

# Instrumentation of a GEM-Based Neutron Detector

Laura Rodríguez Gómez

Saime Gürbüz, Jochen Kaminski, Markus Köhli,  
Michael Lupberger, Divya Pal, Klaus Desch

DPG Spring Meeting in Heidelberg  
24 March 2022

GEFÖRDERT VOM

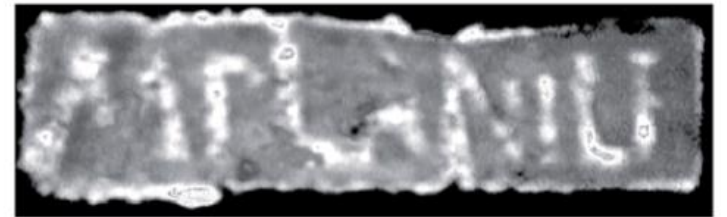
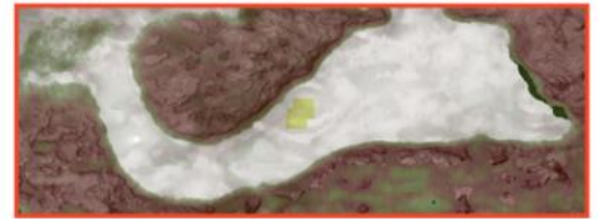
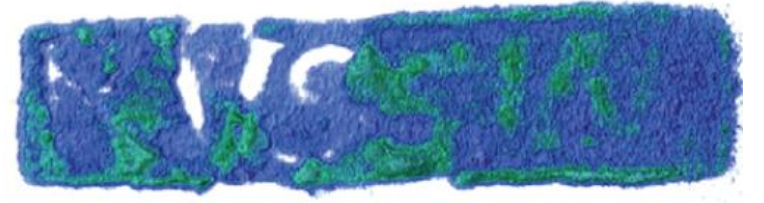
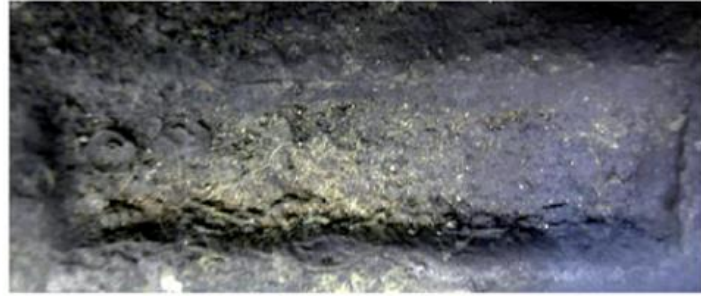


Bundesministerium  
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2

# Instrumentation of a GEM-Based Neutron Detector

1

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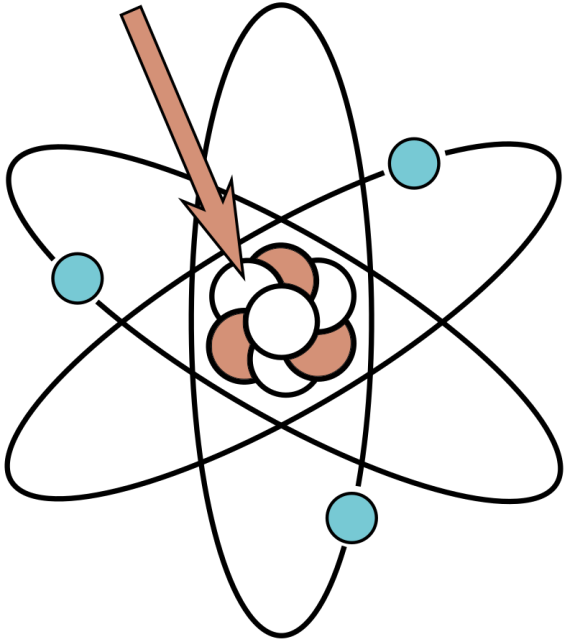
Bundesministerium  
für Bildung  
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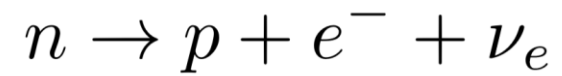
Physikalisches  
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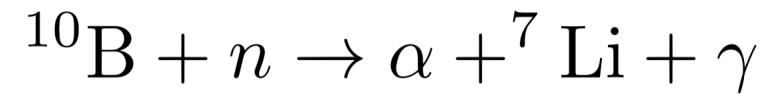
# Neutrons



