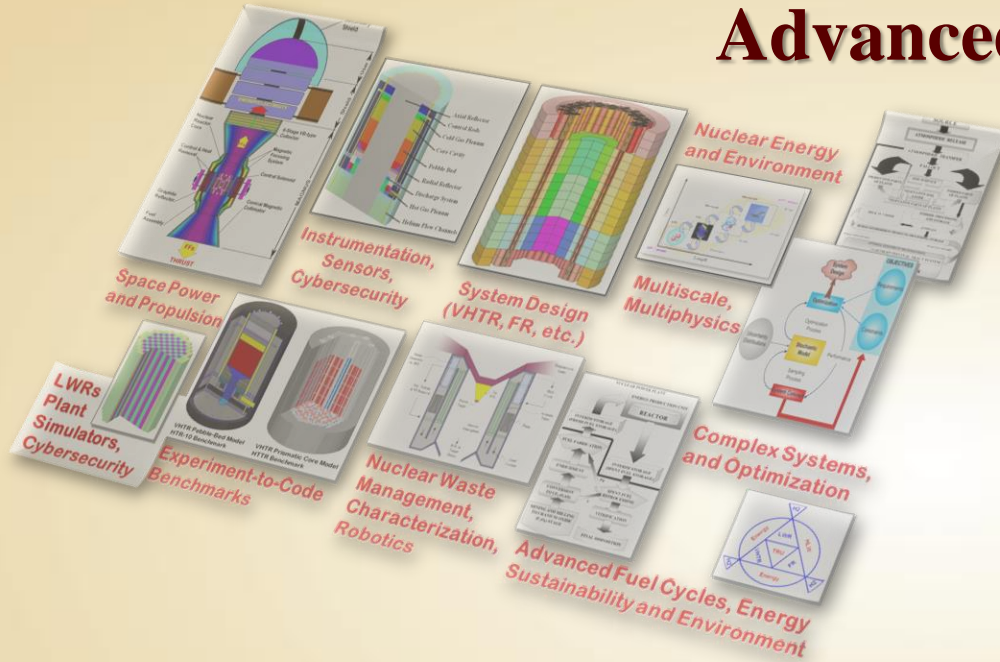


Advanced Energy Systems Research



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November 18 – 19, 2022, Georgia Tech Hotel & Conference Center, Atlanta, Georgia



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Opportunities in Non-proliferation R&D: GRADUATE WORKSHOP

- My path in the nuclear engineering field
- What are we interested in and why?
- Current research efforts and collaborations
- Our research team

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Opportunities in Non-proliferation R&D: GRADUATE WORKSHOP

My path in the nuclear engineering field



PI Profile

Dr. Pavel V. Tsvetkov, tsvetkov@tamu.edu 3

- **1989-1995 - Russia – BS/MS in nuclear engineering** (accelerator driven systems for waste incineration, environmental aspects)
- 1996-1997 - TU Delft fellowship – Reactor Physics/advanced reactors
- 1998-1999 - Russia + PNNL/Microsoft (UK) – Cyberphysical security, data science and engineering
- **1999-2002 - Texas, US – PhD in nuclear engineering** (direct energy conversion, got introduced to experiments and accelerator lab)
- 2002-2004 - Texas, US - visiting positions and research jointly with Sandia labs (direct energy conversion, advanced reactors)
- **2005 - Texas A&M University – academic career** (advanced energy systems and applications development and demonstration)

