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Sandia National Laboratories

Negative Ion-Based Associated Particle Neutron Generator

SL11-ImgNeutGen-PD03
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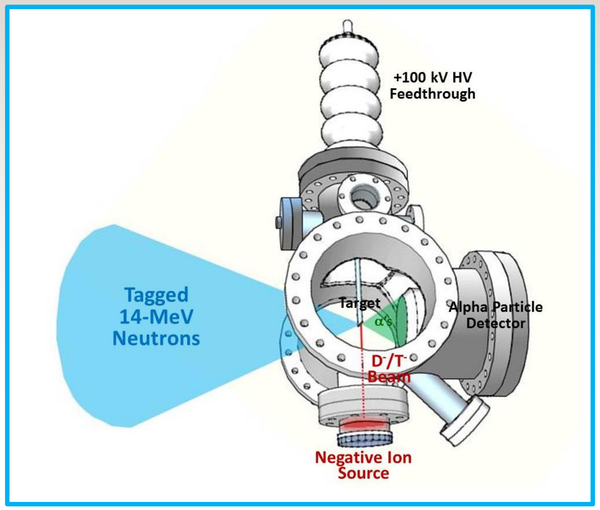
I. Goals

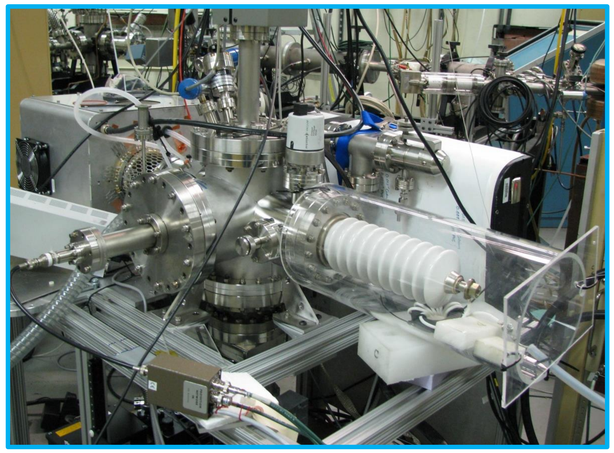
Sandia is developing a Negative Ion-Based Associated Particle Neutron Generator (APNG) with >10^8 D-T n/s neutron output from a 1-mm-diameter beam spot that has high operational reliability.

II. Introduction

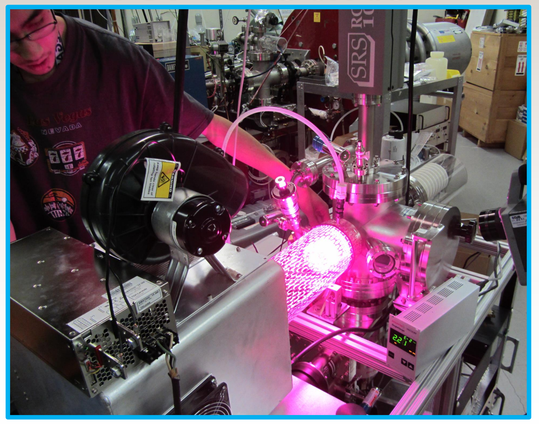
- **(n,γ) imaging, induced fission imaging, and fast neutron radiography benefit from an associated particle neutron source to reduce background and improve material characterization with high spatial fidelity.**
- **The negative ion-based APNG enables**
  - ✓ **Efficient neutron production**
    - **100% atomic ion beam**
  - ✓ **High fidelity imaging**
    - **1 mm neutron spot size**
  - ✓ **Reliable operation**
    - **eliminates backstreaming electrons and HV breakdowns**
  - ✓ **Long lifetime**
    - **Beam-loaded target**
    - **Reduced sputtering degradation**

III. Methods





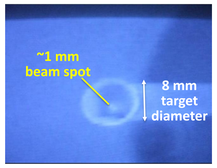
IV. Results



Demonstrated stable HV operation for >1 hr without breakdown

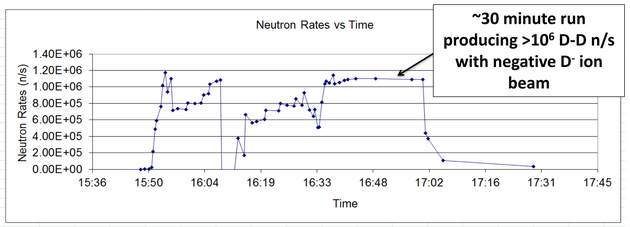
	Ion Source Pressure	Target Chamber Pressure	Positive Ion Beam	*Negative Ion Beam*
HV without beam	0.0001 mTorr	0.0001 mTorr	-100 kV	***+100 kV***
HV with beam	30 mTorr	0.1 mTorr	-44 kV	***+100 kV***

***Demonstrated* 1-mm-diameter neutron spot size**

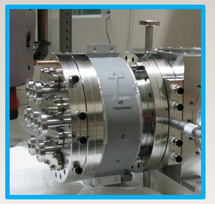


- **Hi-Res Infrared Camera viewing target through window port**
- **Operational parameters: 50 kV, few mA D+ ion beam**

Demonstrated >10^6 D-D n/s



V. Next Steps



- **Test all-metal negative ion source with internal antenna**
- **Enable D-T operation**

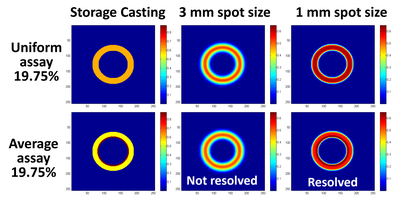
Technology Demonstration

Concurrently demonstrate:

1) **Neutron output ≥10^6 D-D n/s (equivalent to 10^8 D-T n/s)**
2) **≥3 hour stable operation at HV (reliable/stable operation)**
3) **3) point (~1 mm) neutron source production (enables high resolution imaging)**

VI. Conclusions and Relevance to Program Objectives

Negative Ion-Based APNG enables improved SNM detection



- **Simulated induced-fission images of storage castings for a (1) uniform assay of 19.75% ^{235}U and (2) average assay of 19.75% ^{235}U where the ^{235}U has been concentrated in an inner ring**
- **Use of a ApNG with 1 mm resolution (beam spot size) resolves the aberrant case**
- **Simulations performed by P. Hausladen, ORNL**

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