

AFCI at ISU/IAC FY 2005

The Idaho Accelerator Center (IAC) AFCI research is conducted to support activities in three AFCI national programs: Transmutation Engineering, Separations, and Fuels. At IAC there four Work Packages:

- The Student Research WP supports undergraduate and graduate students, post-docs, engineering staff, administers the program, and provides infrastructure for conducting the three technical WP (15 undergraduates, 24 graduates, 6 post-docs, 7 summer and visiting scientists and 5 staff in FY'04-05).
- Materials Science WP supports research goals in the Fuels and Transmutation Engineering technical areas. IAC developed defect imaging and mapping capability is being used as a unique probe for radiation damage in materials at the micro-structure level.
- The Materials Accountability WP is in the Separations technical area. In this WP IAC will conduct research and development on both active and passive radiation detection and measurement technologies for use in proliferation resistance assessment and material accountability.
- Accelerator Nuclear Research and ADS. The purpose of this work is to support research goals in the Transmutation Engineering technical area. This research includes the use of electron accelerators to produce neutrons for radiation effects and driven sub-critical systems.

AFCI at ISU/IAC FY 2005

- Our research is conducted to support activities in three AFCI national programs:
 - Transmutation Engineering,
 - Separations, and
 - Fuels.
- At IAC there four Work Packages:
 - Student Research WP supports 3 technical WPs.
 - Materials Science
 - Materials Accountability
 - Accelerator-driven Nuclear Research and ADS

Student Research WP

- supports undergraduate and graduate students, post-docs, and engineering staff (15 undergraduates, 24 graduates, 6 post-docs, 7 summer and visiting scientists and 5 staff in FY'04-05).
- administers the program, and
- provides infrastructure for conducting the three technical WPs:
 - Materials Science
 - Materials Accountability
 - Accelerator Nuclear Research and ADS

IAC AFCI Technical WPs

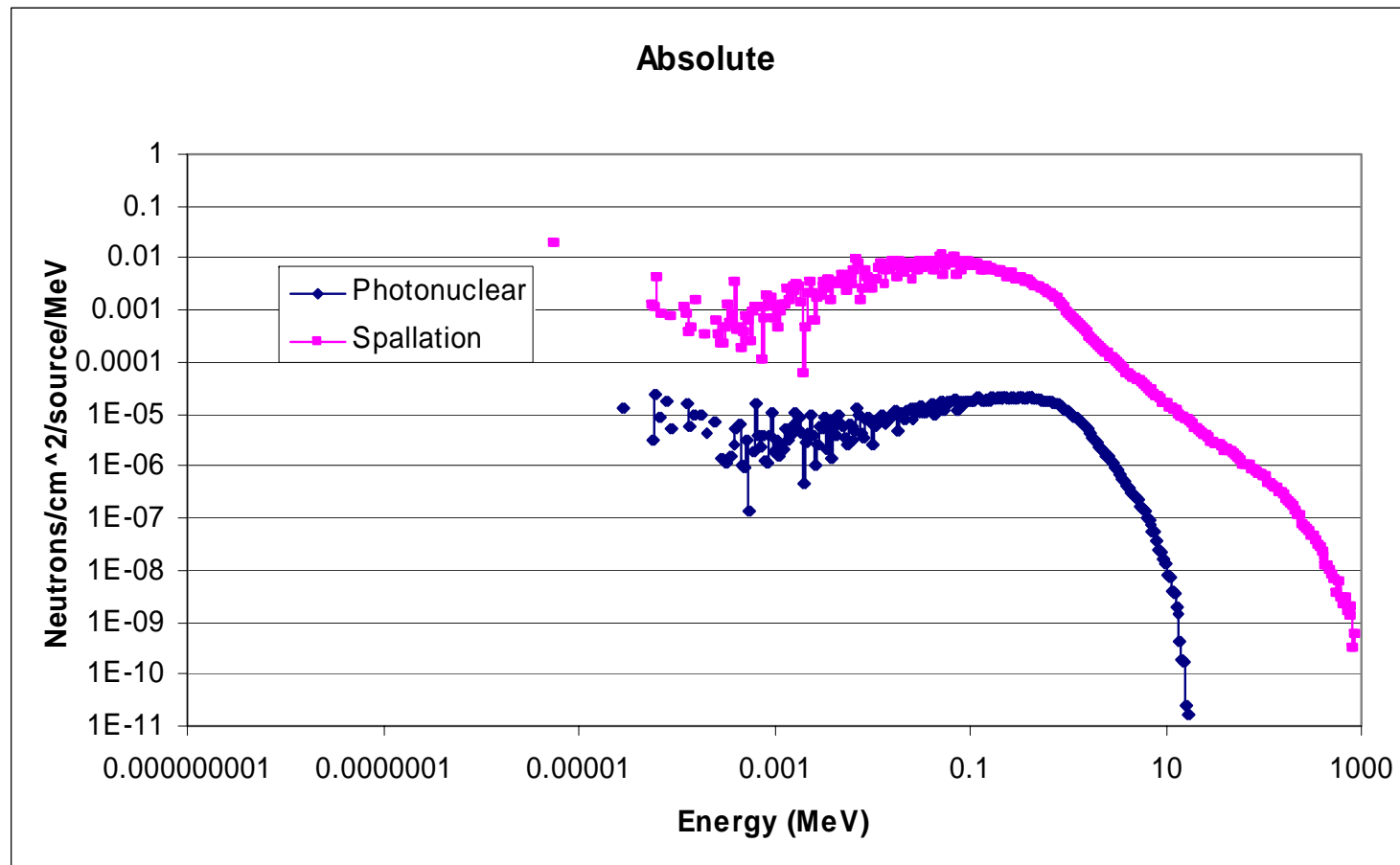
- Materials Science supports research goals in AFCI Fuels and Transmutation Engineering.
 - IAC-developed defect imaging and mapping capability is being used as a unique probe for radiation damage in materials at the micro-structure level.
- Materials Accountability supports AFCI Separations.
 - In this WP IAC will conduct research and development on both active and passive radiation detection and measurement technologies for use in proliferation resistance assessment and material accountability.
- Accelerator Nuclear Research and ADS supports AFCI Transmutation Engineering.
 - This research includes the use of electron accelerators to produce neutrons for radiation effects and driven sub-critical systems.
 - Includes the Reactor-Accelerator Coupling Experiments (RACE) Project.