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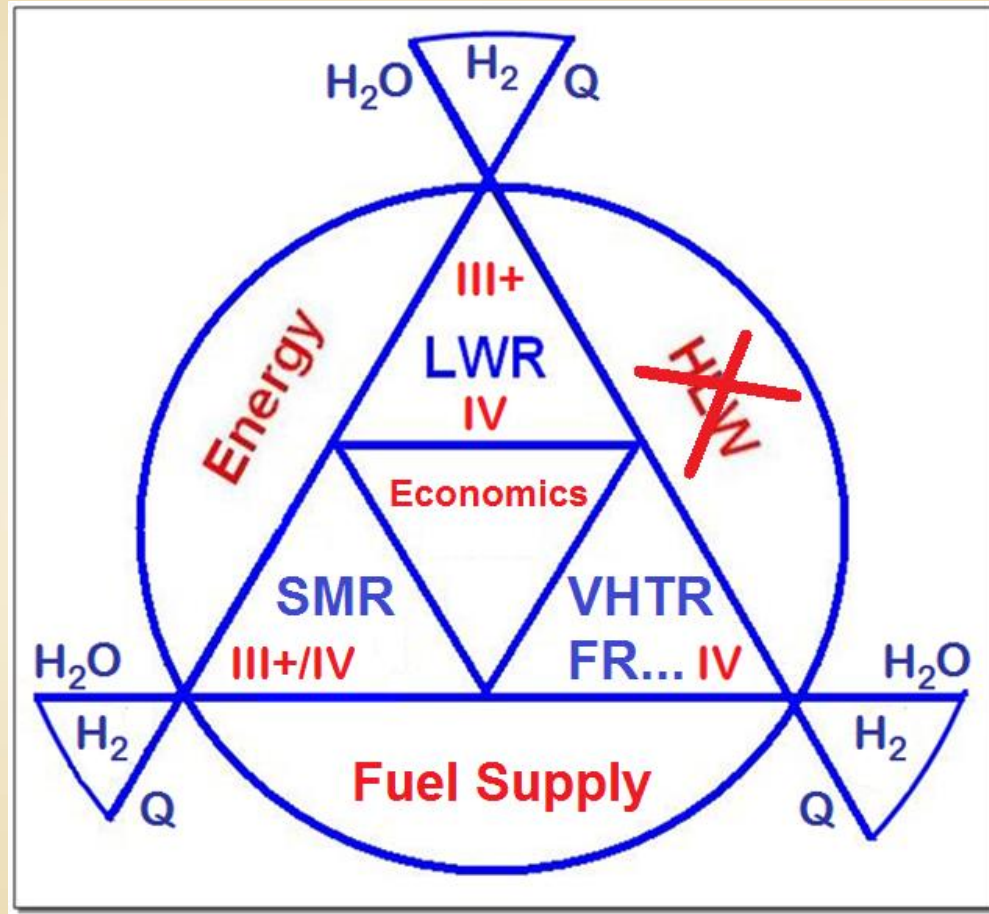


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What are we interested in and why?

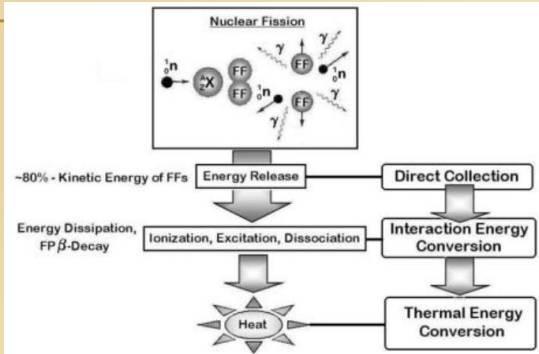
Nuclear energy as a sustainable energy source



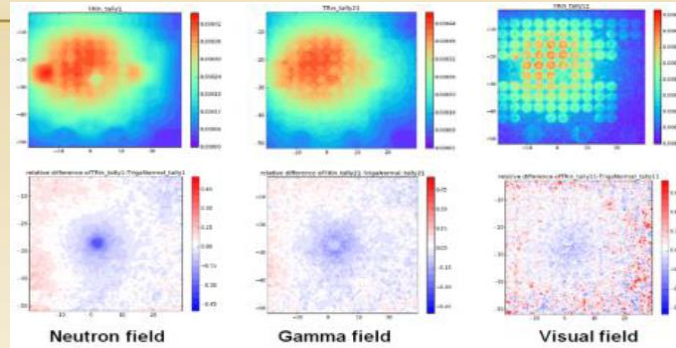
We are interested in system approach in design and applications!

