# A Picture is Worth A Thousand Words and an Experiment is Worth Fifty Slides: Development of Experiments in Health Physics To Reinforce Basic Radiation Protection Concepts

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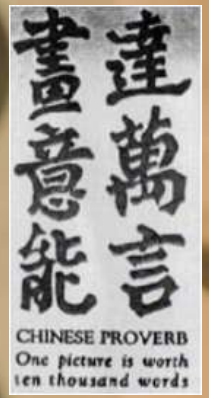
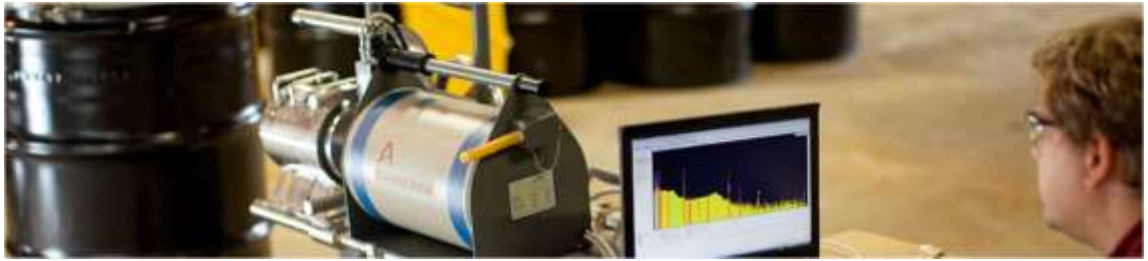


