Niowave's Domestic Production of Mo-99 from LEU without a Nuclear Reactor

Niowave, Inc.
Lansing MI

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Presented at the Mo-99 Stakeholders Meeting
Washington, DC

NIOWAVE
Accelerating Your Particles

Outline

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- Superconducting Linacs and Their Applications
- Mo-99 Production from LEU
  - Uranium Target Assembly
  - Uranium Targets
  - Isotope Separation (LMC and UREX)
  - Uranium Recycling
- Future Steps

Niowave's Commercial Markets

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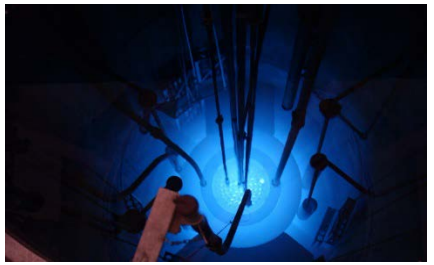
Superconducting Electron Linacs

< 9 MeV → **Sterilization & Advanced Manufacturing**
Eliminate dirty bomb material

9 MeV → **Radiography & Active Interrogation**
Cargo inspection for contraband and shielded nuclear bombs

> 9 MeV → **Medical & Industrial Radioisotopes**
Domestic supply without nuclear reactor or highly-enriched uranium

> 9 MeV → **Nuclear Energy Advanced Technologies**
Domestic fast neutron irradiation and advanced reactor development



Superconducting Linac Facility

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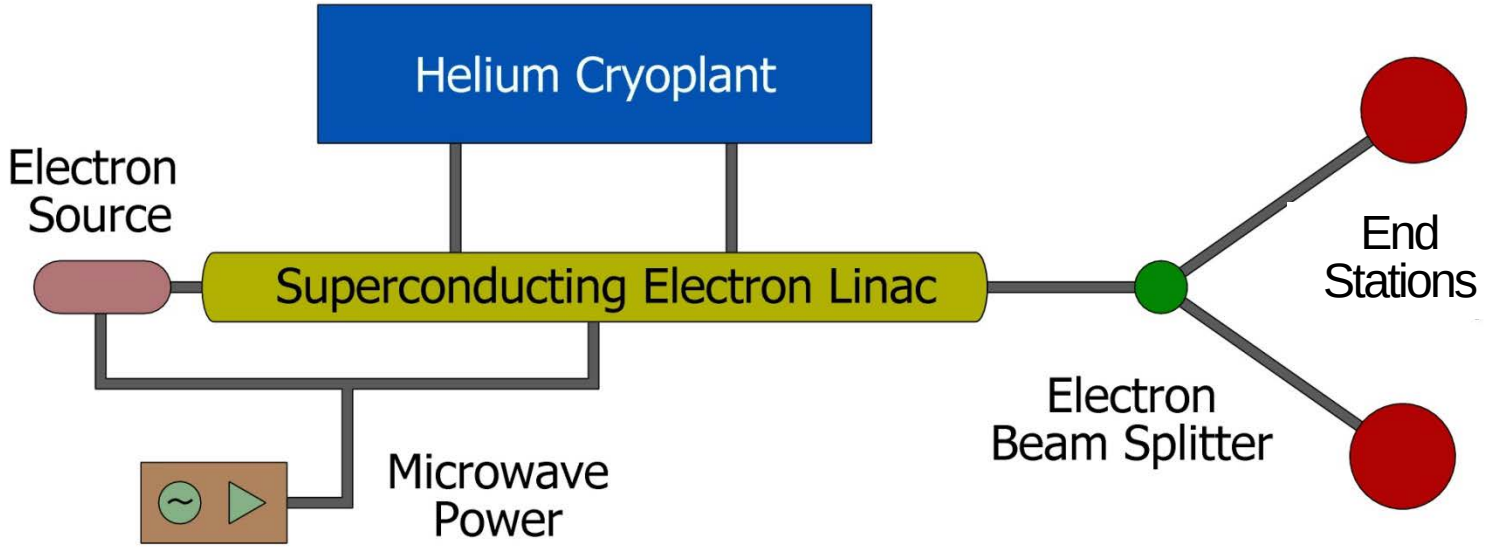

