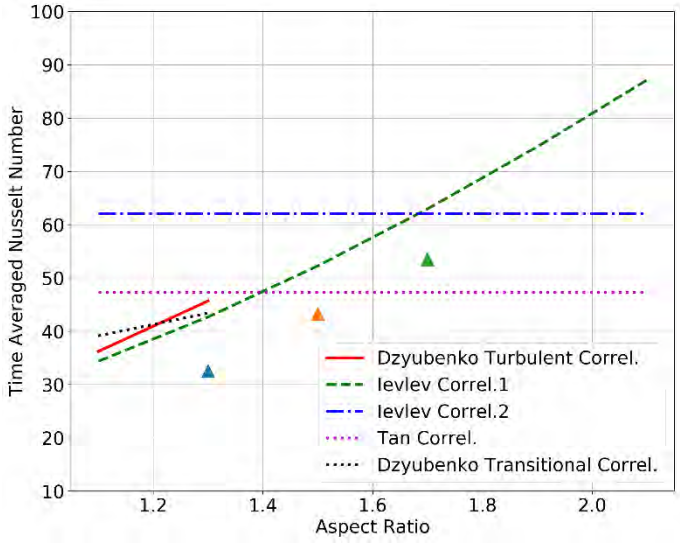


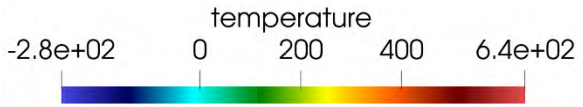
Wiggins, C., et al., “Noninvasive interrogation of local flow phenomena in twisted tape swirled flow via positron emission particle tracking (PEPT),” Nuc. Eng. Des., Vol. 387, pp. 1116012022, 2022.

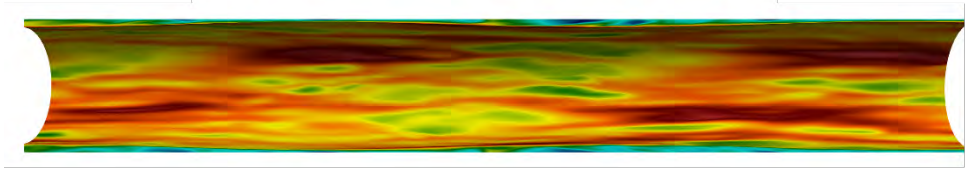
FAST RG Computational Activities

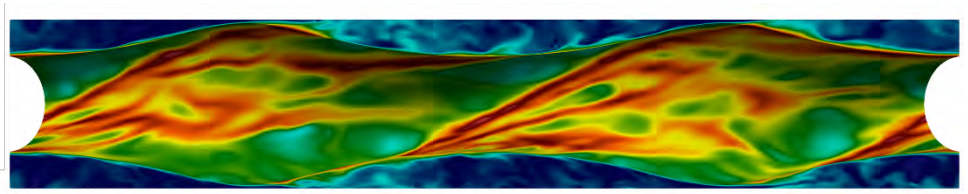


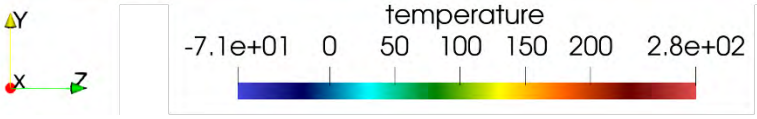
Simulations done using Nek5000 for Large Eddy Simulations of shell side flow in twisted tube heat exchangers for molten salt reactors











Tutwiler, S., Shaver, D., Carasik, L. B., "Determination of Aspect Ratio Influence on Flow and Heat Transfer Behavior in Twisted Elliptical Tubes for Molten Salt Applications," Adv. In Thermal Hydraulics, 2022 (Submitted)

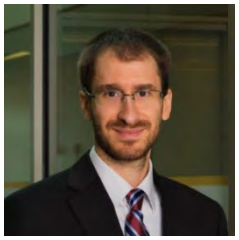
Dr. Goddard's Research Team

Research Area:

Nuclear Security, Nonproliferation, and Radiation Measurements

Senior Members

Dr. Braden Goddard



Dr. Claudio Gariazzo

Dr. Alexander Solodov

Dr. Sombo Chunda

Dr. Amany Gouda

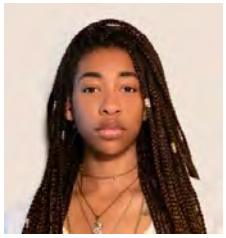
Graduate Students

Victoria Davis

James Padgett

Undergraduate Students

Ashanti Brantley

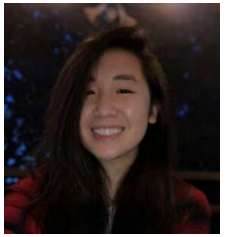


Barbra Diaz

Reagan Bui

Nguyen Tran

Athena Le

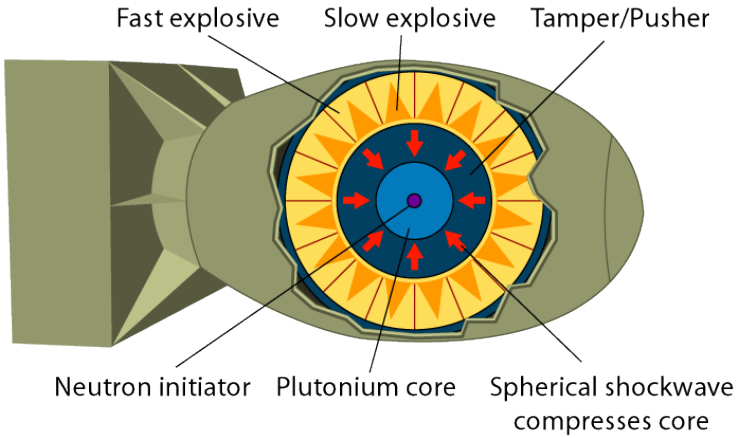


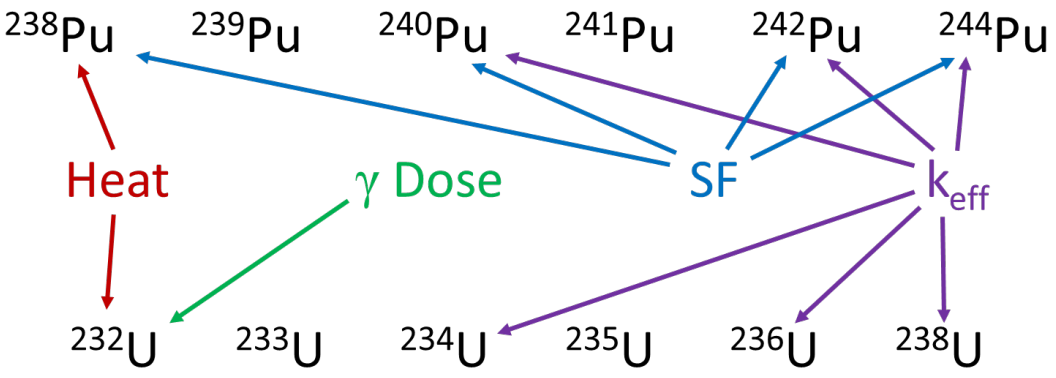
Caleb King*

Tristan Norrgard*

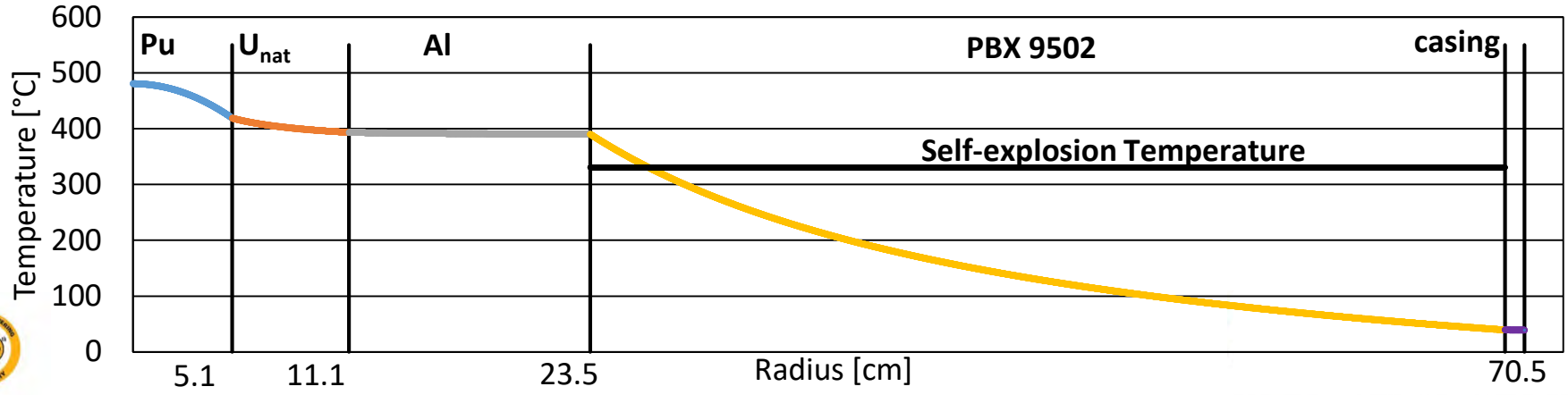
* Student works for multiple professors

Nuclear Material Attractiveness





$$FOM_1 = 1 - \log_{10}\left(\frac{M}{800} + \frac{Mh}{4500} + \frac{MS}{6.8(10)^6} + \frac{M}{50}\left(\frac{D}{500}\right)^{\frac{1}{\log_{10} 2}}\right)$$



Workshops and Tours

Funding and Research Projects

1. ATF evaluation (co-PI), NRC
2. Plutonium disposition, Lightbridge
3. Pa-233 safeguards, ANL (NNSA)
4. 3S workshop, CRDF Global (completed)
5. Proliferation workshops 2020, ANL (DOS)
6. Proliferation workshops 2019, ANL (DOS) (completed)
7. Nuclear facility tours, TAMU (NNSA)
8. Faculty development, SNL (NNSA) (completed)
9. Course development, Stanton Foundation (completed)
10. Equipment grant X-ray diffraction (co-PI), DOE (completed)
11. Equipment grant HPGe (co-PI), VA Trust Fund (completed)

- Students graduated: 2 PhD, 2 MS, 7 BS
- Journal papers: 34
- Conference papers: 61
- Invited talks: 48

Dr. Rojas' Research Team

- Research areas:
  - Radiation chemistry and radiation processing
  - Radioisotopes applications
  - Nuclear materials, radiation effects
  - Accident tolerant fuels
- Team members

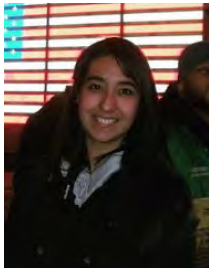
Graduate Students

Rajnikant Umretiya

Connor Donlan

Furkan Erdogan

Alumni



Maria Molina
Postdoc. 2020

Gabrielle Seymore
M.S Medical physics, 2020

DERI Scholars:
Mary C. Heinen
Bethany Costello
June.19 – June 20

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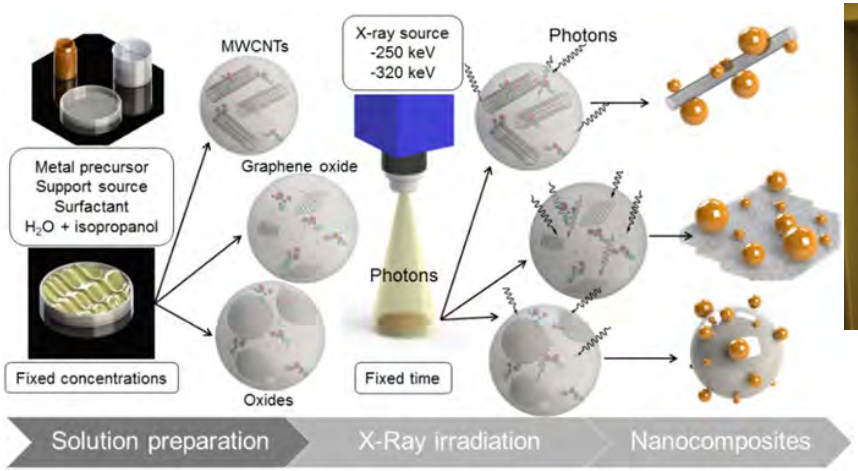
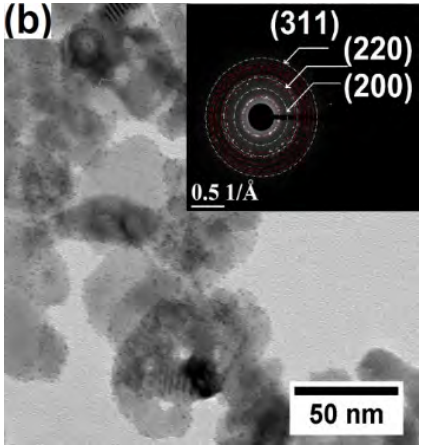
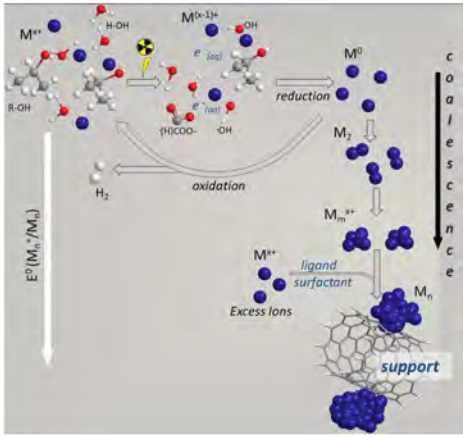
Radiation chemistry and processing:

metallic nanoparticles deposited on carbon substrates and oxides using and X-rays



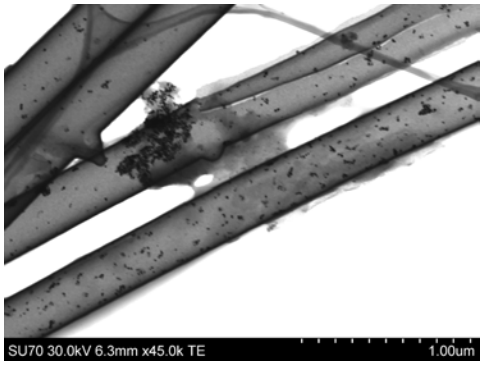
Clifford DM, Castano CE, Rojas JV "Supported transition metal nanomaterials: Nanocomposites synthesized by ionizing radiation" *Rad. Phys. and Chem.* 132 (2017) 52–64.

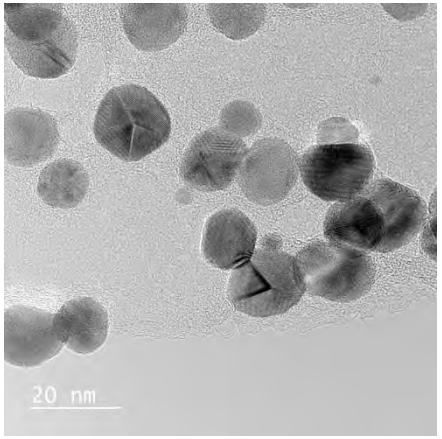




Radiolytic synthesis alternative to conventional chemical and physical methods!

