R&D NEEDS FOR NATIONAL SECURITY ACCELERATOR APPLICATIONS

Jay Davis

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DENNIS KOVAR ASKED ME TO OUTRAGEOUS IN THIS PRESENTATION

- At various times I have built or created accelerators and their applied programs
  - Seven total at LLNL over three decades
- At various other times, I have done national security work as an inspector
  - Iraq in 1991, Russia, Ukraine and Poland in 1998
- For three years, I headed DTRA, lasing treaty inspections and response to WMD technologies
- At present, I sadly do mostly policy studies

Outrageous statements will helpfully be placed in red text

FOUR DIFFERING AREAS OF APPLICATIONS SPRING TO MIND: I'LL DEVELOP EACH

- Understanding origins – forensics
- Imaging materials in motion – radiography and tomography
- Materials modification – causing or understanding damage or alteration
- Detecting materials – inventory or interrogations

1. I doubt that there are any credible weapons applications

I'D LIKE TO TAKE EACH AREA SEPARATELY AND DEVELOP IT A BIT

- Expressing challenges or opportunity
- Creating "desirements" for hardware
- Suggesting needed R&D
- I'm good at the questions, less so at the answers

MY NOTION OF ACCELERATOR SPACE IS PRETTY EXPANSIVE

- Mass spectrometers and electron microscopes are at one end
- Neutron sources for NIF detector characterization are at the other
- If it has an ion source or electron gun and a potential drop or an RF field, we should include and assess it

ORIGINS AND FORENSICS

- For conventional mass spectrometers and accelerator mass spectrometry, we need
  - Fast sample prep methods
  - Coupling LC and GC systems to ion sources for biological samples
  - Clever and/or automated sample selection and preparation means for nuclear forensics
- For materials characterization, particularly in biology, we need better non-destructive means to place samples in vacuum
- Multiple intercompared platforms to meet legal requirements

RADIOGRAPHY AND TOMOGRAPHY

- We will always want the ability to image at the smallest scale (not well known in advance) at the highest possible speed. Thus
  - Brighter ion sources
  - Higher energies
  - Spectrometric detector systems with greater acceptance

A next generation purpose-built pRad machine is greatly to be desired

MATERIALS DAMAGE OR MODIFICATION

- An accelerator-driven pulsed low enrichment uranium assembly to replace fast burst reactors for weapons effects research
- Multiple ion beam simultaneous irradiation capabilities to simulate fusion or fast reactor conditions in materials
- Perhaps a new 14 MeV neutron source for fusion materials work

2. These last two are at the edge of my franchise unless you believe fusion bears on national security

DETECTING MATERIALS: INVENTORY

- The next sequence of nuclear arms control treaties will require:
  - Warhead counting
  - Inventory verification
  - Dismantlement verification
  - A fissile materials cutoff treaty
- The varying issues of classification, non-proliferation safeguards, and security restraints impose real limitations on the use of passive detector systems
- Can we make clever and uniquely capable probing radiation sources so the detectors can be dumb?

DETECTING MATERIALS: INTERROGATION

- We all fancy using radiation sources and detectors to find bad things
- I think they can work very well in constrained (i.e., treaty-mandated applications)
  - Sandia's Cargo Scan at Votkinsk has been a real success
- I am dubious about their real utility against terrorists
  - To me, they are mostly just expensive and vulnerable triggering devices

SO MY CHALLENGE TO THIS WORKSHOP IS:

- Let's create some taxonomy of applications
- Pick out one or two accelerator systems for each application that look promising
- Address the inadequacies of what we have
- Identify the research needs that would improve the concept
- Look laterally across all applications for commonalities that would help us in setting resource priorities