Introduction to

University of Florida
Nuclear & Radiological Engineering (NRE) Department
(Students, Faculty & Research)

Dr. Alireza Haghighat (haghighat@ufl.edu)
Professor and Chairman
(352) 392-1401 Ext. 306

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ATLANTIC OCEAN
Dothan
Chattahoochee R.
Escambia R.
Crestview
Milton
Ferry Pass
Pensacola
Pensacola Beach
Ft. Walton Beach
Niceville
Destin
Gulf Islands Nat. Seashore
Marianna
De Funiak Springs
Panama City
Panama City Beach
Apalachicola R.
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Tallahassee
L. Seminole
Valdosta
Perry
Lake City
Alachua
Gainesville
Macclenny
Jacksonville
Orange Park
Yulee
Fernandina Beach
Amelia I.
Timucuan Ecological & Historic Preserve
Fort Caroline Nat. Mem.
Jacksonville Beach
St. Augustine
St. Johns R.
Fort Matanzas Nat. Mon.
Palatka
Palm Coast
Ormond Beach
Daytona Beach
Port Orange
New Smyrna Beach
L. George
Silver Springs
Ocala
De Land
Deltona
Sanford
Canaveral Nat. Seashore
Crystal River
Homossassa Springs State Wildlife Park
Lady Lake
Leesburg
Mount Dora
Altamonte Springs
Titusville
Kennedy Space Center
Ocoee
Clermont
Orlando
L. Buena Vista
Walt Disney World
Kissimmee
St. Cloud
Cocoa
Cocoa Beach
Merritt Island
Melbourne
Palm Bay
Spring Hill
Bayonet Point
Port Richey
New Port Richey
Tarpon Springs
Palm Harbor
Plant City
Lakeland
Tampa
Davenport
Haines City
Winter Haven
Lake Wales
Clearwater
Indian Shores
Treasure Island
St. Pete Beach
Brandon
Pinellas Park
St. Petersburg
Tampa Bay
Ellenton
DeSoto Nat. Mem.
Bradenton Beach
Longboat Key
Bradenton
Sarasota
Sebring
Yeehaw Junction
Sebastian
Vero Beach
Fort Pierce
Port St. Lucie
Stuart
Hobe Sound
Jupiter
Venice
North Port
Port Charlotte
Punta Gorda
Lake Okeechobee
Palm Beach Gardens
W. Palm Beach
Belle Glade
Wellington
Lake Worth
Lehigh Acres
Boynton Beach
Delray Beach
Boca Raton
Pompano Beach
Ft. Lauderdale
Hollywood
Bal Harbour
Miami Beach
Miami
Coral Gables
Hialeah
Miramar
Weston
Plantation
Coral Springs
Immokalee
North Fort Myers
Fort Myers
Cape Coral
Sanibel I.
Fort Myers Beach
Bonita Springs
Golden Gate
Naples
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Marco Island
Everglades National Park
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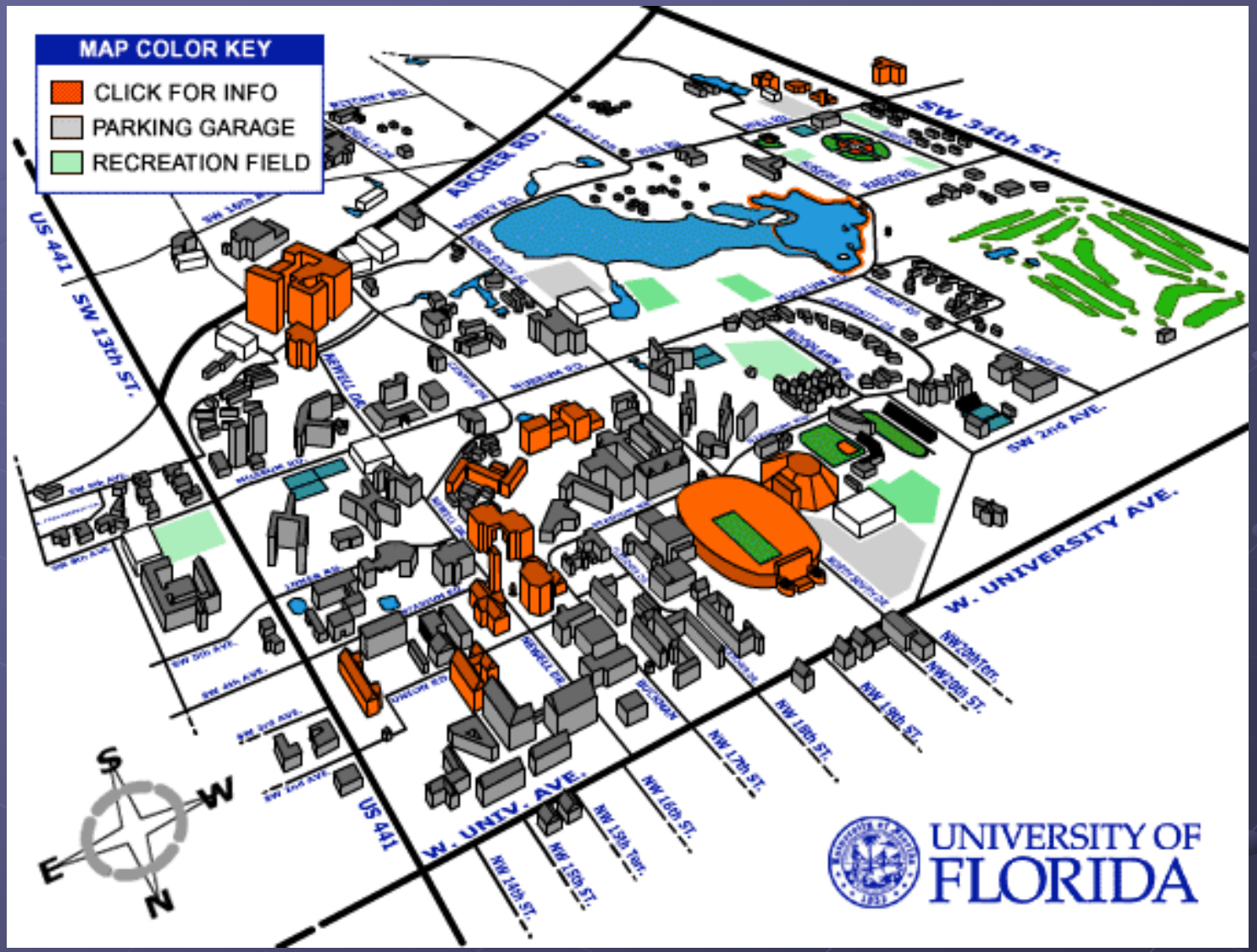
Kendall
Biscayne Nat. Park
Florida City
Key Largo
Florida Keys
Islamorada
Marathon
Key West
Dry Tortugas National Park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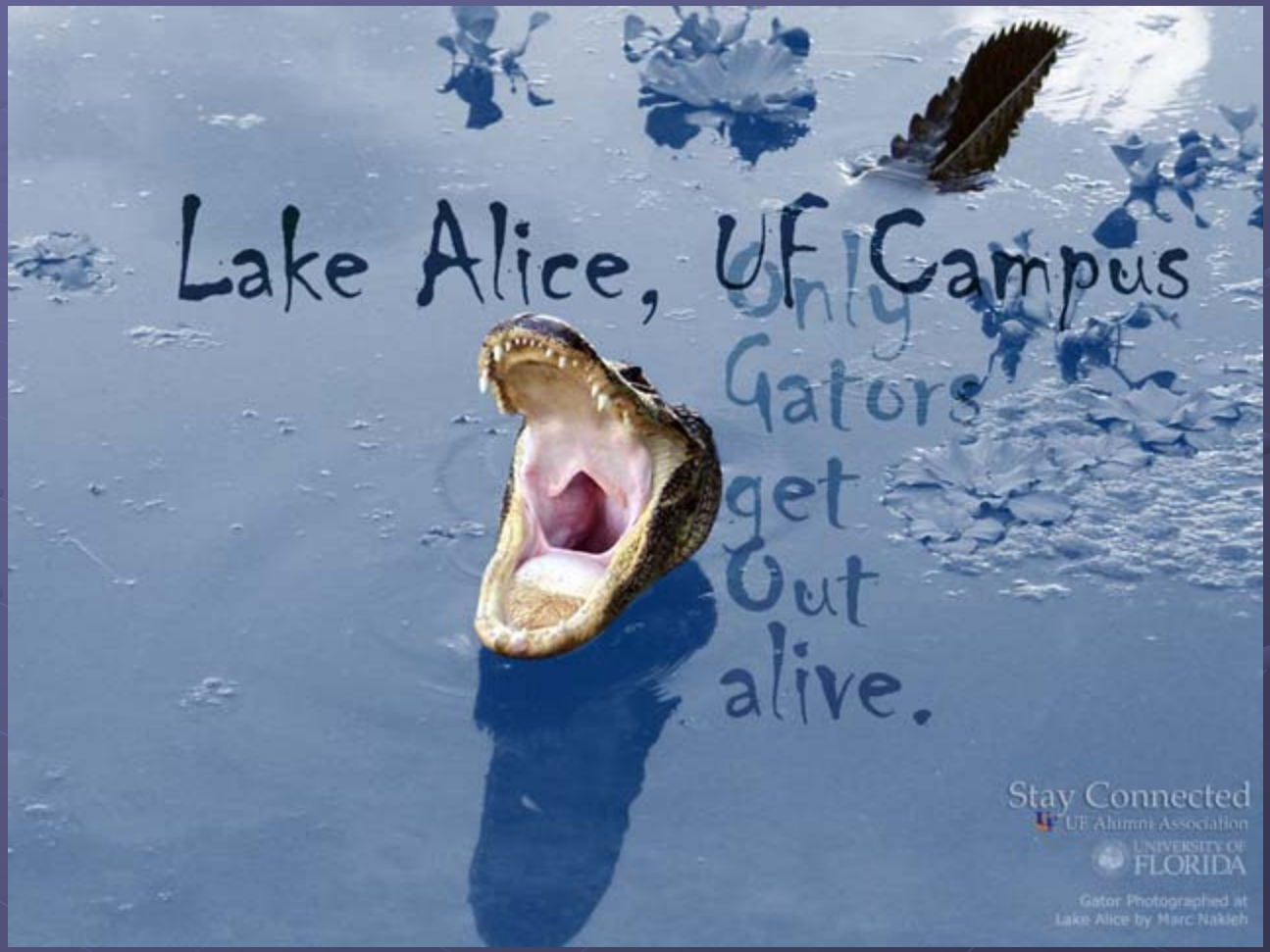
Lake Alice, UF Campus
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Gators
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UF Alumni Association
UNIVERSITY OF
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Gator Photographed at
Lake Alice by Marc Nakleh

