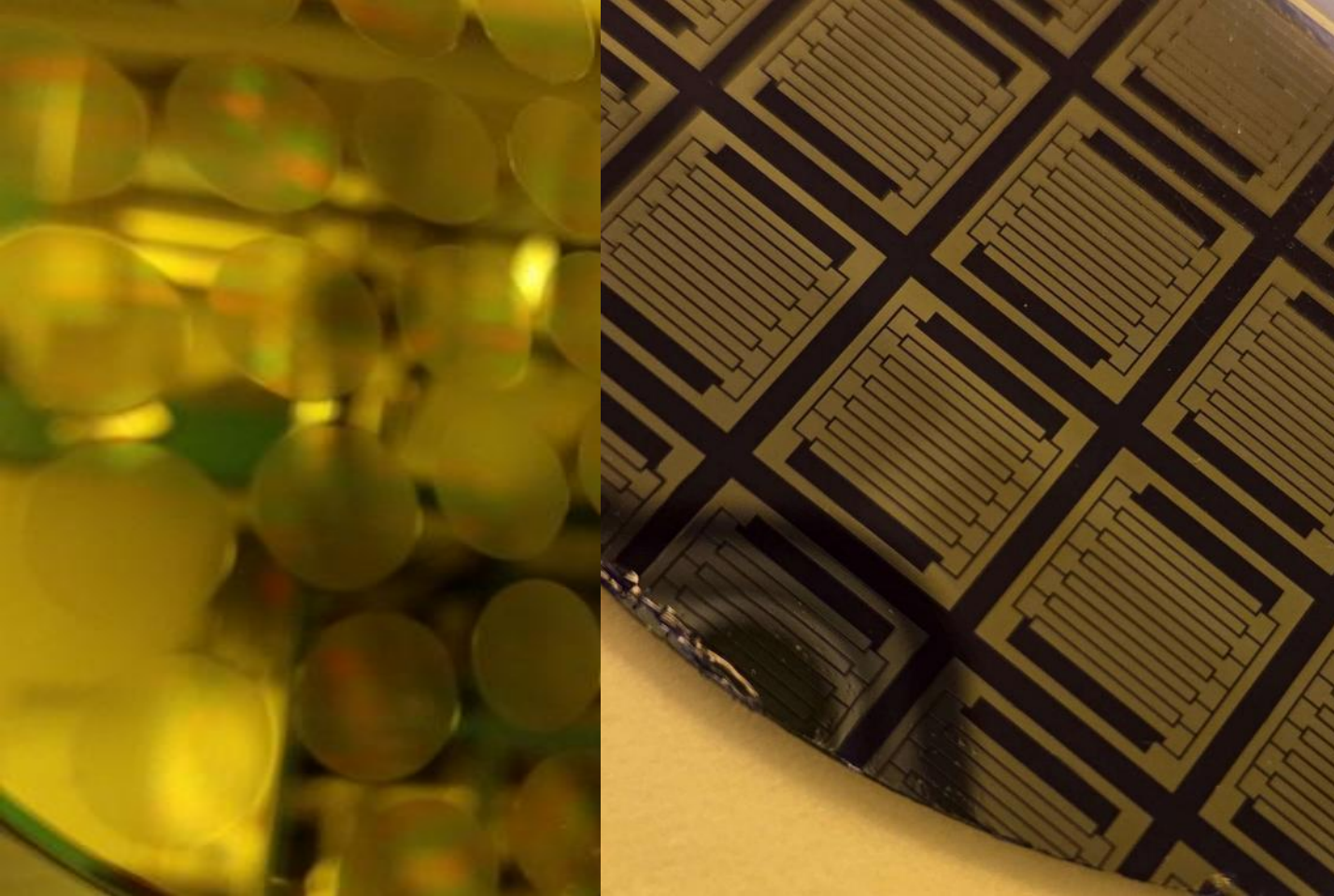




RADIATION DETECTION TECHNOLOGIES, INC.

- Taylor Ochs, Ph.D. — ochs@radectech.com
- 4786 Lake Elbo Rd - Manhattan KS
- www.radectech.com

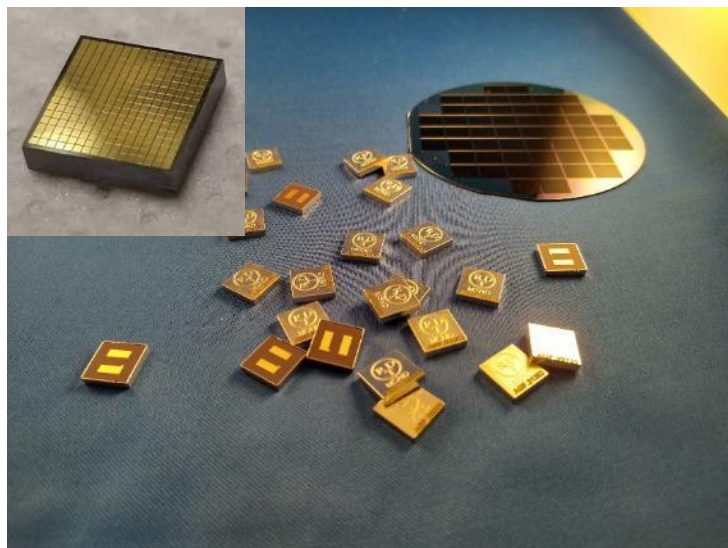
SEP 2026



RDT — WHAT WE DO

Radiation Sensors and Monitoring

- Neutron Detectors
 - MSND/Domino
 - Lithium Foil
 - MSND Based Instruments
 - **Micro-Pocket Fission Detectors**
 - **In-core Nuclear Reactor Sensor**
- Gamma Detectors
 - CZT/CdTe - Medical / Industrial



ochs@radectech.com

Semiconductor Materials

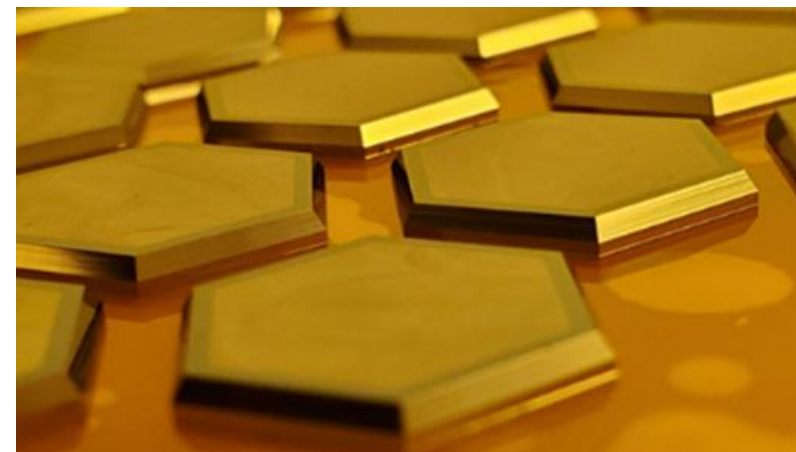
- CdZnTe (gamma spec)
- CdTe (solar)
- ZnSe (IR substrates)
- Other III-V, II-VI



montag@radectech.com

High Power Semiconductor Diodes

- Directed Energy applications
 - Pulsed Power Switches
- Si, pin Diode, Silicon opening Switch (SoS, Silicon closing Switch (ScS), Silicon Avalanching Switch (SAS), Fast Ionization Dynistor (FID)
- Wide bandgap (future)
 - SiC, GOX



bellinger@radectech.com



Advancements in Commercially-Configurable Micro-Pocket Fission Detectors

Radiation Detection Technologies, Inc.

Idaho National Laboratory

Kansas State University

TRTR Annual Conference – 2026.9.24

Funding: DOE Fast Track SBIR: DE-SC0026241



MPFD TECHNOLOGY — MOTIVATION

There is a need for real-time, distributed, in-core neutron flux sensors to support advanced test reactor experiments and development of next-gen reactors

MPFDs can

- be deployed in-core with minimal flux perturbation
- reduce need for iron-wire/foil activation fluence measurements
- improve accuracy of neutron radiation monitoring
- deliver multi-nodal and multi-energy group response
- provide a US-based manufacturing option for in-core neutron sensors