Turn-key Systems

- Superconducting Linac
- Helium Cryoplant
- Microwave Power
- End Station
- Licensing

Beam Energy	1-40 MeV
Average Beam Power	10-100 kW
Duty Cycle	10-100%
Closed-loop Cooling Capacity	40-110 W @ 4 K

Isotope Production Flowchart

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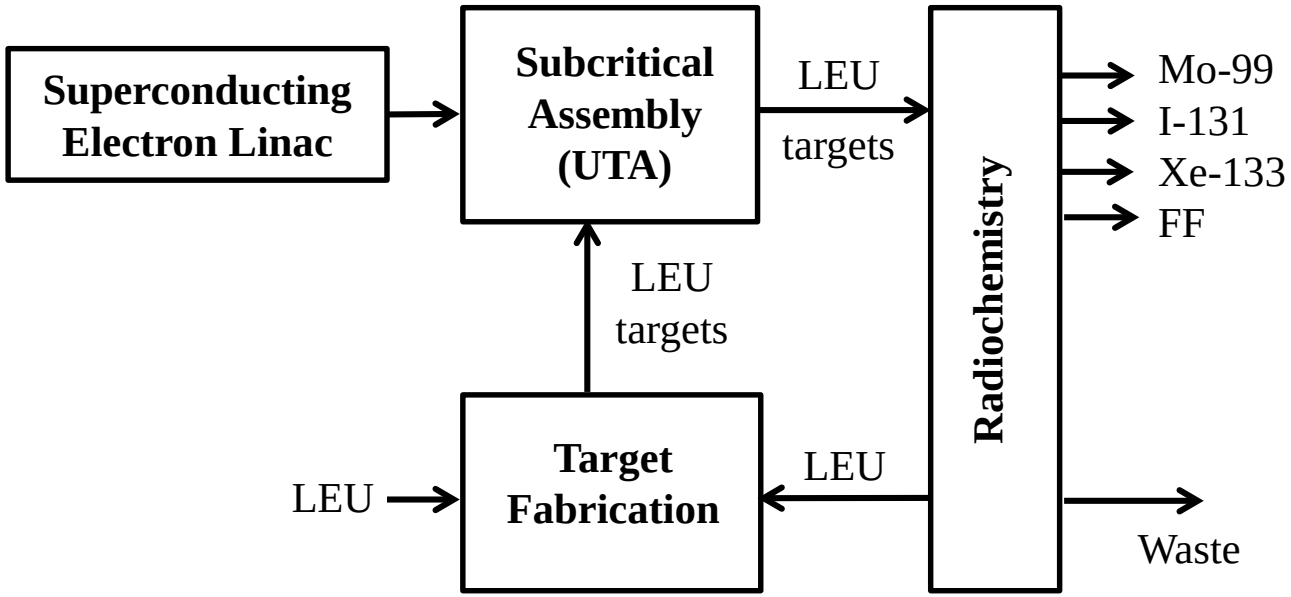
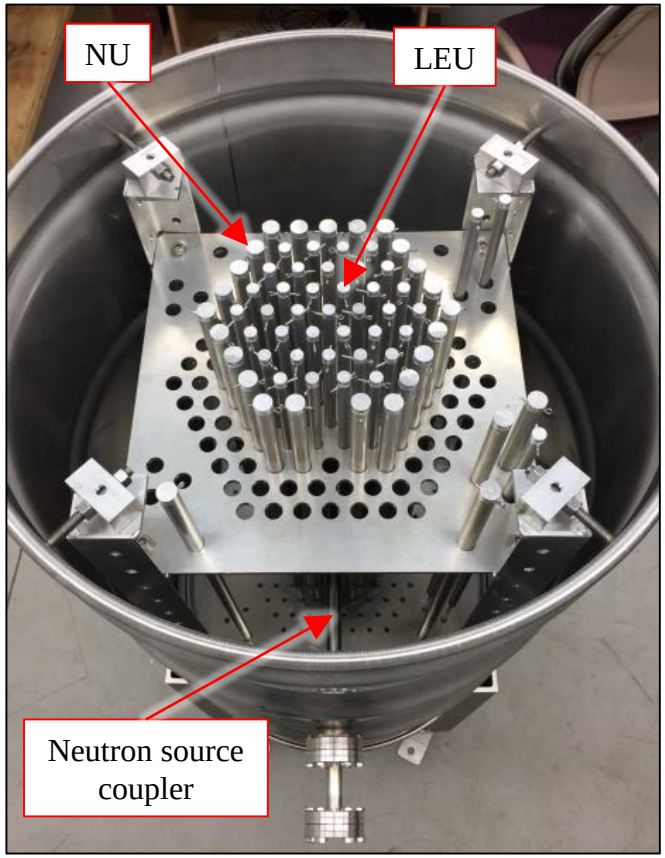
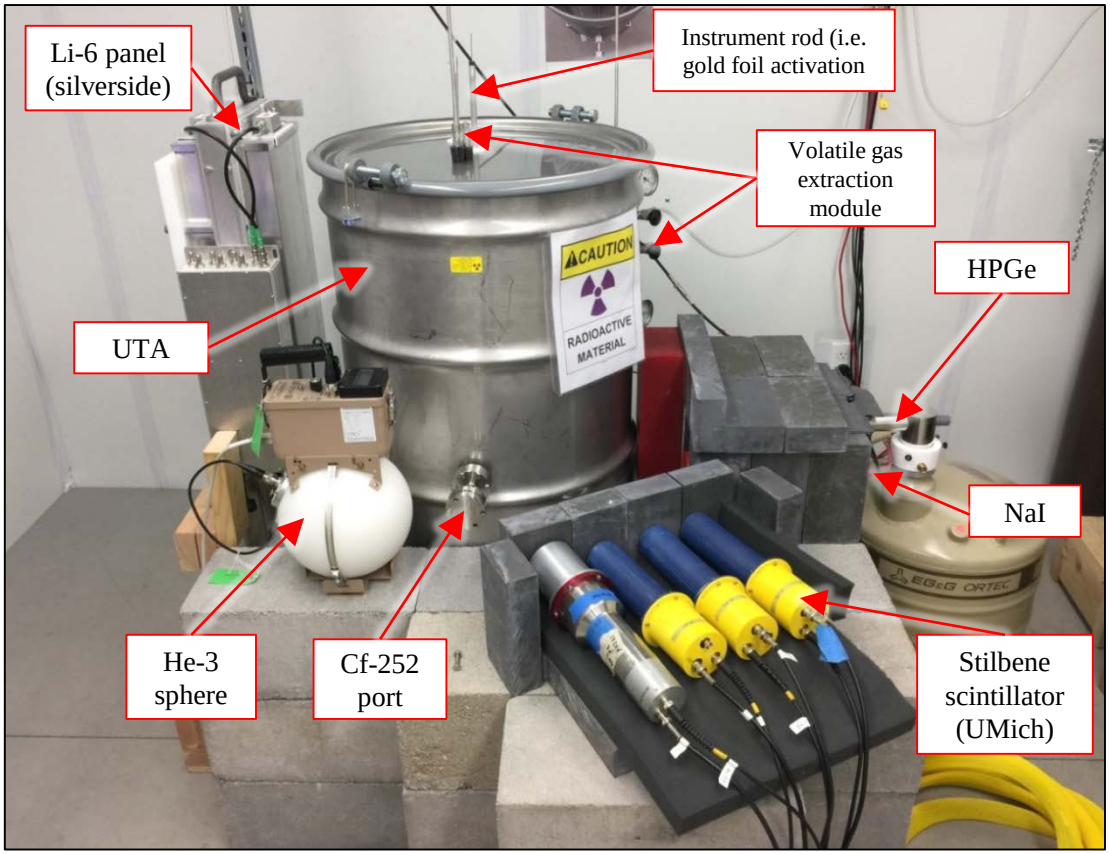
- 10 kg LEU will be processed each week
- 10 kCi of Mo-99 per week