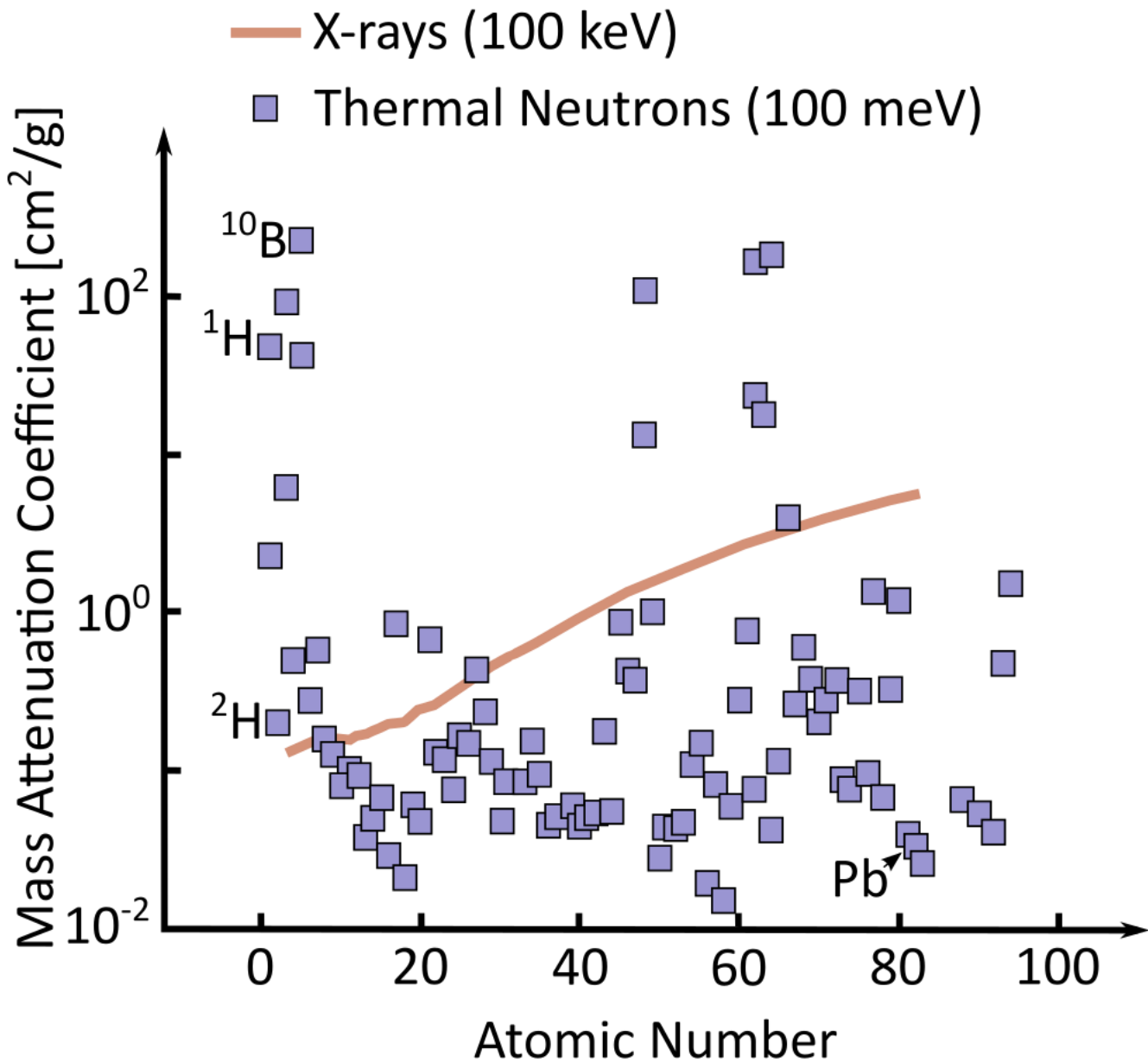
- unstable



- electrically neutral



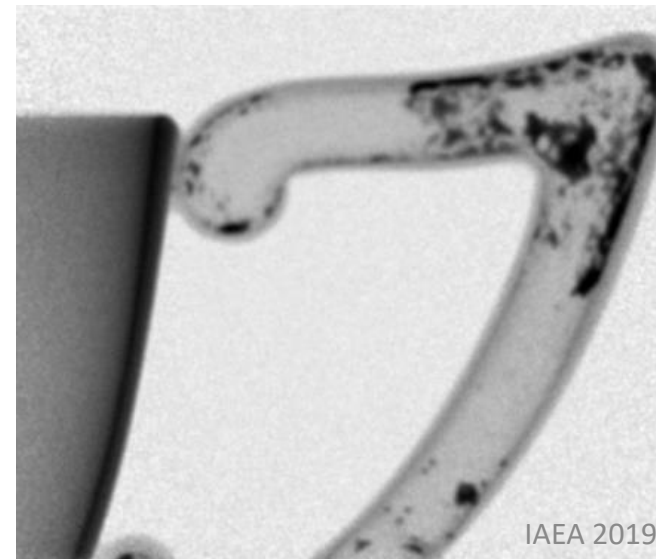
# Neutrons

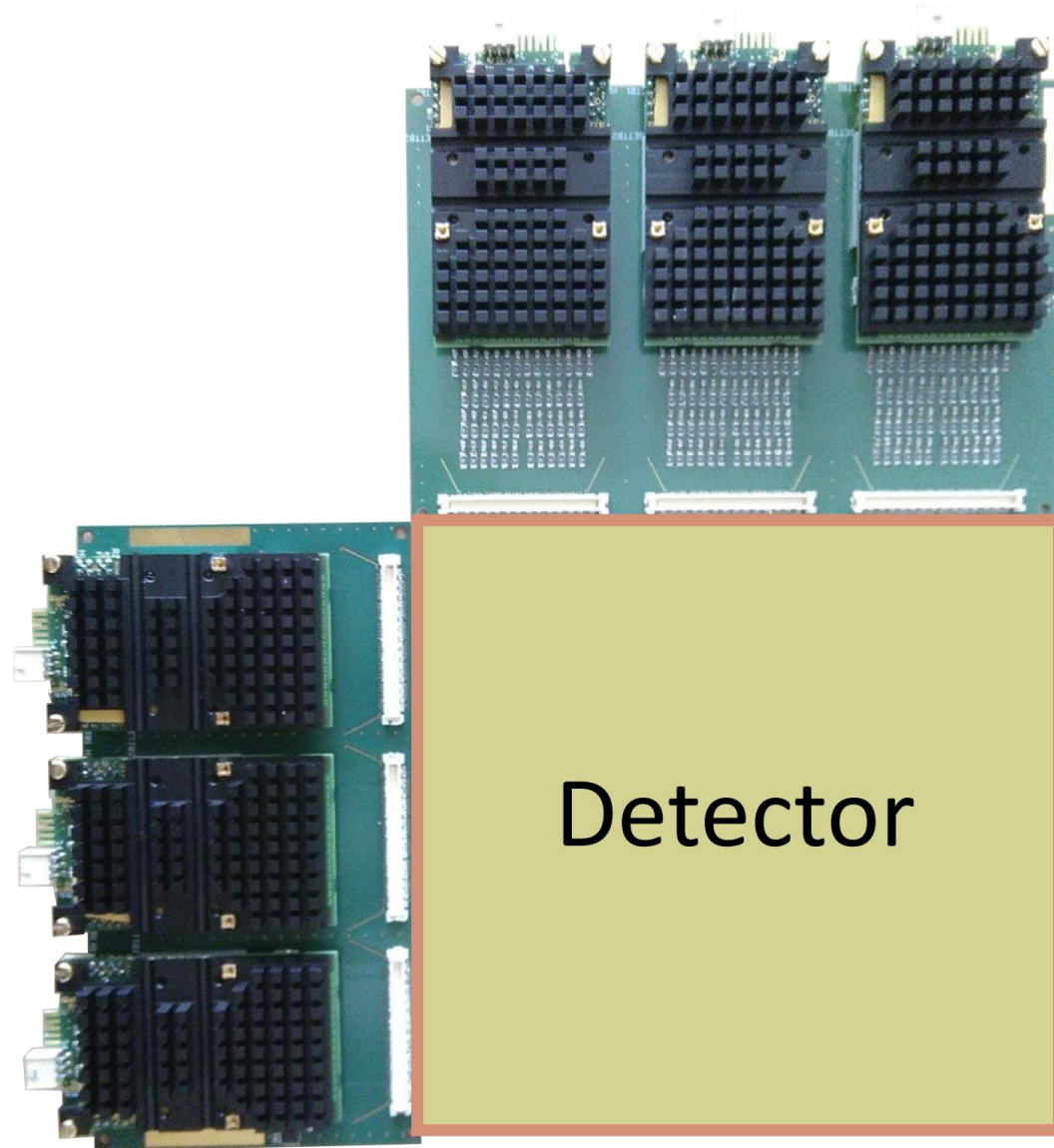


X-Rays



Neutrons

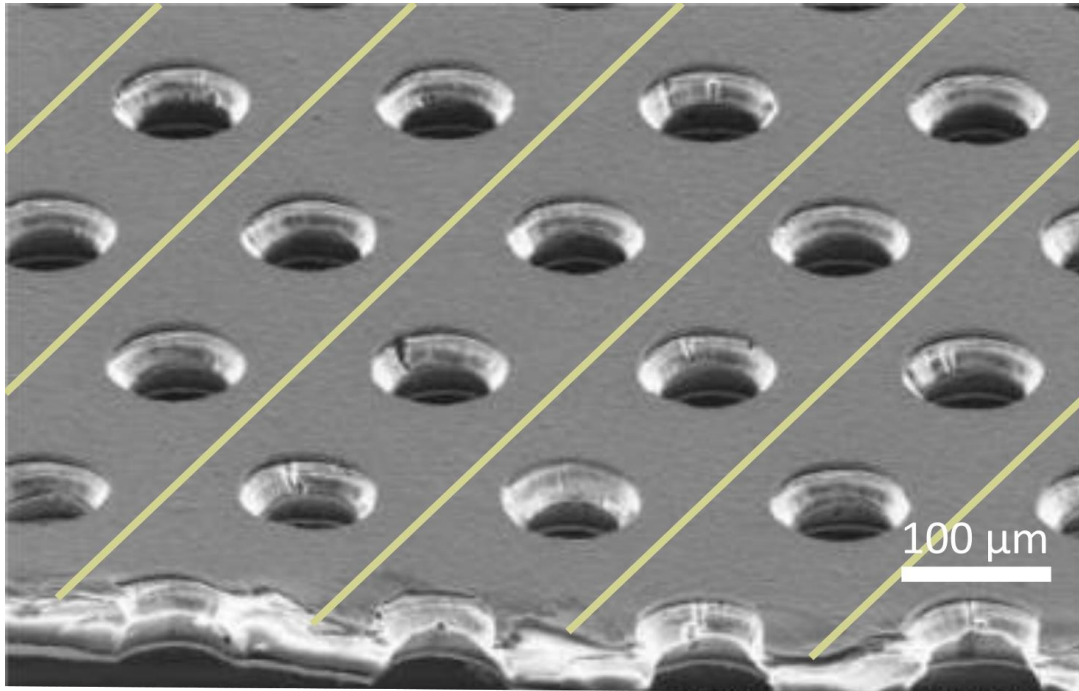




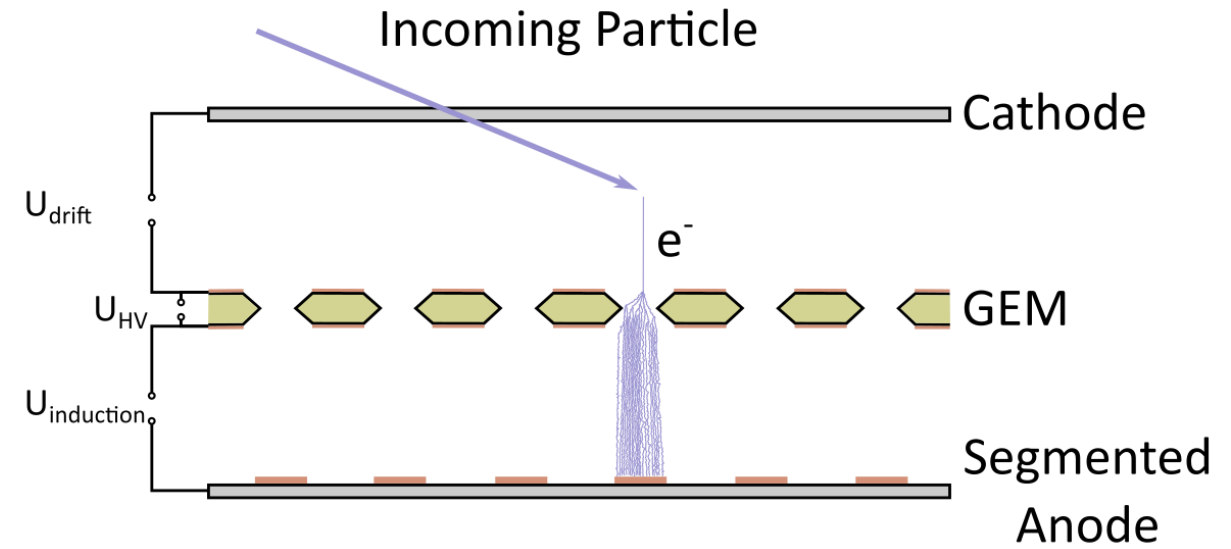
Detector