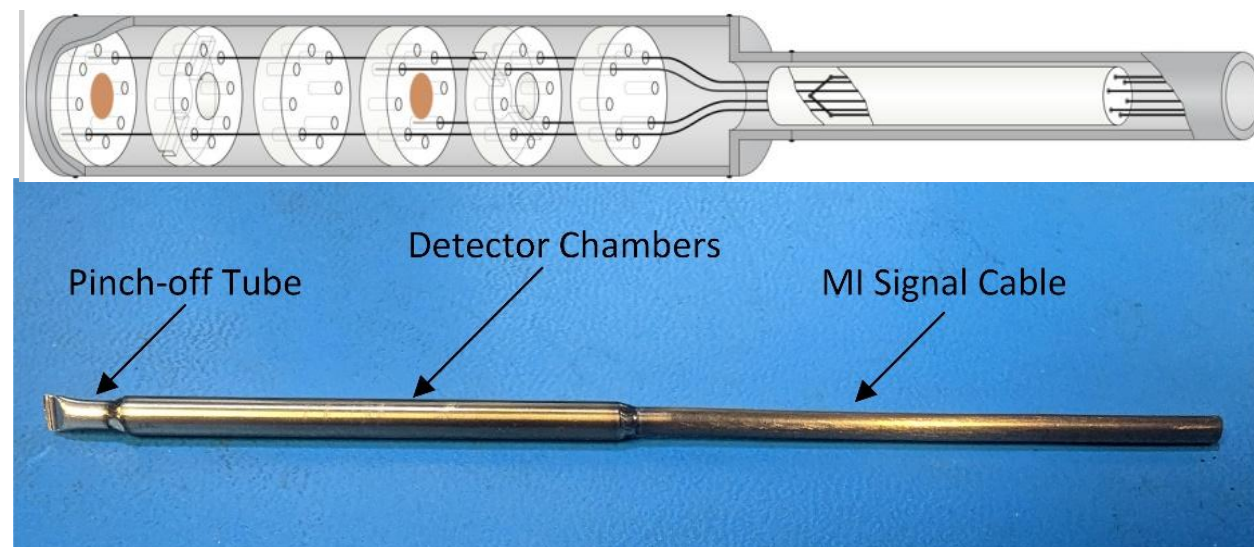
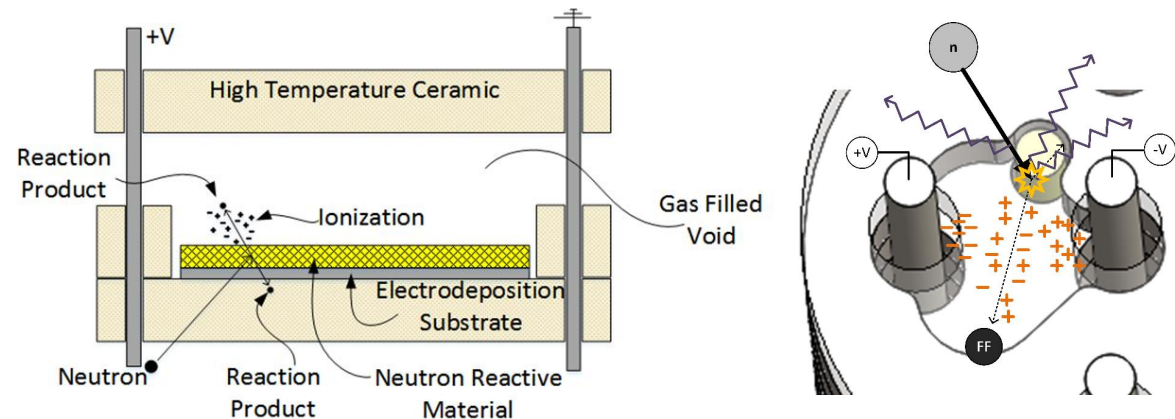
MPFDs have garnered interest from government, university, and commercial nuclear reactor groups



MPFD TECHNOLOGY - OVERVIEW

Initial MPFD development performed at Kansas State University and Idaho National Laboratory. RDT is leading commercialization.

- Pulse and/or current mode operation
- 0.5-3 mm³ fission chamber
- Successful deployments at KSU TRIGA, UWNR, and INL-TREAT
- Potential Uses: Startup/performance verification, flux mapping, fluence monitoring for irradiation experiments, power monitoring



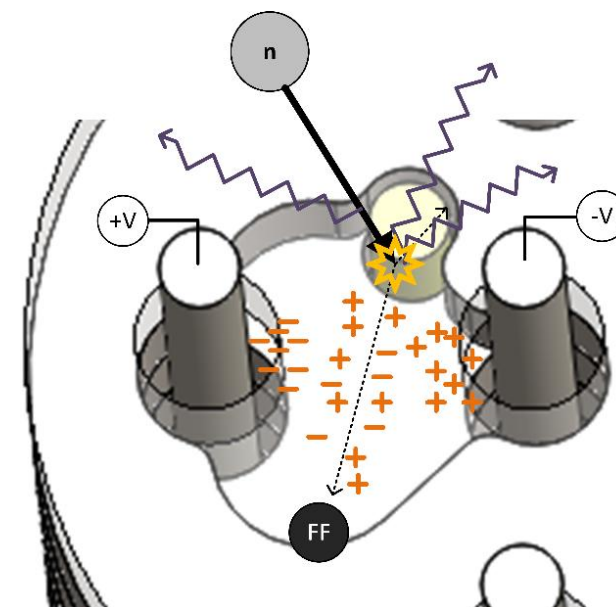
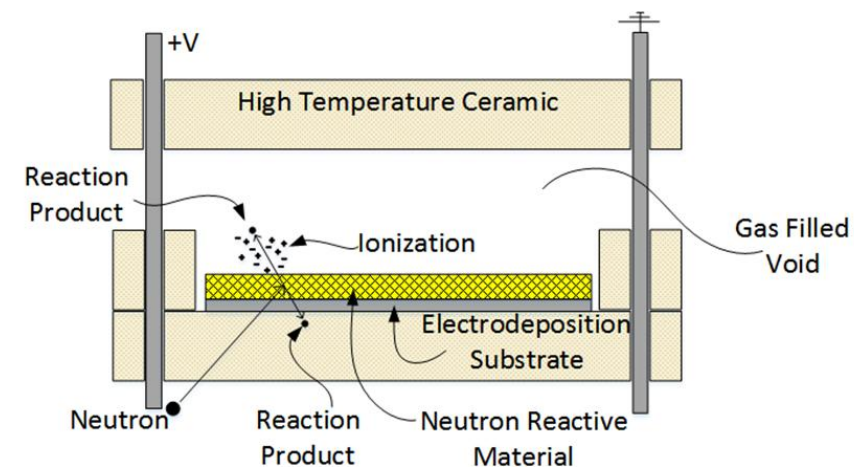


MPFD TECHNOLOGY - OPERATION

- 4-Node, 5-wire design has 4 detectors chambers that share a common cathode. Each anode is read out individually.

Detection Mechanism

1. Neutron is absorbed by fissile coating on neutron conversion wire
2. A fission fragment enters the MPFD chamber and ionizes argon fill gas
3. Electrons and ions are swept out via an applied voltage bias
 - At low flux/interaction rates, individual pulses are read out
 - At high flux/interaction rates, current is read out





PREVIOUS MEASUREMENTS — POWER TRACKING

- Observed linear response with reactor power at KSU

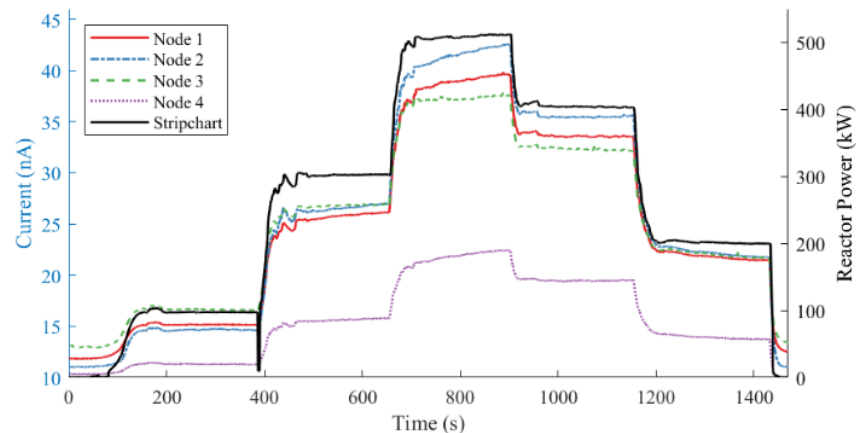


Fig. 5-5. Plot of DRT for MPFD array 3 performed in current mode. Note that raw count rate is presented for MPFD response.

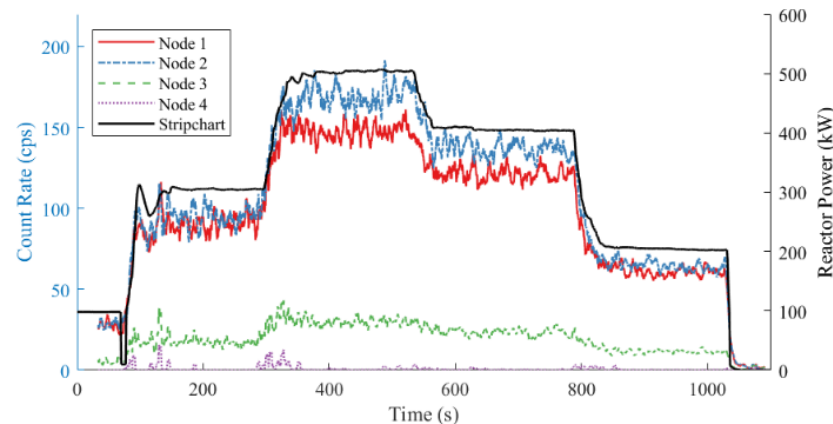


Fig. 5-6. Plot of DRT for MPFD array 3 performed in pulse mode. Note that MPFD data presented is smoothed with a moving average window of 200 data points.

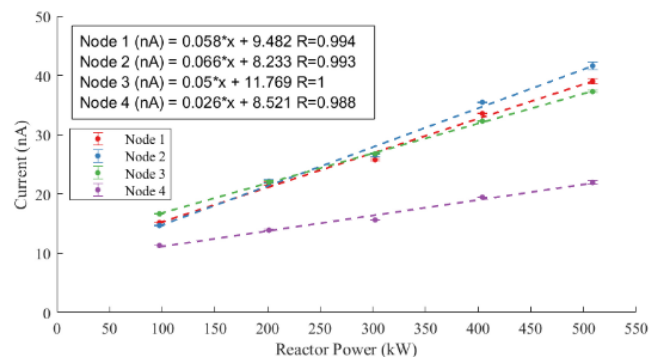
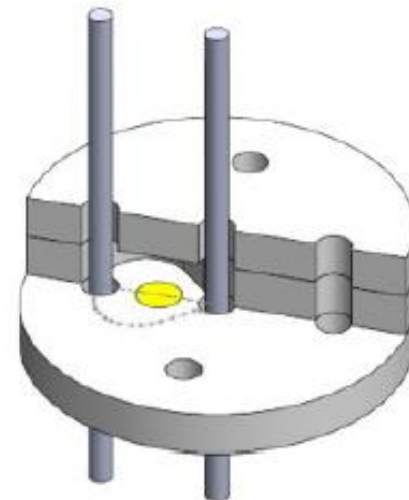


Fig. 5-7. Current mode linearity response of MPFD array 3 based on data presented in Fig. 5-5. Linear least-square equations are shown for each node.