Advanced Energy Systems Lab

Energy Conversion



3D Mixed Field Reconstruction Methods

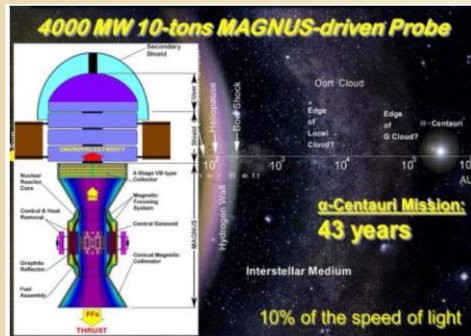


System Simulators & Cybersecurity

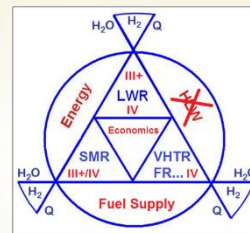


Direct Energy Conversion (DEC)

Design & Optimization



Global Surveillance and remote sensing



Environmental impact and waste

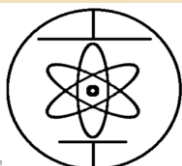
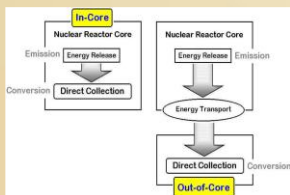
Systems & Applications

- VHTR, Deep Burn HTR
- Fast Reactor (SFR, LFR, other)
- FHR, MSR
- SMR/microreactors and applications
- Waste Management, Robotics,
- Special purpose systems

Commercial Systems, microreactors

Advanced Data Science and Sensing and I&C Engineering

Collaborators

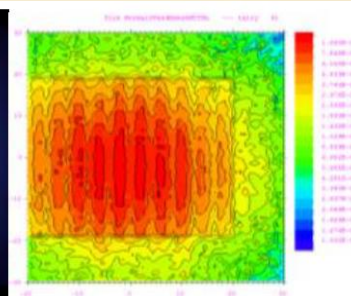
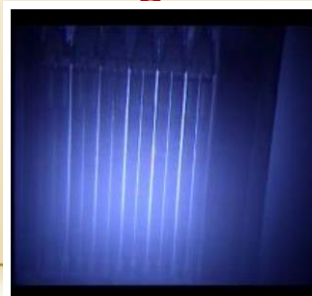


DEC3



NuGen

DEC1/DEC2 (Prometheus)



- INL, ORNL, SNL, PNNL, LANL, BNL
- Westinghouse, Sothorn
- "NuGen", "Prometheus"
- GT, OSU, ACU, UT, VCU, UTK, UM, MIT, UW-M, UCB, others

Current research efforts and collaborations

PI Profile



Dr. Pavel V. Tsvetkov, tsvetkov@tamu.edu 6

- Design methods and applications
- System design
- System characterization
- Experimental demonstration in prototypic conditions
- Applications focusing on enabling technologies and contemporary needs

We collaborate with INL, PNNL, SNL, LANL, NASA centers, and many vendors as well as utilities and consulting companies...

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Enabling Technologies and Innovation R&D at Texas A&M University

Thrust Areas 1 and 3: Multi-Modal Global Surveillance

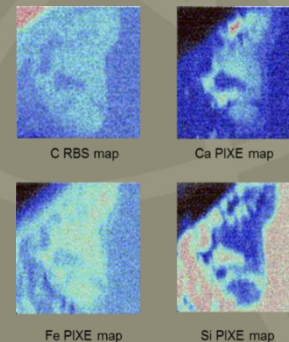
Mario Mendoza*, Pavel Tsvetkov (Texas A&M)

Troy Guy, Michael Lewis (NanoRacks, LLC)



Thrust Area 2: Methods for Ion Interrogation and Signature Analytics and Development

Miguel Pena*, Lin Shao, Frank Garner (Texas A&M)





TEXAS
The University of Texas at Austin



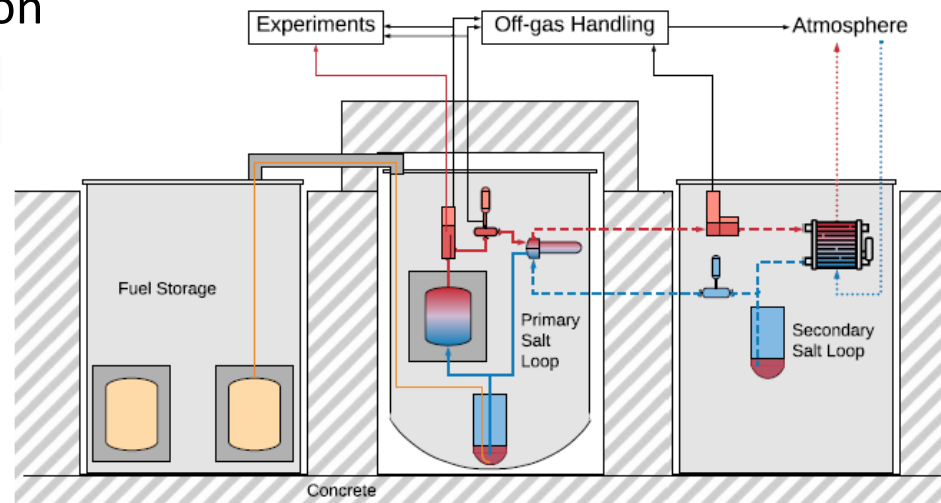
Molten Salt Research Reactor Consortium: Build research reactor in Texas by 2025!