- ✓controlled reduction of metal ions
- ✓No excessive reducing agents
- ✓No undesired oxidation reactions
- ✓The reducing agent is uniformly generated in the solution.
- ✓The rate of reaction is well-known
- ✓Number of reducing equivalents defined by dose
- ✓The process is achieved at room temperature





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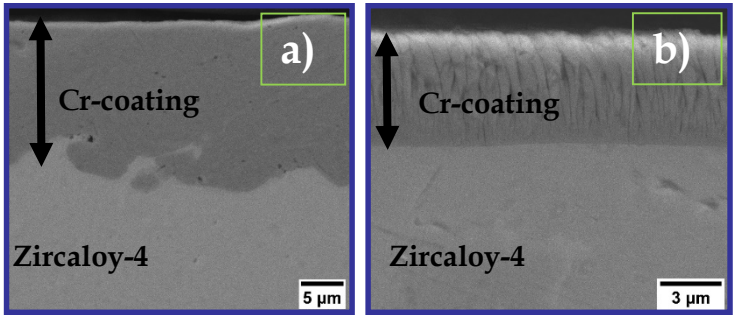
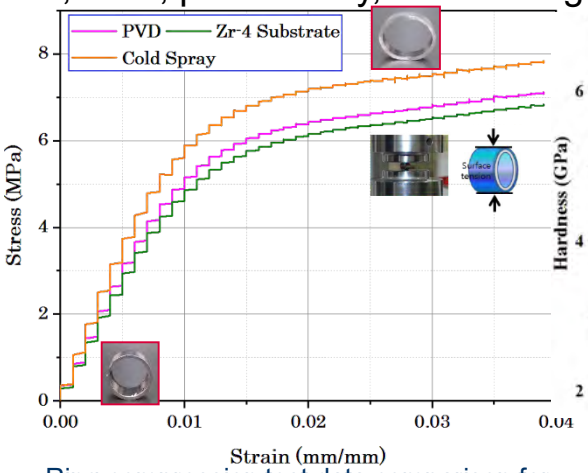
NanoNuclear & Radiation Processing Lab

Accident tolerant fuels: Evaluation of Accident Tolerant Fuels Surface Characteristics in Critical Heat Flux Performance

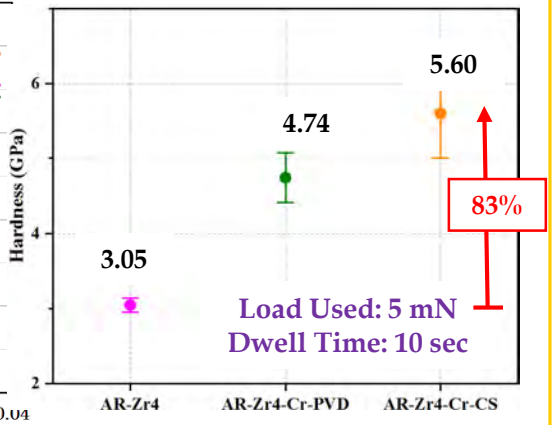
Characterization of the cladding surfaces of the ATF concepts under study has taken off after receiving samples from the companies involved. SEM, FIB, AFM, profilometry, contact angle, and XRD



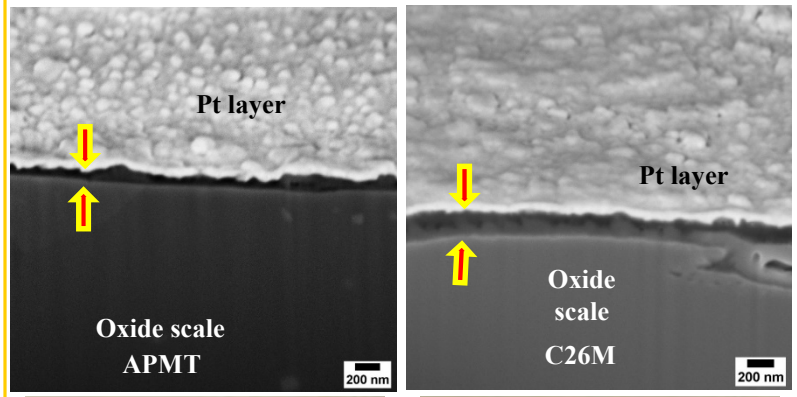
Cross sectional SEM view for Cr-coated Ziraloy-4: a) AR-Zr4-Cr-CS and b) AR-Zr4-Cr-PVD. *(R. V. Umretiya, et. Al. J. of Nuc. Mat.. 541 (2020) 152420)*

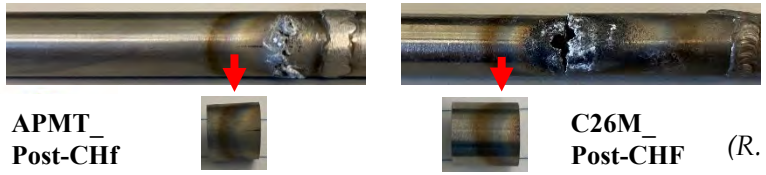


Ring compression test data comparison for Substrate Zr-4 Cr-PVD and Cr-CS



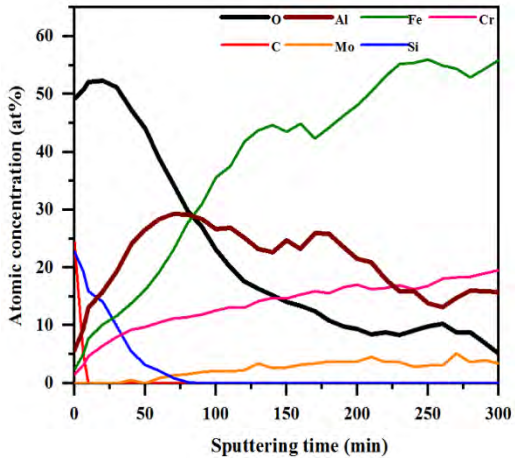
Nano-indentation test results



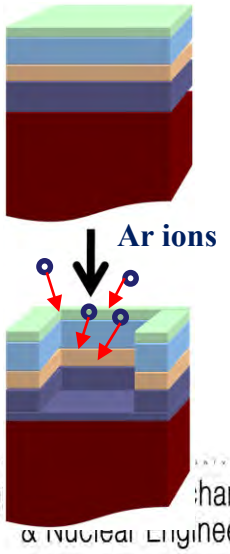


APMT_ Post-CHf

C26M_ Post-CHF



Element composition vs. depth (sputter time) profile on the post-CHF samples surface of APMT_Post-CHF



(R. V. Umretiya, et. Al. submitted to Acta Materialia, 2021)

