Neutron Field Profiling for Neutron Activation Analysis

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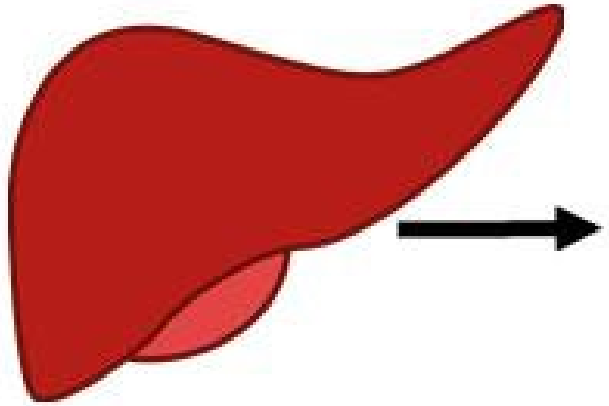
Importance of Neutron Activation Analysis (NAA)

- Quantifying trace elements
  - Arsenic: 19ppm from 100 mg; 19 needles in 1 ton of hay
- Used in over 300 SRMs since 1990

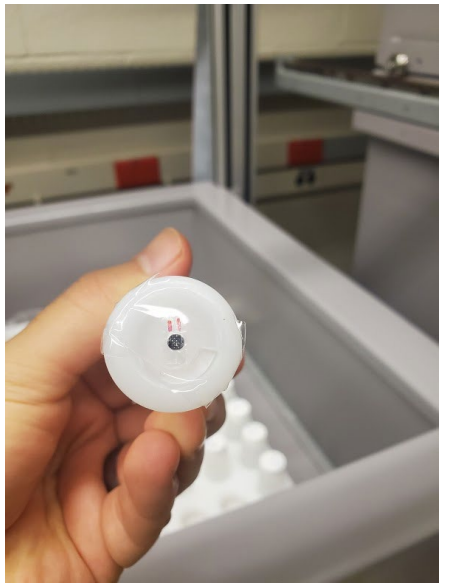
Standards!

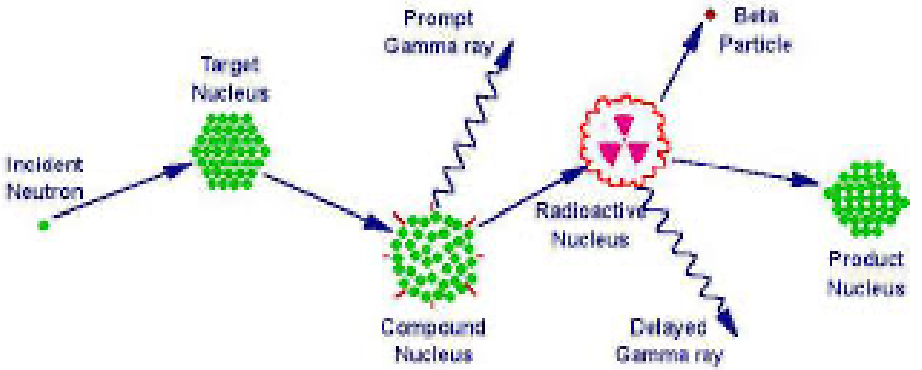


How NAA Works

- Technique
  - Neutron irradiation
  - Counting radioisotope
- The gamma rays energy identify elements
- Interactions are dependent on energy of neutrons in the core
  - **Important**
- Used at UMD reactor