Build a university research and test reactor:

- Molten salt cooled
- Liquid fueled
- $\leq 1\text{MW}_{\text{th}}$
- Research reactor
- Can investigate the removal of fission fragments
- Needs salt sampling or testing loop
- Can be built rapidly (5 years)

TAMU team roles:

Design (Tsvetkov and team lead)
Thermal Management (Kimber)
Salt Management (McDeavitt)
Materials Needs/PIRT (Raiman)



2020

2021

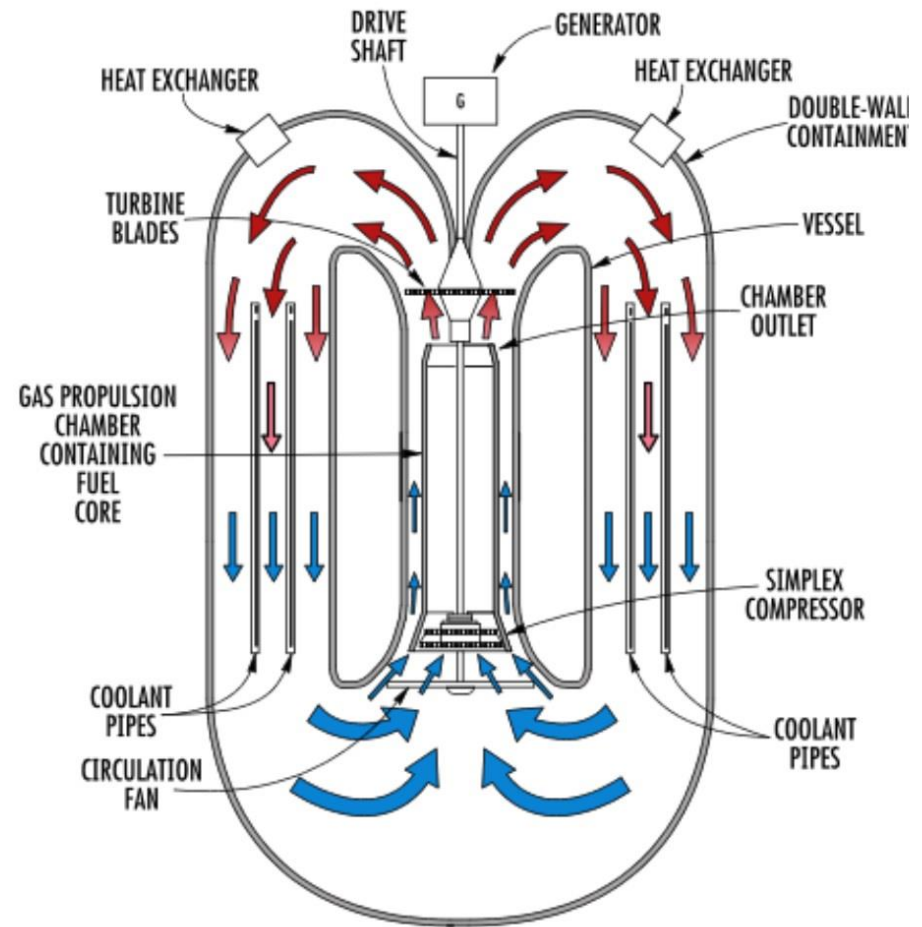
2022

2023

2024

2025

NuGen Design and Performance Concept



NuGen engine performance

Patent is pending, details of the core and certain other innovative features are not shown