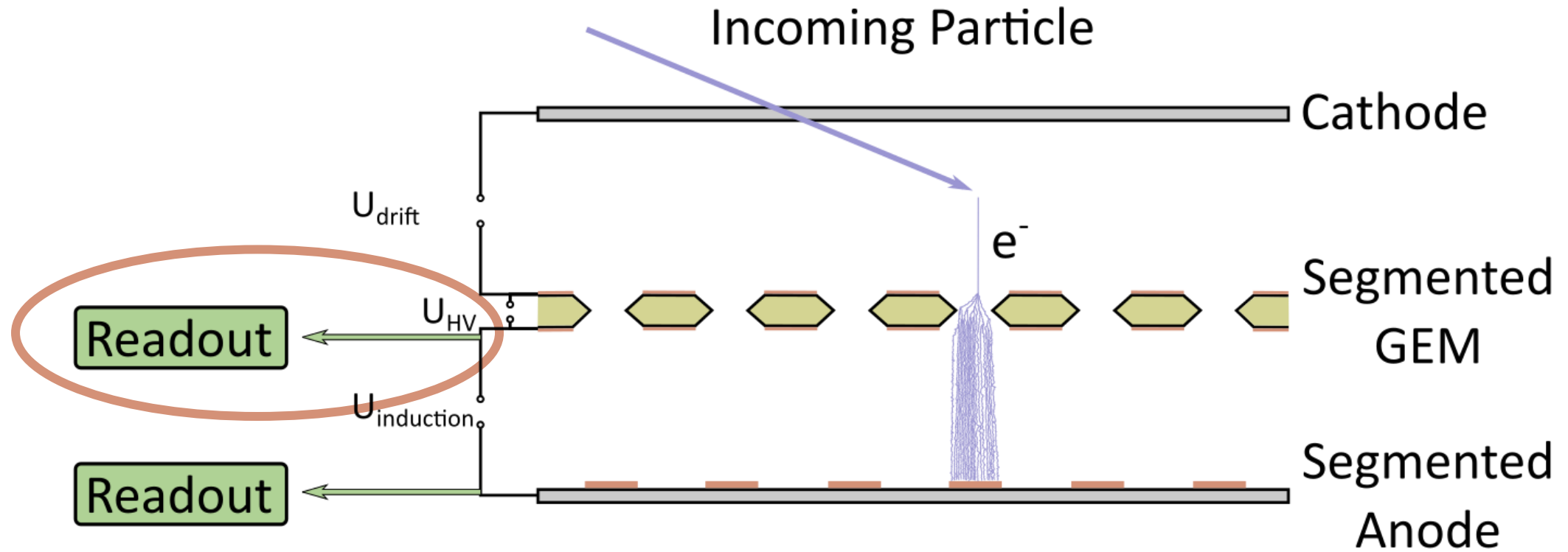
# Detector Idea: Gas Electron Multiplier (GEM)



CERN GDD



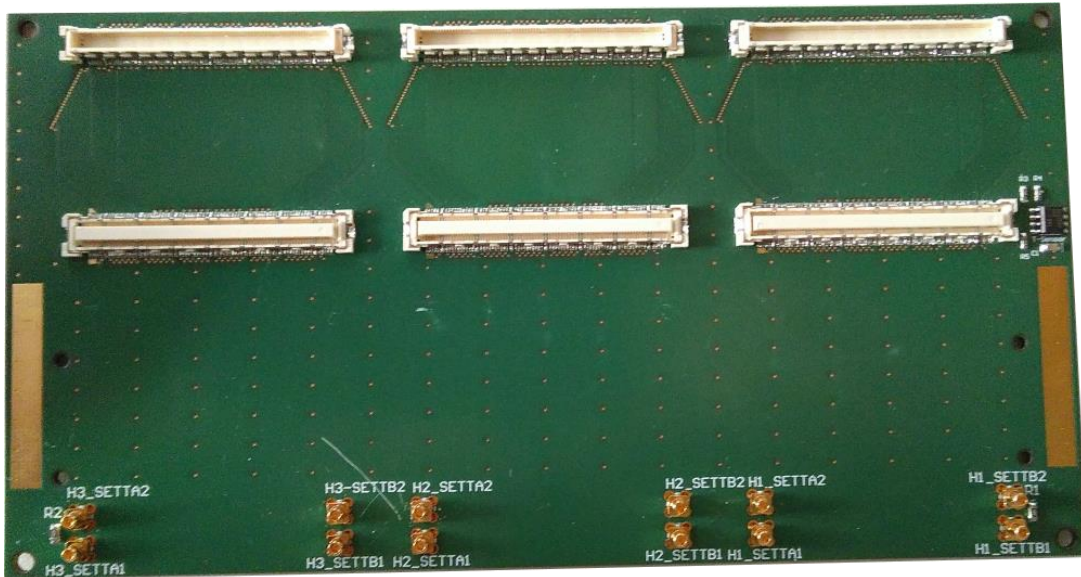
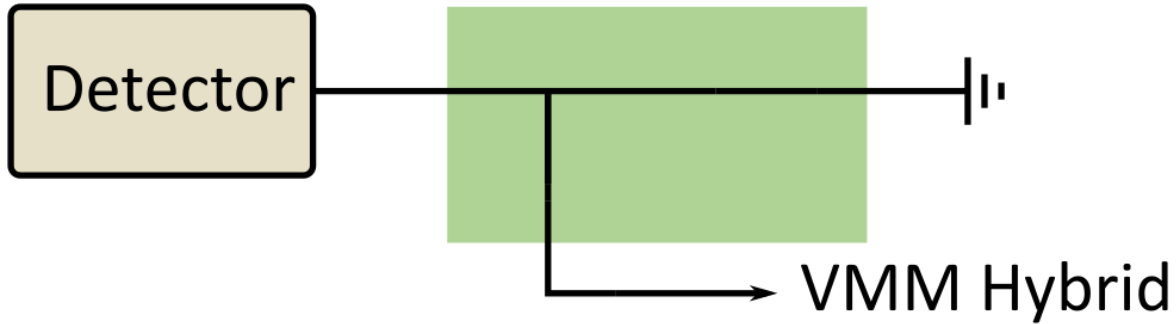
# Detector Idea: Gas Electron Multiplier (GEM)



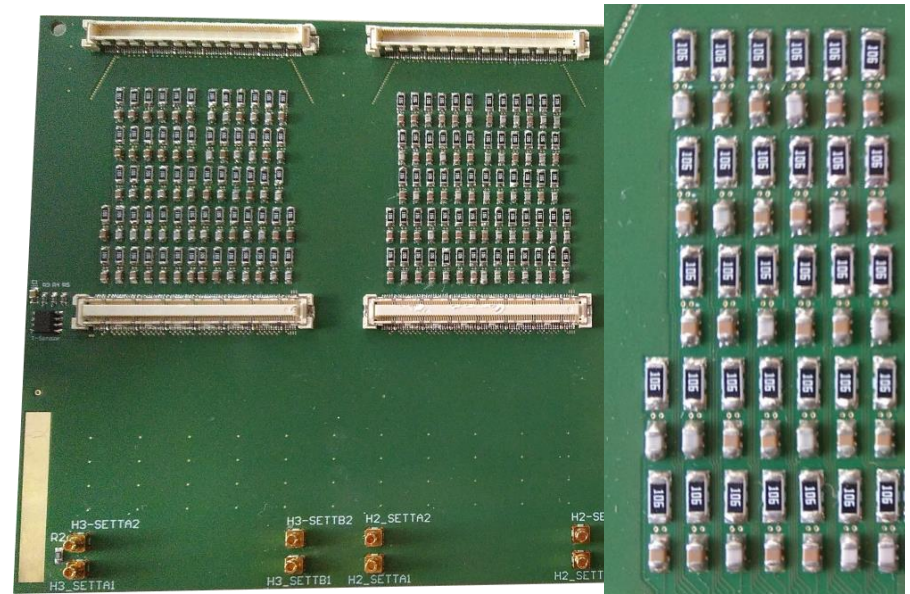
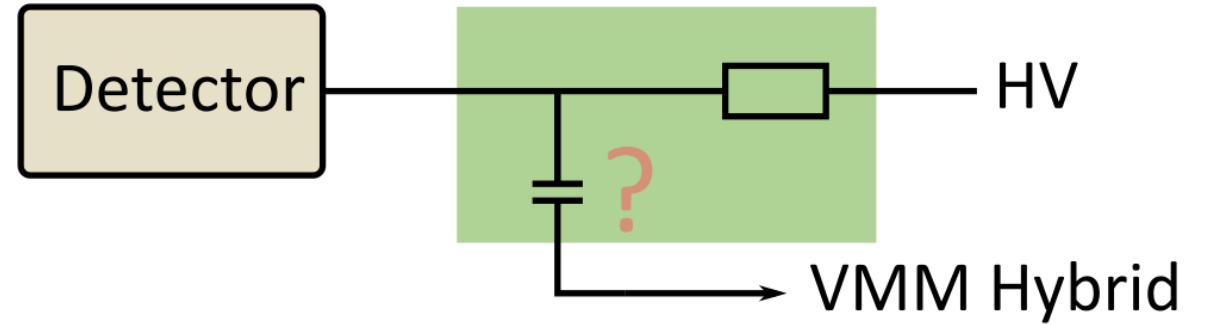


