Nuclear Data Needs for Homeland Security

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How I use nuclear data bases

- For nuclear data, reaction rates, thresholds, yields etc.
- From within radiation transport codes for predictions of signals, doses, system performance etc.

A Reminder: Why use modeling?

- It can save time and money
- Insight can be gained
- But only if the predictions are right enough
  - There are important calculations that we can't do "right enough", sometimes due to data problems
  - Model users would like to see good, relevant benchmark comparisons between calculations and experiments.

Remember: Very often months in the laboratory can save hours of computation.

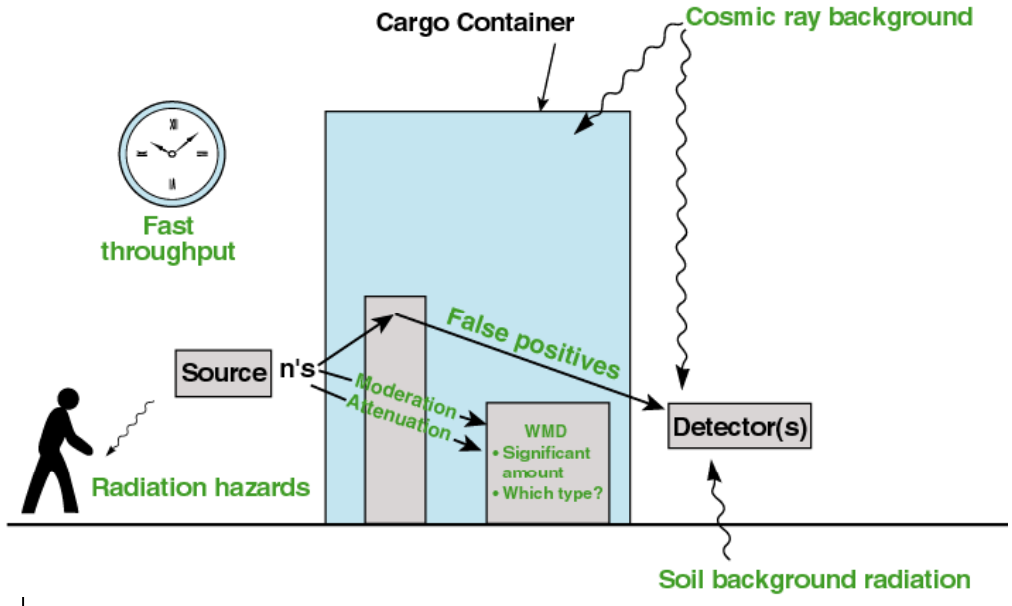
Detection of fissile material is one major focus

- Hard fact of life: Detection technology will always be pushed to lower minimum detectable mass in shorter measurement time => we have to live where background is as important as signal

System assessment or optimization needs good predictions of background as well as signals

There are several ideas for detection of fissile material

- Passive
  - Neutron counting
  - Photon counting
  - Correlations
  - Muon methods
    - Muonic x-rays, muon tomography, muon induced fission



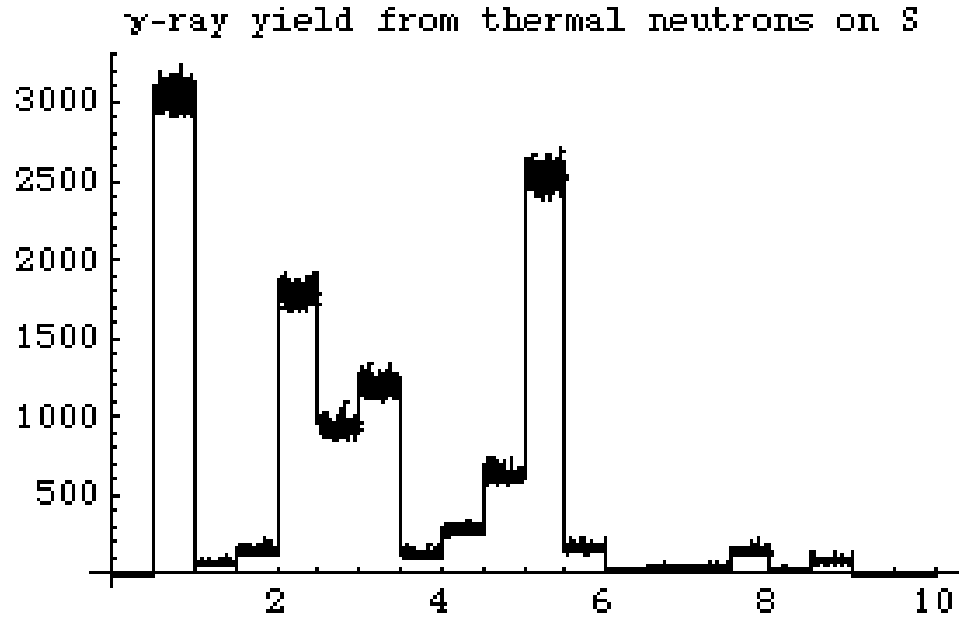
Fissile material detection ideas

- Active Interrogation
  - Neutron
    - Detect neutrons, photons
    - radiography
  - Photon
    - Photofission detect photons, neutrons
    - Radiography modes

Data Problems

- Missing Data
- Low Resolution Data

ERROR: Ge (32000) not in neutron library



Data needs for predictions

- Signal predictions
  - (γ,*f*) cross section, γ and n spectra and multiplicity distributions
  - (n, *f*) neutron and γ multiplicity-energy distributions
  - More complete β-delayed neutron and γ emission data
  - High energy photon production
  - (α, α') and (α, γ) cross sections and spectra
  - Spontaneous and cosmic-ray induced fission data

There are some data that are missing. Low resolution data can produce very bad predictions of high resolution spectra.

Data needs for predictions

- Backgrounds
  - (n,γ) data for detector materials
    - e.g. Ge! (for HPGe and BGO detectors)
  - (n,γ) and (n,n' γ) for cargo and environmental/construction materials

In general the data are in good shape for prediction of integral experiments, for Homeland Security much more complex predictions are required.

Data needs for attribution

- The attribution problem: Faced with material, a device or post-detonation residue how can the origin of the material be established?
  - The usual approaches rely on accurate predictions of production of exotic products during material production, processing, aging and explosion. Data that have been adequate for reactor and weapons work before will not be adequate for this job.

Summary

- Homeland Security applications need good, validated, nuclear data beyond what is needed for nuclear reactor or nuclear explosive work