University of Florida

It currently ranks among the top five universities in the nation in the number of degrees and programs available to its nearly ~49000 students.

College of Engineering (COE)

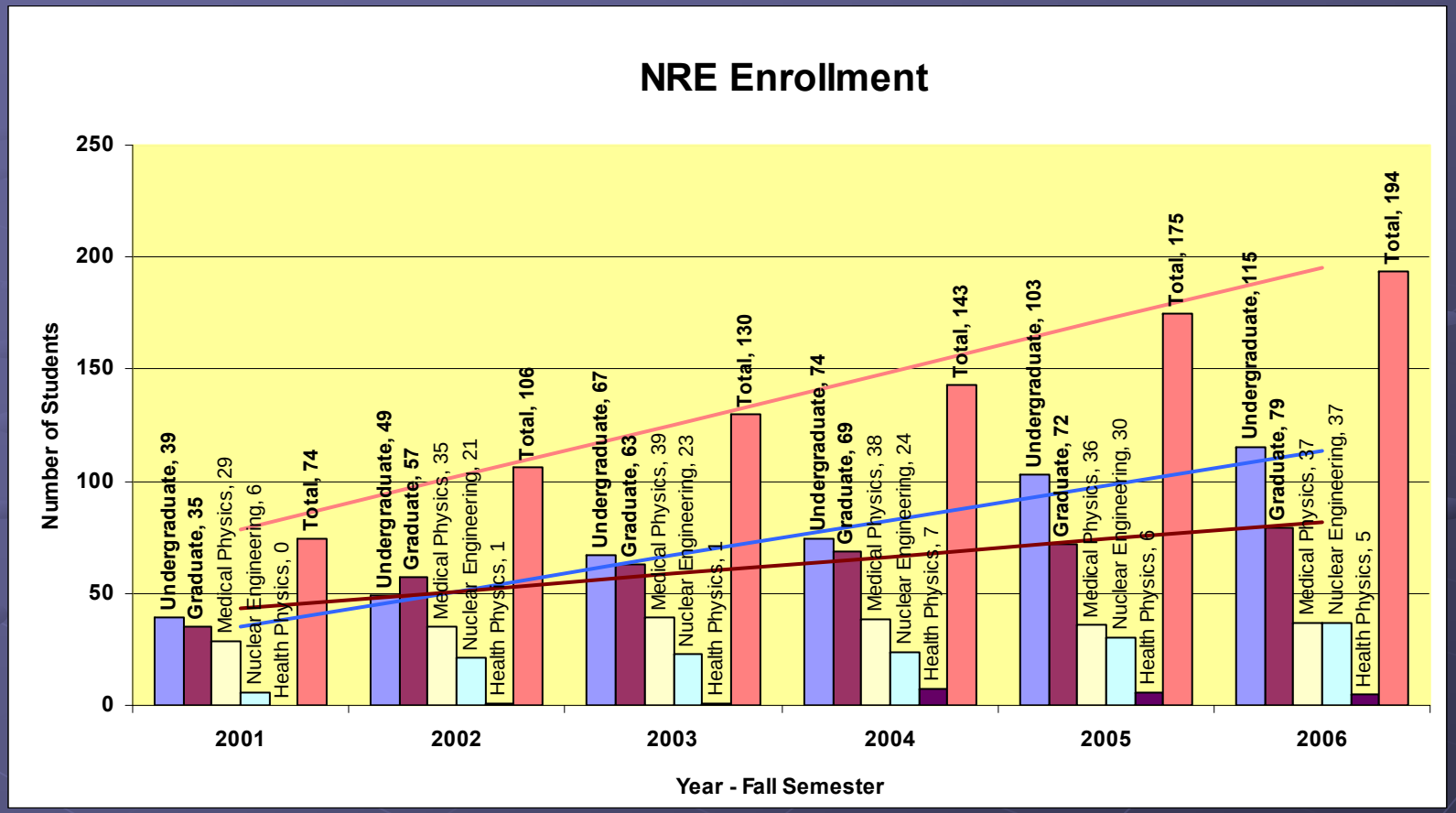
- 11 departments; 280 faculty
- Number of undergraduate students is ~5000
  - Incoming freshman class for the last two years has an average SAT of ~1310
- Number of graduate students is ~2000

Degrees offered at NRE

- **B.S.**
  - Nuclear Engineering (NE) (ABET accredited)
  - Nuclear and Radiological Sciences (NRS)

- **M.S. & Ph. D.**
  - Nuclear Engineering
  - Medical Physics [CAMPEP (Commission on Accreditation of Medical Physics Educational Programs) accredited]
  - Health Physics

- Developing a new PhD Track
  - Computational Medical Physics (CompMP)


NRE Enrollment
Number of Students
250
200
150
100
50
0
2001
2002
2003
2004
2005
2006
Year - Fall Semester
Undergraduate, 39
Graduate, 35
Medical Physics, 29
Nuclear Engineering, 6
Health Physics, 0
Total, 74
Undergraduate, 49
Graduate, 57
Medical Physics, 35
Nuclear Engineering, 21
Health Physics, 1
Total, 106
Undergraduate, 67
Graduate, 63
Medical Physics, 39
Nuclear Engineering, 23
Health Physics, 1
Total, 130
Undergraduate, 74
Graduate, 69
Medical Physics, 38
Nuclear Engineering, 24
Health Physics, 7
Total, 143
Undergraduate, 103
Graduate, 72
Medical Physics, 36
Nuclear Engineering, 30
Health Physics, 6
Total, 175
Undergraduate, 115
Graduate, 79
Medical Physics, 37
Nuclear Engineering, 37
Health Physics, 5
Total, 194