# Hybrid to Detector Connection Boards

## Ground Side

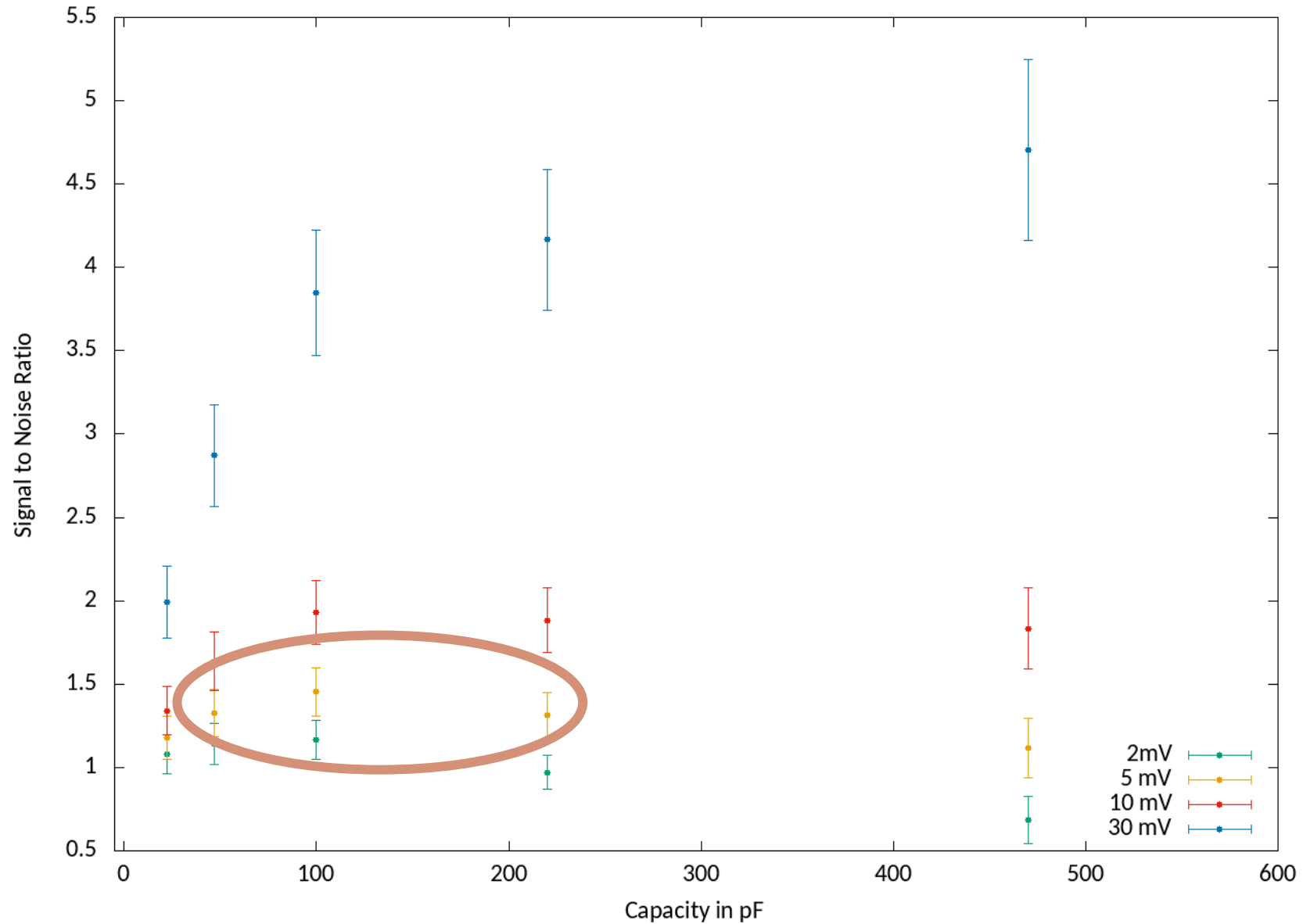


## HV Side

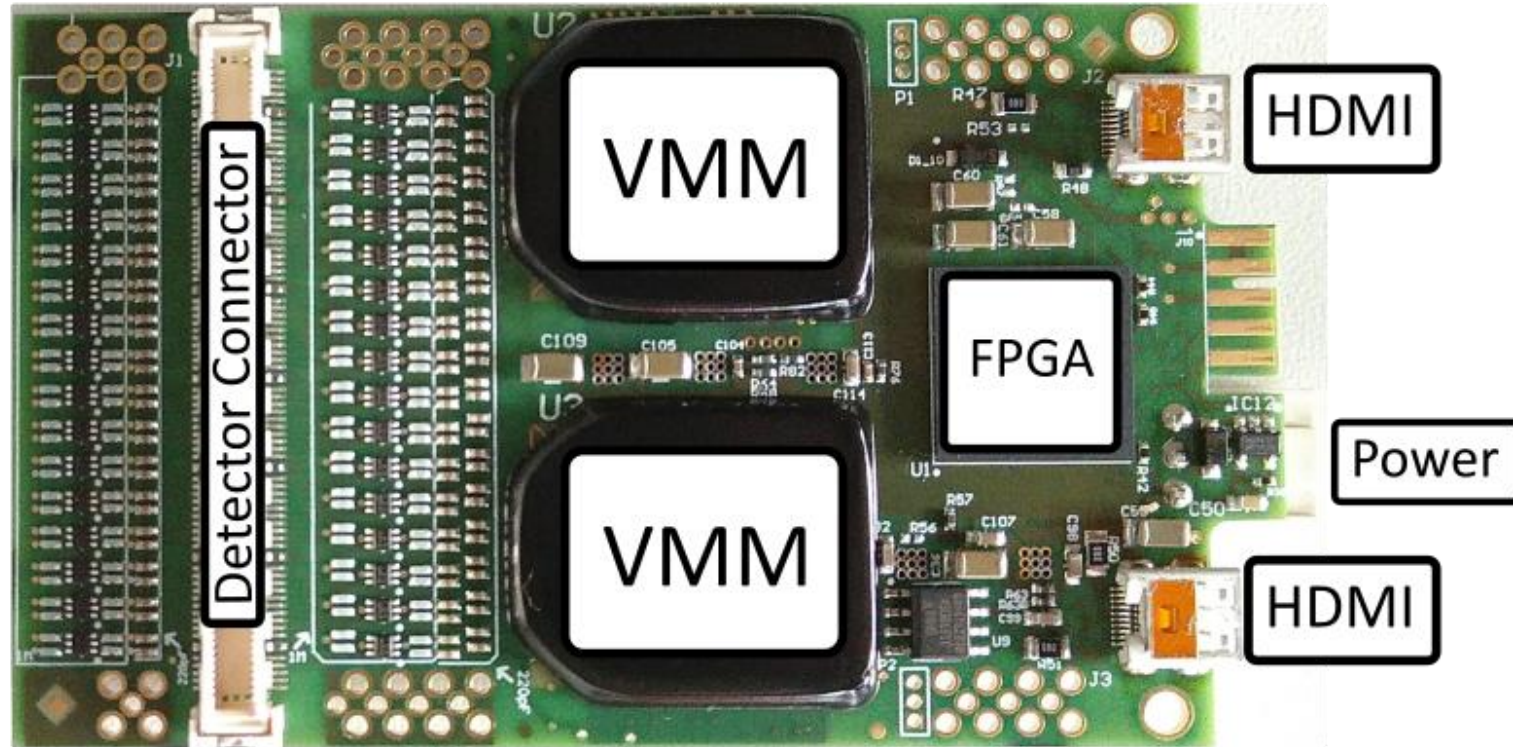


# Capacitor Tests

Signal to Noise Ratio with Different Signal Amplitude



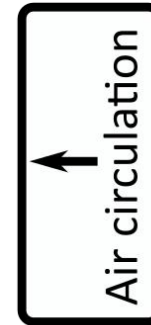
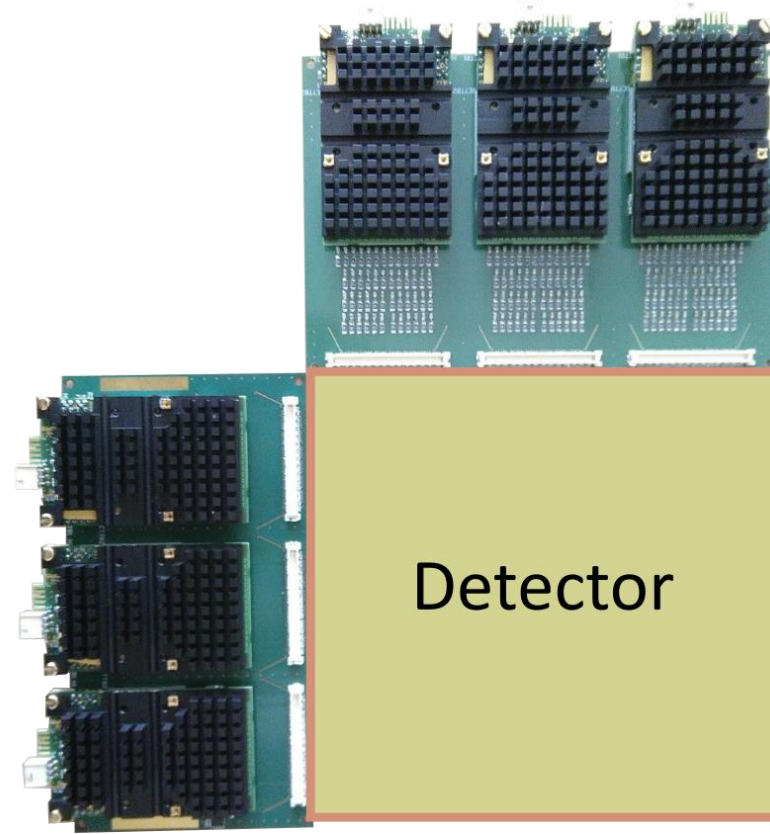
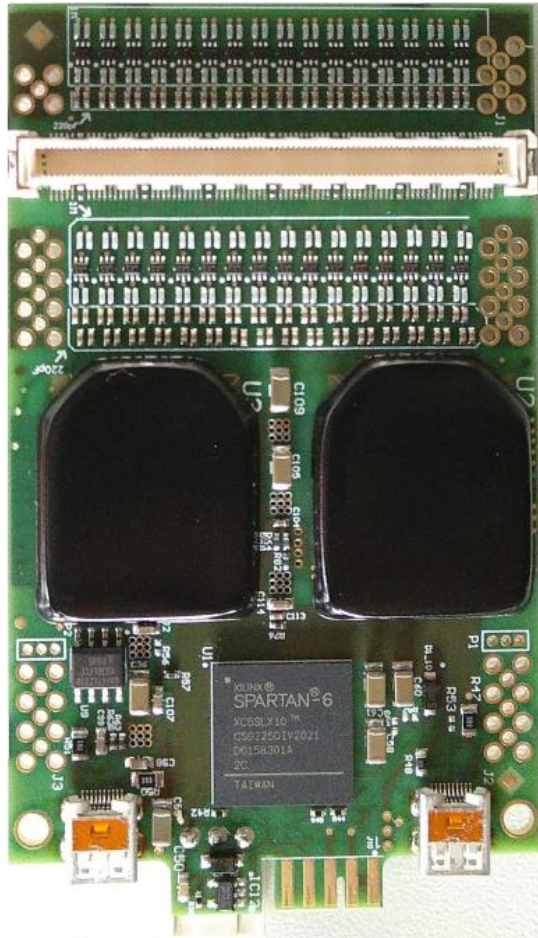
# VMM Hybrids



