Wake Forest University
Graduate Program in Medical Physics

Department of Radiation Oncology
WFU School of Medicine

Department of Physics
WFU Graduate School of Arts and Sciences

Department of Biomedical Engineering
VaTech-WFU School of
Biomedical Engineering and Sciences

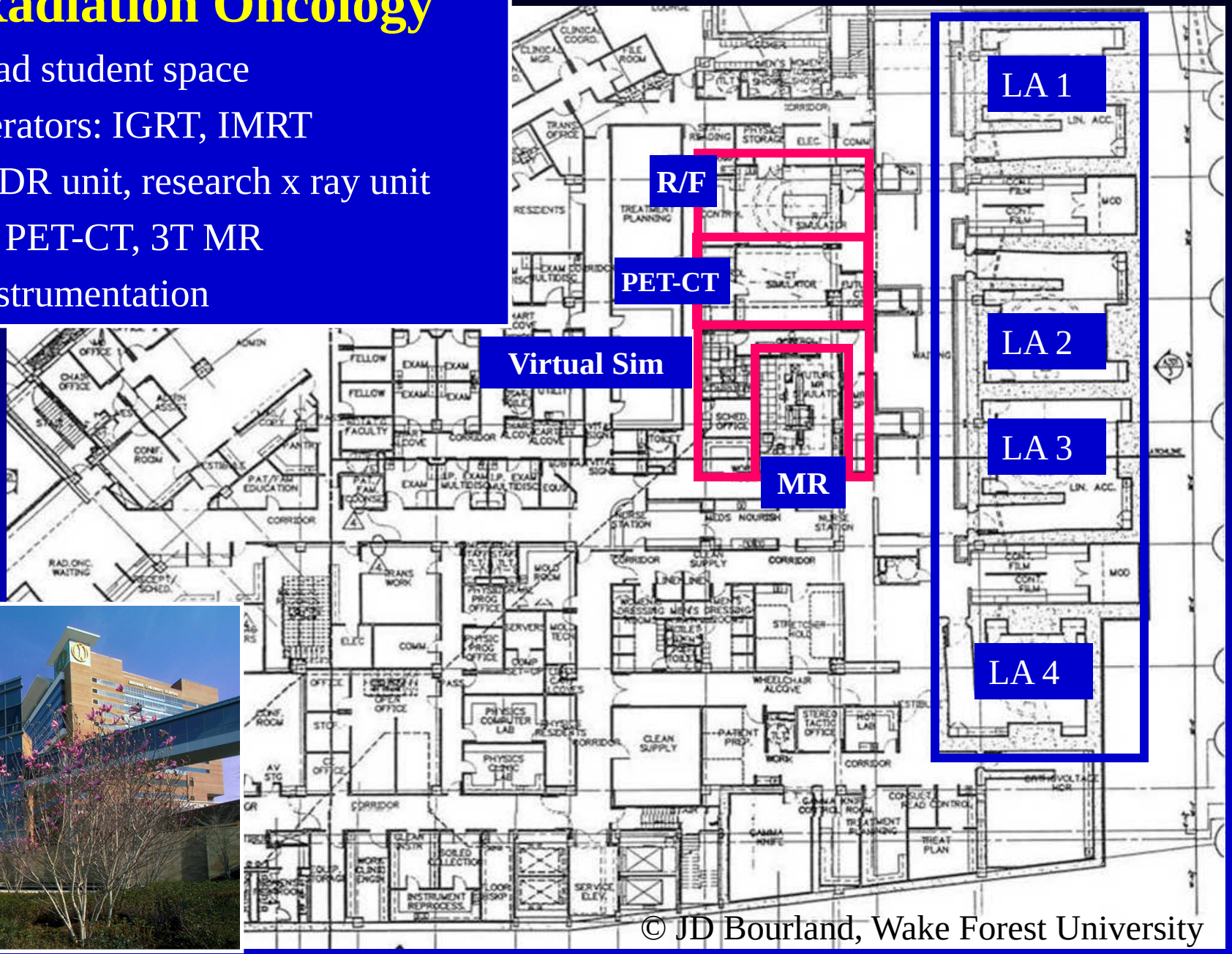
Medical Physics and Medical Imaging Faculty