Scholarships/Fellowships

- Department
  - Elite Nuclear Engineering ($6000 per year; starting as a sophomore or junior)
    - 2 Florida Power Light
    - 2 Progress Energy Florida
    - 2 Southern Nuclear Operation Company
    - 1 KAPL
  - Private “named” ($1000 - $2000 per year)

    Undergraduate
    - Pagano
    - Schessow

    Graduate
    - Swander
- Others
  - ANS
  - College of Engineering, UF
  - DOE
  - DOE-AFCI
  - DOE-Navy
  - NANT (INPO)

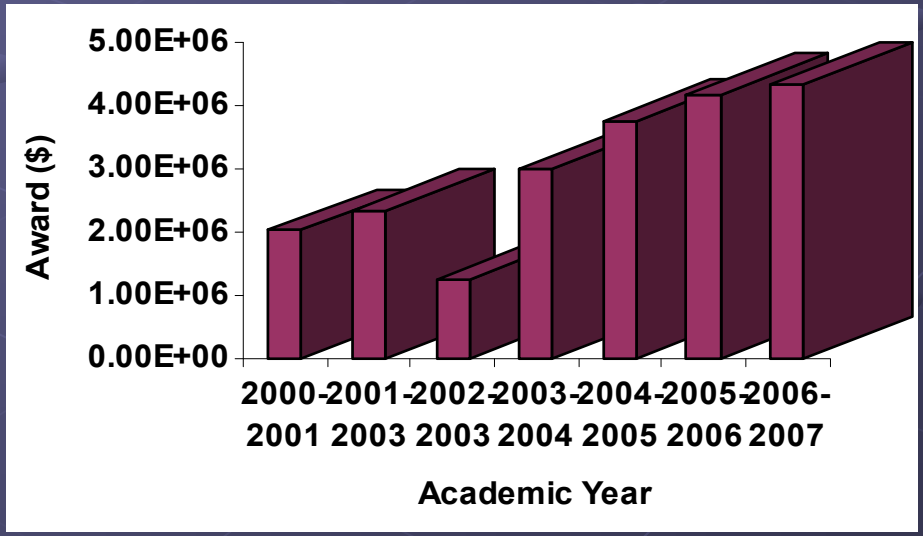
Research Activities

- Homeland Security & Nondestructive Detection
- Medical
- Nuclear Power
- Space Nuclear Propulsion

Research Projects & Scholarships/Fellowships

(~$4,750,750)

NE = ~24.3%, MP+HP = ~41.5%, INSPI = ~3.9%, UFTR=~9.6%, FINDS = ~15.5% Fellowships + grants = ~5.3%



NRE Faculty

Research Interests

Dr. Anghaie (Prof.) (Director of INSPI) (anghaie@ufl.edu): Reactor design, Fluid dynamic simulation, thermal hydraulics, nuclear materials, Inverse transport simulation **(NE + MP)**

Dr. James Baciak (Assistant Prof.) (jimmer@ufl.edu)- Radiation measurements, room temperature gamma-ray spectroscopy, radiation instrumentation, scintillation detectors, compound semiconductor materials, national security - nuclear nonproliferation, active and passive interrogation, gas detectors. **(NE + MP)**

Dr. Wesley Bolch (Prof.) (Grad. Coordinator) (HP Coordinator) (wbolch@ufl.edu): Assessment of internal organ dose from external and internal radiation sources, use of medical images for improved anatomic modeling during radiation transport simulations, and radiation bioeffects at the molecular level. **(HP + MP)**

Dr. Rebecca Detwiler (Research Assistant Professor) (rdetwiler@ufl.edu) Evaluation and enhancement of radiation detection equipment, simulation of man-made and natural effects on neutron background and field detection, and providing training for DOE emergency response facilities on detection equipment. (**NE – Homeland Security**)

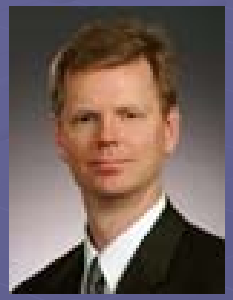
Dr. Edward Dugan (Associate Prof.) (Undergrad. Coordinator) (edugan@ufl.edu) - Radiation transport, Monte Carlo analysis, reactor analysis and nuclear power plant dynamics and control, space nuclear power and propulsion, and radiographic imaging techniques applied to non-destructive examination **(NE)**

Dr. David Gilland (Associate Prof.) (gilland@ufl.edu): Medical imaging, nuclear medicine imaging, single photon emission computed tomography (SPECT), positron emission tomography (PET), medical image processing, image reconstruction from projections, medical image evaluation using receiver operating characteristic (ROC) analysis. **(MP)**

Dr. Alireza Haghighat (Prof.) (Chairman) (haghighat@ufl.edu) - Particle transport methods and their applications, parallel computing, Monte Carlo methods, reactor physics, perturbation techniques, simulation and design of reactors and nondestructive devices. **(NE + MP)**

Dr. Hintenlang (Associate Prof.) (Coordinator Of MP) (dhinten@ufl.edu) : Clinical applications of radiation imaging and dosimetry. Currently focused on the development of techniques to accurately quantify and minimize pediatric and mammographic doses while optimizing image quality. Development of optimization techniques for state-of-the-art diagnostic imaging modalities. **(HP + MP)**

Dr. Sanjiv Samant (associate Prof.) (samant@ufl.edu) Radiation therapy physic, megavolt x-ray imaging, detector design, medical image processing, Monte Carlo simulation, dosimetry. **(MP)**



Dr. Glenn Sjoden (Associate Prof.)(sjoden@ufl.edu)- Particle transport and numerical methods, nuclear systems analysis: medical, power generation, defense programs, NDT, and detection. Also convective heat transfer, computational fluids, and high performance computing applications. **(NE + MP)**

James Tulenko (Prof.) (tulenko@ufl.edu): Nuclear fuel cycle, radioactive wastes, reactor analysis, engineering application of radioisotopes, robotics, intelligent databases, system analysis **(NE).**

Dr. William Vernetson (Associate Engineer) (Director of UFTR) (vernet@ufl.edu): Utilization of nonpower reactors, reactor operations and training, nuclear power plant systems, reactor safety and risk assessment, neutron activation analysis, criticality analyses and evaluations **(NE + HP).**

Affiliate Faculty

Manuel Arreola	Radiology, Assistant Professor
Frank Bova	Brain Institute, Professor
James Dempsey	Radiation Oncology, Assistant Professor
Jatinder Palta	Radiation Oncology, Professor
Tony Manacuso	Radiology, Professor & Chair
Nancy Mendendall	Radiation Oncology, Professor & Chair
Bill Properzio	Director of EHS
Katherine Scott	VA, Physicist
Shalindra Shukla	VA, Physicist
Siyong Kim	Radiation Oncology, Physicist

NRE Performance
(fall 2001 – fall 2006)

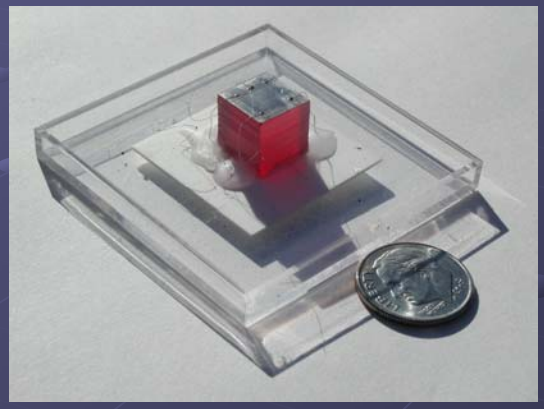
- Student enrollment has increased by a factor of ~2.6
- Sponsored research awards have doubled
- Our teaching load of ~3 is high
- Graduate student per faculty is high: ~8-9