~ 3 W heat



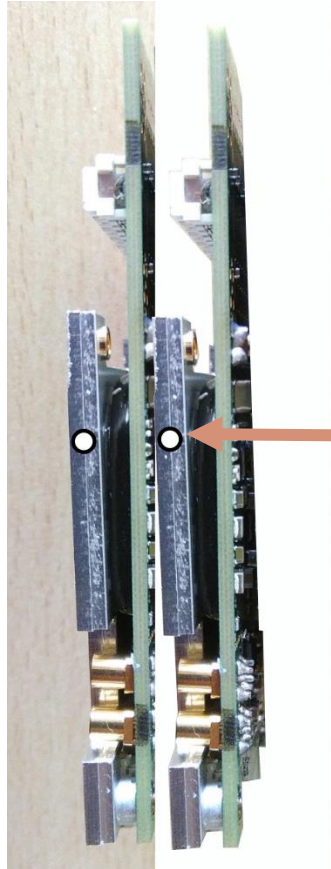
# Test Layer Preparations: Cooling



stable  
@ approx. 35 °C

Too thick for multi-detector setup!

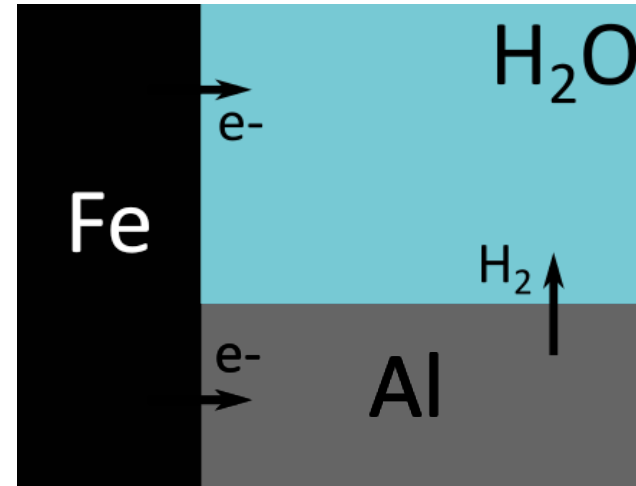
# Hybrid Cooling for Several Detector Layers



Aluminium  
Pipes



Too thick for multi-detector setup!



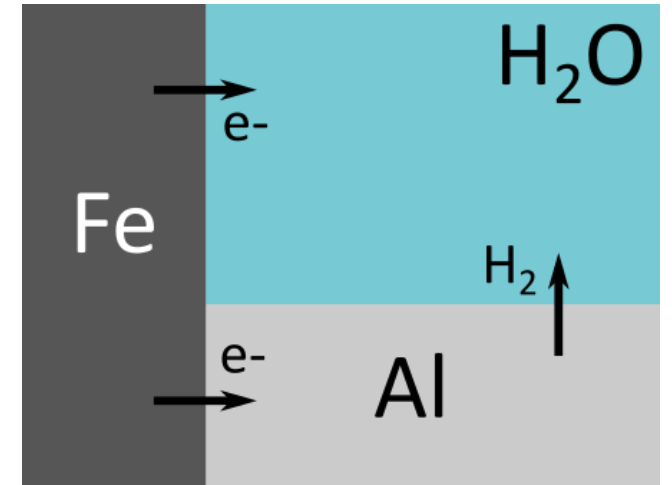
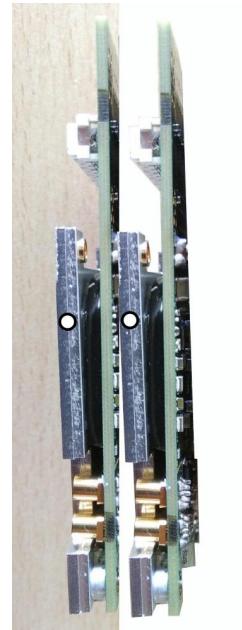
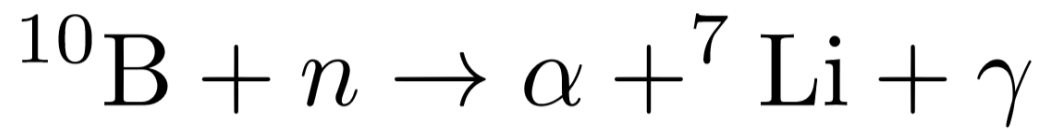
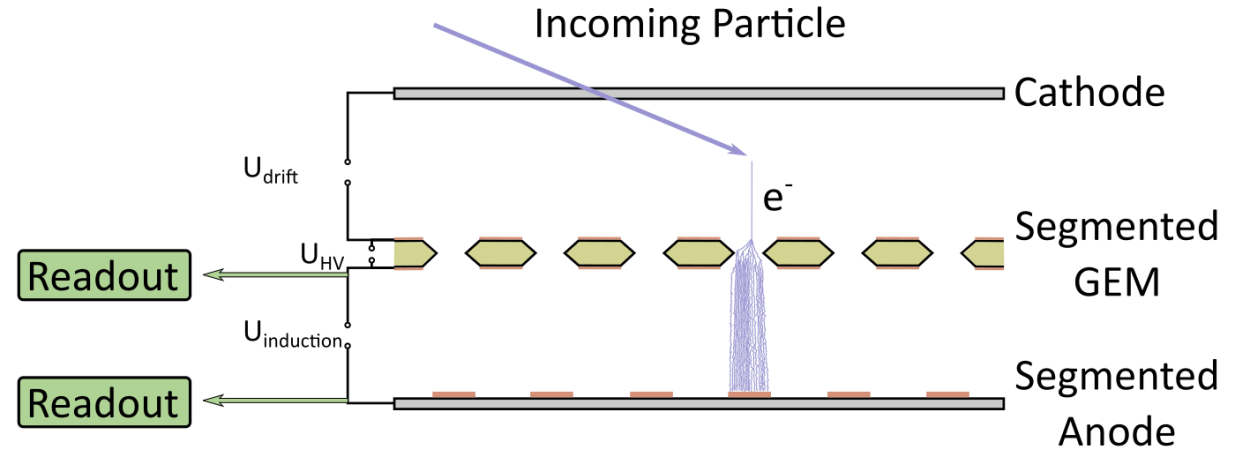
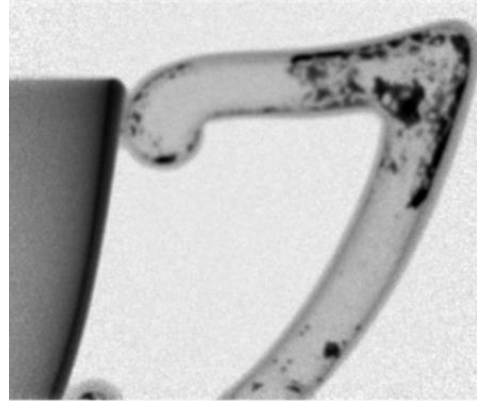
- corrosion
- possible solutions:
  - other cooling liquid
  - aluminium cooler