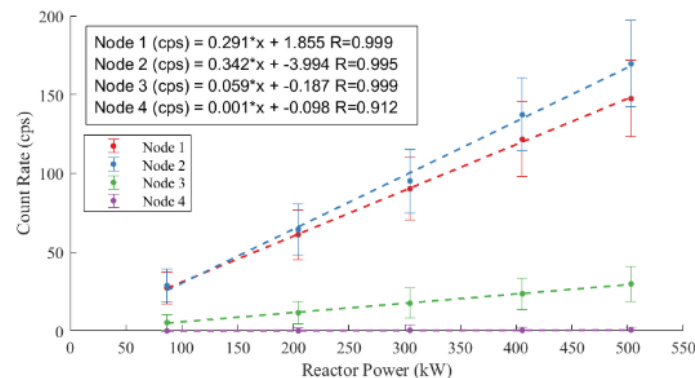
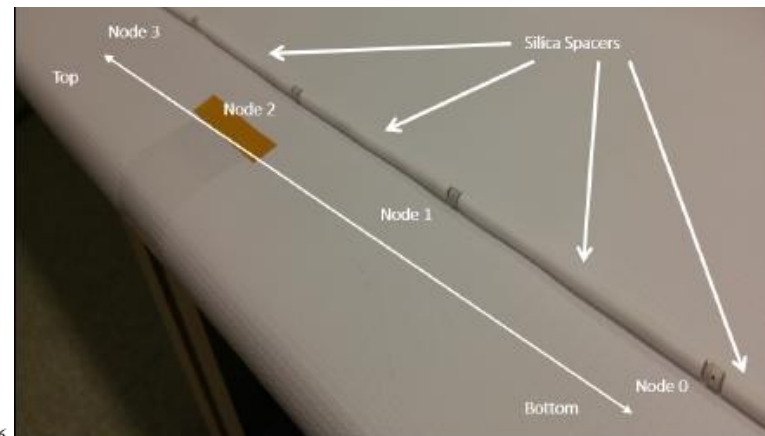


Fig. 5-8. Pulse mode linearity response of MPFD array 3 based on data presented in Fig. 5-6. Linear least-square equations are shown for each node.



D. M. Nichols, "Development and optimization of the micro-pocket fission detector," Mechanical and Nuclear Engineering, Kansas State University, 2022.

M. A. Reichenberger, "Micro-pocket fission detectors: development of advanced, real-time, in-core, neutron-flux sensors," Department of Mechanical and Nuclear Engineering, Kansas State University, 2017.



PREVIOUS MEASUREMENTS — PULSED TRANSIENT TRACKING

- Ability to track pulsed transients (TREAT, UWNR)

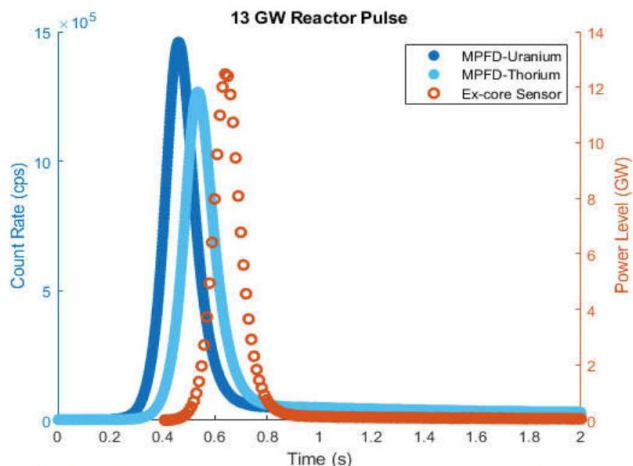


Fig. 9. MPFD response for both the uranium and thorium coated chambers for the 13 GWth reactor pulse.

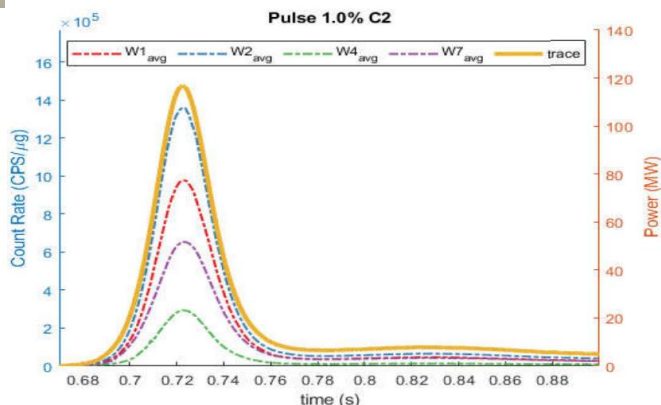


Fig. 7. Averaged response of MPFD wands distributed throughout the UWNR core. These wand locations are indicated in Fig. 2.

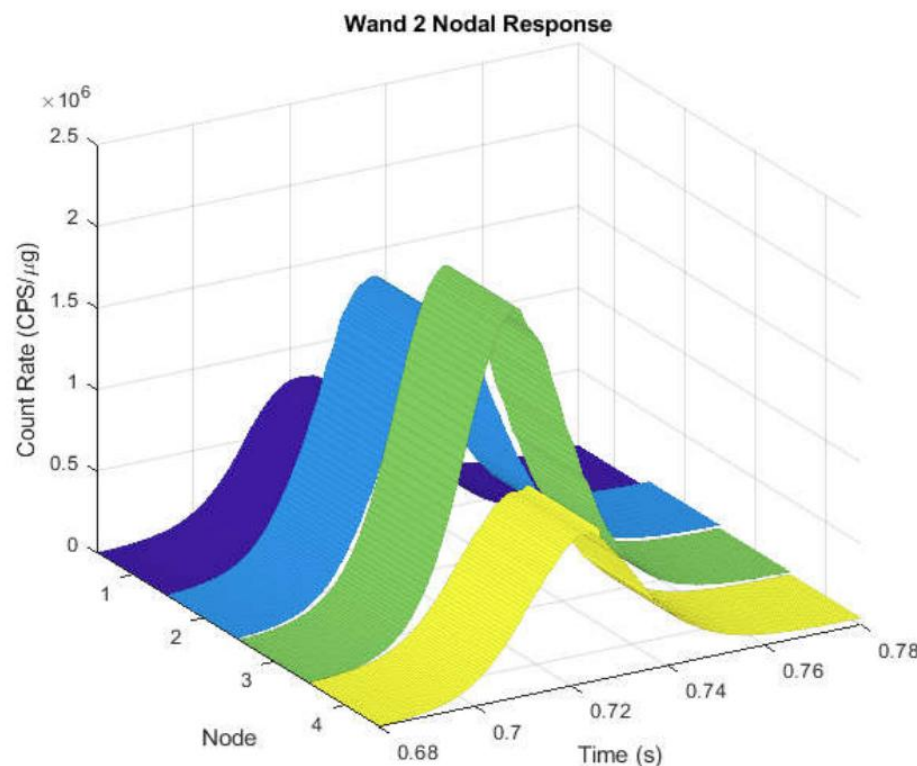
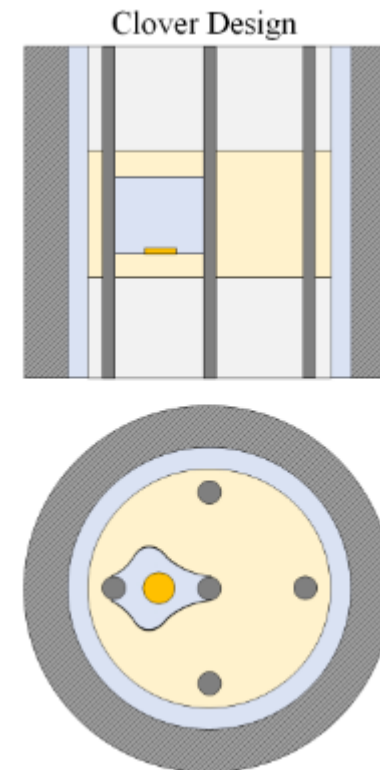


Fig. 8. Axially distributed detector response for Wand 2. Nodes 1, 2, 3, and 4 are located at +4.5, +1.5, -1.5, and -4.5 inches displaced from the center plane of the fuel region respectively.