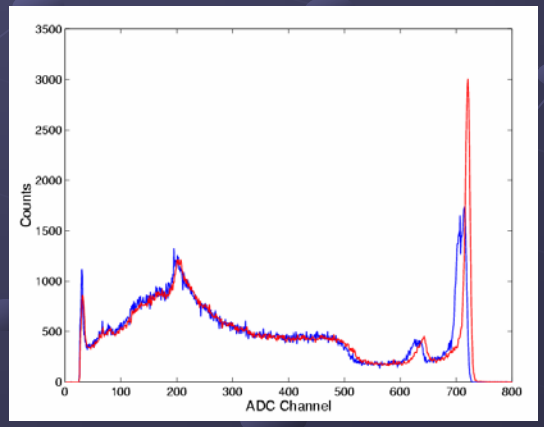
Space Nuclear Power & Propulsion (Samim Anghaie; INSPI)

- Measurement and Quantification of Water Radiolysis in the Mixed Radiation Field
- Development and Hot Hydrogen Testing of Mixed Uranium-Refractory Carbide Fuels for Nuclear Thermal Propulsion Applications
- Design of Test Section for NASA Hot Hydrogen Test Facility
- Space Nuclear Thermal Propulsion Fuels and Materials
- Development and Testing of Foam Nuclear Fuel Matrix

Radiation Measurements and Advanced Detector Systems (James Baciak; Progress Energy ADRAD)

- Scintillator Detection System for ASEDRA
- HgI2 Detectors for Room Temperature g-Ray Spectroscopy
- HgI2 Crystal Characteristics (Measurement of charge transport properties in a-crystallographic direction)
- BiI3 Gamma-Ray Spectrometers
- LaBr3 Compton Telescope
- High Pressure Xe Gas Utilizing Pixelated Electrodes for High Resolution g-Ray Spectroscopy



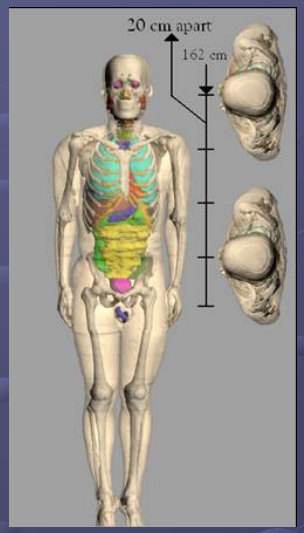


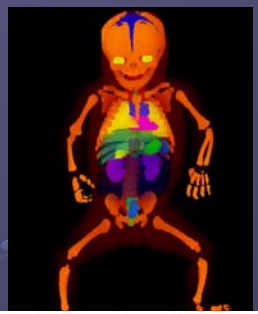
Advanced Laboratory for Radiation Dosimetry Studies (ALRADS) (W. Bolch)

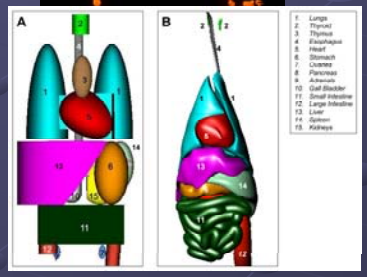
- *Bone Imaging and Dosimetry (BID) Project*
- *3D Image-Based Skeletal Dosimetry*
- *Bone Imaging and Dosimetry (BID)*
- *Pediatric Organ Dose (POD) Project*

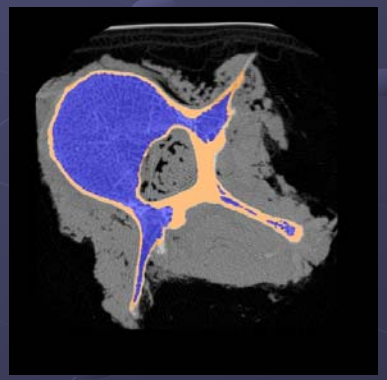
- *Pediatric Organ Dose (POD)*
- *Pediatric Organ Dose (POD)*
- *Voxel Phantoms for Evaluation of Rapid Screening Methods Following Radiological Contamination Events*

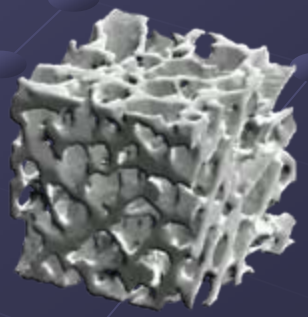
- *Radionuclide Therapy for Pediatric Bone Cancer*









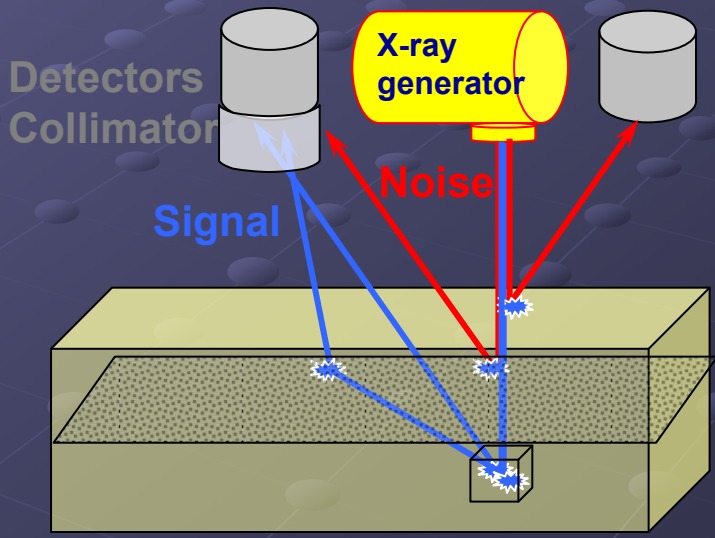


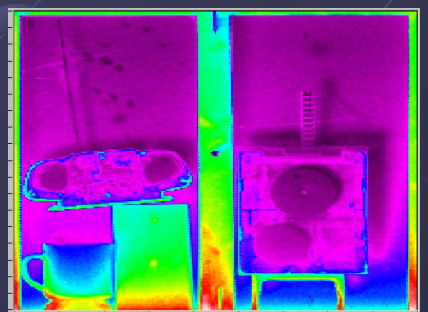
X-Ray Backscatter Radiography by Selective Detection (RSD) (Ed Dugan; SXI Lab)

- **Land mine detection (U.S. Army)**
- **Flaw detection (DOE, Lockheed & NASA)**
  - Cracks and voids
  - Delaminations
  - Corrosion

  Aerospace components; oil and gas pipelines; Rx components; concrete

  - **Materials**
    - Aluminum and Titanium Alloys (aircraft components)
    - Reinforced carbon-carbon composites
    - **Space shuttle external tank foam thermal insulation**
    - Honeycomb structures (aircraft wings)
    - Steel foil thermal insulation
    - Laminates
    - Concrete
- **Security applications**



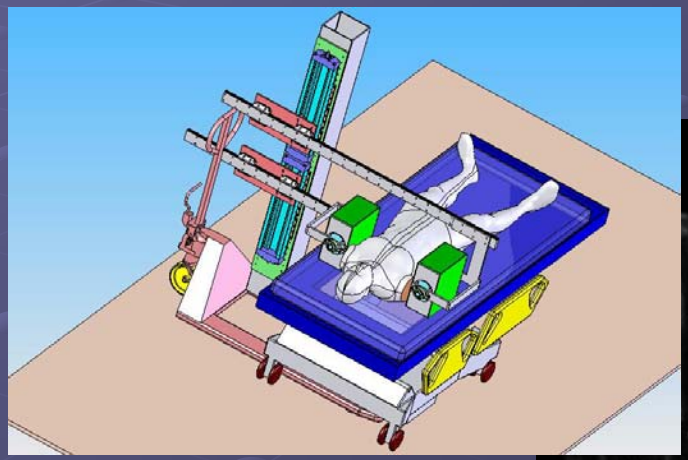


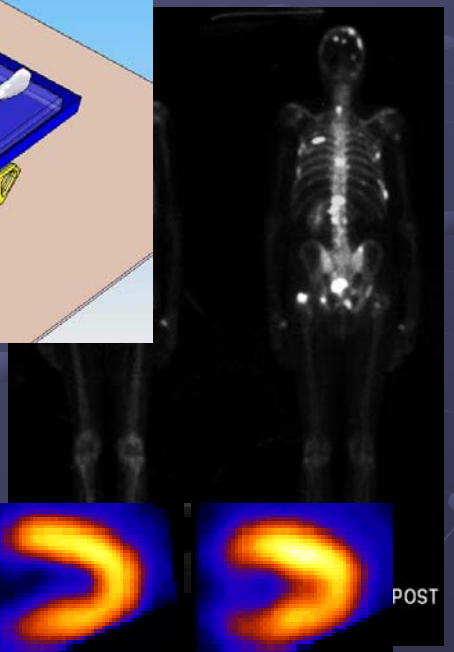
Medical Imaging using Nuclear Medicine (David Gilland)