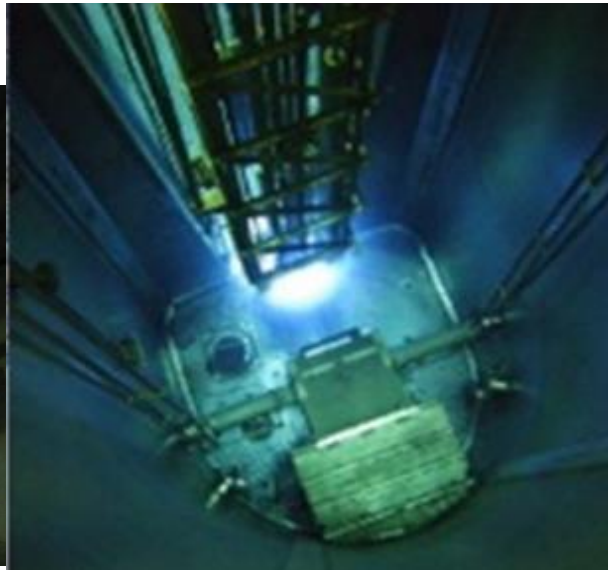
Novel reactor instrumentation

- Develop an optical fiber based gamma thermometer (OFBGT) in order to determine the power distribution in a reactor core by using statistical data analytic methods
 - An OFBGT measures the ΔT along the axial length of the sensor which can be used to infer core power distribution using response functions generated by MCNP (ΔT is measured by optical fiber)
 - We plan to demonstrate this measurement technique in both the Ohio State University Research Reactor (OSURR) and the Texas A&M TRIGA Reactor
- Participants: The Ohio State University, Texas A&M University, INL

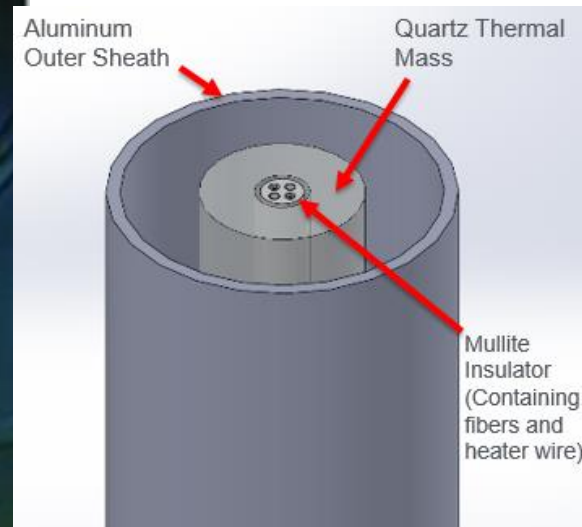
OSURR



TAMU TRIGA



OFBGT



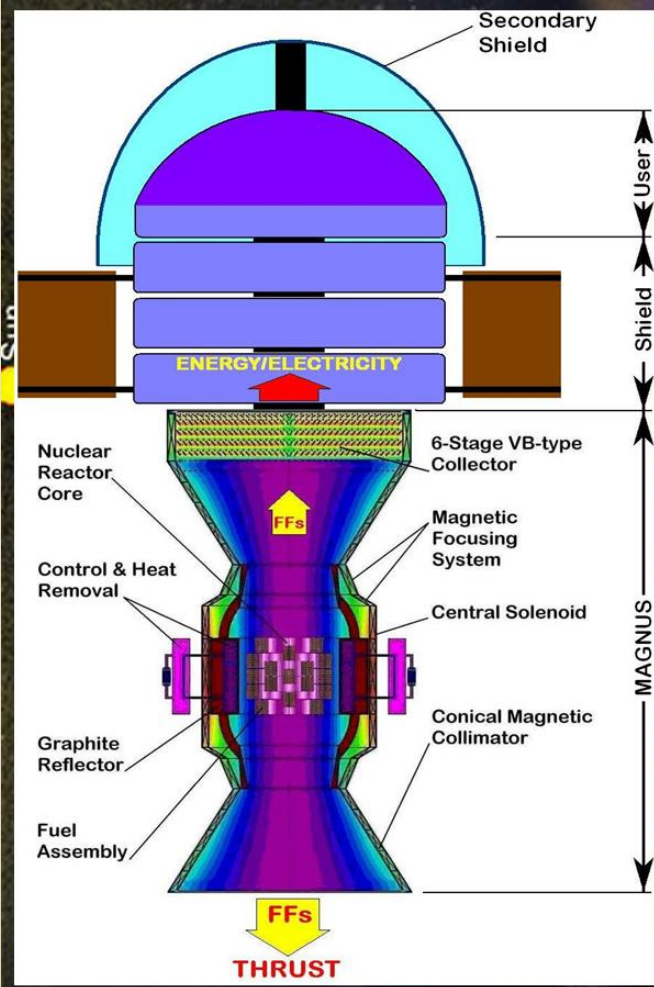
Current research efforts and collaborations