- Alan Baydush, PhD, Rad Onc, Cone-Beam Imaging
- Dan Bourland, PhD, Rad Onc, Oncology Imaging, Dose
- Bob Dixon, PhD, Diag Rad, X-ray/CT Imaging
- Craig Hamilton, PhD, MR Imaging, Cardiac MR
- Youngkyoo Jung, PhD, MR Physics, Arterial Spin Labeling
- Bob Kraft, PhD, MR Physics, fMRI
- Mike Munley, PhD, Rad Onc, Low Dose Effects, Dosimetry
- Ge Wang, PhD, CT Reconstruction/Physics (VaTech)
- Hengyong Yu, PhD, Diag Rad, CT Reconstruction

Research sponsored by industry, NIH, BARDA

WFBMC Radiation Oncology

- 55,000 sq ft; grad student space
- 4 Linear Accelerators: IGRT, IMRT
- Gamma unit, HDR unit, research x ray unit
- Large-bore CT, PET-CT, 3T MR
- Radiological instrumentation

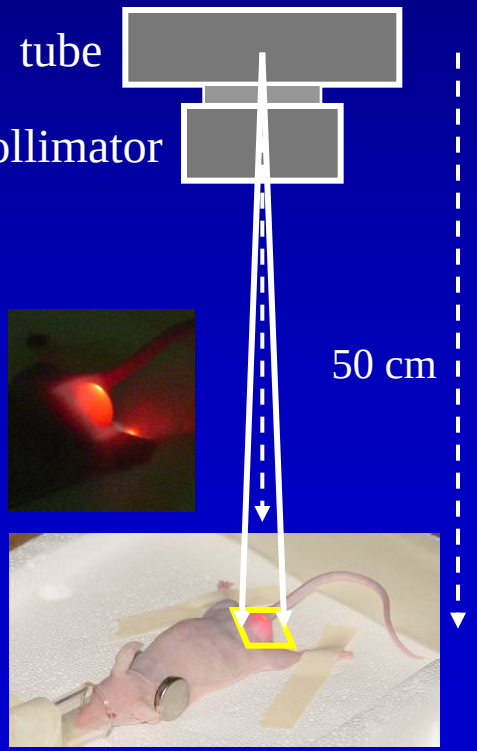


WFU Irradiation Devices

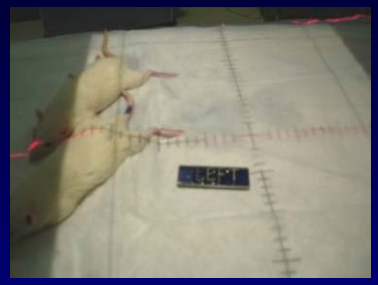
- Cesium Irradiator (0.662 MeV)
- Gamma Knife (1.25 MeV)
- X-ray CT (80-140 kVp)
- Orthovoltage X-Ray (0.3 MeV)
- Linear Accelerator (4 MV up)

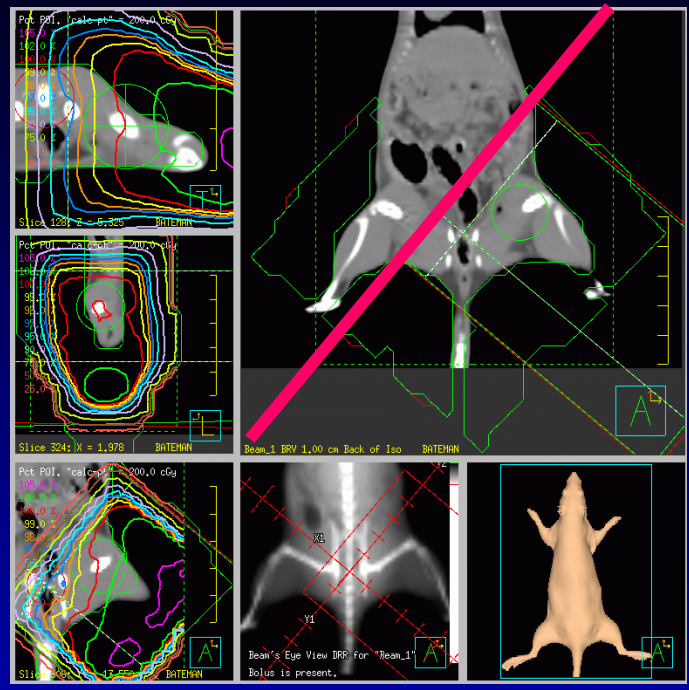
Radiological Terrorism Core (NIH)