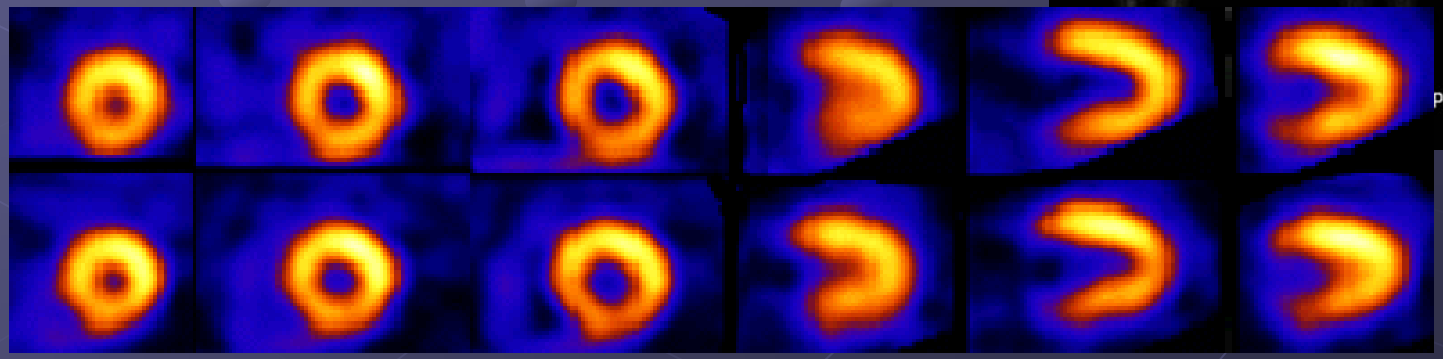
3D nuclear medicine imaging

SPECT: single photon emission computed tomography

PET: positron emission tomography

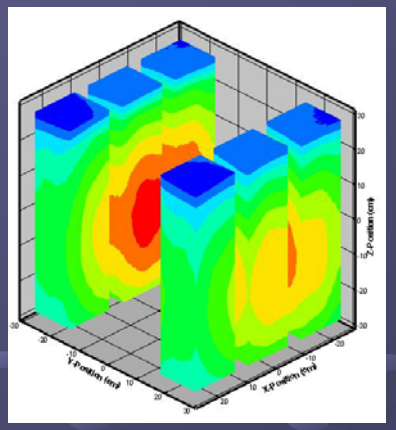


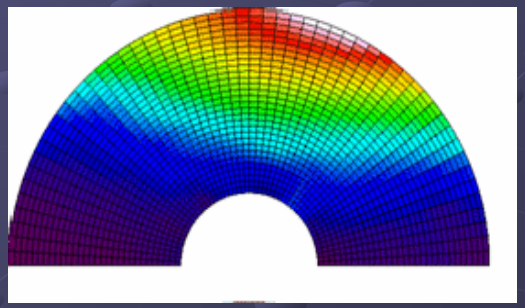


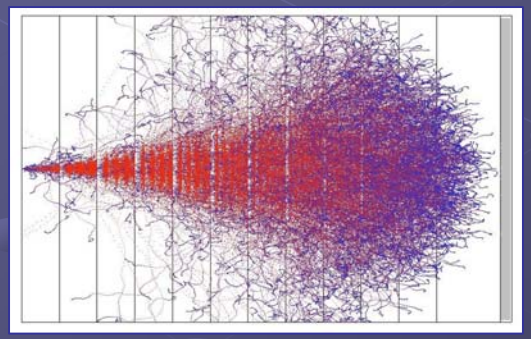


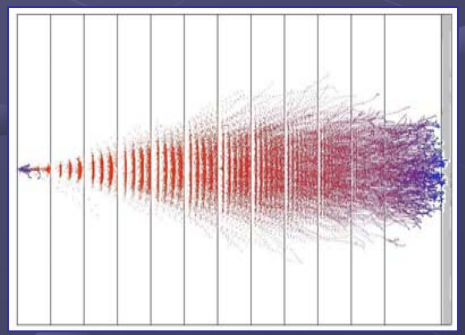
A. Haghighat (UFTTG)

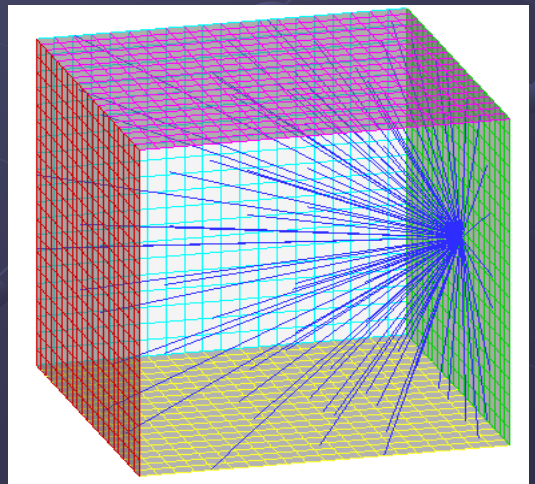
- Acceleration of Monte Carlo Electron Transport
- Acceleration of Monte Carlo Criticality Calculations .Development of Computational Models and Methodologies for Simulation of Scintillator Detectors
- Development of a hybrid method for problems containing low scattering regions
- UFTR Characterization Project
- Design on new experimental stations for UFTR









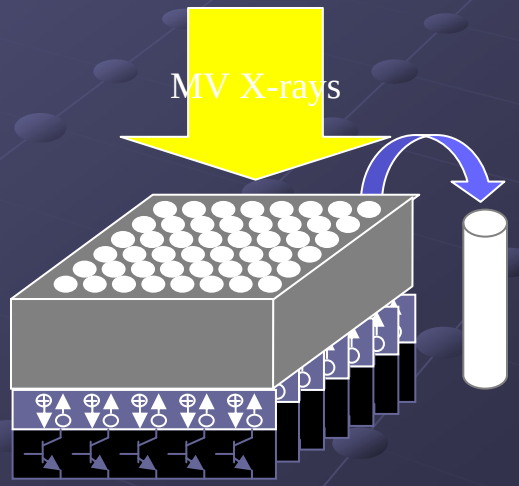


David Hintenlang

- Clinical applications of radiation imaging and dosimetry.
- Optimization of radiological imaging through quantitative evaluation of image quality and patient dose
- Applications:
  - Pediatric Radiology
  - Mammography
  - Computed Tomography
  - Radiation Therapy