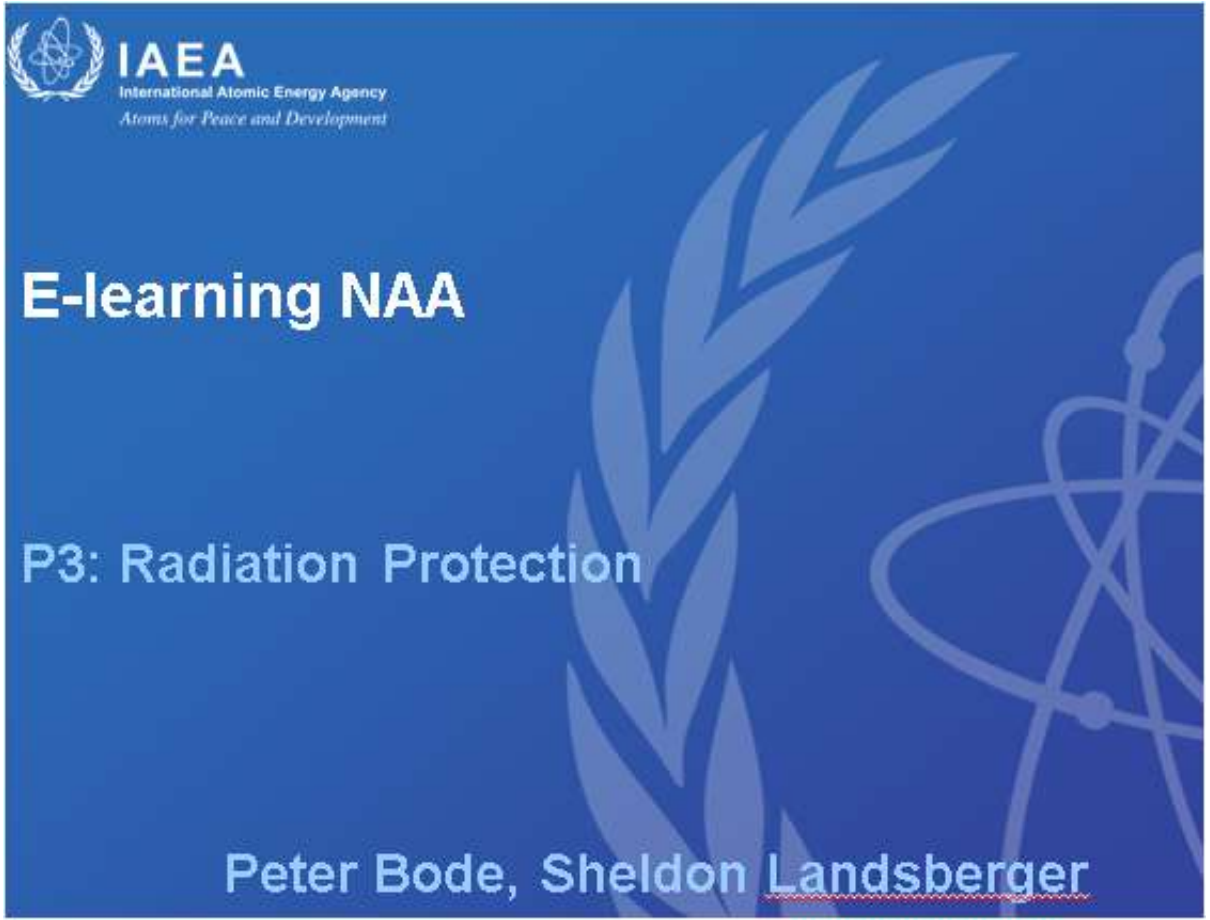

# Radiation Protection Educational Challenges

https://www.orau.org/health-physics/index.html

# Teaching Objectives

- Terminal Training Objectives:
  - Provide the basic knowledge of radiation protection concepts through traditional classroom lectures and detailed experiments
- Enabling Training Objectives:
  - Provide modern experimental equipment to perform laboratories in radiation, radiation protection, nuclear instrumentation and radiochemistry


IAEA
International Atomic Energy Agency
Atoms for Peace and Development
E-learning NAA
P3: Radiation Protection
Peter Bode, Sheldon Landsberger

# Nuclear and Radiation Engineering at UT-Austin

## Vision

- A nationally and internationally recognized program that promotes
  - basic & applied research and training/education in nuclear science and engineering and
  - technology development to support the nation's critical mission needs

## Mission

- Educate the next generation of leaders in nuclear science and engineering
- Conduct leading research at the forefront of the international nuclear community
- Apply nuclear technology for solving multidisciplinary problems
- Provide service to the citizens of Texas, the U.S., and the international community

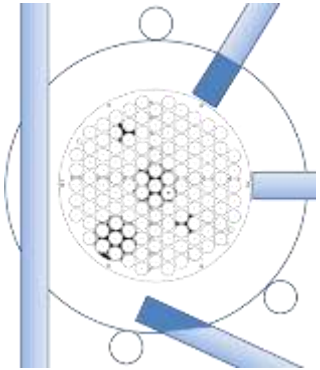
# Facilities

Radiation Sources

- 1.1 MW TRIGA Nuclear Reactor
- Thermo MP320 14-MeV Neutron Generator ($1x10^8$ n/s with a Pulse Rate up to 20 kHz)
- Neutron, $\alpha$, $\beta$, and $\gamma$ Radiation Sources