# Take-home Message

## X-Rays



## Neutrons





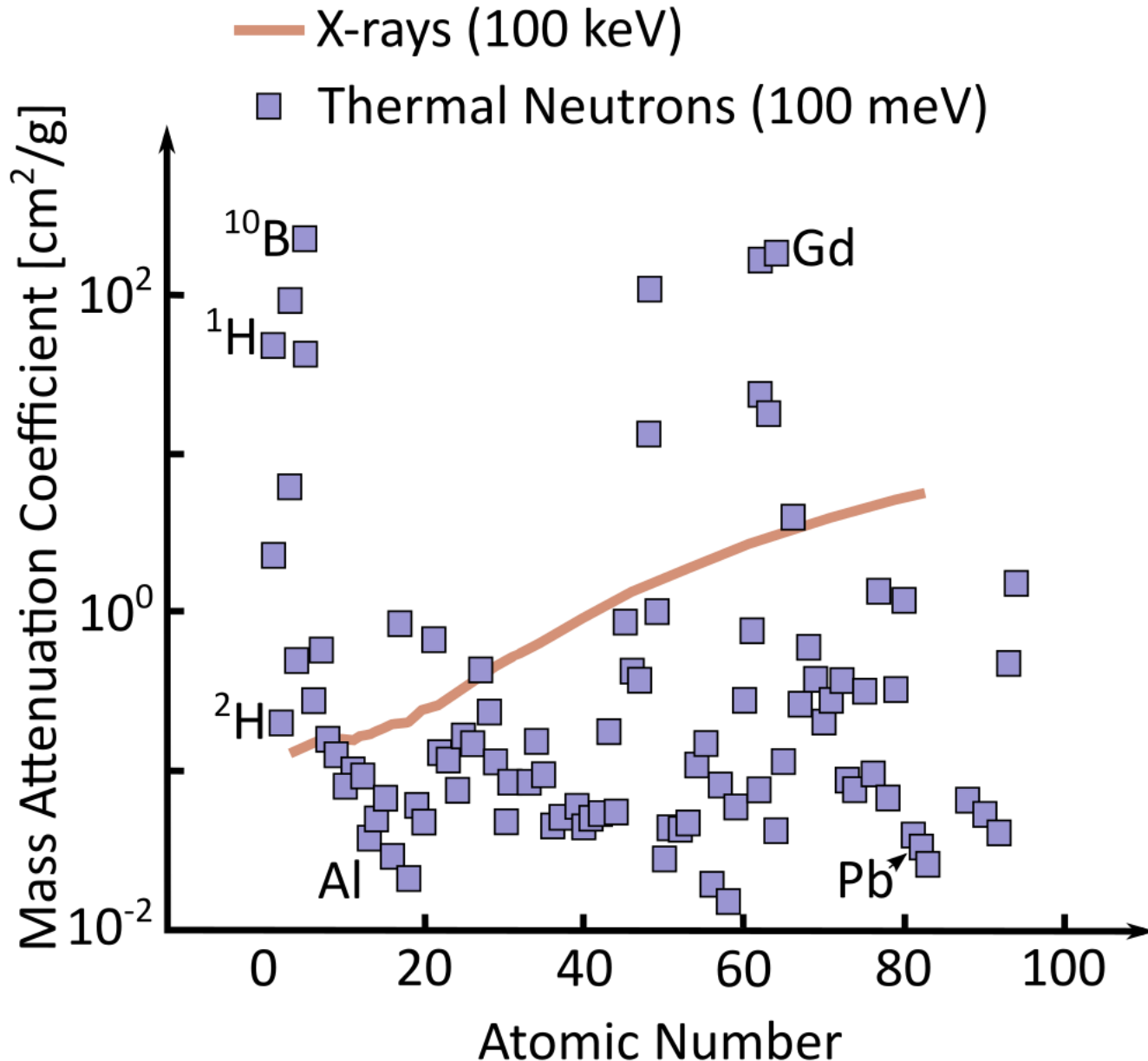


Thank you for listening!

Questions?

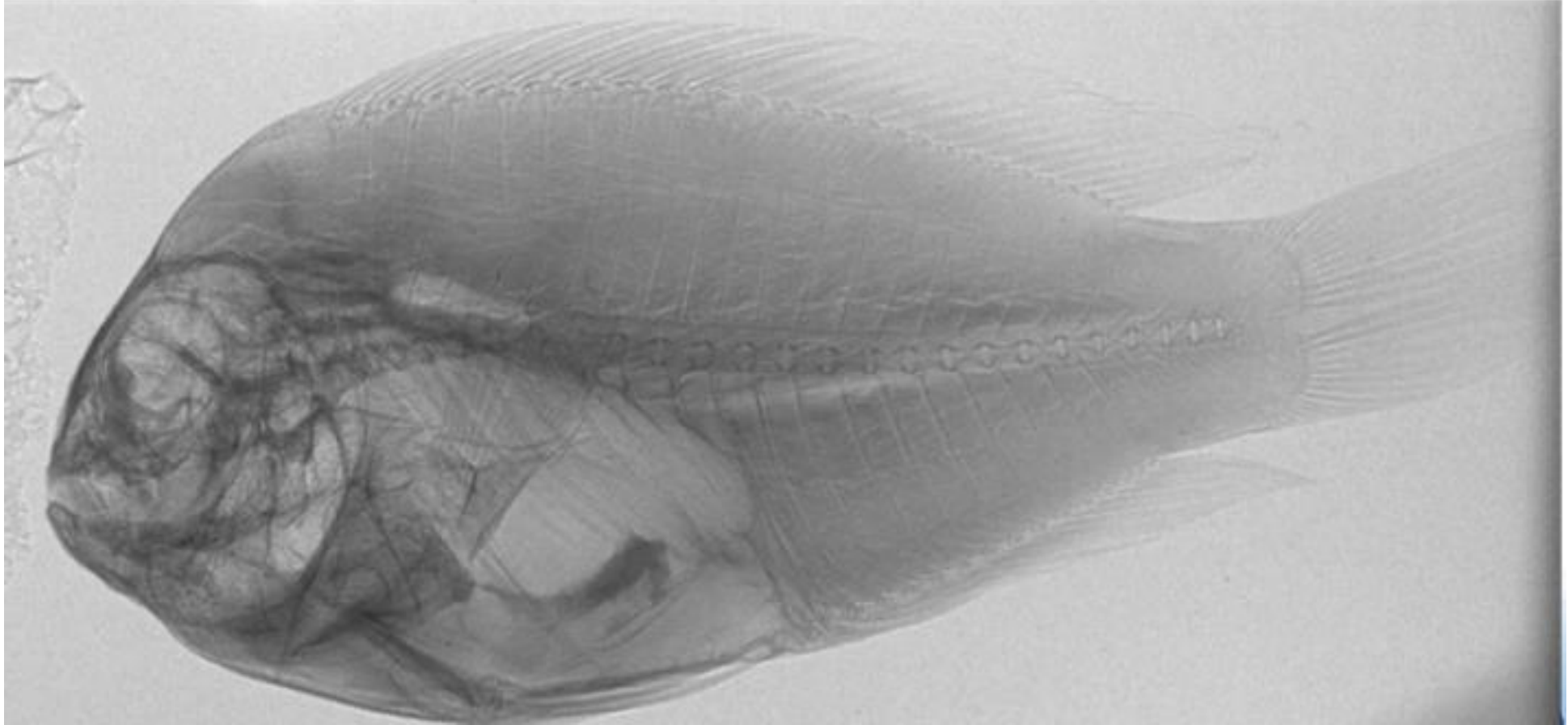
**BACKUP**

# Aluminium in Mechanical Parts of Neutron Detectors



- safety concern: Material activation!
- activation product: <sup>23</sup>Na
  - half-life: 15 h
  - photon emission

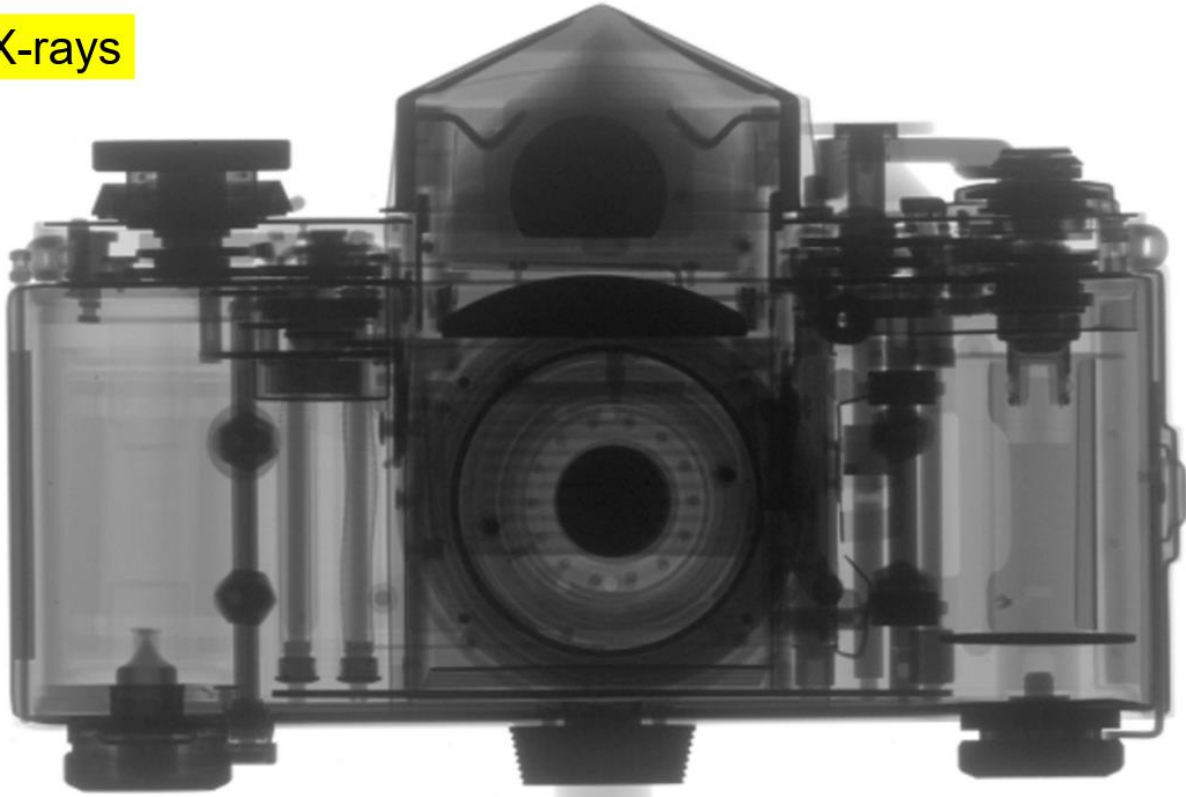
Only use thick pieces!