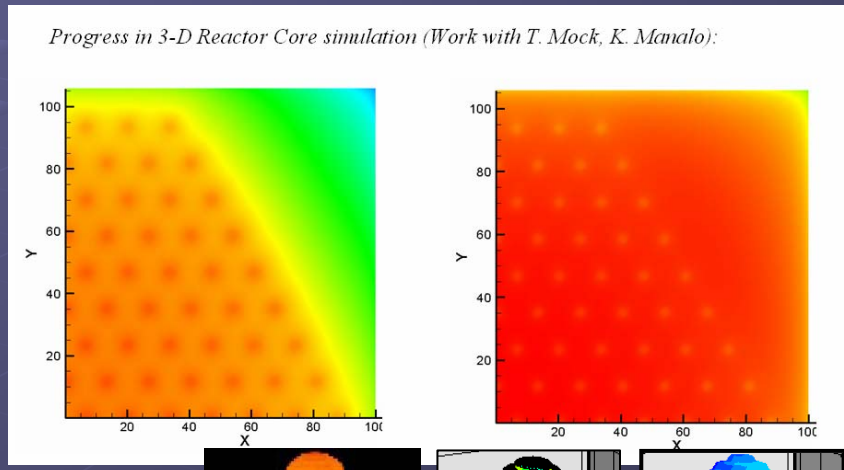
Radiation Therapy: Detectors, Image Processing and Image Guided Radiotherapy (Sanjiv Samant)

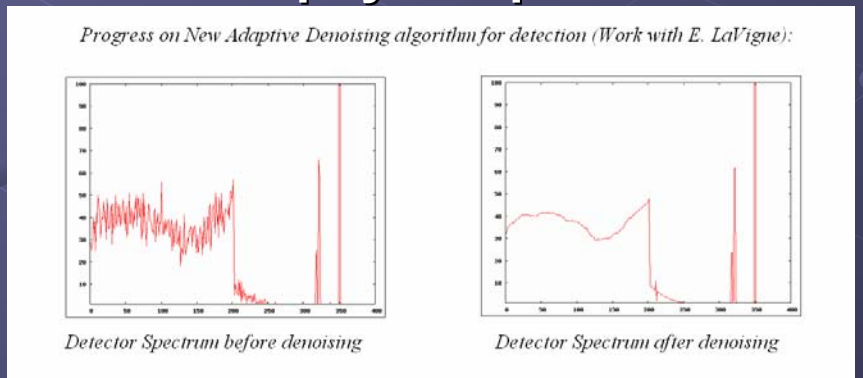
- Design of new imaging systems for improved image quality, very low exposure imaging, customized user interface
- Thick scintillator crystal video
- Fiber-Optic Scintillation Glass Array (FOSGA)
- Application EPID
- Image Guided Radiotherapy (IGRT): Automated position using digital image processing

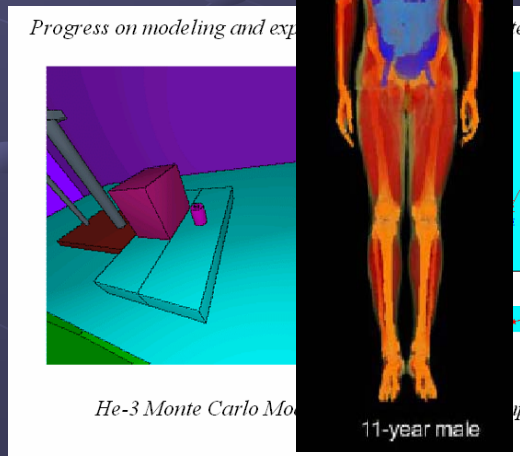


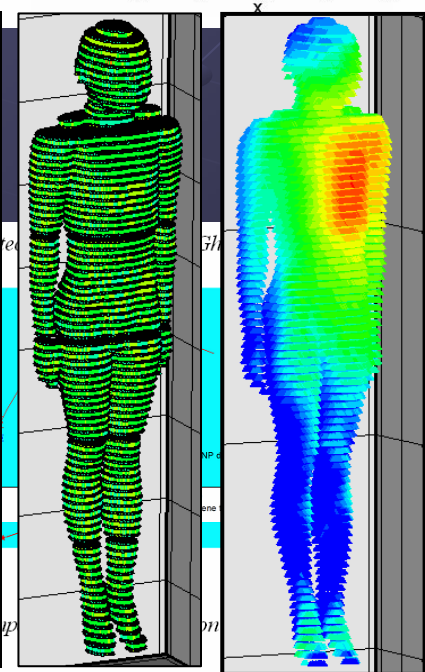
G. Sjoden (UFTTG)

- Design, computationally optimize, and demonstrate an SNM parcel screening device
- ASEDRA- Advanced Synthetically Enhanced Detector Resolution Algorithm
- ACHIP Noise Reduction RDT&E
- *PENBURN*: 3-D Reactor Transport and Burnup Simulations
- Particle transport methods and numerical methods for solving medical physics problems









J. Tulenko – Advanced Nuclear Fuel (Will retire by the end of falll 2007 semester

- Fuel Design,
- Fuel Performance,
- Fuel Management, or
- Waste Management

Resources

Institutes

FINDS - Florida Institute for Nuclear Detection and Security (FINDS)

INSPI - Innovative Nuclear Space Power and Propulsion Institute

Facilities

●Advanced Laboratory for Radiation ●Dosimetry Studies (ALRADS) ●Advanced Nuclear Fuels and Materials Laboratory ●High-Speed Computational Laboratory Hot Cell ●Neutron Activation Analysis Laboratory ●Particle Transport & Distributed Computing Laboratory (PTDC) ●Robotics Laboratory ●SPECT imaging laboratory ●TLD Dosimetry Laboratory

Access to:

Six totally filmless Hospitals, part of Shands Healthcare, Inc. ● Three 16-slice CT scanners ● 3-Tesla clinical MRI scanner ● PET imaging facility ● State of the art magnetic spectrometers and MRI at the McKnight Brain Institute (MBI)

Nuclear Reactor

University of Florida Training Reactor (UFTR, 100 KW)

Workshops

Annual International Training Course/Workshop on Methodologies for Particle Transport Simulation and Their Application

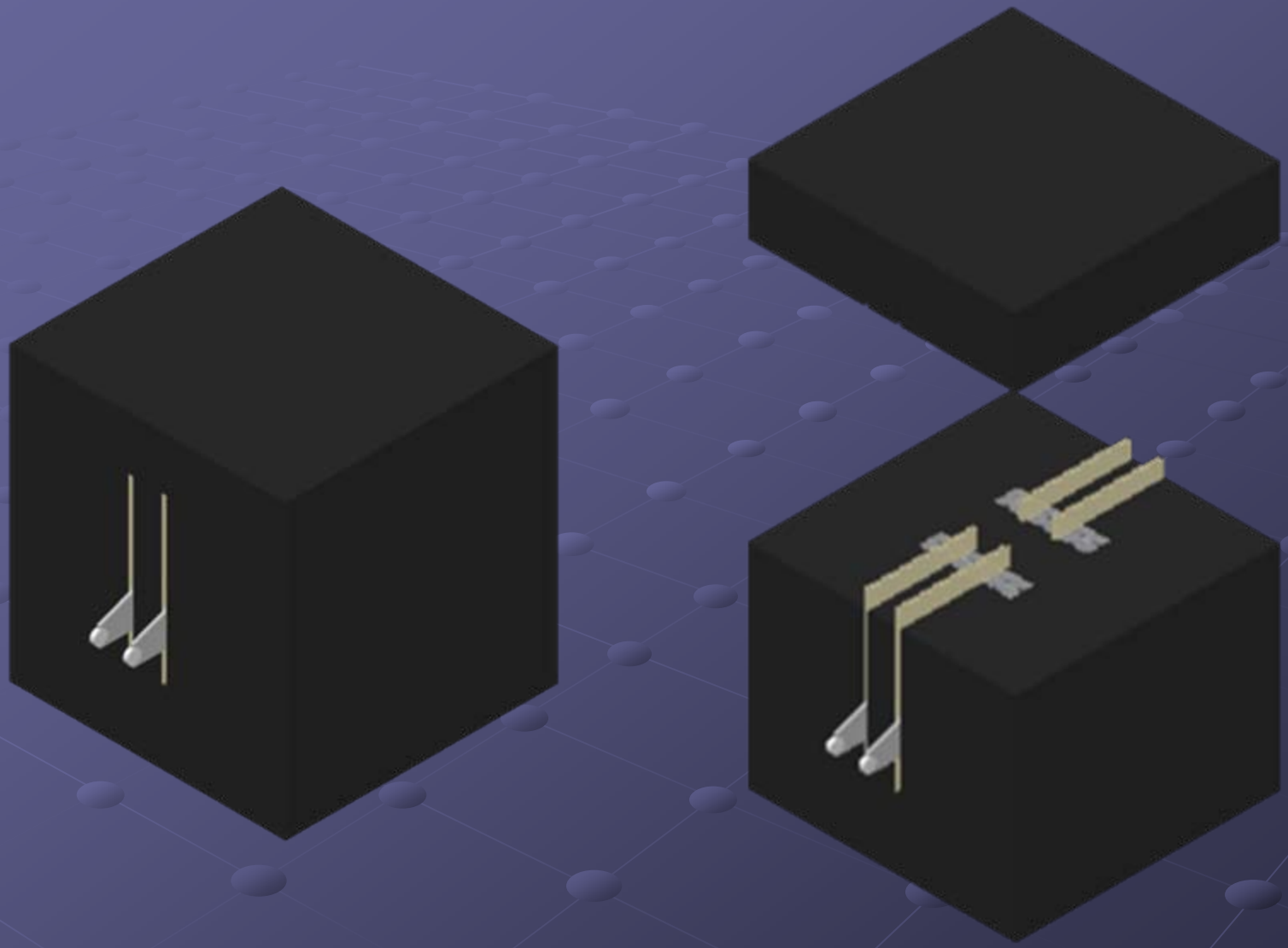
The UFTR HEU/LEU Fuel Conversion Project completed in a record time of 15 months. This work demonstrates that when competent and driven people are assembled, any goal can be accomplished.