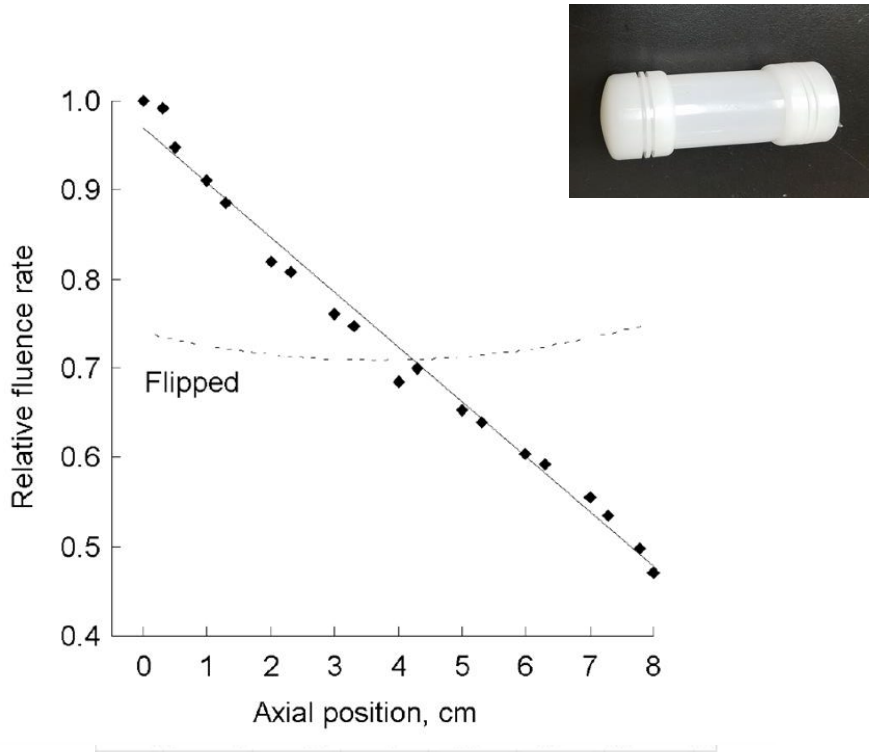
Rabbit

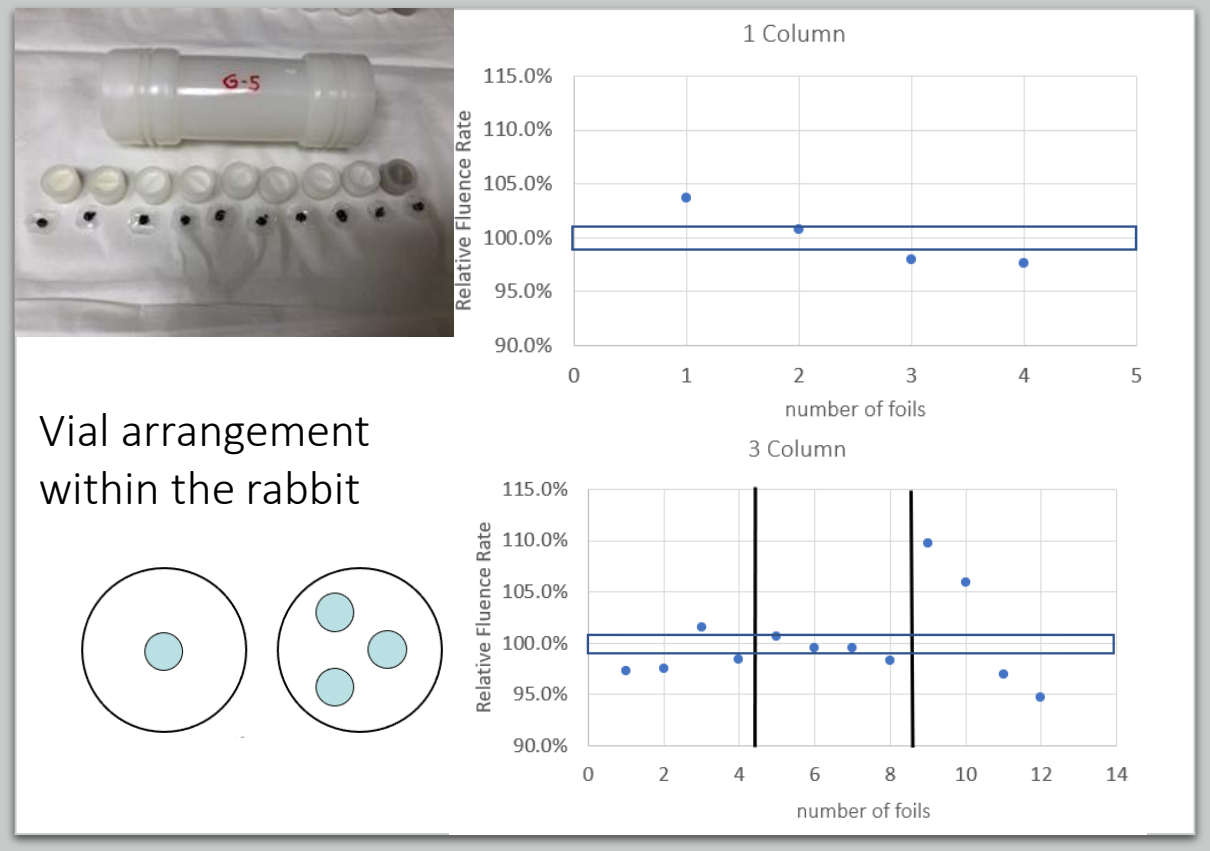




Reason/Background

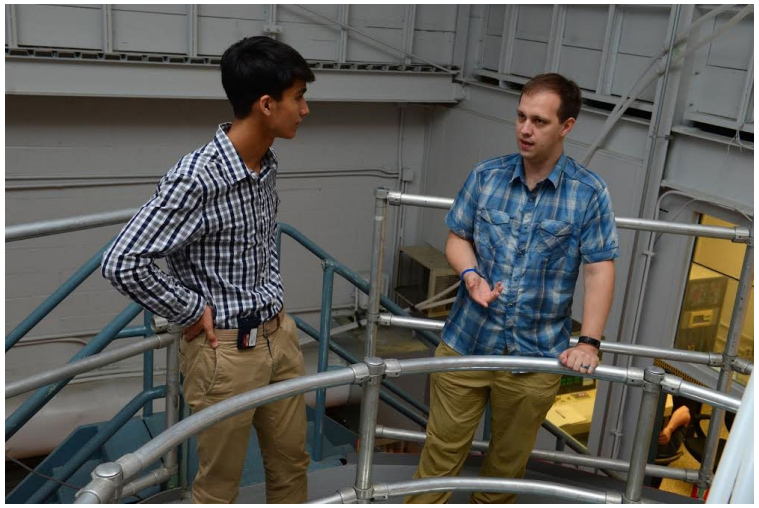
- Neutron drop inside the rabbit
- correction used at the NIST reactor no longer reliable
- Investigate this discrepancy for the purpose of standardization