Radiation + Drug Response

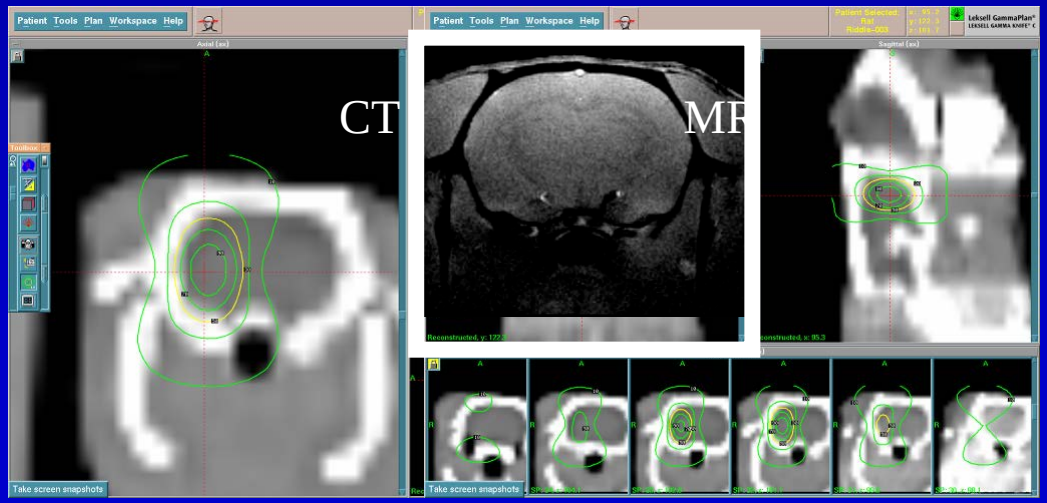


Bone Loss Irradiations





GK Rat Irradiation for Apoptotic Response



3D Gel Radiation Dosimetry

"High Field Magnetic Resonance Imaging-Based Gel Dosimetry for Small Radiation Fields"

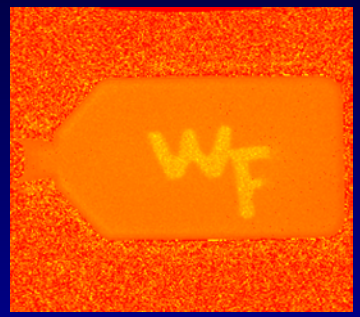
Leo Ding, PhD, Physics 2012 – Residency, Univ Penn

