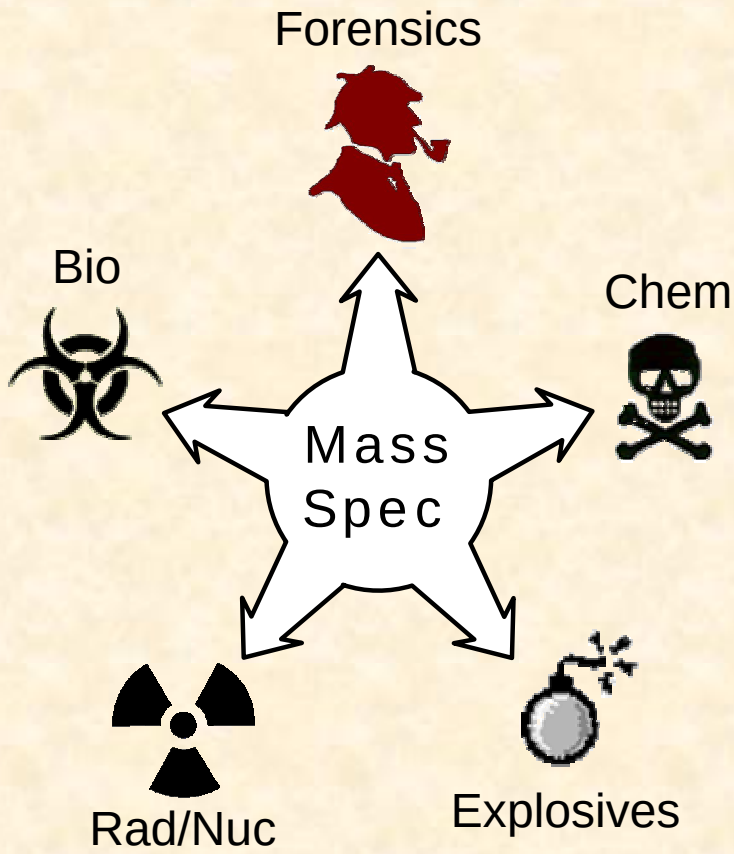
Mass Spectrometry's Role in National Security

- **Mass Spectrometry (MS) is key technology for addressing the broadest range of national security issues – chemical, biological or nuclear related**
- **Oak Ridge National Laboratory has a**
  - **60 year long history in MS (beginning with the Y-12 Calutrons)**
  - **an expansive and often unique MS infrastructure (people and equipment)**
  - **and an unparalleled reputation for the research, development and application of mass spectrometry as an analytical technique, both in the National Laboratory and wider scientific communities**
- **<u>ORNL's MS programs provide a unique resource for Homeland Security and National Defense</u>**

Why is Mass Spectrometry So Important?

- **Target *Identification*,** not just *detection* (sensors)
- **Unknown identification,** (if not target, then what?)
- **Universal detector** (biological, organic, inorganic molecules, low-to-high molecular mass) for "chemical" and elemental signatures
- **High sensitivity** (reduces false negatives)
- **High specificity** (reduces false positives)
- **Legally defensible**, ultimate standard identification technique (gold standard)
- **Versatile** (rapidly reprogrammable for new threats)
- **Fast** (physical/electronic measurement)

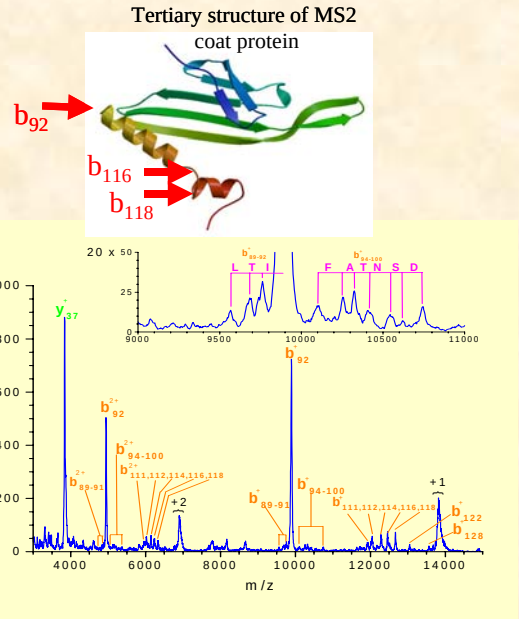


Mass Spectrometry National Security Research Areas Currently at ORNL

- **Nuclear**
  - **Inorganic and Isotope Ratio MS**
  - **IAEA Treaty Support**
  - **Chemical and Nuclear Signatures**
  - **Surfaces and Particle Isotope Imaging**
  - **Environmental**
- **Chem/Bio**
  - **Chemical and Biological Agent Detection**
  - **Protein Analysis (Toxins/Virus**
  - **CW Treaty Verification**
- **Other Counterterrorism**
  - **Explosives detection**
  - **Taggants**
- **Miscellaneous**
  - **Forensic**
  - **Drug Detection**
  - **Fieldable and Miniature MS Instrumentation**

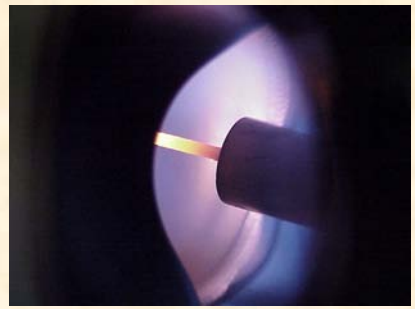
MicroTrapMS
Hand-held Mass Spectrometer
2003 R&D 100
Award Winner

Boarding Pass Analyzer
for Airport Security



Protein sequence mass spectrum for the coat protein of the bacteriophage and DoD BW simulant - MS2

Block II
Chemical and
Biological Mass
Spectrometer
(CBMS)
2000 R&D 100
Award Winner



New rf cavity
ion source for
inorganic mass spectrometry

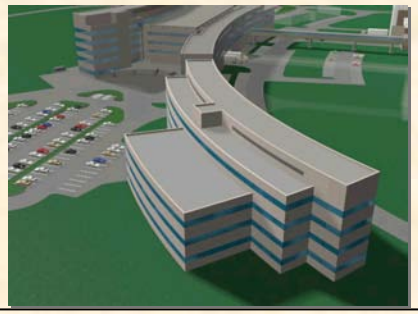
Examples of Broader Impact of Mass Spec Technologies Derived from National Security Efforts

- **Fieldable MS => handheld chemical detectors, forensics, environmental monitoring and remediation**
- **ESI/protein => public health, agriculture monitoring, proteomics, bioassay, clinical diagnostics**
- **Particle MS => indoor air monitoring, auto exhaust**
- **CBMS => building monitoring, process monitors,**
- **Inorganic => geological applications, bioassays, materials science, environmental**
- **Negative ion det. => environmental, bioassay**
- **Wide field of view SIMS => bio-tissue imaging; geological applications (dating); forensic applications**

Mass Spectrometry Important in Many ORNL Science & Technology Initiatives – Cross Directorate

Complex Biological Systems

Advanced Materials



Center for Nanophase Materials Sciences

Mass Spec

DOE GENOMICS:GTL
ACCELERATING DISCOVERY FOR ENERGY AND ENVIRONMENT
OFFICE OF SCIENCE
U.S. DEPARTMENT OF ENERGY

Center for Molecular and Cellular Systems

Computational Biology Institute
ccs institutes

SensorNet
Oak Ridge National Laboratory

CMBS Block II

National Security

GST

University Partnerships

MOUSE HOUSE

Mouse Genetics and Genomics

Some of the Mass Spectrometry at the Oak Ridge National Laboratory Site