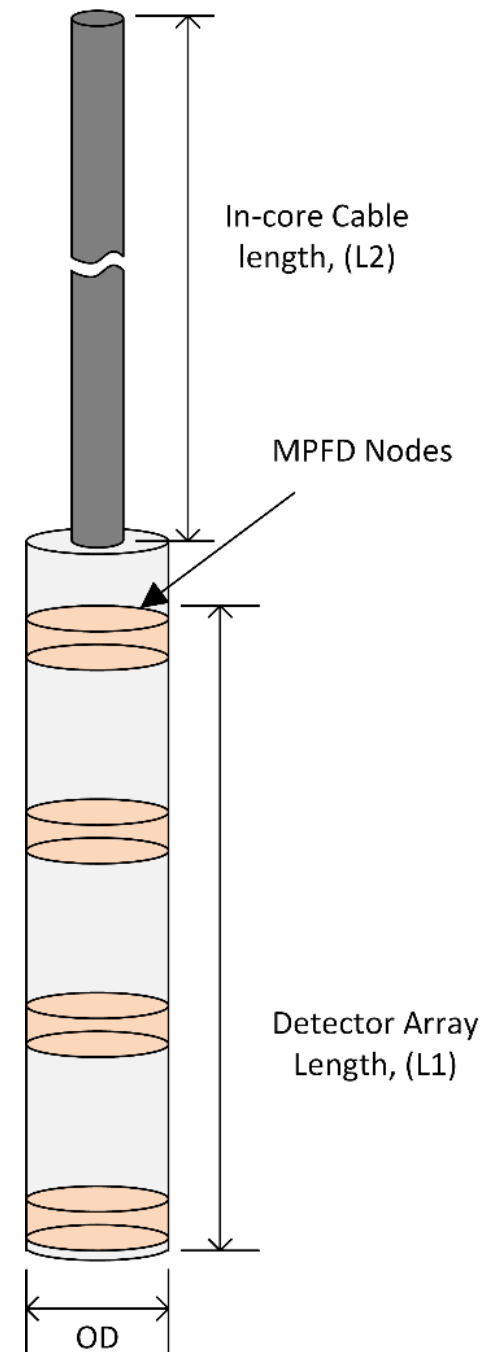


Data from:
Nichols, D. M., et al. (2019). Reactor Pulse Tracking using Micro-Pocket Fission Detectors in Research Reactors. 2019 IEEE Nucl. Sci. Symp.



COMMERCIAL MPFD TARGET SPECIFICATIONS

- Number of nodes – 1-4
- Chamber size: $0.5\text{-}3\text{ mm}^3$
- Chamber Tube OD: $0.125'' - 0.25''$ ($3\text{ mm} - 6.5\text{ mm}$)
- Detector Array Length (L1): up to $\sim 6\text{ ft}$ (2 m)
- MIC OD: $0.0625'' - 0.25''$ ($1.5\text{ mm} - 6.5\text{ mm}$)
- MIC Length: $\sim 10\text{-}20\text{ ft}$ ($\sim 6\text{ m}$), researching upper limit
- Fissile Coatings: U (HALEU), Th
- Temperature: Target up to 1000°C
- Flux: Proven 10^8 , target 10^{16}
- Total Fluence $< 5\%$ response change: Target 10^{22}
- Pulse and Current mode operation
- Signal Processing Electronics – COTS





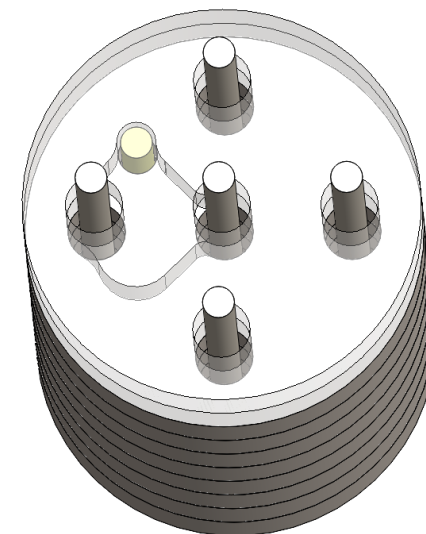
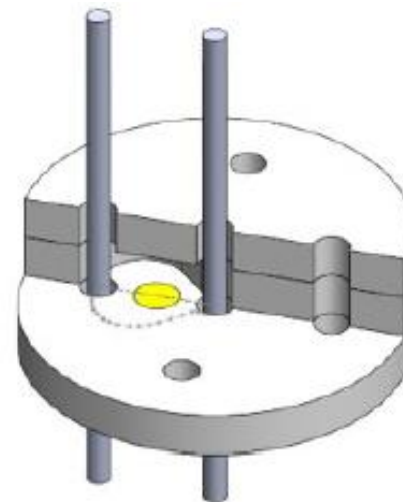
COMMERCIALIZATION PROGRESS

- DOE SBIR Phase I (2022-2023): Subcomponent Redesign
 - RDT, INL, KSU
 - Redesign for reliability and manufacturability
 - SBIR Phase II (Aug 2023): Not awarded
- DOE “2025” Fast Track SBIR (Phase I-II)
 - RDT, INL, KSU
 - Phase I: July-Nov 2026, Phase II: 2027-2028
 - Build, Test, Iterate, Demonstrate Full Scale Systems

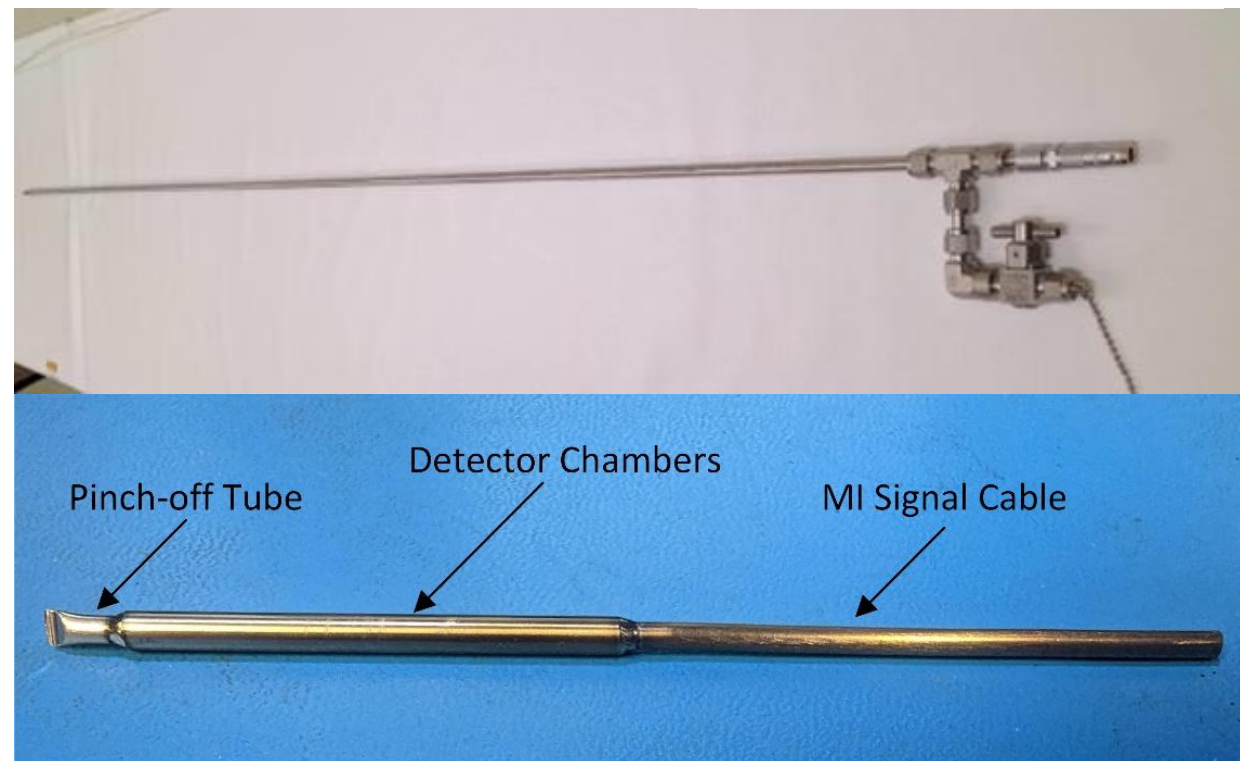
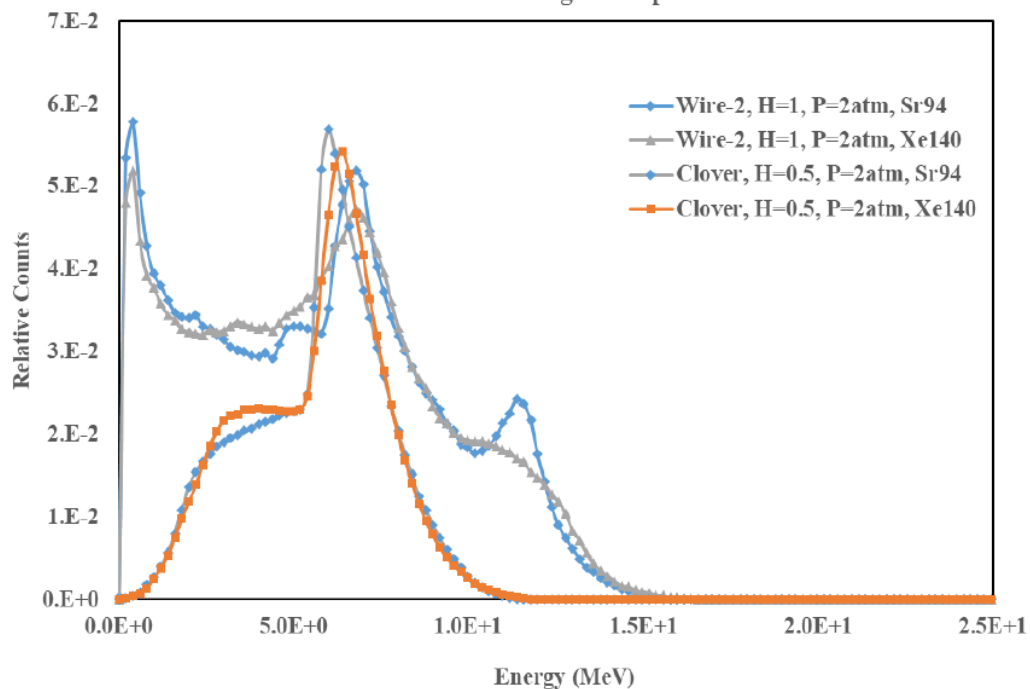


PREVIOUS PHASE I PROGRESS

- Chamber Redesign
 - Reduce complexity, improve integrity
- Batch electroplating
- Welded assembly with Pinch-off tube integration