UTA Characterization





- Commissioning and characterization of UTA and instrumentation system
- Validate computer models and simulations

UTA Driven by a Linac

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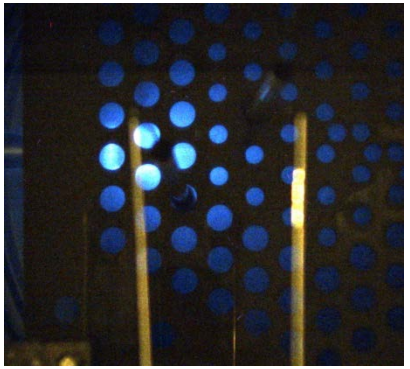
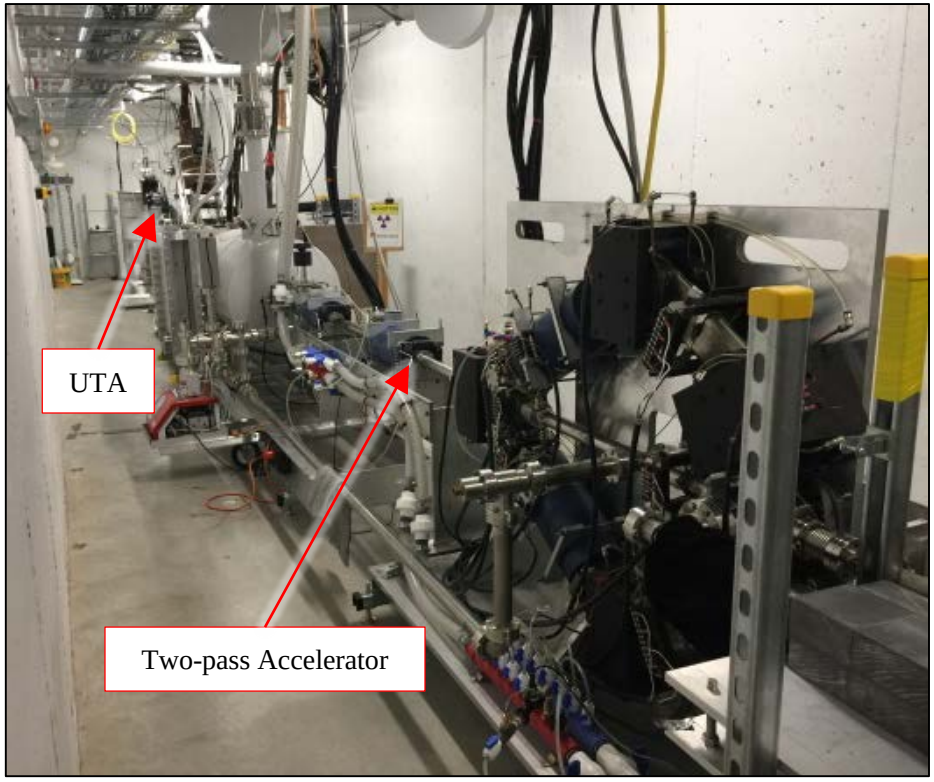
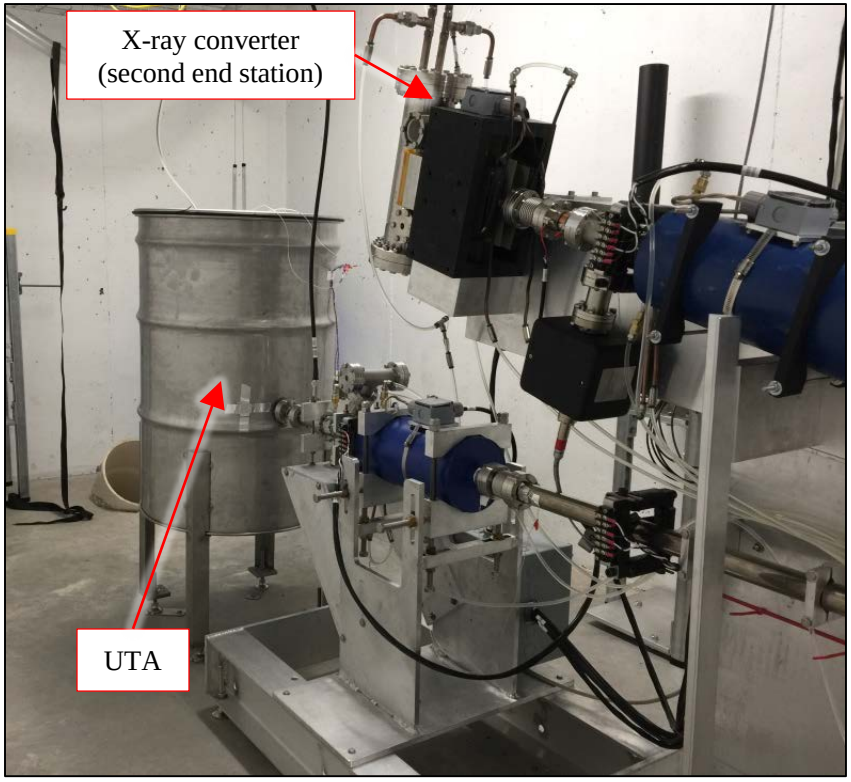
Successfully operational fully coupled system:

- Superconducting linac coupled to UTA
- Neutron production verified and validated
- Mo-99 and other FF are produced







LEU Acquisition and Target Preparation

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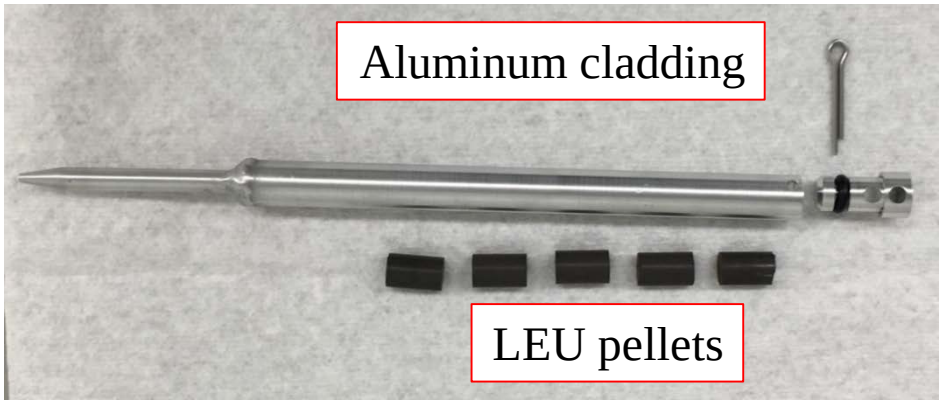
Natural uranium

- 345 kgU (metal and oxide) at Niowave

Low Enriched Uranium (<20 wt% ^{235}U)

- 1.8 kgU oxide at Niowave
- 18 kgU metal purchased from Y-12/NNSA



Mo-99 Extraction

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- Working with ANL since 2015:
  - Training Niowave's staff
  - Helping to establish a radiochemistry facility at Niowave
  - Assisting in improving the efficiency of separation and scaling up the processes