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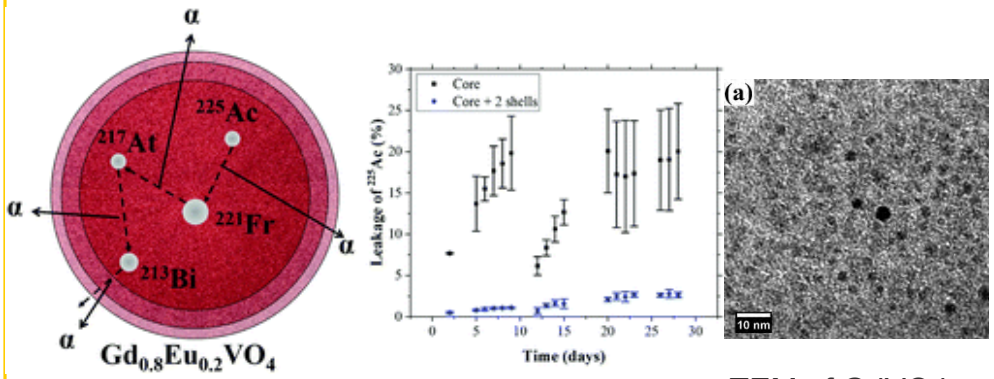
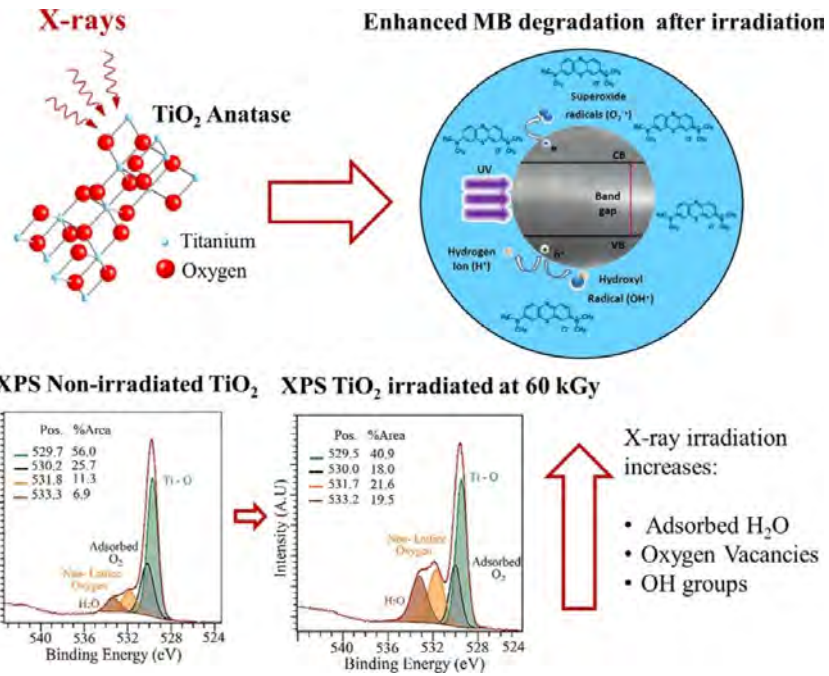
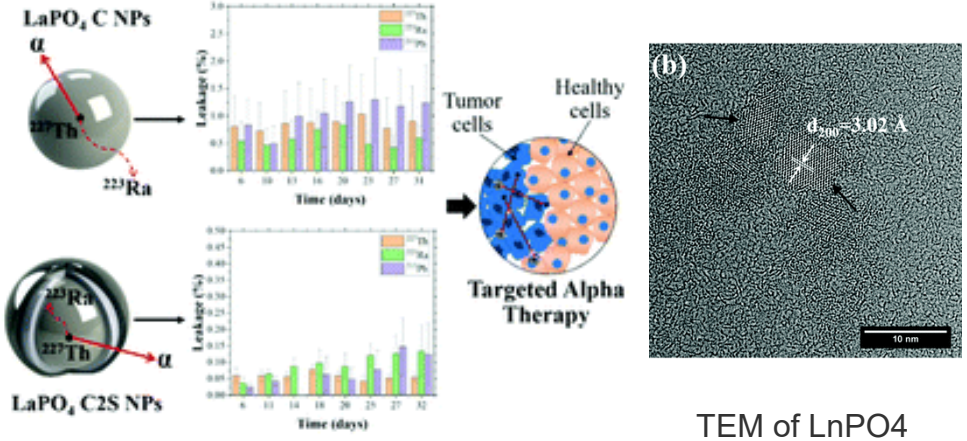
NANO-CERAMICS: Encapsulation of radioisotopes, radiation enhancers, and radiation processing

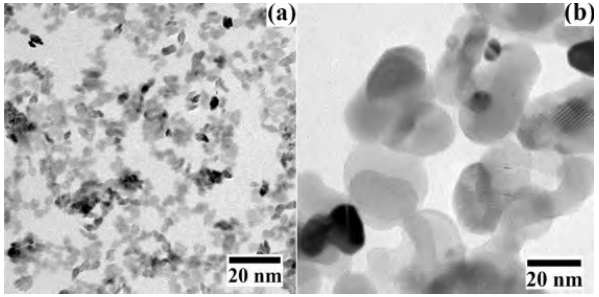


TEM of GdVO4





TEM of LnPO4



TEM of
a) $TiO_2^{6.5nm}$
b) $TiO_2^{21.6nm}$

Multifunctional ceramic nanoparticles and their performance as radionuclide carriers for targeted radionuclide therapy.

Toro-González, M. et al. *Nanoscale* 12.17 (2020): 9744-9755.

Higgins, M. C. M., Hall, H., & Rojas, J. V. (2021). *J. of Photochem. Photobio A: Chemistry*, 113138.

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Reactor Physics Research Group

- **Research Area:**
  - Reactor Physics, Advanced Reactor Design and analysis,
  - Computational methods for neutron transport equation
  - Nuclear data sensitivity and uncertainty analysis
  - Multiphysics platform for reactor analysis
- **Team members:**
  - Graduate students

PI: Zeyun Wu

Tao Liu

Kyle Britton

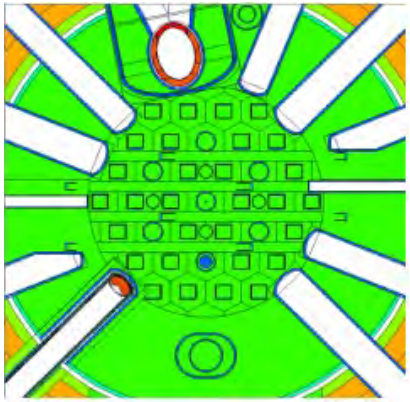
Yue Zou

Mohamed Elhareef

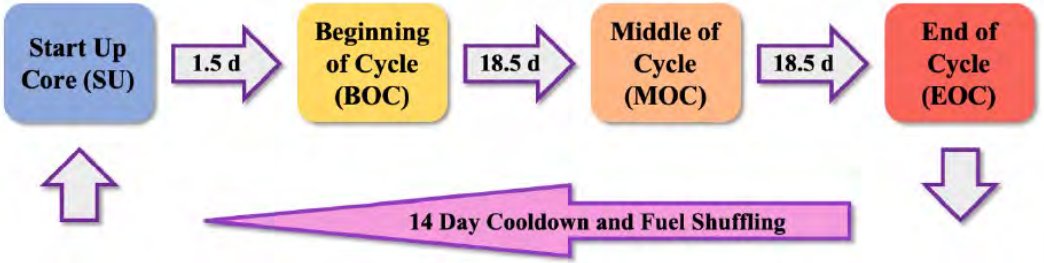
- **Research Collaborators and Funding:**
  - University of Maryland College Park
  - University of California Berkeley
  - Idaho National Laboratory
  - Argonne National Laboratory
  - DOE Nuclear Energy University Program (NEUP)

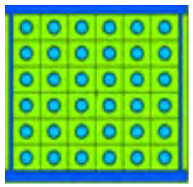
Reactor Core Design and Analysis

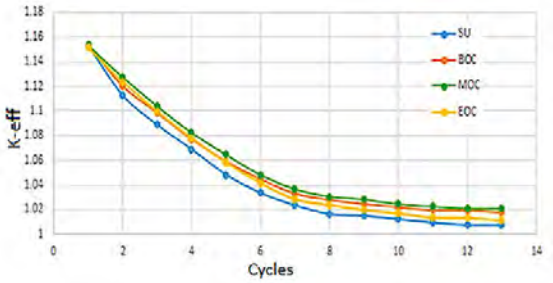
K. A. Britton and Z. Wu, “Reactor Physics Evaluation of the TRIGA LEU Fuel in the 20MW NIST Research Reactor,” *Nuclear Engineering and Design*, **360**, (April 2019)



- Full scale Neutronics Analysis of the TRIGA fuel in the NBSR located at NIST in Gaithersburg, MD.







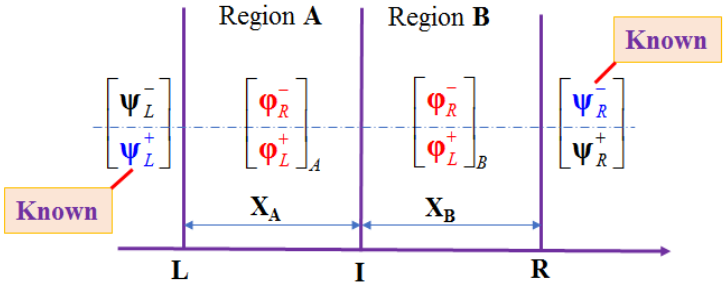
The control shim arm positions of HEU and TRIGA fueled equilibrium cores.