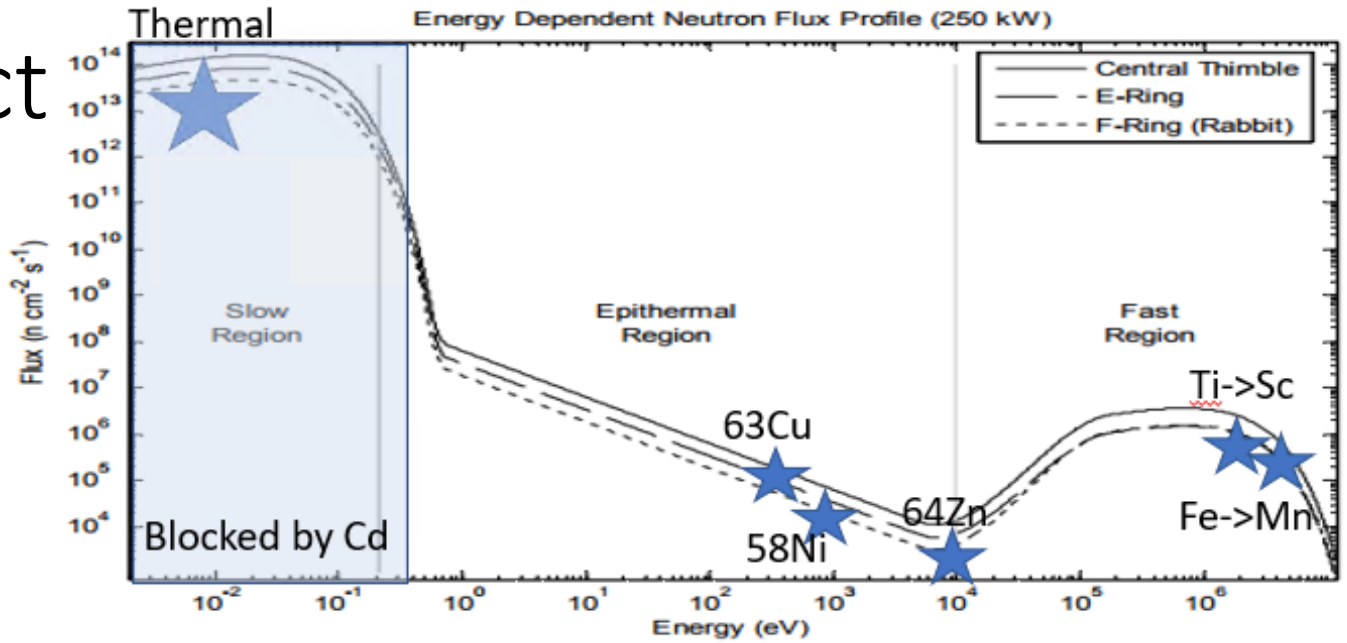


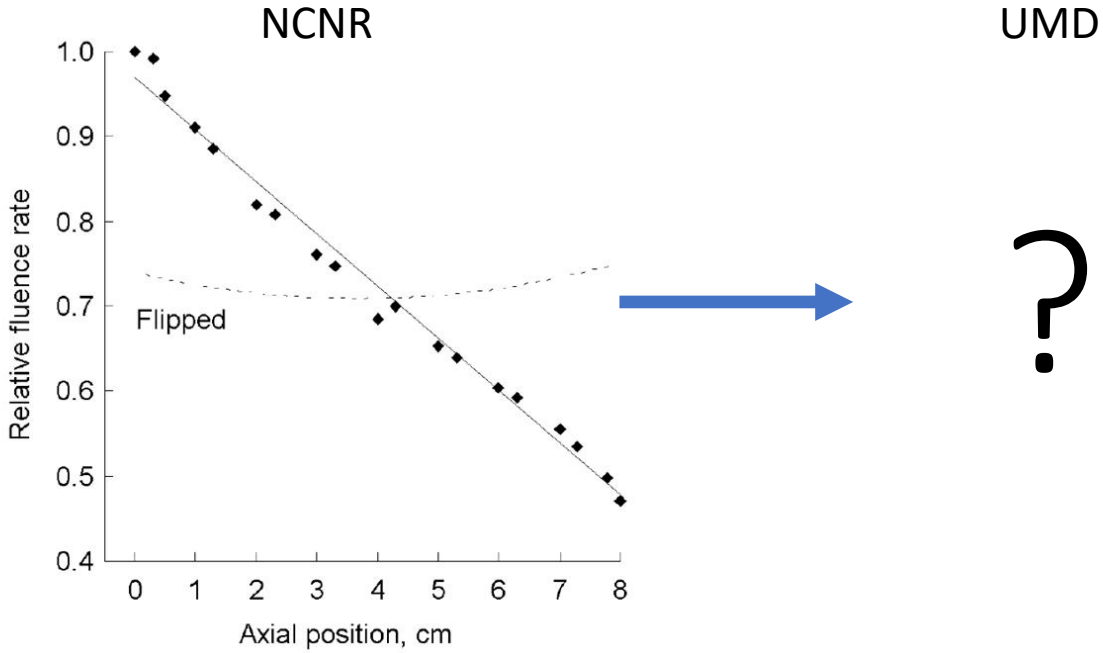


Purpose/Aim of this project

- UMD MUTR: 100 KW, light water
- NIST reactor: 20 MW, heavy water
- Foils target regions
  - Metal foils include: Cu, Ni, Zn, and Fe