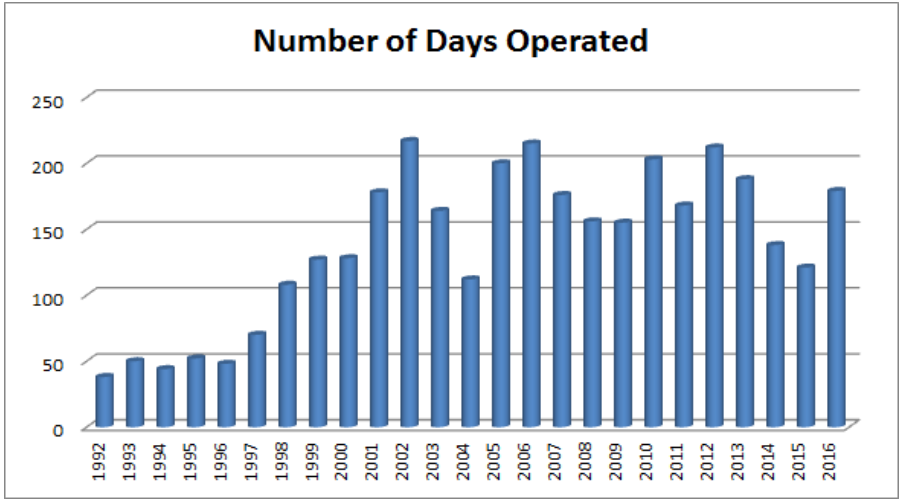
Beam Port Facilities

- Neutron Radiography
- Neutron Depth Profiling
- Prompt-Gamma Activation Analysis
- Fast Neutron Facility



# Reactor Utilization

- The NETL Reactor is operated approximately 200 days per year
- This includes operation for
  - education
  - undergraduate research
  - graduate research
  - external research collaborations, and
  - irradiation services




**Health Physics is of Paramount Importance**

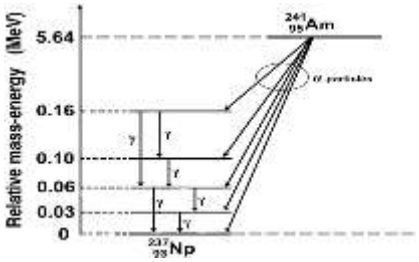
# Laboratory Facilities

- Analytical Laboratories
  - NAA Laboratory
  - Radiation Effects and Detector Development Laboratory
  - Gamma-Ray Spectroscopy Laboratory
  - Chemistry and Sample Preparation Laboratory
  - Radioactive Experiment and Radiochemistry Laboratory
  - Corrosion, Embrittlement, and Electrochemistry Lab
- Detector Systems
  - Three Compton Suppression $\gamma$-Ray Spectroscopy Systems
  - $\beta$-$\gamma$ and $\gamma$-$\gamma$ Coincidence and $\alpha$-Spectroscopy System
  - Numerous Portable Instruments
- Nuclear and Applied Robotics
  - Develop and deploy advanced robotics in hazardous environments to minimize risk for the human operator

# Major Courses in Health Physics/Nuclear Instrumentation

- Radiation and Radiation Protection Lab - 2 weeks
  - 8 laboratories
- Gamma-Ray Spectroscopy – one semester
  - 6 laboratories
- Nuclear and Radiochemistry – one semester
  - 6 laboratories
- Nuclear Forensics Summer Course – one month
  - 6 laboratories





# Laboratory Classes

- Personnel Monitoring
- Radiation Statistics
- Gamma Spectroscopy
  - uncertainty measurements
  - resolution
- Reactor Health Physics
- Contamination Lab
- Liquid Scintillation Counting
  - Tritium in $H_2O$
- Half-Life Measurement
  - $^{137}Cs$ - $^{137m}Ba$ generator
  - Secular equilibrium
- Neutron Shielding
- GM Counting
- Gamma Shielding ($^{137}Cs$ source)
- Simple Shielding with Pb and Al shields
  - $1/r^2$ concepts;
  - $I = I_0 * e^{-\mu x}$;
  - Gamma Spectroscopy with NaI
- Gamma-Ray Efficiency Calibration
- Fission Product Identification HP(Ge)
- Self- Attenuation of Photons in NORM
- Radiochemistry Extraction
- $^{137}Cs$ depth profile soil analysis