Fabrication

Irradiation

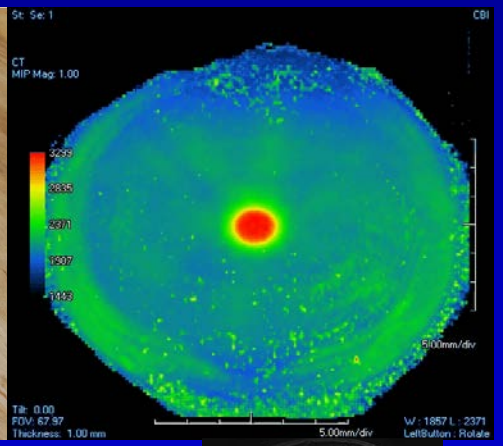
Scanning

20 MeV electron irradiation



Result

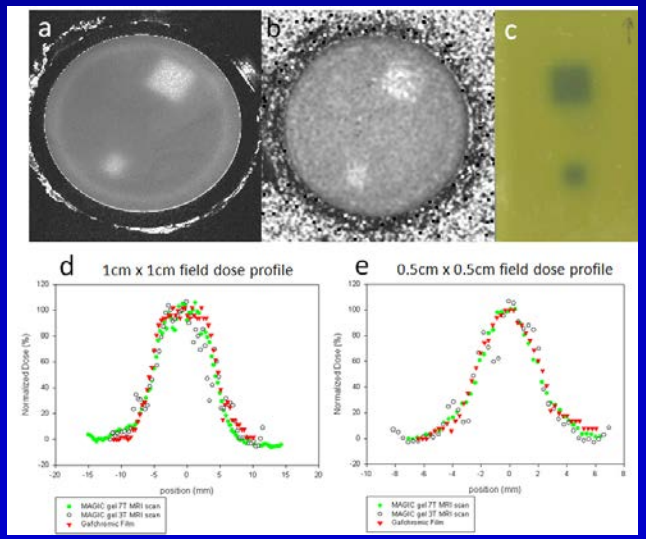
GammaKnife (Co^{60}) irradiation 8mm collimator

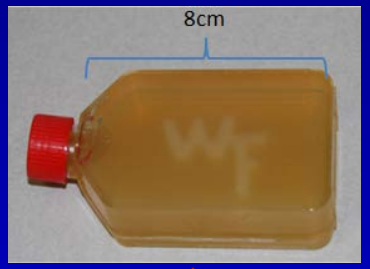


Advantage:

a. **Measure small field irradiation (<1cm)**
b. **Real 3D imaging and dose measurement**
c. **High resolution (~100um)**

Small X-ray beam measurements



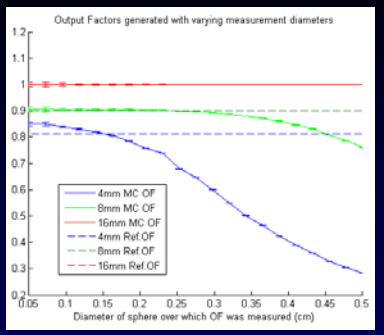


X. Ding et al **High resolution polymer gel dosimetry for small beam irradiation using a 7T micro-MRI scanner** *Journal of Physics conference series*

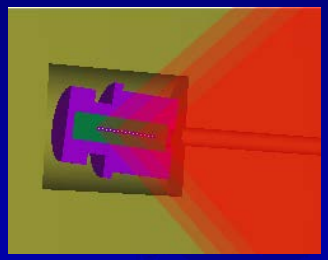
Monte Carlo Modeling: Gamma Knife™ Perfexion

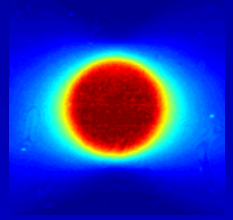
R Best, PhD, Physics, 2012 – Residency, UVa

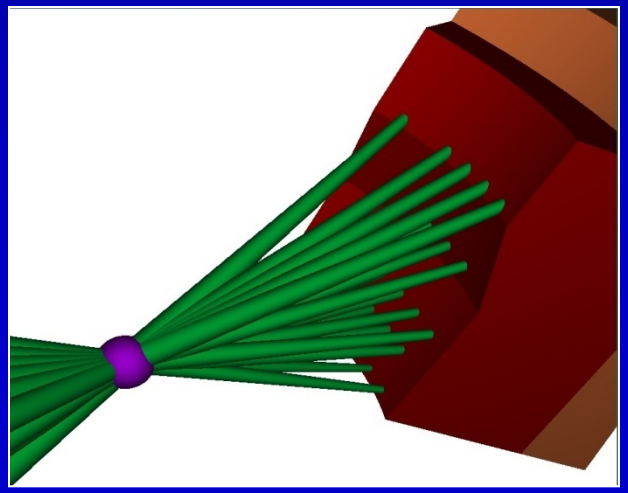
- model of source geometry using radiation interactions