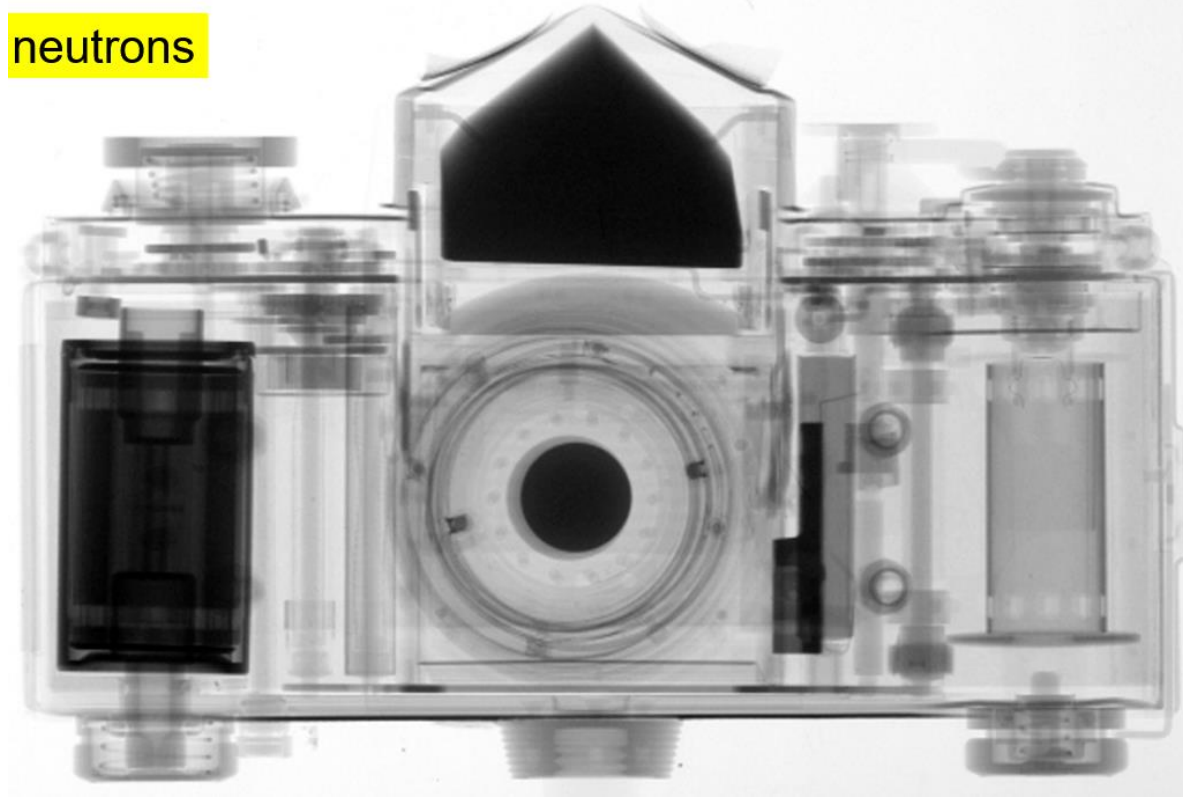




X-rays

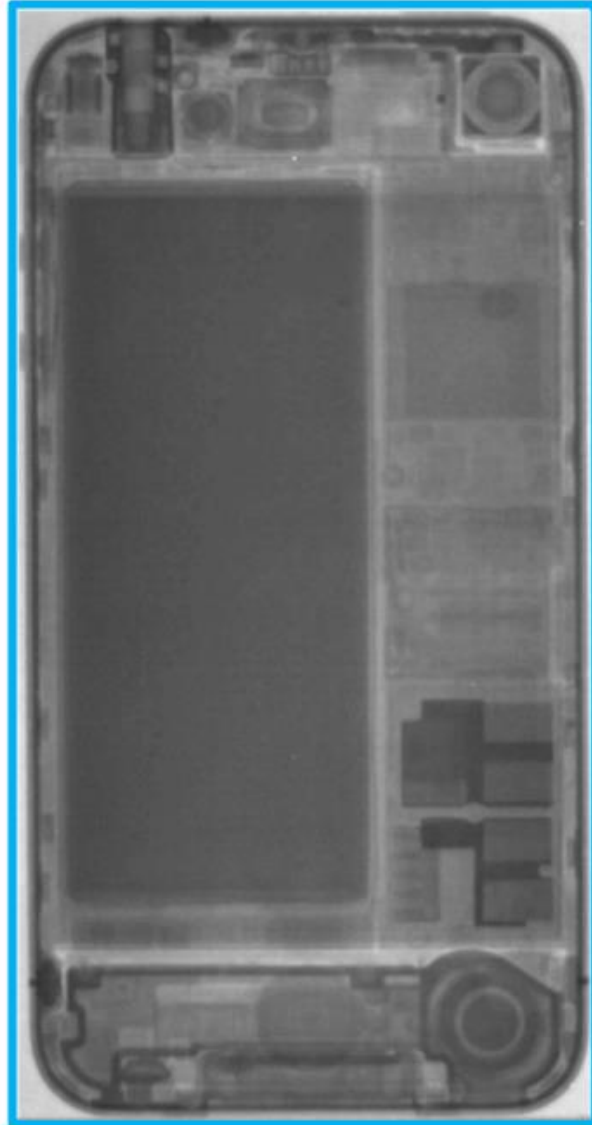


neutrons

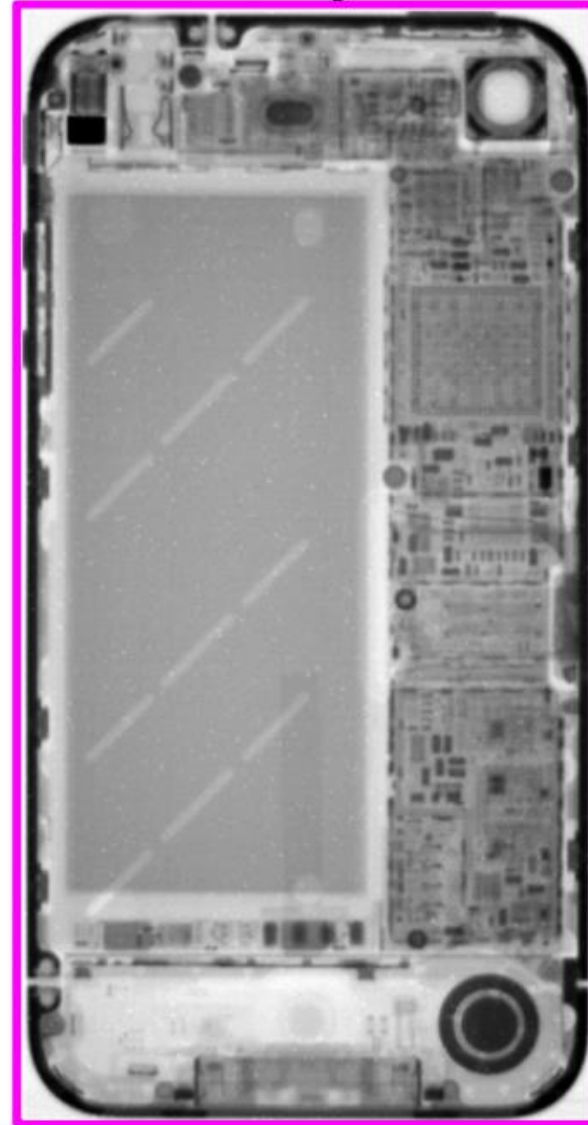




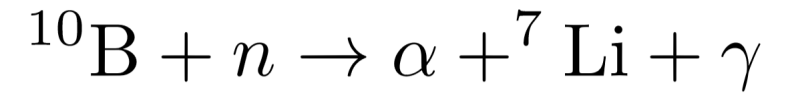
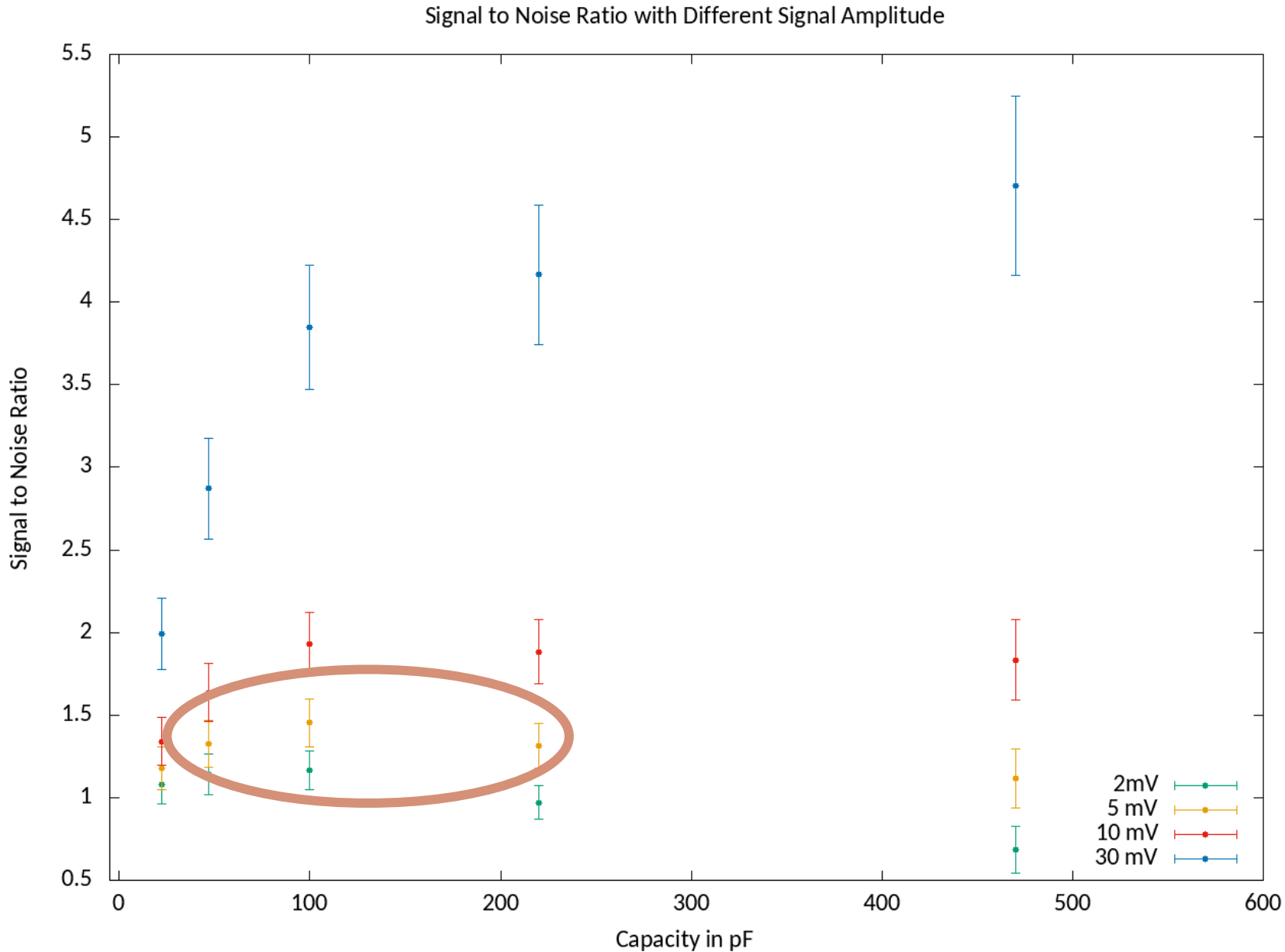
**Neutrons**