PI Profile



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4000 MW 10-tons MAGNUS-driven Probe



α -Centauri Mission:
43 years

10% of the speed of light

Our research team

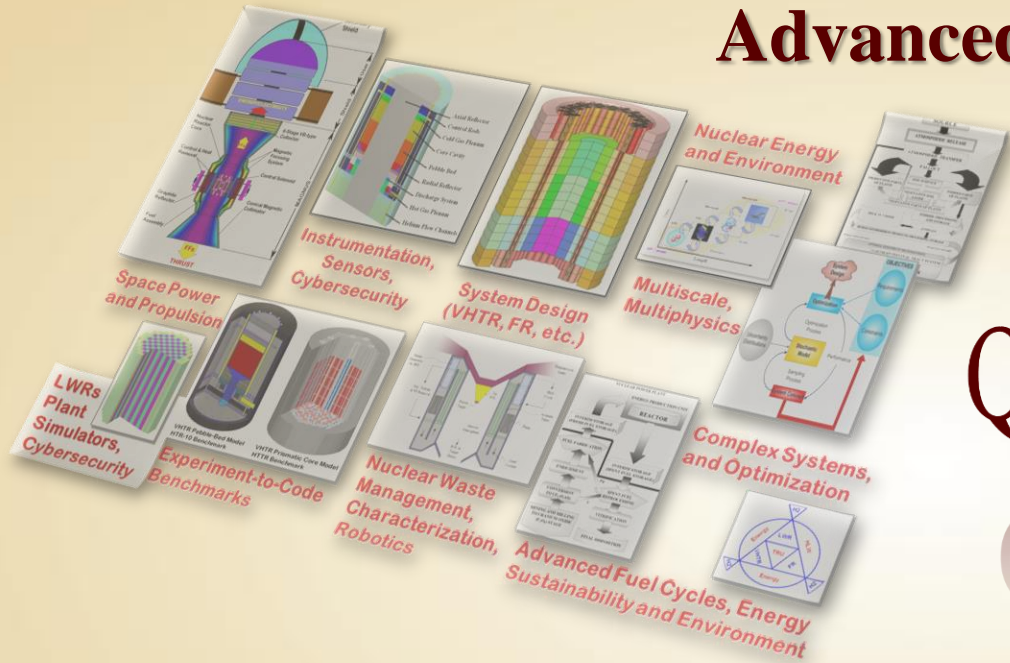
PI Profile



Dr. Pavel V. Tsvetkov, tsvetkov@tamu.edu 12

- **Master students - 5**
 - Miguel Avalos – data science and engineering for security applications
 - Gabriel Crocombe – advanced reactor design
 - Hui Yu Hsieh – operation of integral small modular reactors
 - James Passmore – advanced reactor design methods
 - John Valverde – operation of advanced reactors and fuel cycle considerations
- **Ph.D. students, currently - 9**
 - Thabit Abuqudaira – coupled thermal hydraulics/neutronics modeling
 - Tyler Gates – instrumentation and control and human-machine interface
 - Ronald Gatchalian – reactor physics of subcritical systems
 - Avery Guild-Bingham – remote sensing methods for security applications
 - Matt Johnson – power reconstruction methods for research reactors
 - Ryan Kelly – artificial intelligences methods in core design/optimization
 - Mario Mendoza – artificial intelligence methods in advanced reactor operations
 - Scott Walls – nuclear waste management using advanced reactors
 - Dan Watts – instrumentation and control and system security
- **Undergraduate students, typically 4 – 5 per semester**
 - Davis Golden, Rowan Johnson, Austen Oscans, Christopher Lemke

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QUESTIONS?

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