Performing LMC at Niowave facility

Uranium Recovery and Target Preparation

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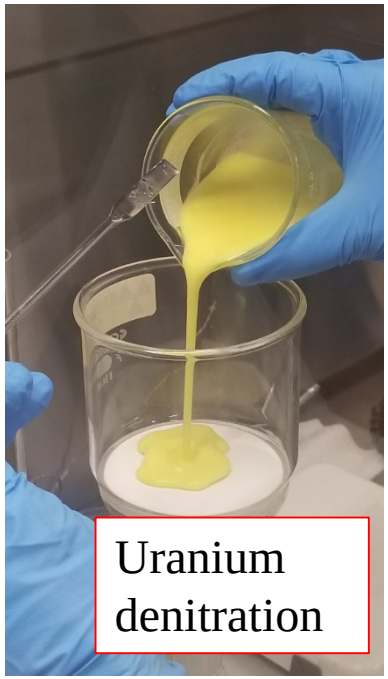
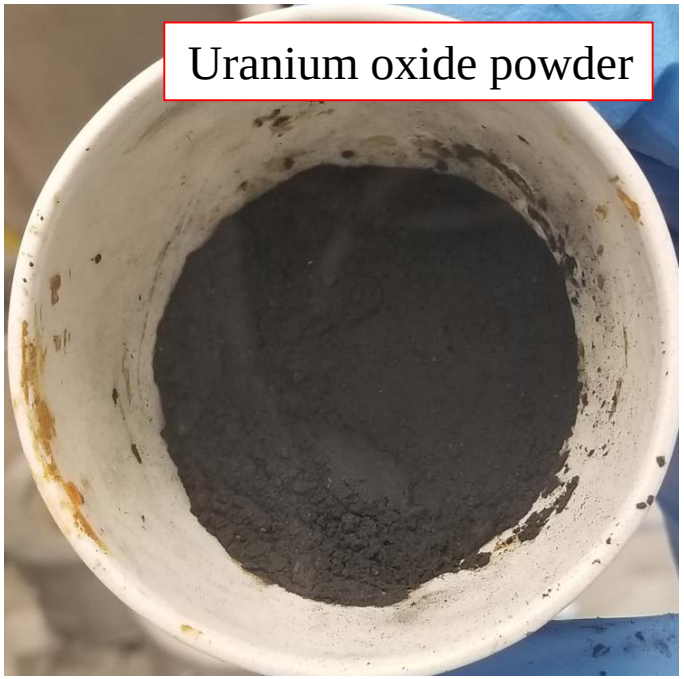
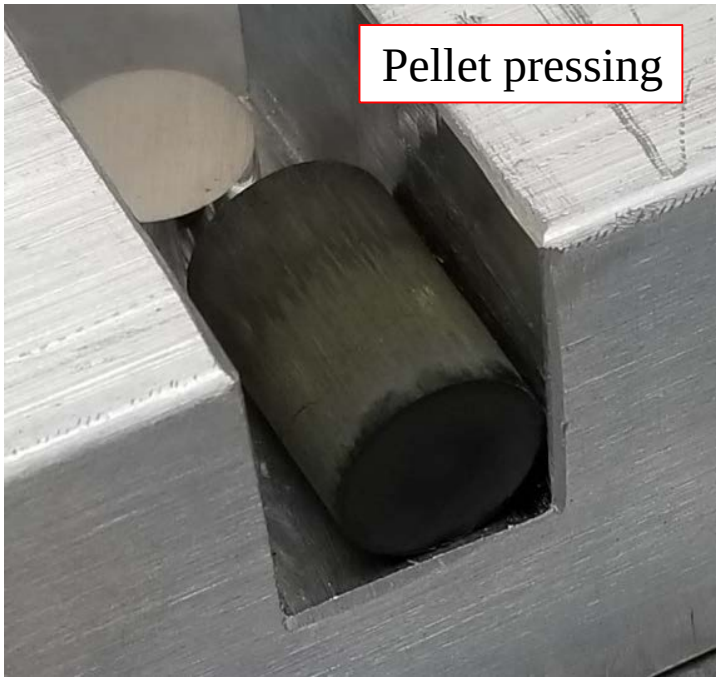
- Working with Y-12 since 2017:
  - UREX
  - Mechanical pressing of uranium oxide powder