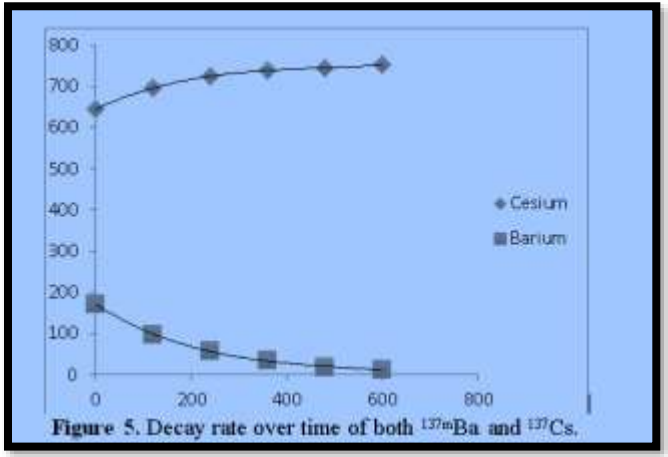



**Figure 5.** Decay rate over time of both $^{137m}$Ba and $^{137}$Cs.

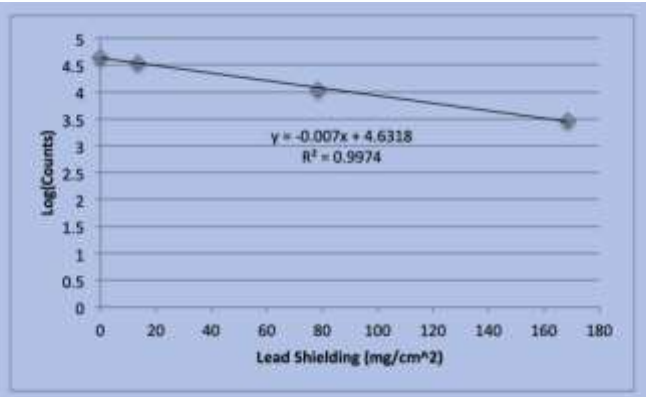



**Figure 3:** Logarithmic relation between shielding and gamma counts, discounting data points where final range of linearity and penetration was reached.

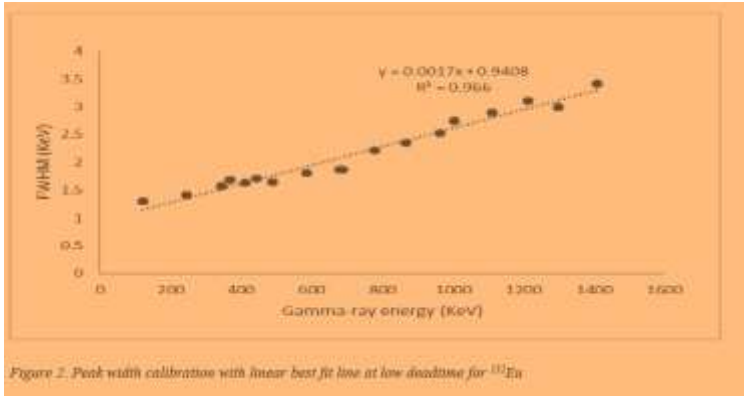
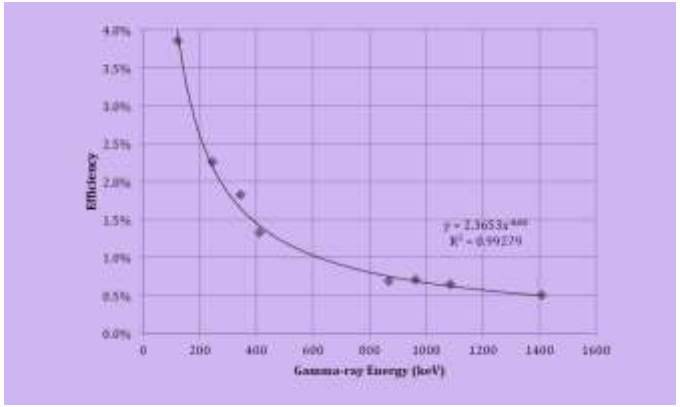



*Figure 2. Peak width calibration with linear best fit line at low deadtime for $^{152}$Eu*



# Conclusions

- Addition of an array of health physics/nuclear instrumentation experiments in traditional courses has been viewed very positively by all the students in all the courses

- Experiments have cemented many of the fundamental aspects of health physics concepts


Thank you!