Clover and Wire Design Comparison

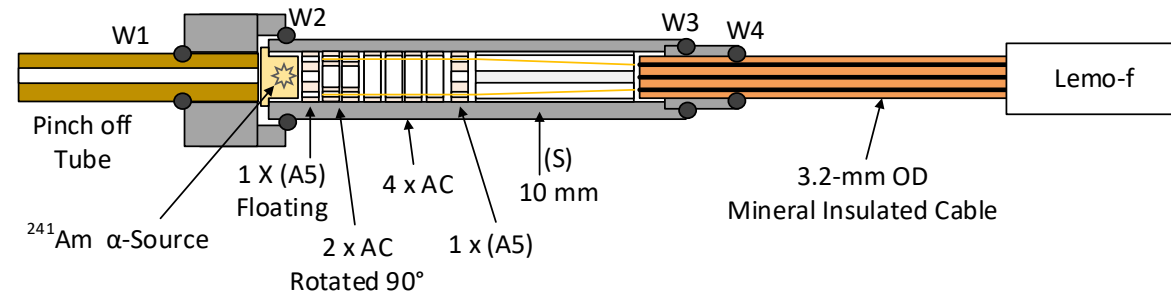




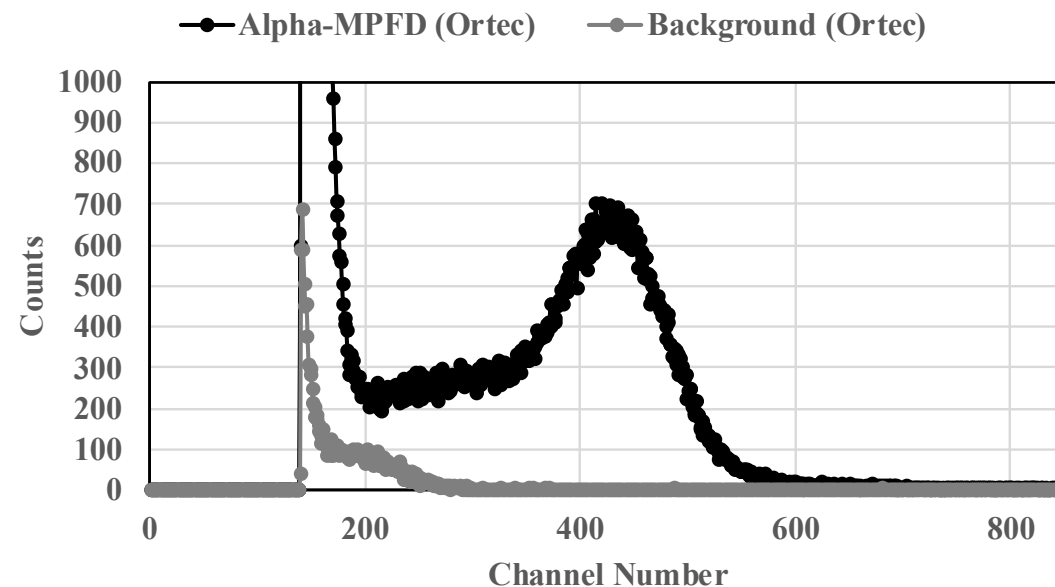
DESIGN PROOF OF CONCEPT

MPFD mockup fabricated with internal ^{241}Am source

- 2-mm chamber
- 3 atm argon backfill
- ~ 600 keV energy deposited in chamber from ^{241}Am . (Expect 5-MeV from Fission)



α -MPFD1 Pulse Height Spectrum





PREVIOUS PHASE I CONCLUSIONS

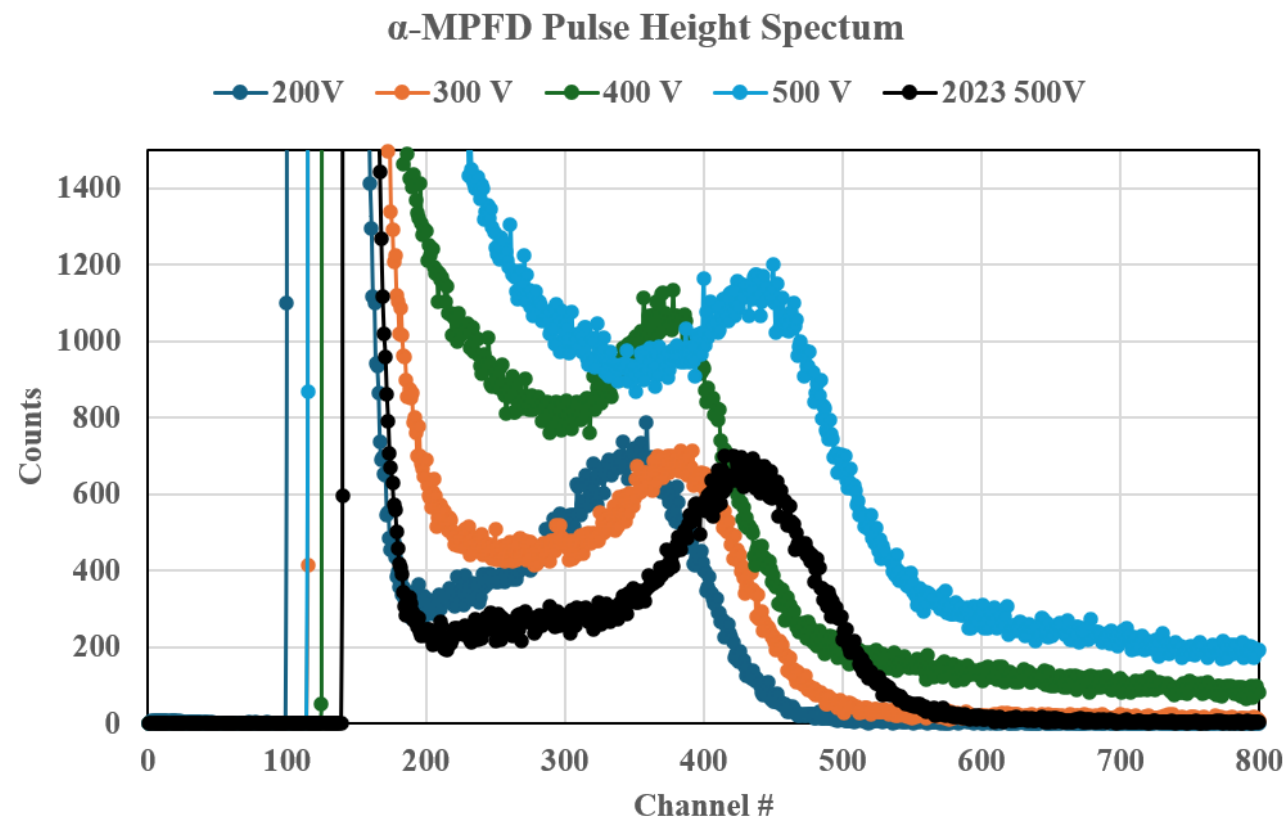
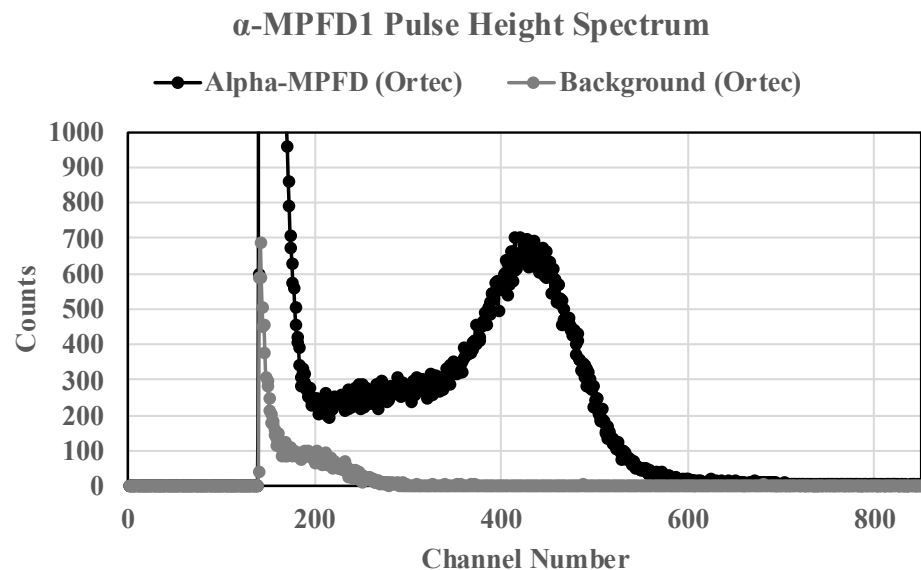
- Pulse mode operation confirmed
 - Ortec 142 PC/Canberra 2022 Amp, and Mesytec MPFD-1 Electronics
- Demonstrated batch electrodeposition technique
- Proved MI Cable - chamber - pinch off tube design is functional



FAST TRACK SBIR PROGRESS (PHASE I)

DOE “2025” Fast Track SBIR (Phase I-II)