Uranium denitration



Uranium oxide powder



Pellet pressing

Pressed pellets are loaded for re-irradiation

Na_2MoO_4 and Xe samples

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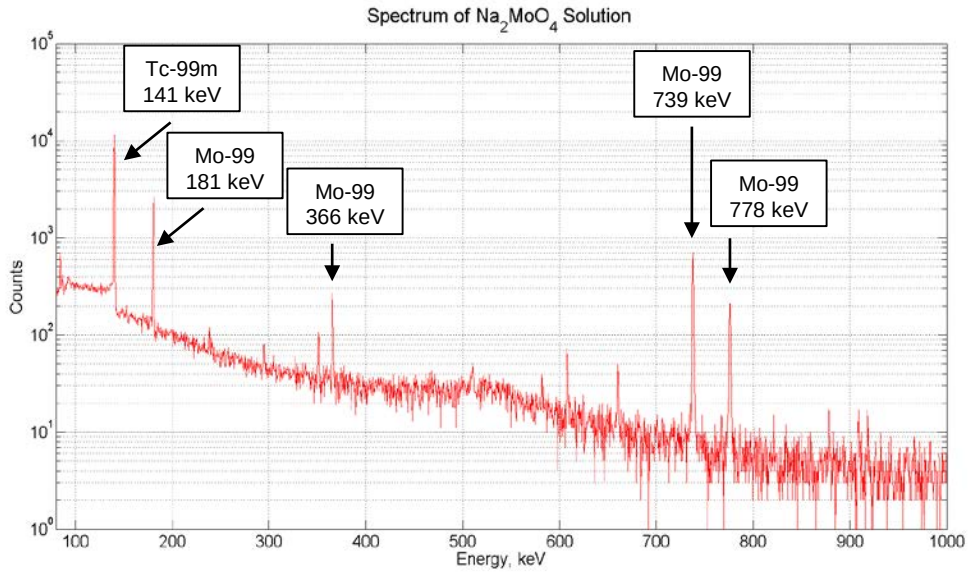