Prof. Haghighat led the project that involved Profs. Sjoden and Baciak, and between 9 to 11 graduate students.

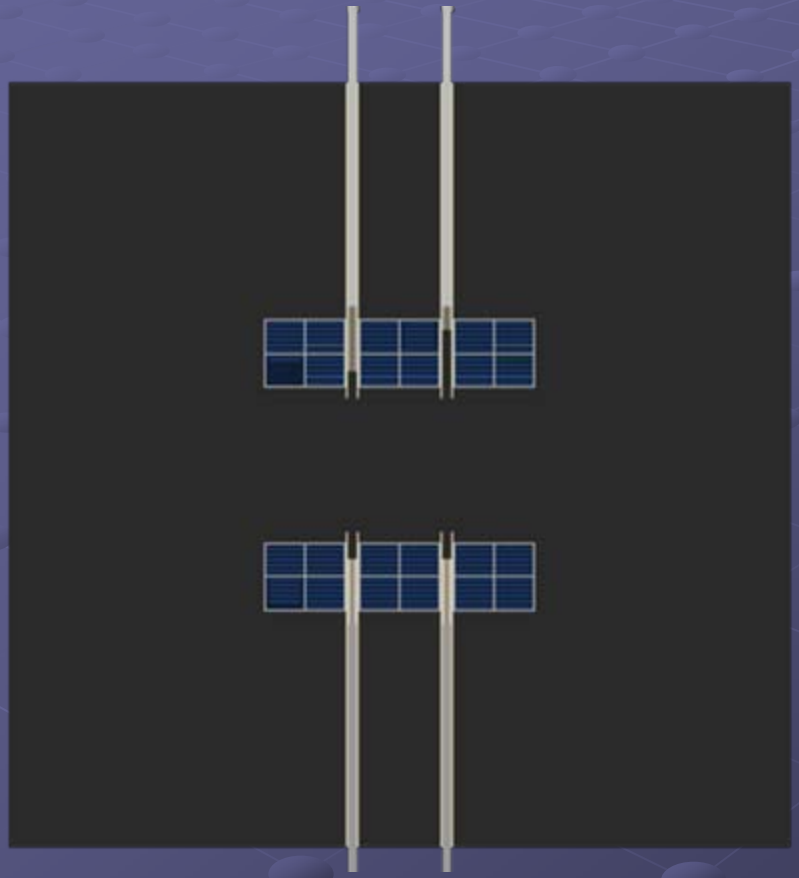
Mr. Benoit Dionne, PhD Candidate was recognized for his exceptional dedicated and contributions to this project

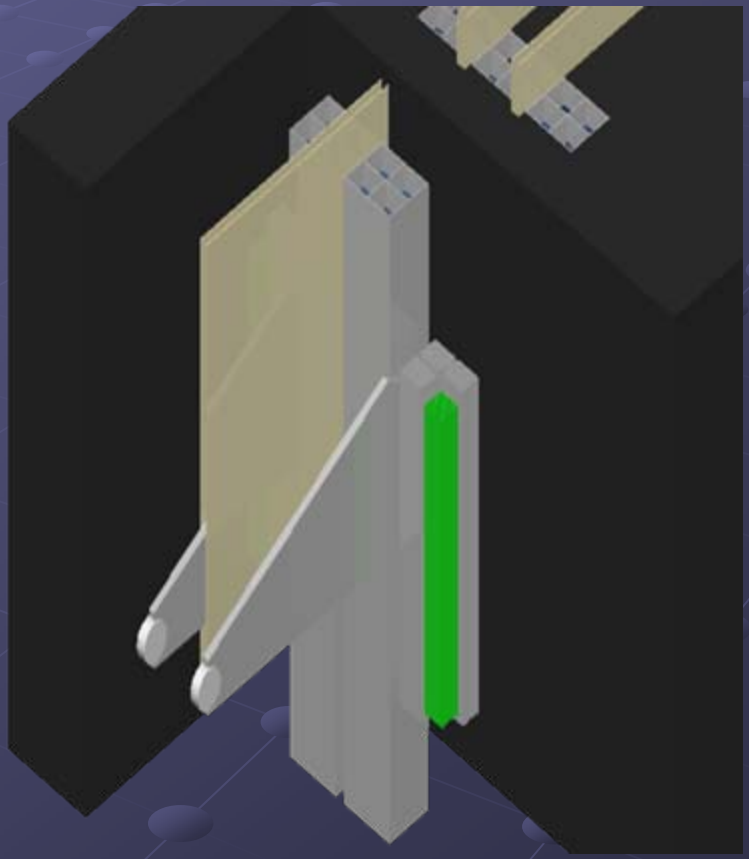
Note: I have been talking with NNSA to become involved in other conversion projects (provide training and perform analysis)

UFTR Core (1)