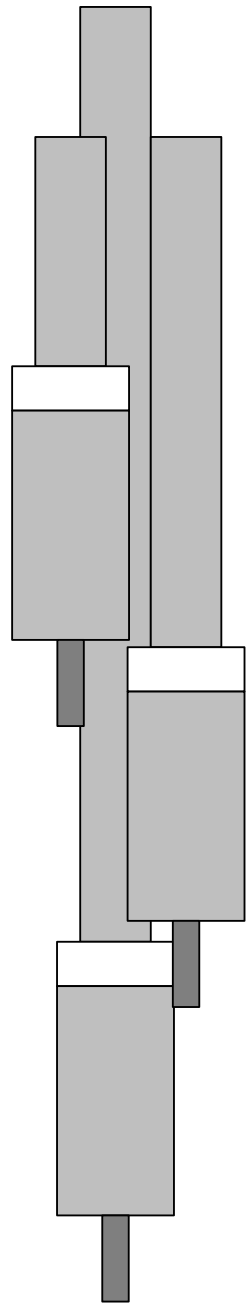
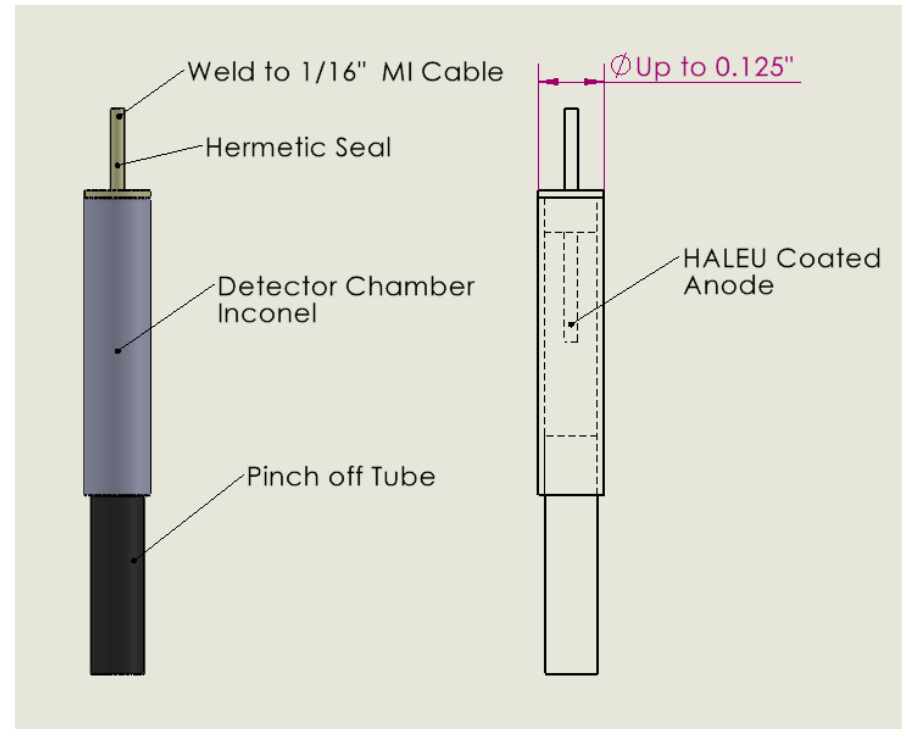
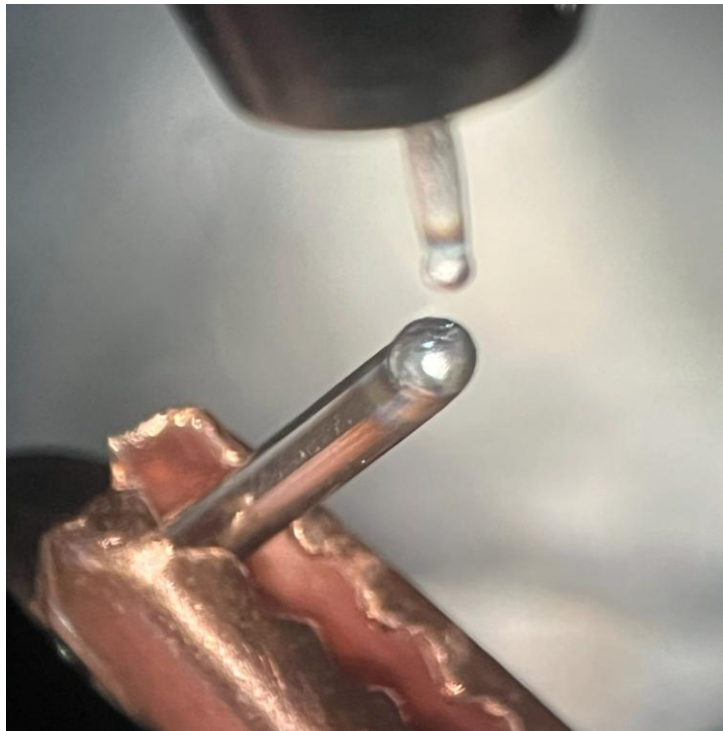
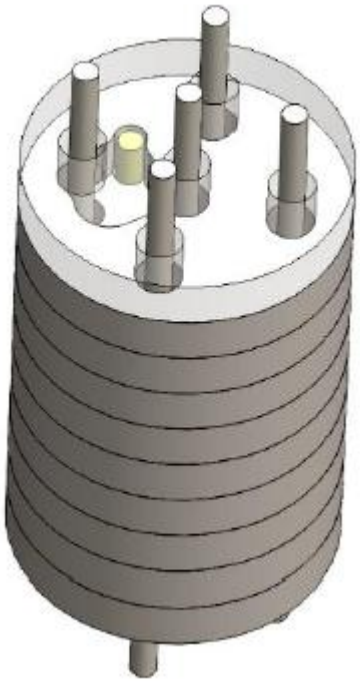
- Phase I: July-Nov 2026, Phase II: 2027-2028
- Build, Test, Iterate, Demonstrate Full Scale Systems
- Re-evaluate alpha-MPFDs (2023)
 - Operational, but noisier
 - Potential gas contamination from MI Cable





FAST TRACK SBIR NEXT STEPS

- Dual path investigation of “Multi-Conductor” and “Bundle” Design
- Add hermetic feedthrough at MI Cable – Detector Chamber interface
- Advanced manufacturing for high-temperature compatibility





TESTING AND DEMONSTRATION ROADMAP

Build, Test, Iterate, Repeat

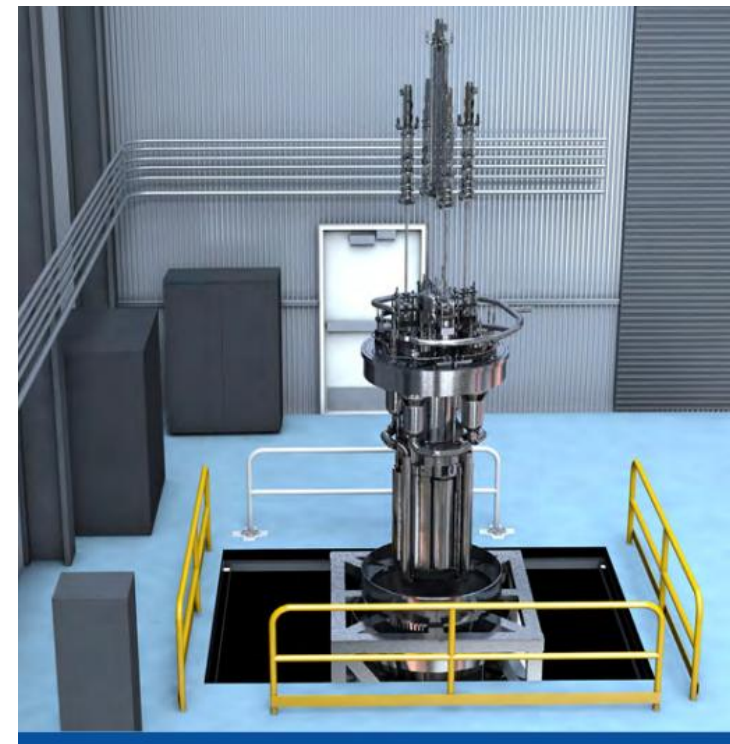
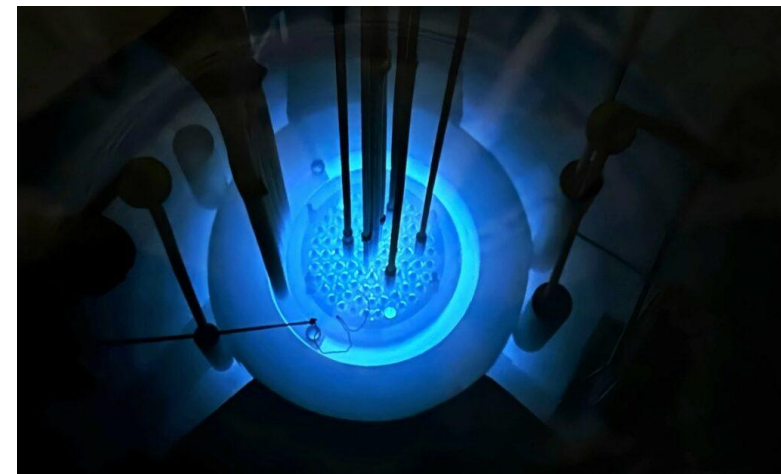
DOE SBIR

- 2027 – Kansas State University
- 2027 – Ohio State University (heated irradiation)
- 2028 – Ohio State University (heated irradiation)

INL MARVEL

- Dry Criticality (2026-2027)
- Full Power operations (2027-2028)