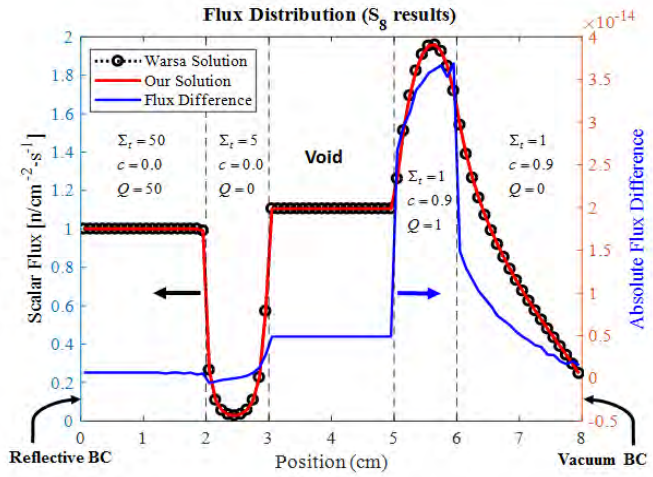
State	HEU	TRIGA
SU	19.7	23.0
BOC	14.6	14.0
MOC	9.20	7.00
EOC	0.00	0.00

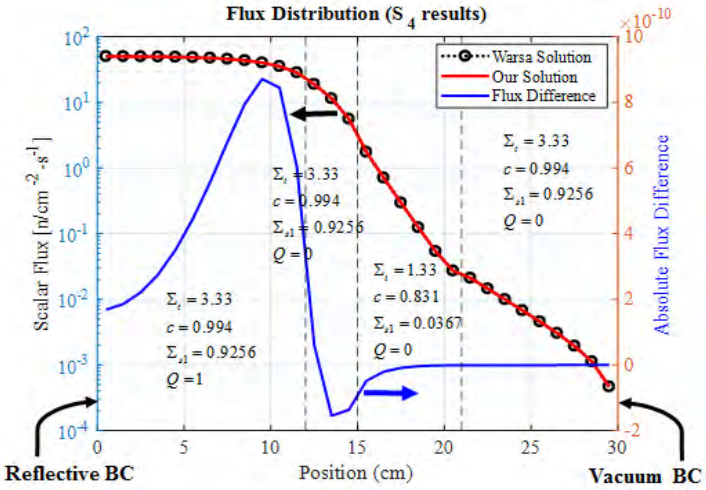
Computational Transport Methods

Z. Wu, “1D Sn Analytic Solution to Heterogeneous Problems with No Iteration on Interfacial Fluxes,” *Trans. Am. Nucl. Soc.*, **121** (Nov. 2019)

Start of program
Allocate Matrix Storage and Solve for Region Constants
Beginning of Semi-Analytic Iteration (SA)
Loop on boundaries
Calculate scalar flux at boundary meshes
Check Boundary convergence, update values of φ
End boundary Loop
Calculate all desired values of scalar flux using converged BC's
End of SA
End of program

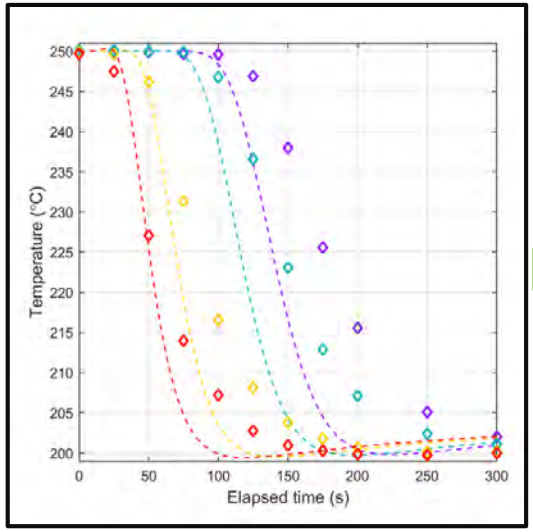


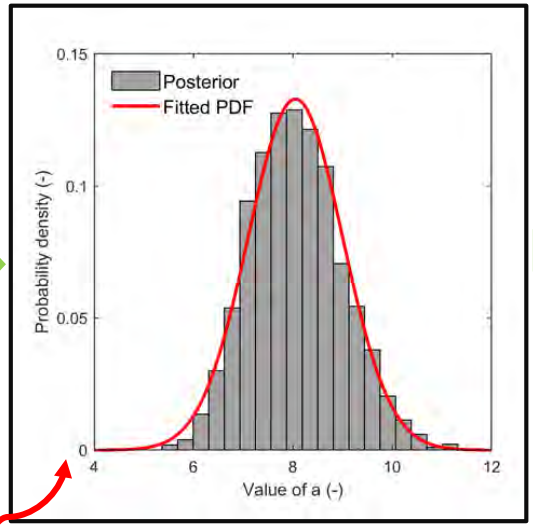


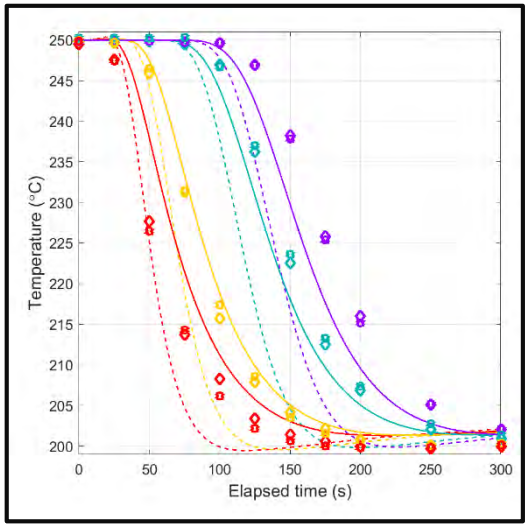


Data Analytics and Machine Learning

C. Lu, Z. Wu, and X. Wu, “Enhancing the 1-D SFR Thermal Stratification Model via Advanced Inverse Uncertainty Quantification Methods,” *Nuclear Technology*, (Aug. 2020);







Preliminary 1-D TS model
- Default parameters
- Tested by 9 data sets from TSTF
- Reasonable performance

Advanced data assimilation
- Bayesian inference theory
- Inverse Uncertainty Quantification
- Trained by 4 data sets from TSTF

Improved 1-D TS model
- Validated with 5 data sets from TSTF
- Reduced predicted errors

$$p(\boldsymbol{\theta}^*|\boldsymbol{y}^E,\boldsymbol{y}^M) \propto p(\boldsymbol{\theta}^*) \cdot \frac{1}{\sqrt{|\boldsymbol{\Sigma}|}} \exp\left[-\frac{1}{2}[\boldsymbol{y}^E - \boldsymbol{y}^M - \delta]^T \boldsymbol{\Sigma}^{-1}[\boldsymbol{y}^E - \boldsymbol{y}^M - \delta]\right]$$

Posterior | Prior | Likelihood function

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Department of Mechanical & Nuclear Engineering

Dr. Miloshevsky's Research Team

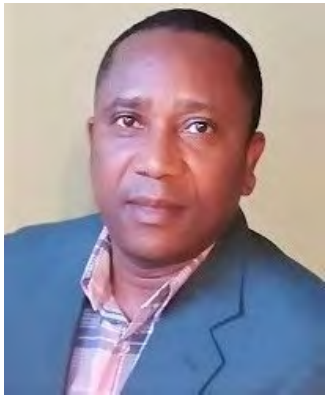
Funding sources:

- DTRA – FY2019-2021
- DTRA – FY2020-2025
- NRC – FY2018 – 2021

Ph.D. students:

Youssef Abouhussien

Cheng Zhang



Edmund Semaha

MS student:

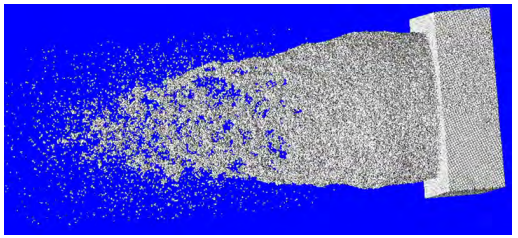
Derek Schauss

High-School student:

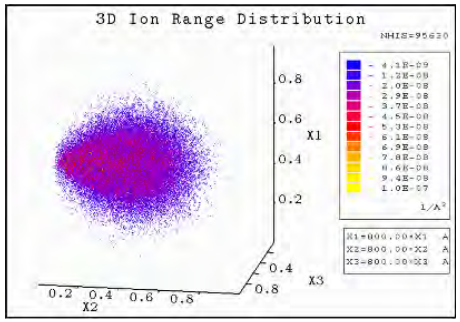
Stamate Theofanos

Computational Energy-Material-Interaction Lab (CEMIL)

Research Focus:

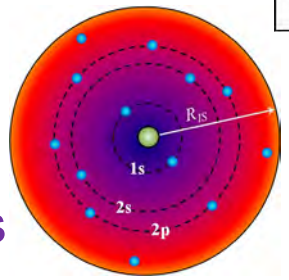


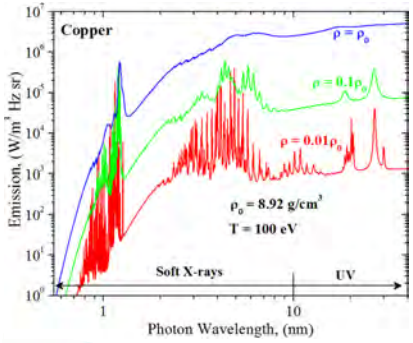
- effects of intense energy fluxes of *radiation, plasma, particle and laser beams* on materials
- *material behaviors and properties* under extreme pressures, temperatures, and high radiation fluxes

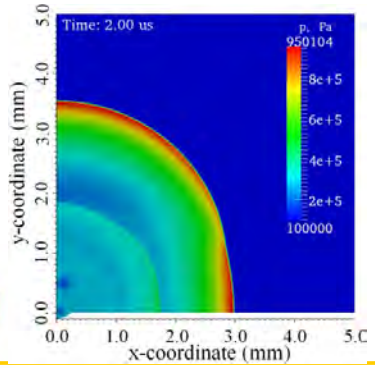


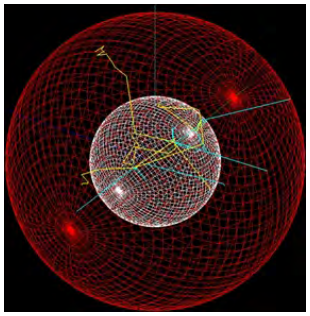
Research Areas:

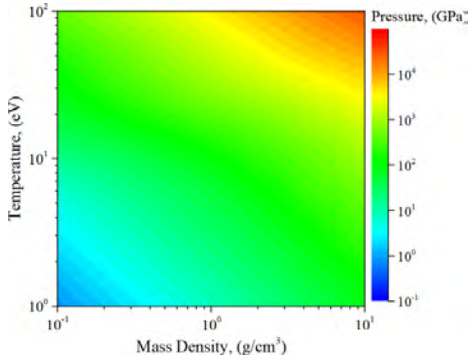
- thermodynamic and optical properties of Warm Dense Plasmas (WDPs)
- ultrafast laser-material interactions
- plasma-wall interactions in fusion devices
- radiation charging of dielectrics and insulators

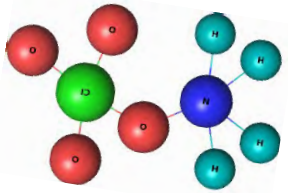












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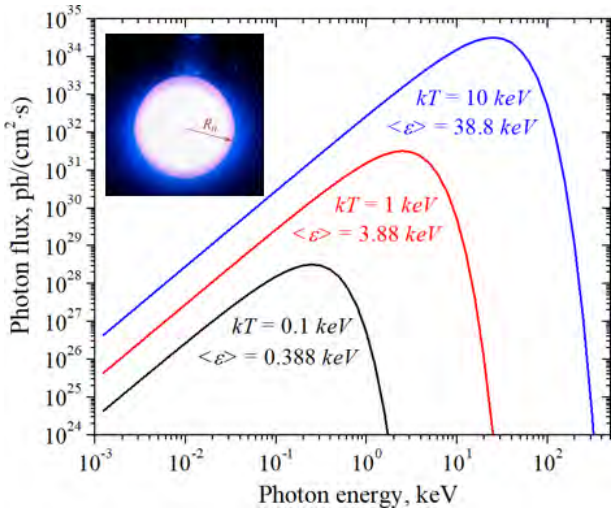
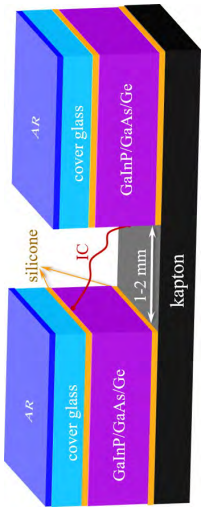
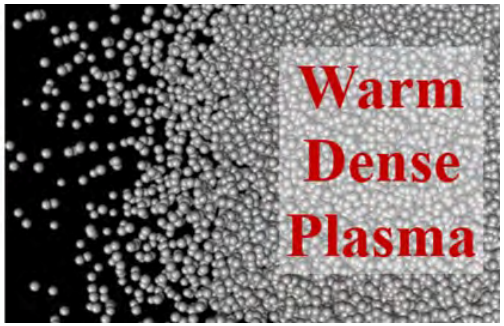
Computational Energy-Material-Interaction Lab (CEMIL)

DTRA Research Project: University Research Alliance (URA) on Nuclear Weapon Effects on Materials and their Behaviors under Extreme Conditions

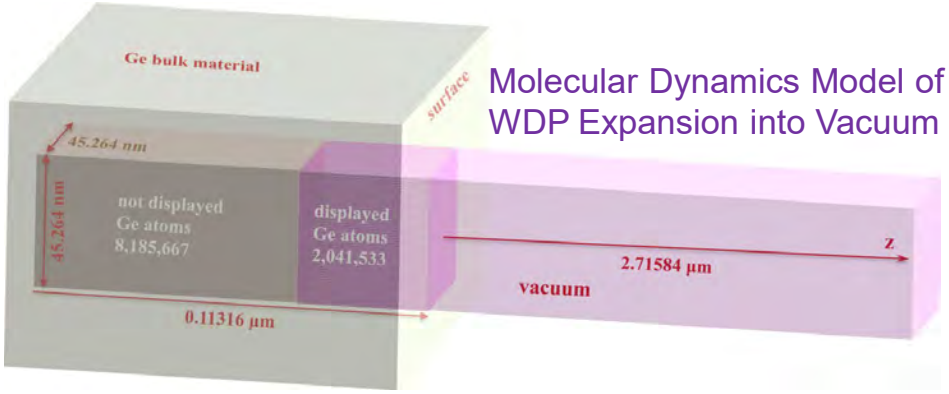




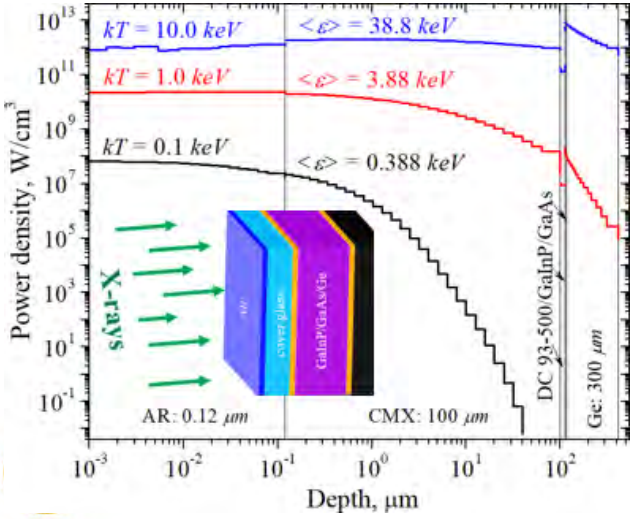
Source of X-rays & Multi-Layer Solar Cell Structure