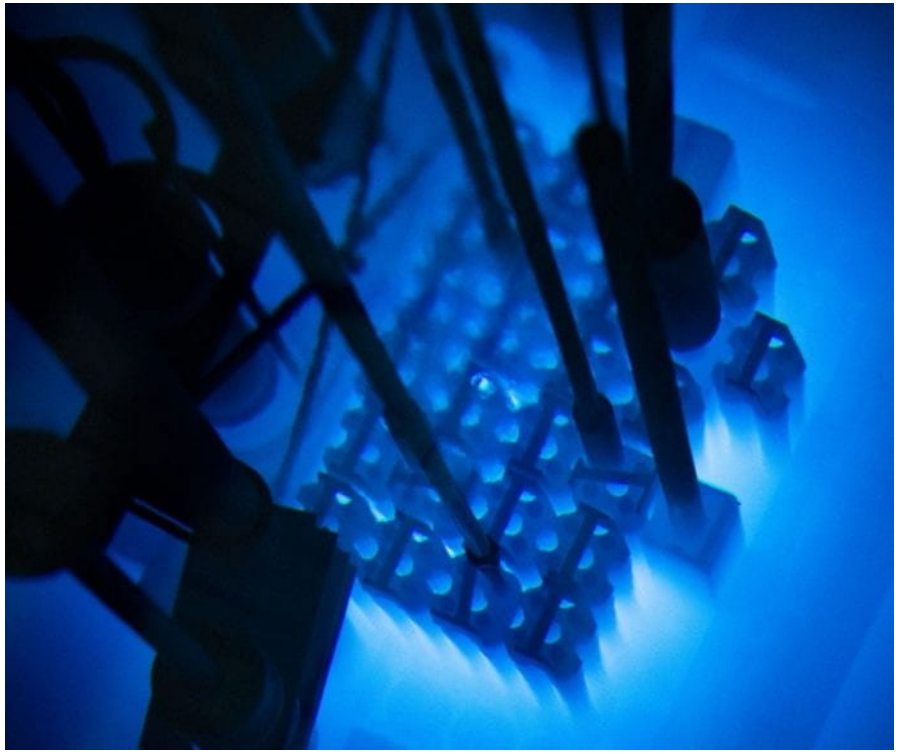






Neutron Monitors

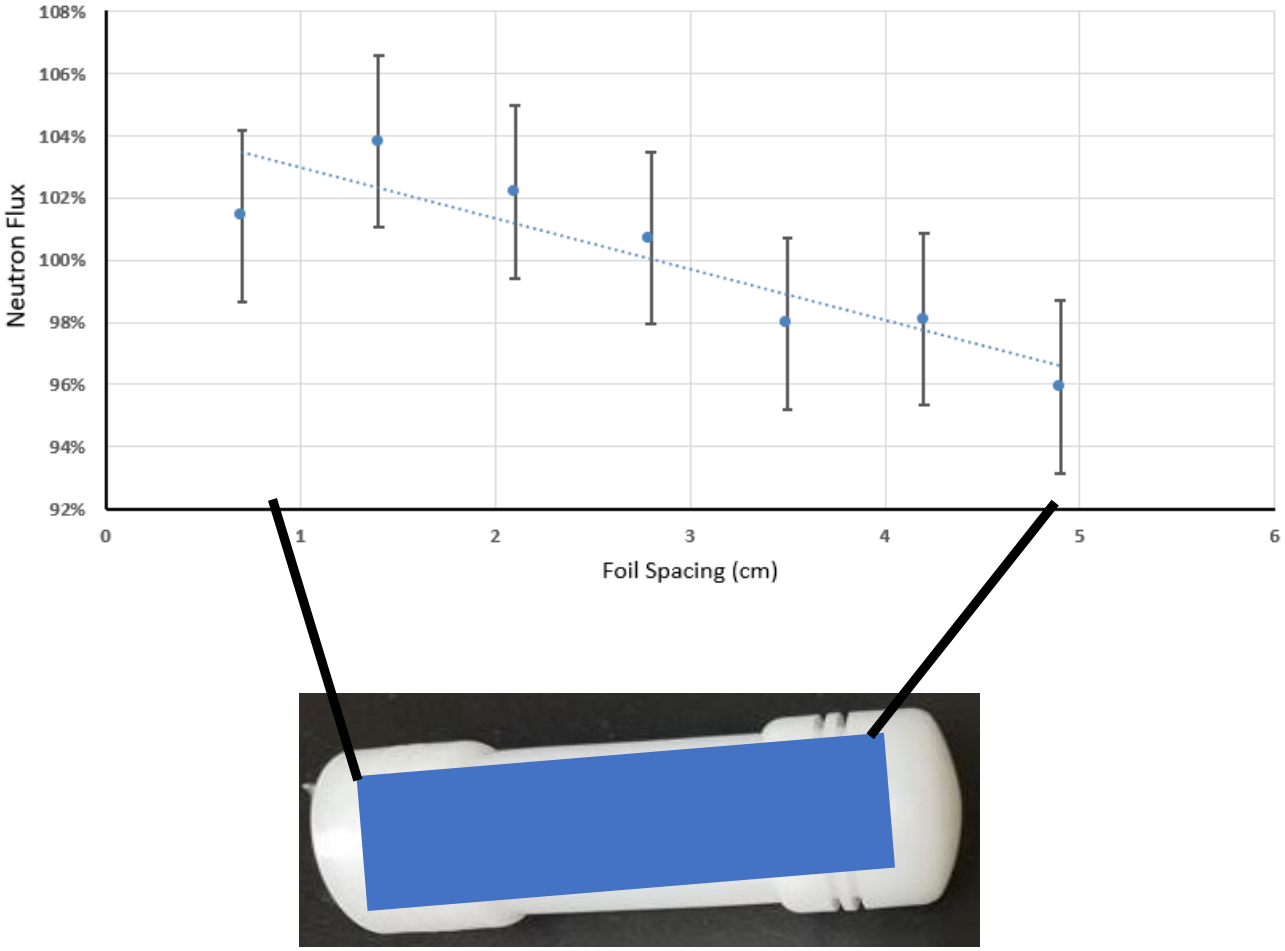
- Gamma Acquisition
  - HPGe detectors
- Total neutrons and neutron energy
  - captured neutrons are dependent on type of metal foil
  - Measuring captured neutrons by released gamma rays