RF Electron Linacs

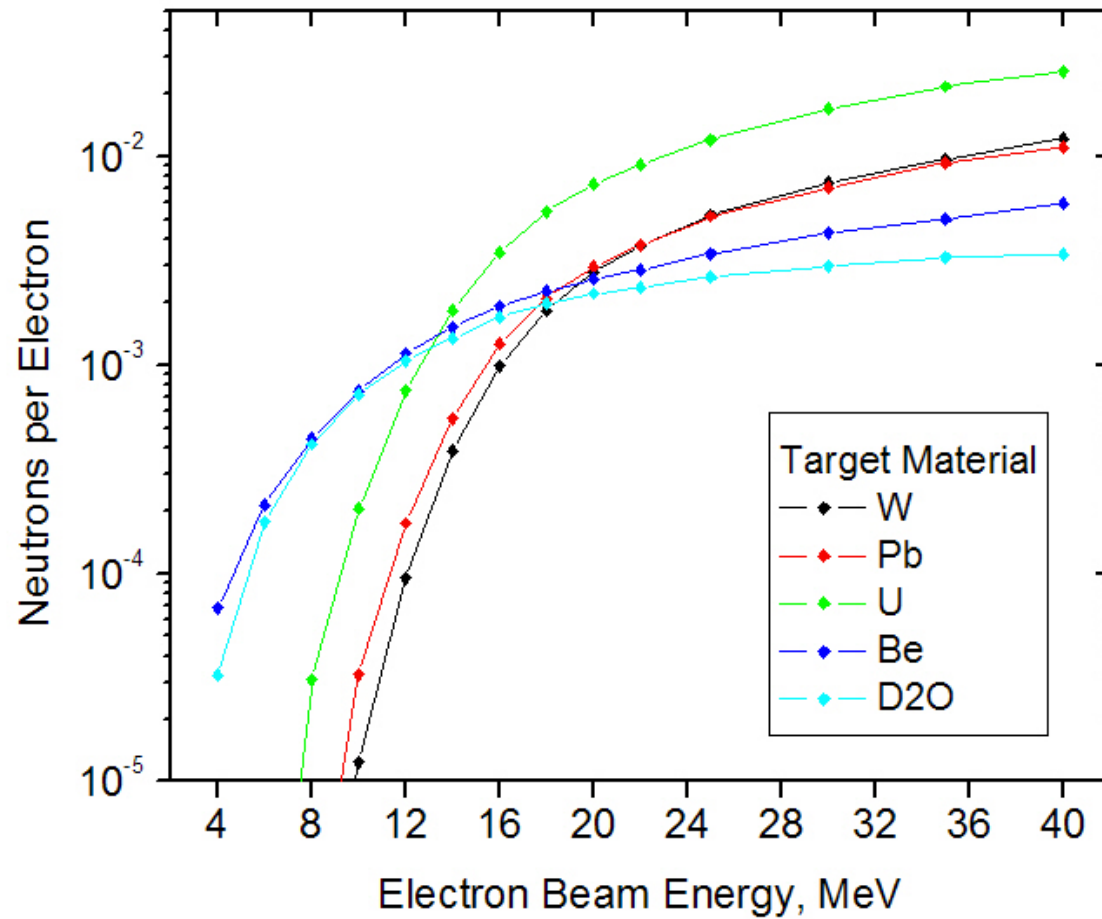
- Photonuclear and photofission neutrons
- Yield/beam power second only to proton spallation
- Robust technology
- Flexible output characteristics
- Inexpensive and “small,” transportable
- Evaporation neutron spectrum, similar to spallation source, but less high energy tail