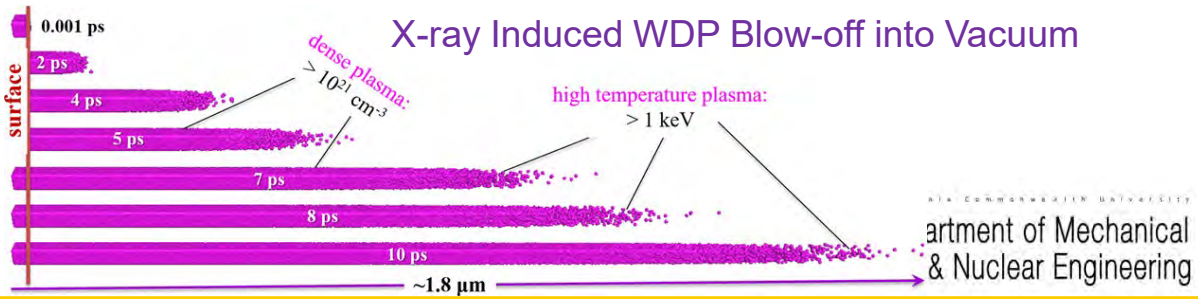
WDP Generation on Solar Panel



Molecular Dynamics Model of WDP Expansion into Vacuum



Power Density Profiles in Solar Cell Layers



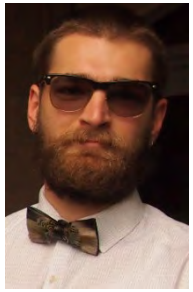
X-ray Induced WDP Blow-off into Vacuum

artment of Mechanical
& Nuclear Engineering

Dr. Phongikaroon's Research Team

- Funding sources (Nuclear Fuel Cycle and Detection Analyses):
  - DOE's Versatile Test Reactor – FY2018-2022
  - SBIR on Reference Electrode Testing Materials ($60k) – FY 2021
- Team members:
  - Ph.D. students

Dimitris Killinger



Expected graduation
May 2022

Logan Robinson

Expected Graduation
Dec 2024

Peggy Cawley

Expected Graduation
May 2025

Undergraduates:

- ✓ Maggie Anderson
- ✓ Kurtis Cox
- ✓ Mohammad Jaffar

Recent Publications:

- McDuffee et al., "Design and Control of a Fueled Molten Salt Cartridge Experiment for the Versatile Test Reactor," Nuclear Science and Engineering, 1-26 (2022)
- Killenger et al., "Investigation of the effects of cerium concentration and overpotential on the morphology and purity of uranium dendrites," Journal of Radioanalytical and Nuclear Chemistry 330 (3), 1155-1164 (2021)
- Andrews and Phongikaroon, "Electrochemical and Laser-Induced Breakdown Spectroscopy Signal Fusion for Detection of UCl_3-$GdCl_3$-$MgCl_2$ in LiCl-KCl Molten Salt," Nuclear Technology 207 (4), 617-626 (2021)
- Killinger and Phongikaroon, "Investigation of W, Ag, and Pt Quasi-Reference Electrode Stability in Molten NaCl-$CaCl_2$ with Ce (0)/Ce (III) as an Internal Reference Redox Reaction," Journal of The Electrochemical Society 168 (3), 036518 (2021)
- Woods et al., "Rapid dissolution of PuO_2 analytical samples using mediated electrochemical oxidation," Journal of Radioanalytical and Nuclear Chemistry 327 (2), 991-995 (2021)

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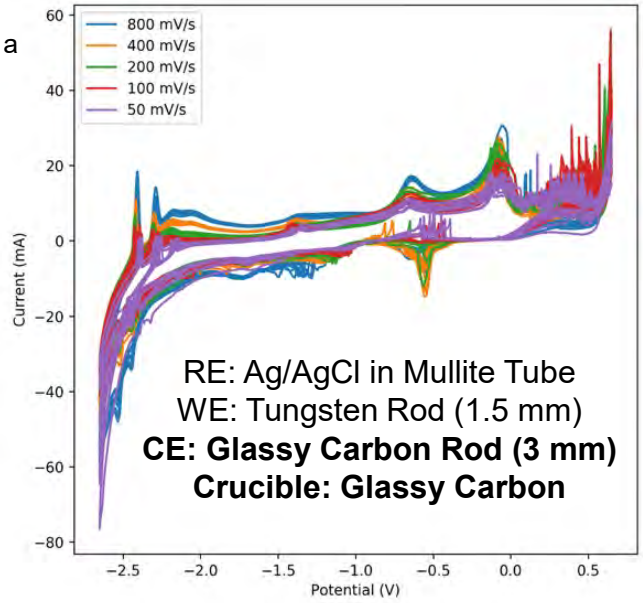
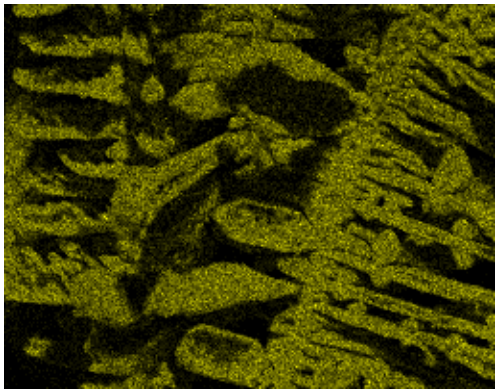
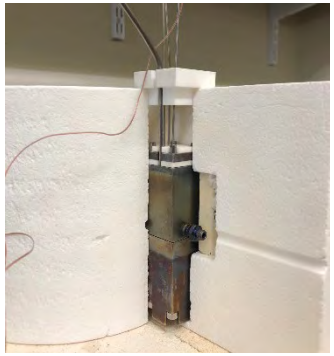
VCU Molten Salt Research

Electrochemically deposited uranium dendrite separated in LiCl-KCl-UCl_3 salt at 500 °C with a 50 mV (vs Ag(I)/Ag) overpotential.

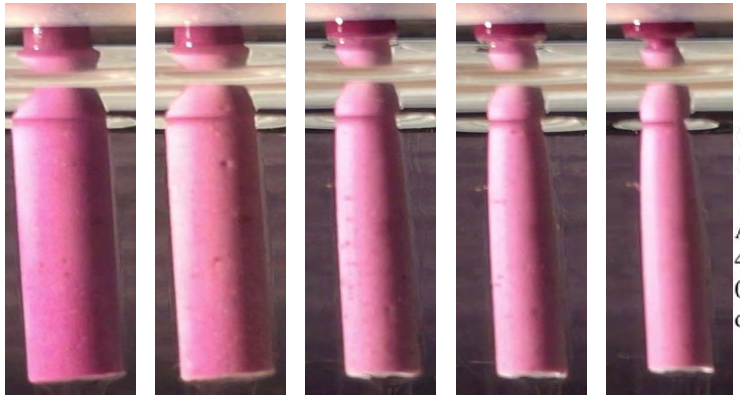




Water Wash (Methanol-Rinse) EDS elemental mappings of uranium.