Working towards 3+ additional demonstrations/test campaigns 2027-2029



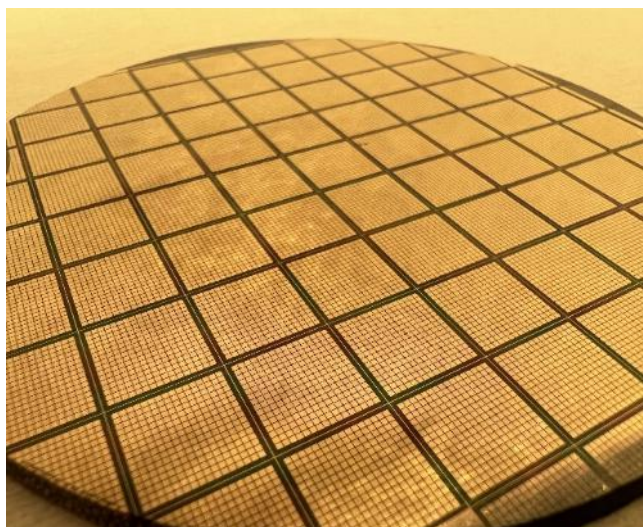
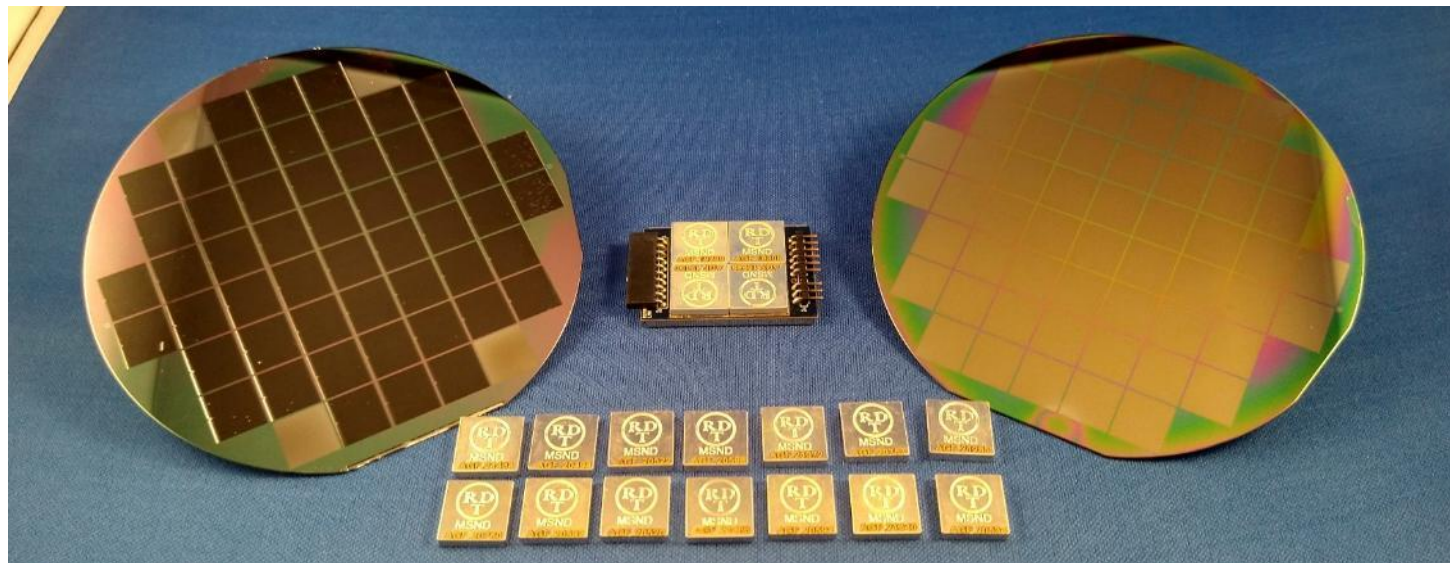


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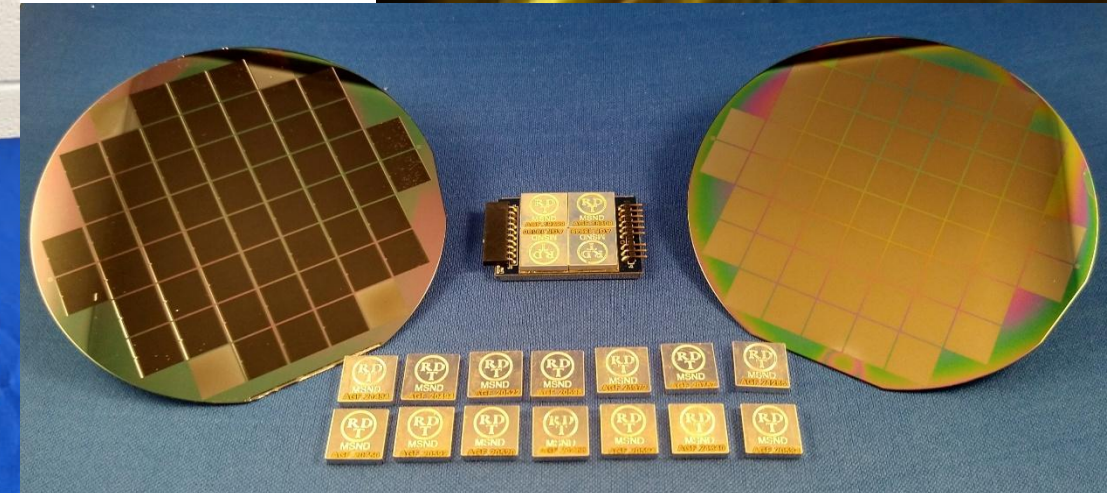
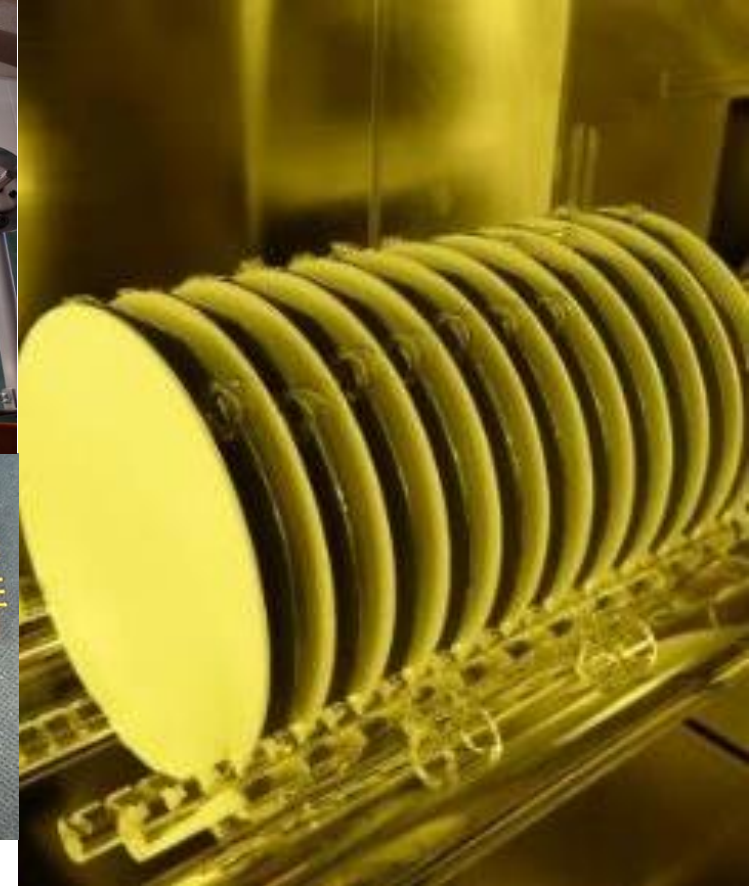
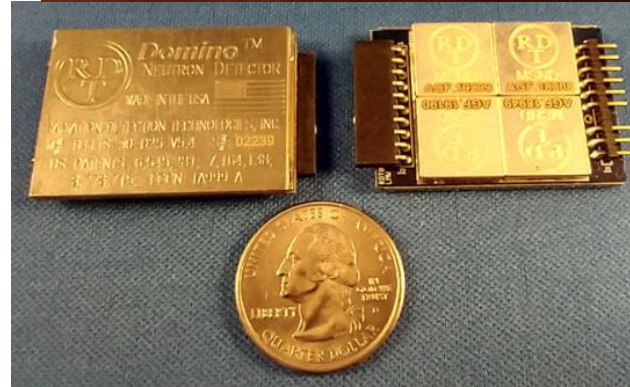
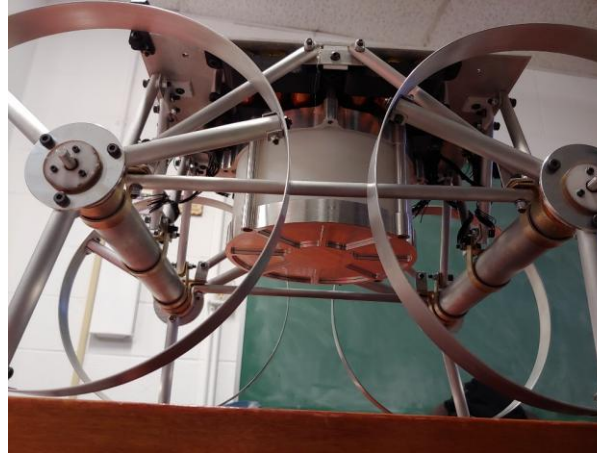


Bonus Slides



MSND & DOMINO

- Excel where SWAP-C is mission critical
- Leading solid-state counting efficiency - **30% thermal neutron efficiency**
 - **50% efficiency with stacked design**
- 13mm x 13mm surface mount package for customizable PCB circuit integration
- High gamma-ray rejection, $>10^{-6}$
- Rugged ^3He replacement