Spectra

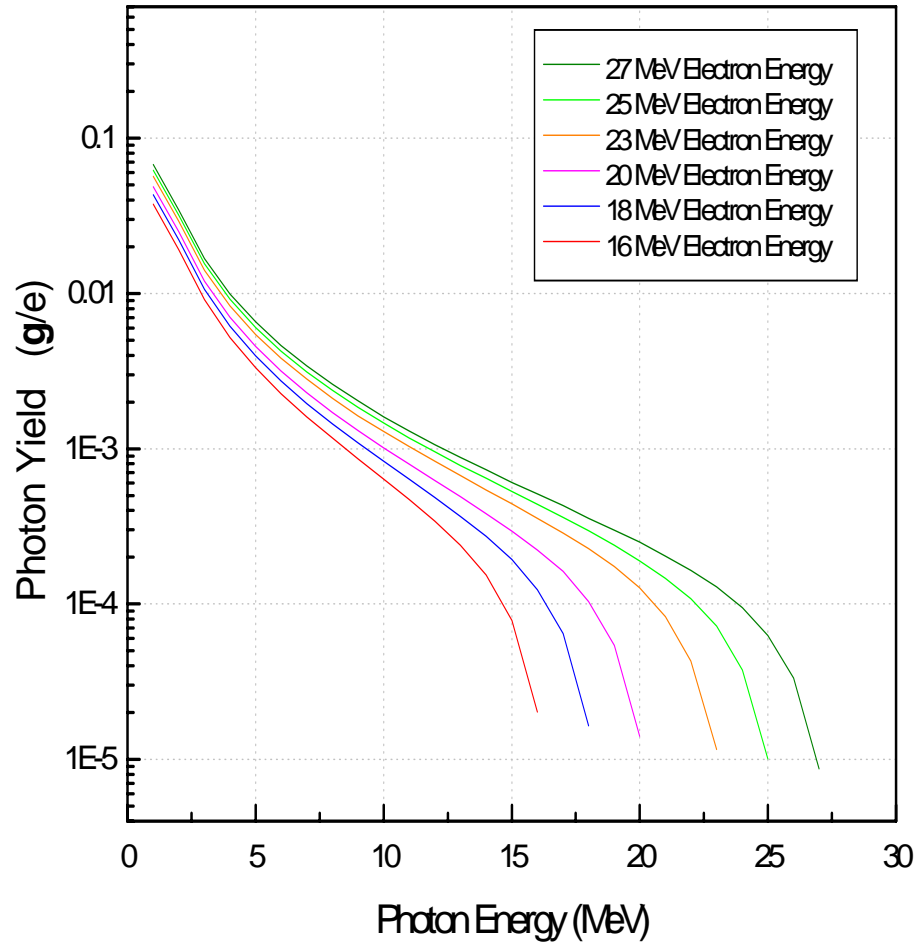
25 MeV electrons (ISU RACE)
compared to 1 GeV protons on W-Cu target