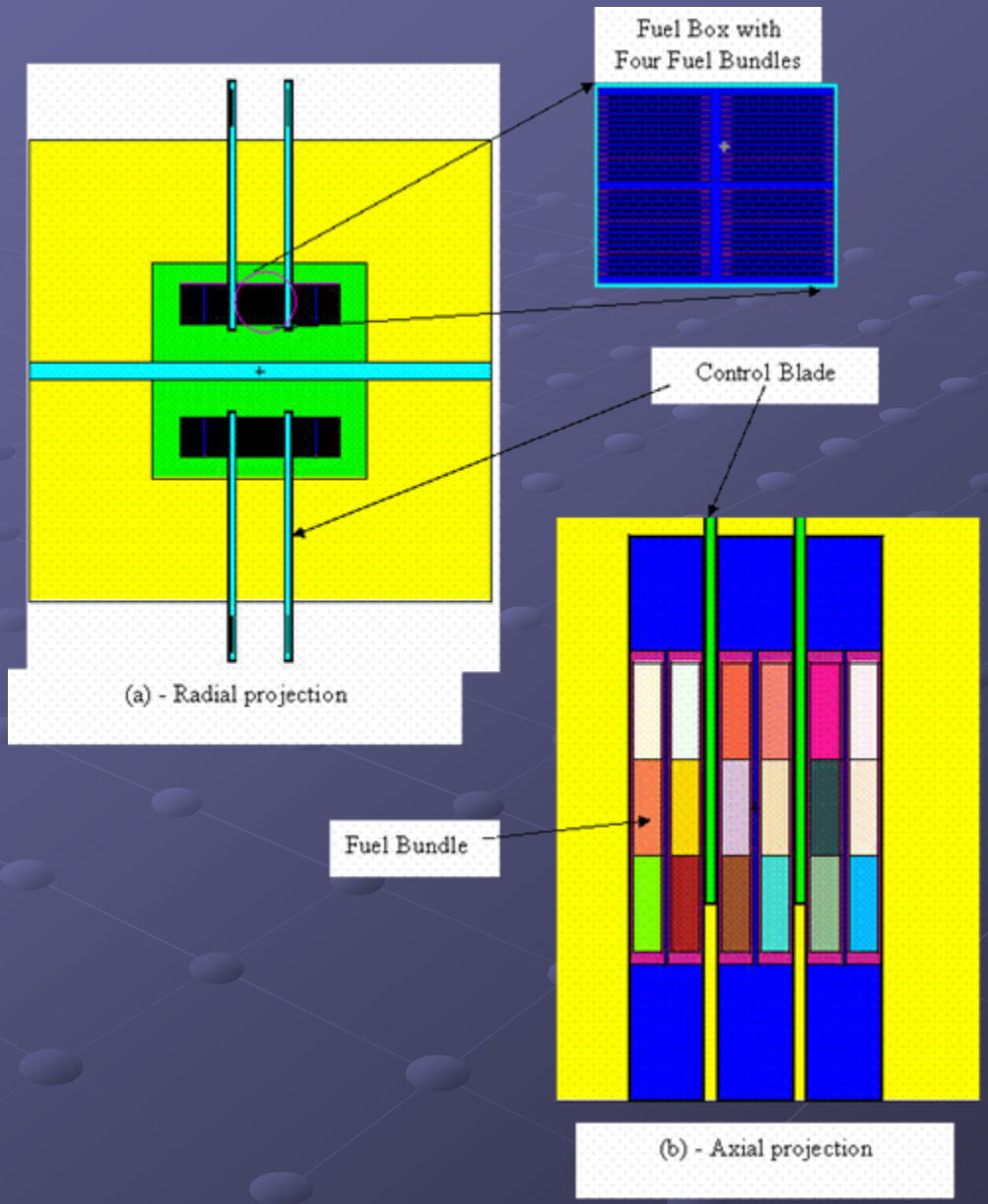


UFTR Core (2)

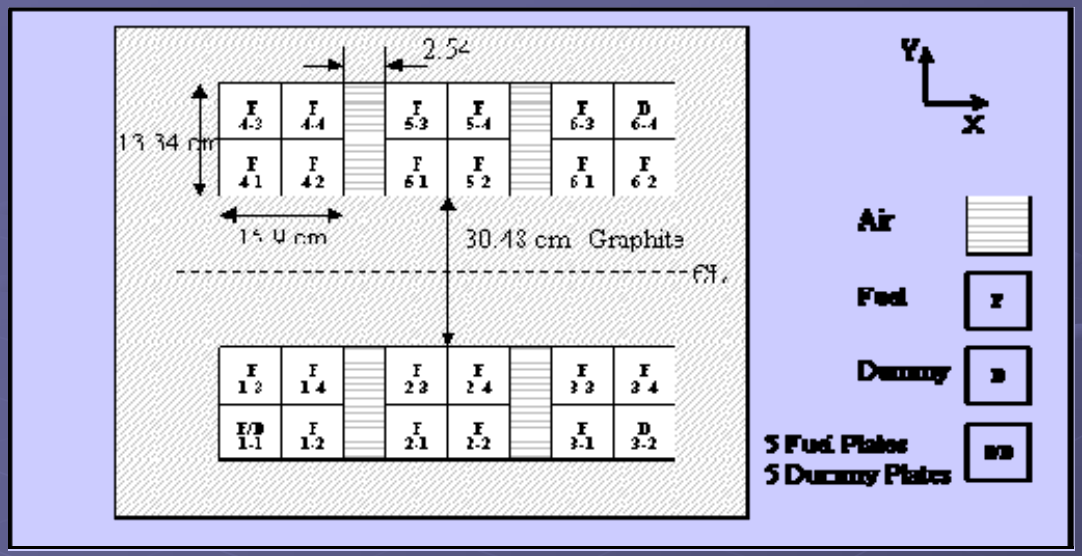


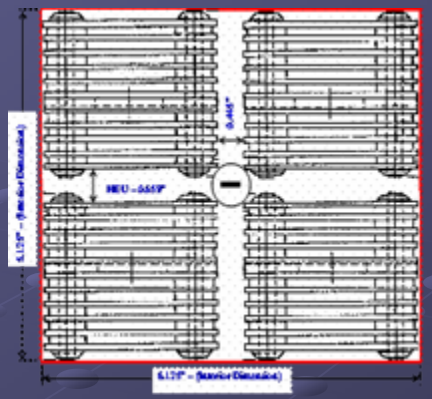


Schematic of the UFTR MCNP5 Monte Carlo Model

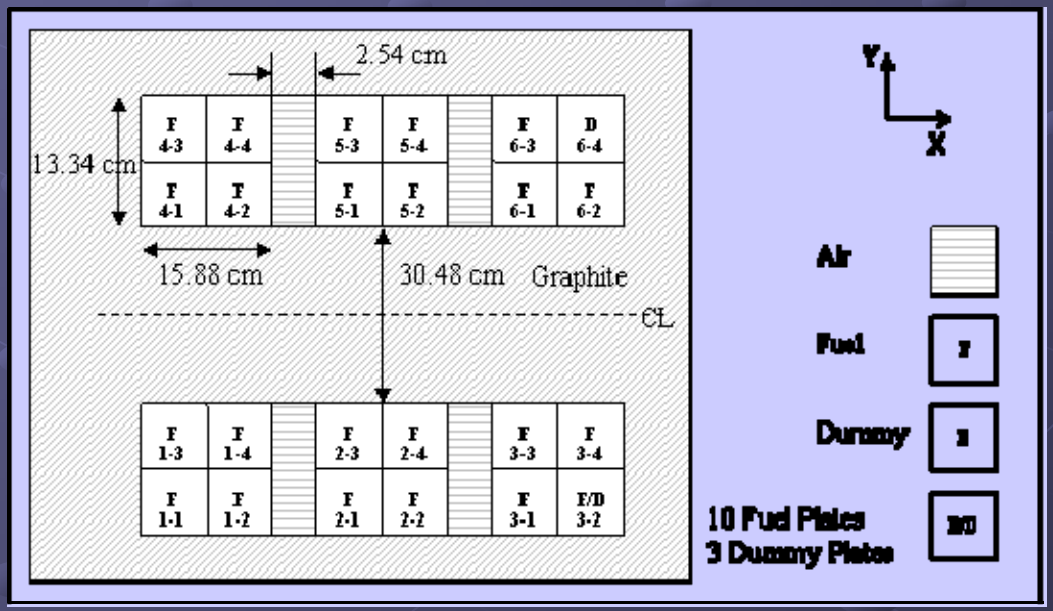


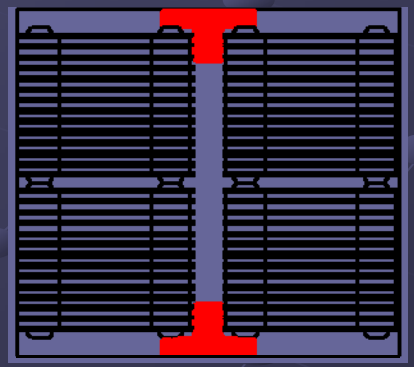
HEU Core





LEU Core





UFTR Status – New Control Room

PEF selected the renovation of the UFTR Control Room, and provided $425,000 that will be matched (one-to-one) through the *Alec P. Courtelis Facilities Enhancement Challenge Grant Program. We will have a total of $850,000.*

Thanks to:

PEF: Jeff Lyash (persident) & Martha Barnwell (VP)

UF : Dean Khargonekar; Foundation office: Becky Hoover, Chris Needles, and Ann McIlwain

UFTR Status

- Characterization
  - Currently, we are in the process of characterizing all access ports of the UFTR
  - The access ports are:
    - Thermal column – Besides characterization, we are developing a new design in order to increase the flux level
    - Six Beam ports
    - Water tank – a proposal submitted for development of a system for burnup reconstruction