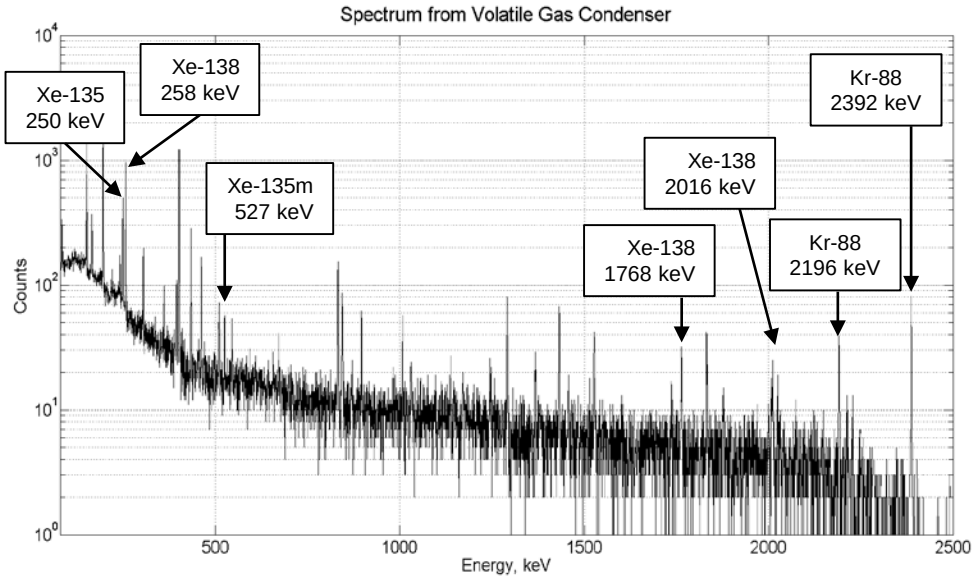

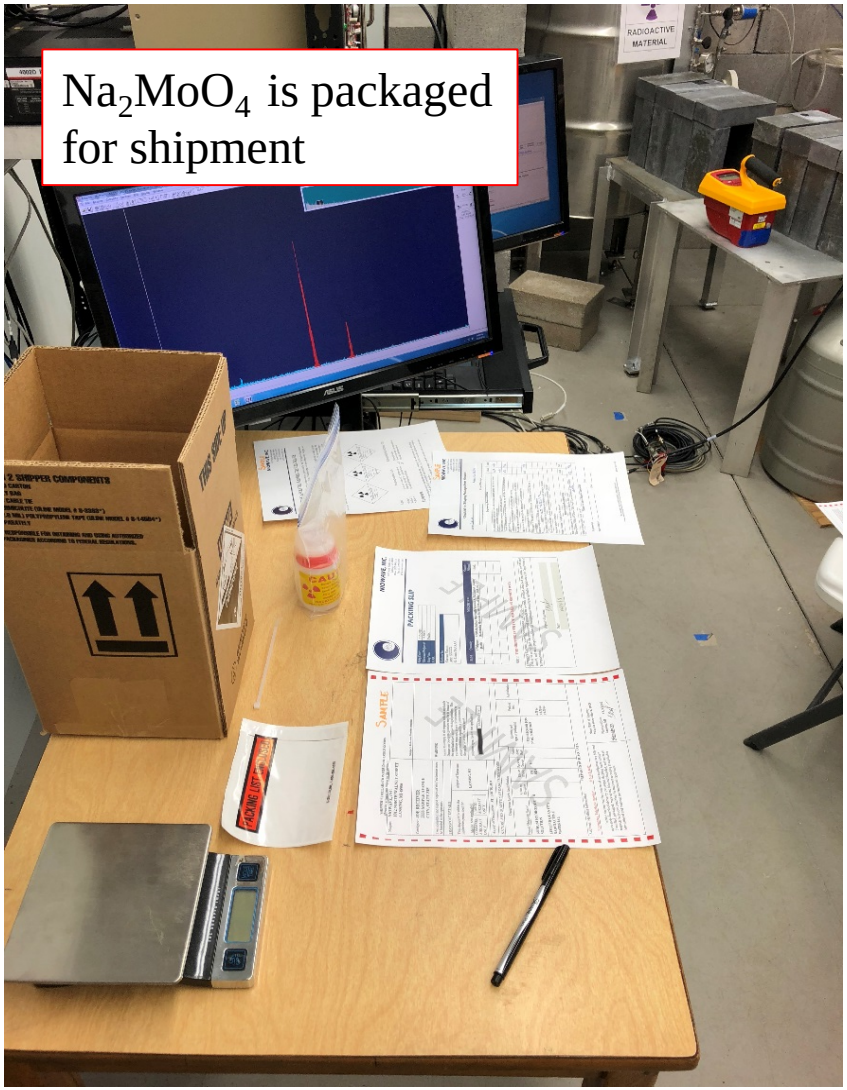

Future Steps

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- Niowave will continue work with Y-12 and ANL to improve and scale up our processes
- In the next 2 years we will be producing:
  - 10 Ci per week of Mo-99 and Xe-133
  - 10 Ci of other beta emitting fission fragments
- Revenue from therapeutic beta emitters:
  - Coproduced during uranium fission
  - Will fund scale up to 10 kCi/week