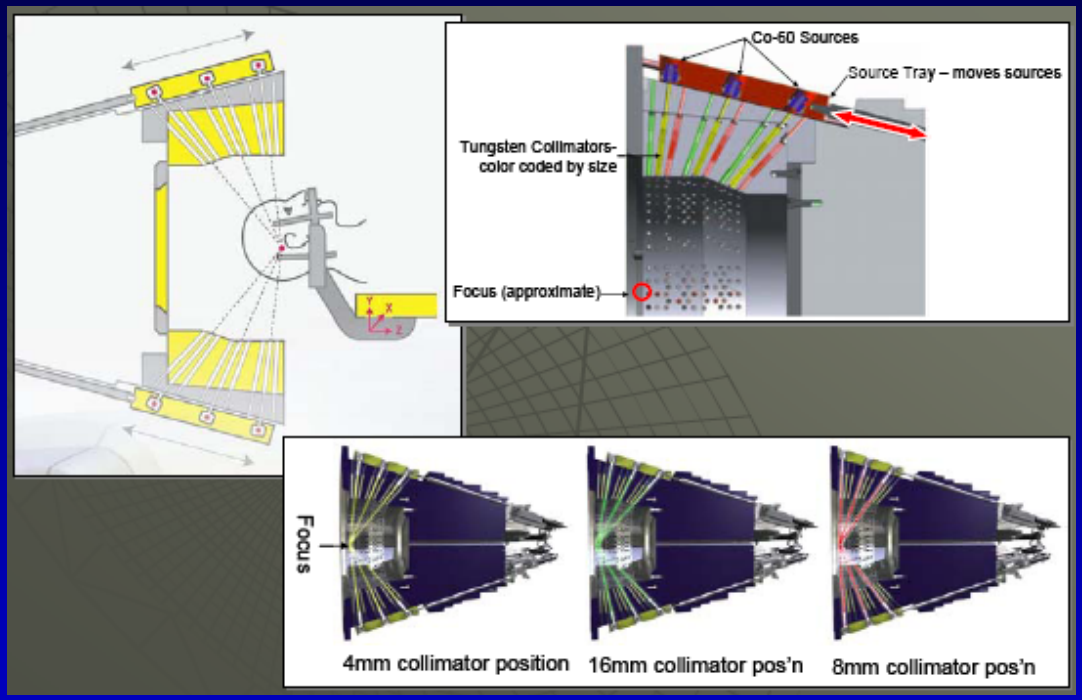


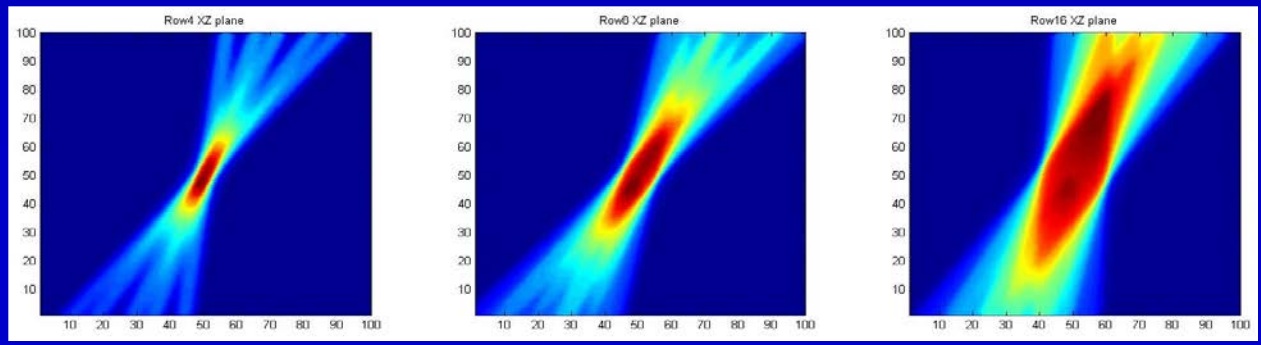
"A Complete Dosimetric Model Of The Gamma Knife Perfexion™ Using Penelope Monte Carlo Codes"