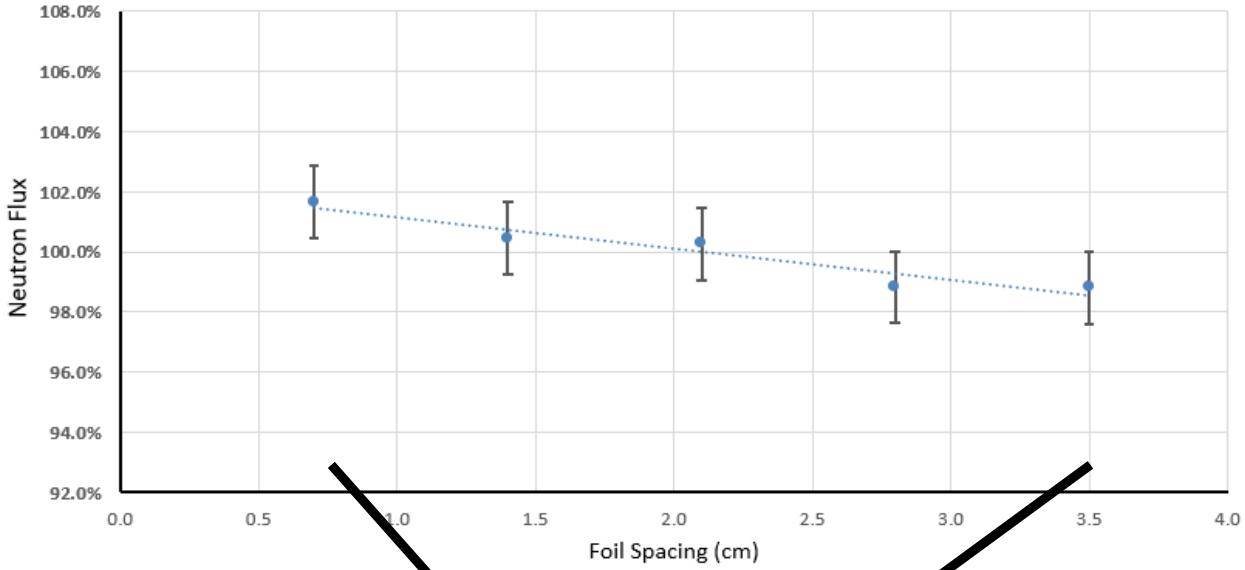
Results

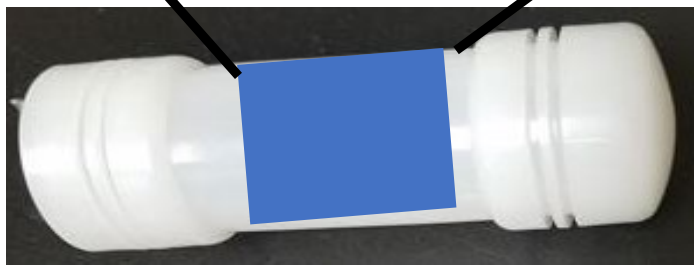
Neutrons/cm^2/second

Rabbit 2-2



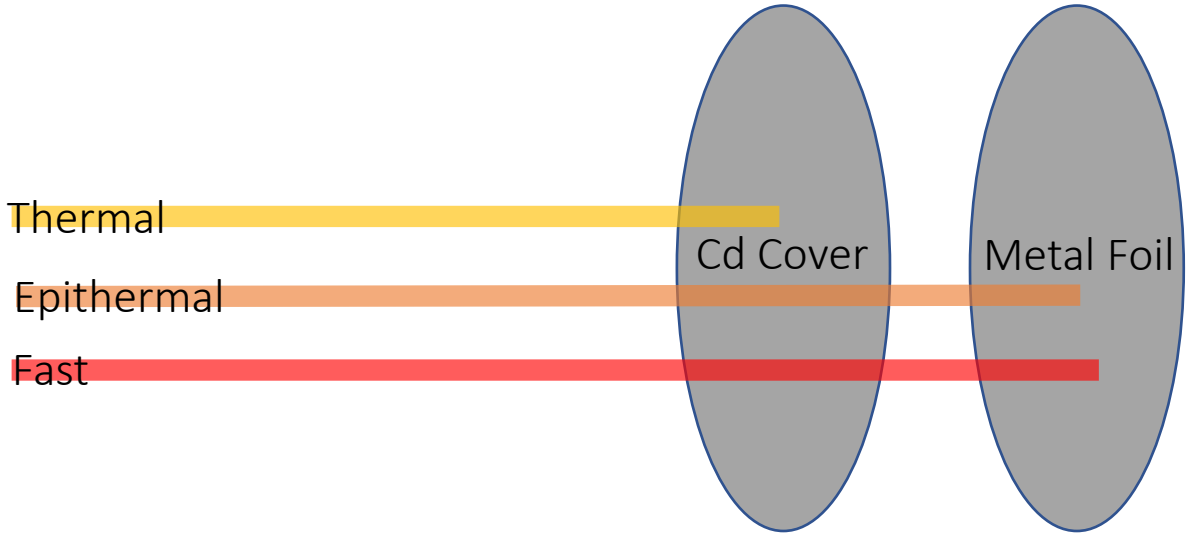
Rabbit 2-1





Results

- Other foils highlight the energy regions of these neutrons
  - Thermal and Epithermal energies
- Cadmium coverings used to isolate epithermal and fast regions of neutron energy



	Thermal+Epithermal Neutrons/cm^2/sec	rsd%	Epithermal Neutrons/cm^2/sec	rsd%	Thermal only Neutrons/cm^2/sec	rsd%
Cu	1.75E+12	5%	6.19E+10	9%	1.70E+12	4%
Zn	1.85E+12	3%	6.69E+10	1%	1.75E+12	7%
Ni	1.75E+12	7%	N/A	N/A	N/A	N/A

Future work

- Calculating the shape of the energy profile
- Investigating scattering effects at UMD
- Perform measurements at NCNR

Acknowledgements

- Dr. Nicholas Sharp
- Luke Gilde - UMD
- Mike Hottinger - UMD