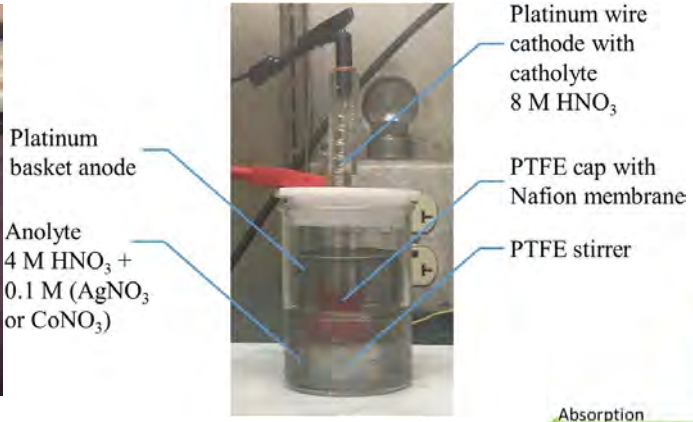


Spectroelectrochemical Cell

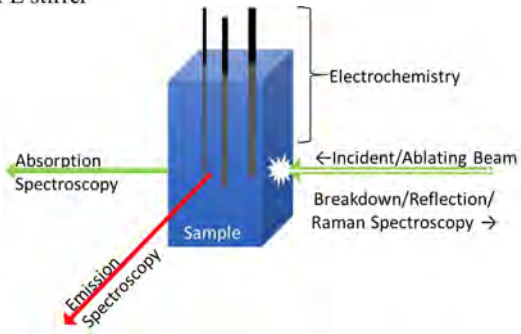


0 seconds | 30 seconds | 60 seconds | 90 seconds | 120 seconds

Visualization of UCl_3-LiCl-KCl salt in water over 120 sec (25°C)



Experimental setup of the PuO_2 dissolution process



Awards

GRADUATE STUDENTS

Dimitris Killinger

- 2021 Innovations in Nuclear Technology R&D Award Winners

Arturo Cabral

- 2021-22 Washington DC Local Section George P. Shultz and James W. Behrens Graduate Scholarship
- 2021 Young Professional Thermal Hydraulic Research Competition Winner

UNDERGRADUATE STUDENTS

Sierra A. Tutwiler

- 2021-22 NEUP IUP Scholarship Winner
- 2021-22 NRC Scholarship
- 2021-22 ANS John and Muriel Landis Scholarships

Ryan P. McGuire

- 2021-22 NRC Scholarship
- 2021-22 ANS John and Muriel Landis Scholarship

Study Abroad Program

- 2 week Practicum at the Technical University of Dresden
- 3-credits
- Sessions:
  - June 15-28, 2015 (8 students)
  - May 23 - June 5, 2016 (7 students)
  - June 19 – July 2, 2017 (7 students)
  - June 30 – July 15, 2018 (7 students)
  - June 16 – June 30, 2019 (6 students)

ANS@VCU Student Section

2022 Meetings

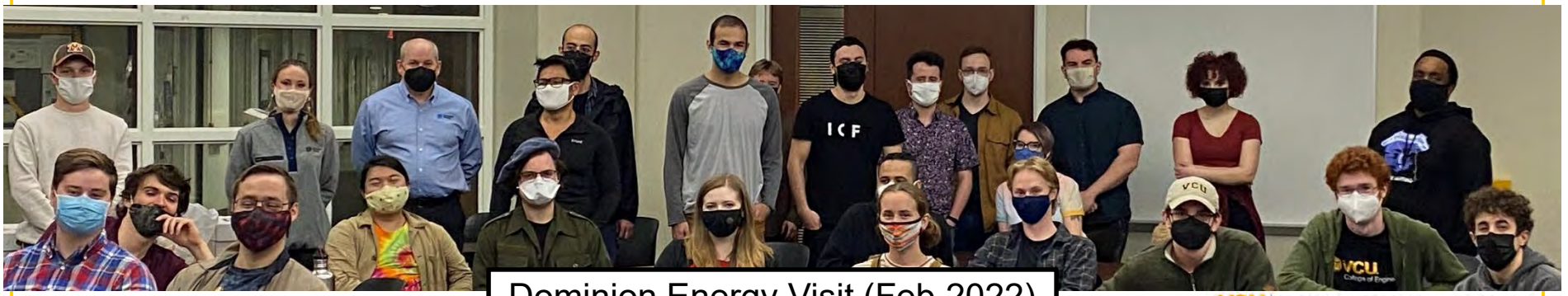
- Introduction to ANS and a Nuclear Career
- Zeno Power Informational Meeting
- Dominion Energy Informational Meeting
- April Wade (VNECA) “Legislation 101” (Planned)

Social Events

Board/Video Game Nights

Spring Picnuke with Local VA ANS (Planned)

Zeno Power Visit (Feb 2022)



Dominion Energy Visit (Feb 2022)

VCU Department of Mechanical & Nuclear Engineering

ANS@VCU Student Section

Outreach and Conferences

- Day on the Hill (2019)
- Girl Scouts (2019)
- ANS Student Meeting (2022!)
- Python Coding Workshop (2019)

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INMM VCU Chapter

- ~Four meetings per semester
  - Ultimate Frisbee Social
  - Grace Kier (Big Nuke Energy) “Women in Nonproliferation”
  - Nuclear Debate Competition
  - Milos Manic (VCU) “Machine Learning and Cybersecurity”
  - End of Year Social
  - William Newman (VCU) “Evolution of U.S. Nuclear Strategy”
  - Jeff Kaplow (William & Mary) “Nuclear Intelligence” – *postponed (COVID-19)*

- Collaborating with other VCU organizations
  - ANS
  - ASME
  - SWE
  - Physics Dept.
  - HSEP Dept.
  - Poli. Sci. Dept.

INMM AT VCU
INSTITUTE OF NUCLEAR MATERIAL MANAGEMENT

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Student Networks (NE focused students)

IAEA

KAERI

Penn State U

RPI

INL

ANL

U Michigan

Dominion Energy

DOE, DOD

NRC

Framatome

Huntington Ingalls

Porvair Filtration

NASA

Duke

GE

NCSU

Y-12

ORNL

U of Tenn

SRS

LLNL

LANL

Existing

Employed/Postdoc

Internship/Graduate Schools

Virginia Nuclear Energy Consortium Authority (VNECA)

Board of Directors

- Department of Mines, Minerals and Energy
- B&W
- Dominion
- Bechtel
- Newport News Shipbuilding
- Framatome,
- Flowserve
- Jefferson Lab
- American Nuclear Society
- Virginia Economic Development Partnership
- University of Virginia
- Virginia Polytechnic Institute
- George Mason University
- Virginia Commonwealth University
- Christopher Newport University
- George Washington University
- Virginia Community College System

Tom DePonty, VNECA Chair

VCU | Virginia Commonwealth University
Department of Mechanical & Nuclear Engineering

Virginia Nuclear Energy Consortium (VNEC)

- Established January 2015
- Board Members
  - VCU – Supy (Treasurer)
  - VT
  - Dominion Energy
  - NNS
  - Lightbridge
  - GE
  - Liberty University
  - UVA
- Chair: John Harrell – Dominion Energy

VNEC Legislative Success:

- ✓ During the 2021 Virginia Legislature, VNEC pursued a budget amendment for a planning grant to develop a nuclear research and innovation hub in Virginia. The planning grant is in the budget conference report for $100k.
- ✓ 2020 Legislature passed:
  - ✓ SJ 60 - Nuclear energy; advancement of nuclear energy research & exploration of economic opportunities
    - ✓ A resolution encouraging the advancement of nuclear energy research and the exploration of economic development opportunities related to nuclear energy
  - ✓ SB 828 - Carbon-free energy and clean energy; definition
  - ✓ SB 817 - Nuclear energy; considered a clean energy source
  - ✓ SB 549 & HB 1303 - Nuclear energy; strategic plan for overall goal of carbon-free energy

http://www.virginianuclear.org/

Thank you for your attention!