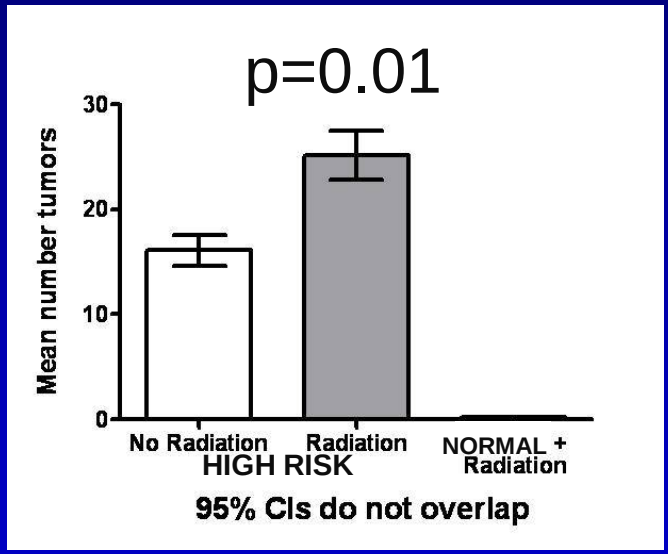




Low Dose Radiation Effects

MT Munley, RA: Matt Walb

- **NIH R01 supported project** to examine low dose lung carcinogenesis from CT radiation in sensitive rodent models representing smokers:
  - Increased tumor multiplicity in high-risk animals exposed to low dose radiation
  - Normal mice – no effect
  - Greater effect for females
  - Future work:
    - Energy dependence
    - Dose rat dependence
  - Applicable to radiotherapy integral and imaging doses

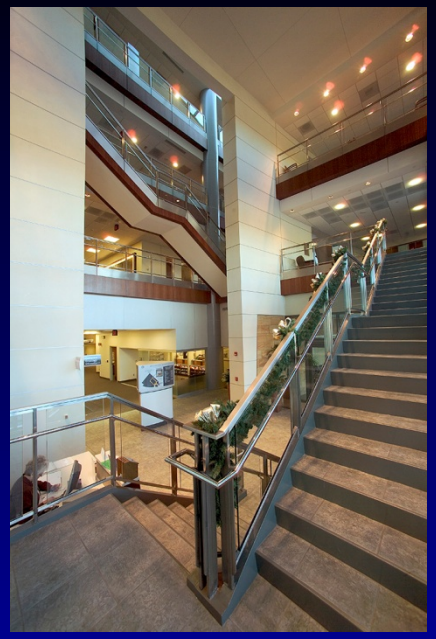


- NASA funding to examine low dose "high" energy (10-18 MV) radiation +/- breathing 100% oxygen in a mouse model

Our Physics Students & Fellows

Marcus Bennett, PhD (Bourland)	**TRADONC Postdoc Fellow, 2012** Resident, RadOnc, U Fla Proton Ctr	3T MR-induced heating in radiosurgery
Leo Ding (Bourland)	**PhD, 2012; MS, 2009** Resident, RadOnc, U Pennsylvania	3D gel dosimetry using 3T and 7T MR imaging
Ryan Best (Bourland)	**PhD, 2012; MS, 2010** Resident, RadOnc, U Virginia	Monte Carlo model of the Gamma Knife
Julius Ojwang, PhD (Munley)	**TRADONC Physics Fellow**	Biological effects modeling
Jenny Dorand (Bourland)	**PhD student - Physics**	Beta skin dosimetry
Inna McGowin, MS (Bourland)	**PhD student - Physics**	Magnetoencephalography (MEG) physics modeling
Matt Walb (Munley)	**PhD student - Physics**	Low dose bioeffects from computed tomography (CT)
Jay Liu (Bourland)	**PhD student - Physics**	Gamma Knife dose optimization
Megan Johnston (Jung)	**PhD student - BME**	MR assessment of cerebral blood flow
Calli Nguyen (Munley)	**MS/PhD student - BME**	Energy & tissue heterogeneity dose effects

Medical Physics - Summary



- WFU has great resources for medical physics
  - Faculty & expertise, facilities, devices, instrumentation
- Our medical physics trainees have done well
  - Physics and BME: PhDs & TRADONC fellows
  - Pass rates: board certification for clinical practice
  - Competitive for training, faculty, community positions

- Collaborations welcomed – our interests:
  - Radiation dose & bioeffects, oncology imaging, dose optimization, and instrumentation
  - Applications of novel physics technologies

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Dan Bourland, PhD, bourland@wakehealth.edu