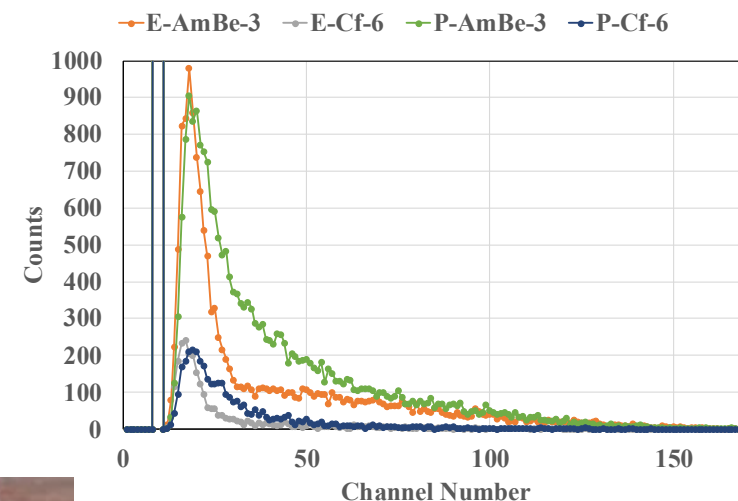
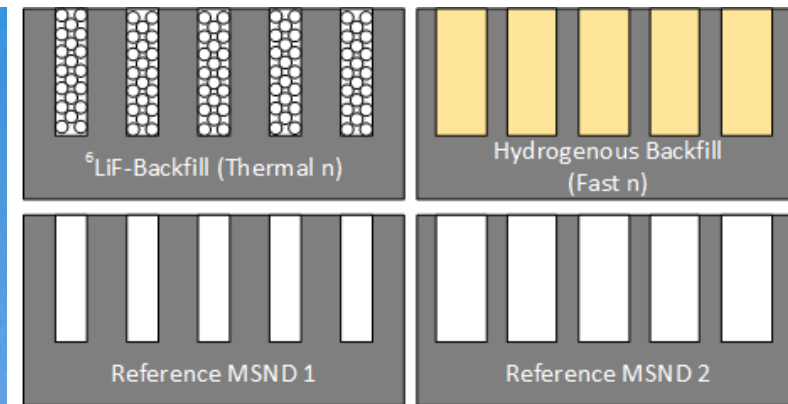
Current Status: Commercially Available
TRL 9



DOMINO MX

- Concurrent Fast Neutron, Thermal Neutron, and Gamma detection
- Markets
 - Used nuclear fuel inspection/monitoring
 - Personal Dosimetry
 - Satellite / Space Deployment
 - Distributed Network Monitoring
- Stacked or Standard MSNDs

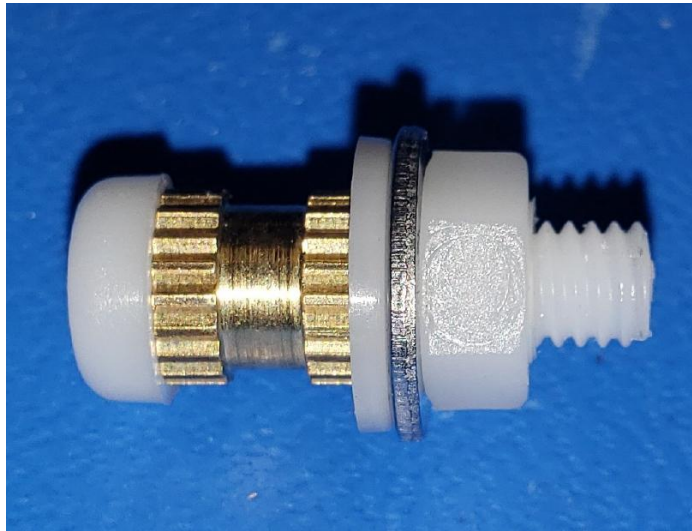
Current Status: Prototypes Demonstrated
TRL 6-7





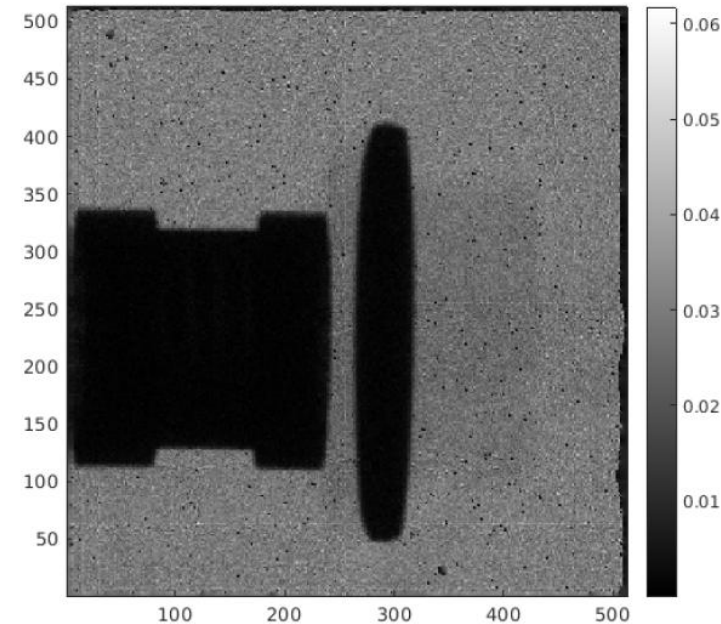
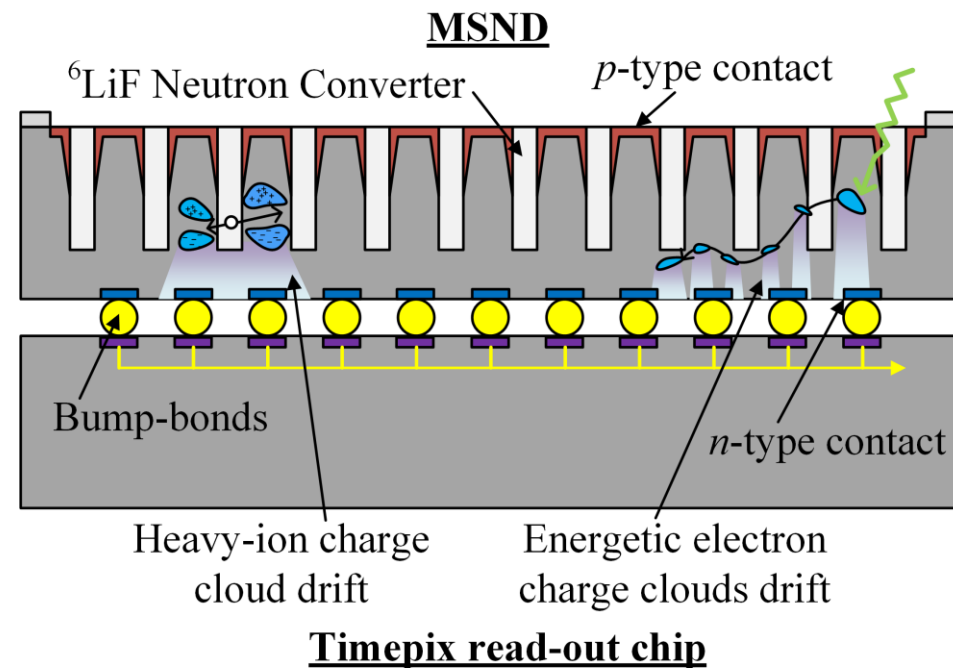
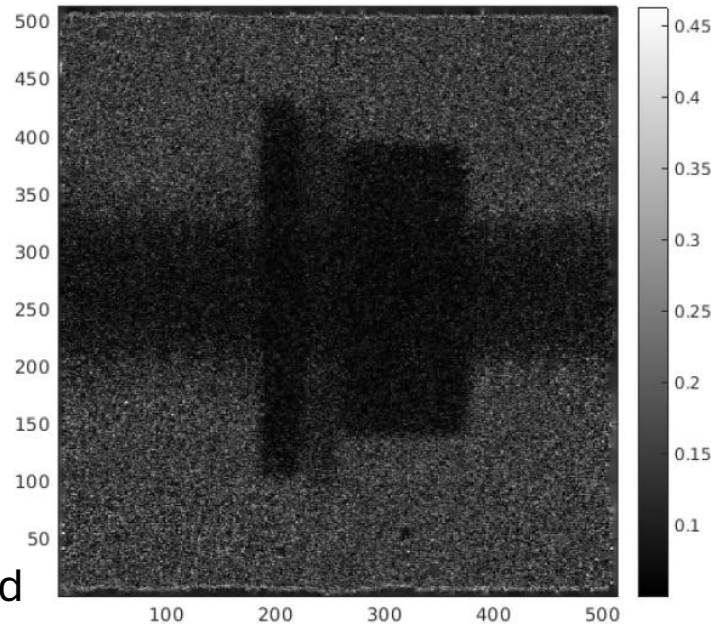
DUAL-MODALITY X-MSND IMAGER

- Dual mode, neutron and x-ray imaging 50,000 frames, 50 ms each
- Flat field correction applied for efficiency and beam non-uniformities
- Cluster centroiding and dead pixel corrections performed



**Current Status: Prototype Demonstrated
TRL 5**

Radiation Detection Technologies, Inc.





LI-FOIL MWPC TECHNOLOGY

- Applications where low-cost, large area neutron detection is needed
 - Backpacks, Portal Monitors, Soil Moisture Monitor
- Thermal neutron detection efficiency is 40%
- High gamma-ray rejection to reduce false positives, $>10^{-8}$
- The neutron sensor currently outperforms available BF_3 units, comparable to He^3
- Drop-in ^3He replacement
- Heart of the Cosmic-SMM technology — volumetric soil moisture monitoring from background cosmic-rays

Current Status: Commercially Available
TRL 9





SINGLE CRYSTAL CZT AND CDTE AT RDT



- Developing the Accelerated Crucible Rotation technique (ACRT) for single crystal growth.
- Three furnaces for CZT/CdTe production at RDT.
- VLSI wafer-level processing.
- Large volume CZT pixel arrays and quasi-hemispherical devices.
- Manufacturing Devices to service medical imaging and security applications.