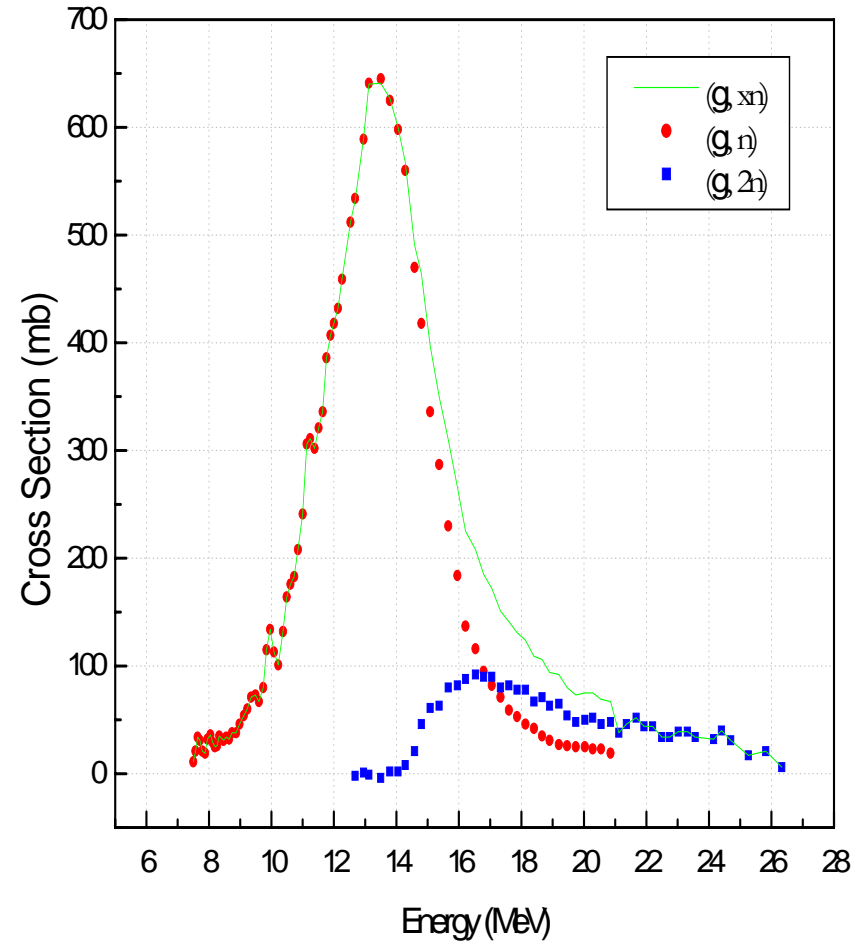
Neutron Yield vs. Electron Energy



Production Process



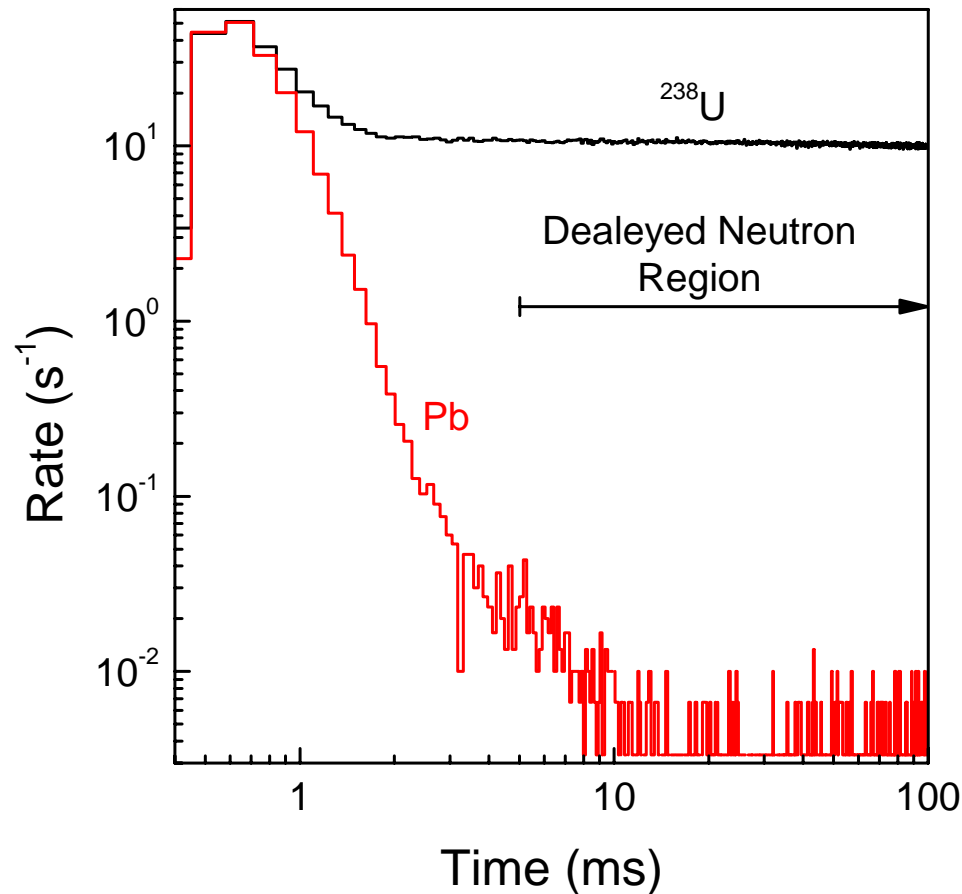
Bremsstrahlung Spectra



Photonuclear Giant Resonance Cross Section for Lead

Neutron Detectors Must Deal with Intense γ -ray Flash

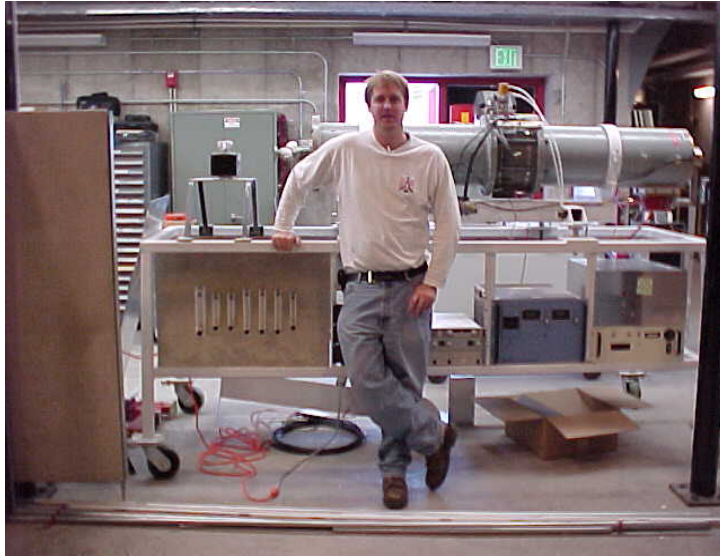
Delayed Neutron Detection Using Pulsed LINACs and Pulsed Photo-Neutron Detectors



20 MeV Bremsstrahlung
No Moderators
0.5 m Separation
1.1 kg ²³⁸U
10 kg Pb
5 min Data Collection

- Shielded ³He Detectors
- Detectors Recover in 600 μ s

RACE Project Accelerators



ISU--2.2 m long, 25 MeV



Texas--1.8m long, 20 MeV

- 1-2 kW beam power with current electron gun and modulator/Klystron
- Relatively compact
- Reliable off-the-shelf components
- Easy to operate
- Flexible output characteristics

High Power Modulator/Klystron for 20-30 kW Beam

Three high power S band power systems are available at IAC. One of these systems can be dedicated to RACE+ for FY'06 and beyond. These systems will directly connect to the 25 MeV RACE accelerator currently used at ISU and the 20 MeV Texas RACE accelerator. With higher current electron injection, beam power can be increased more than 10 times.

- June '05 set up one of the three systems for a high pulse rate accelerator.
- Late June early July Titan Pulse Sciences consultant will help IAC staff and students operate the system.
- This knowledge will allow staff to prepare another system for RACE experiments in 2006, pending 2006 DOE funding.