**X-rays**



# Capacitor Tests

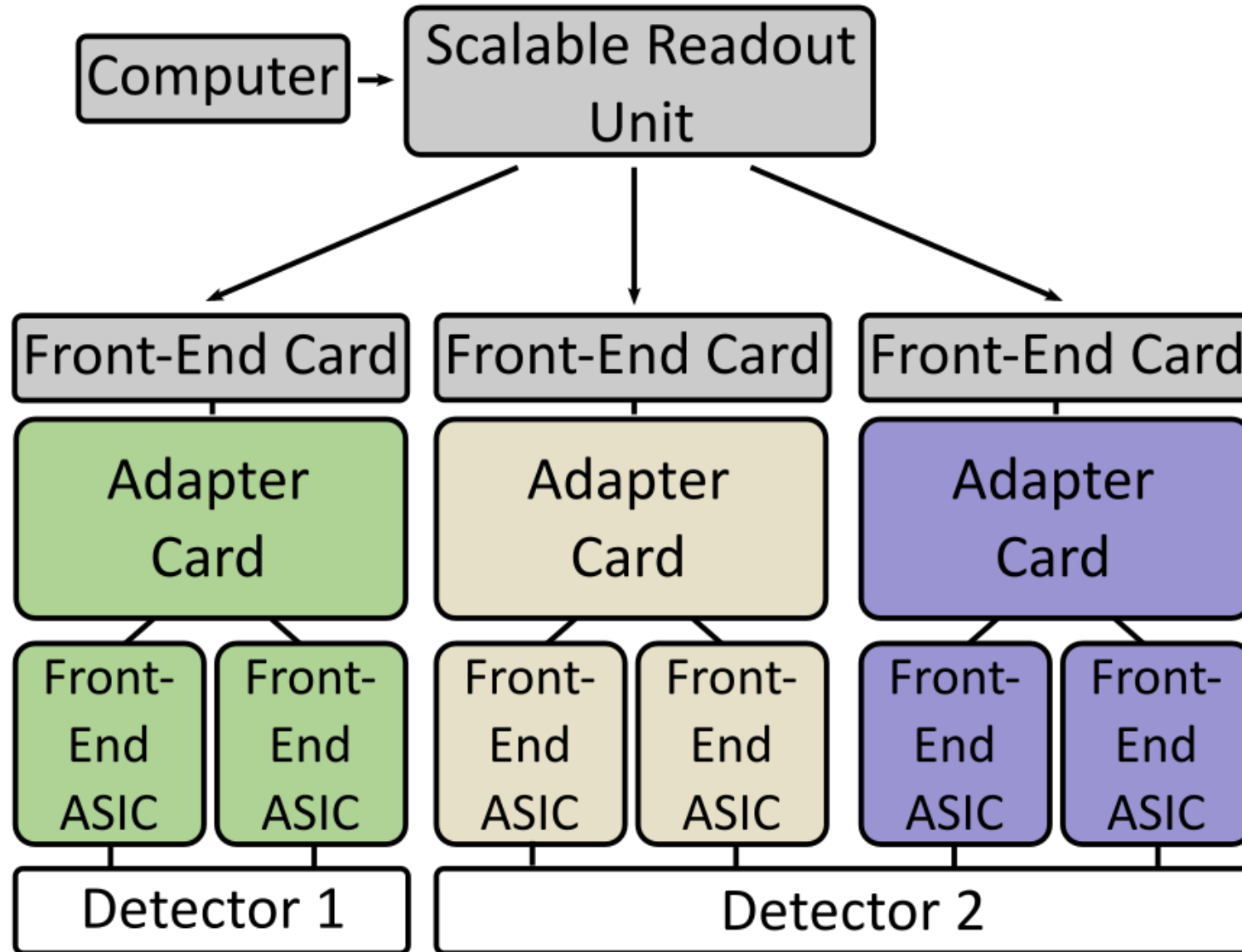


$\sim 10^6 e^-$

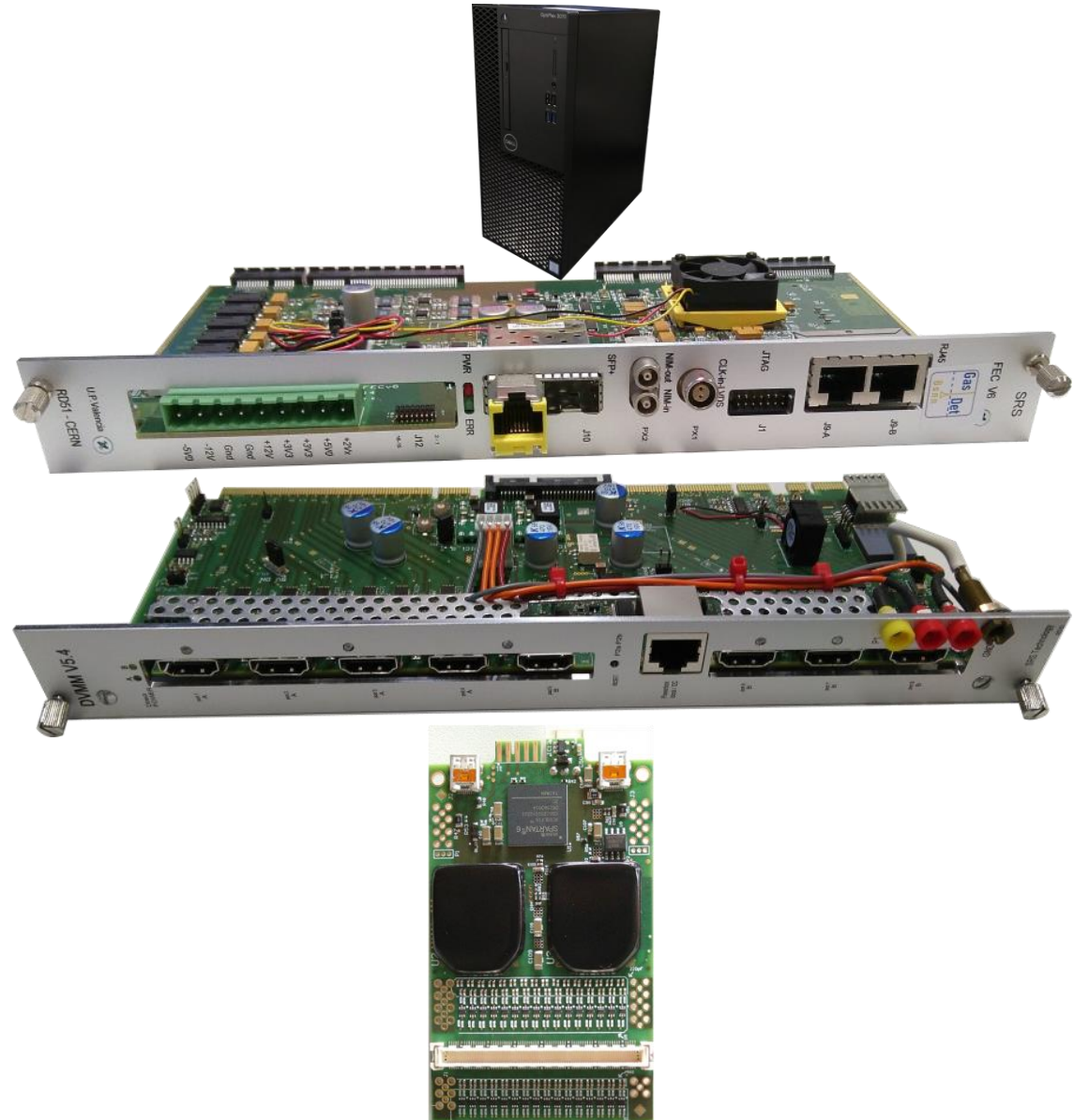
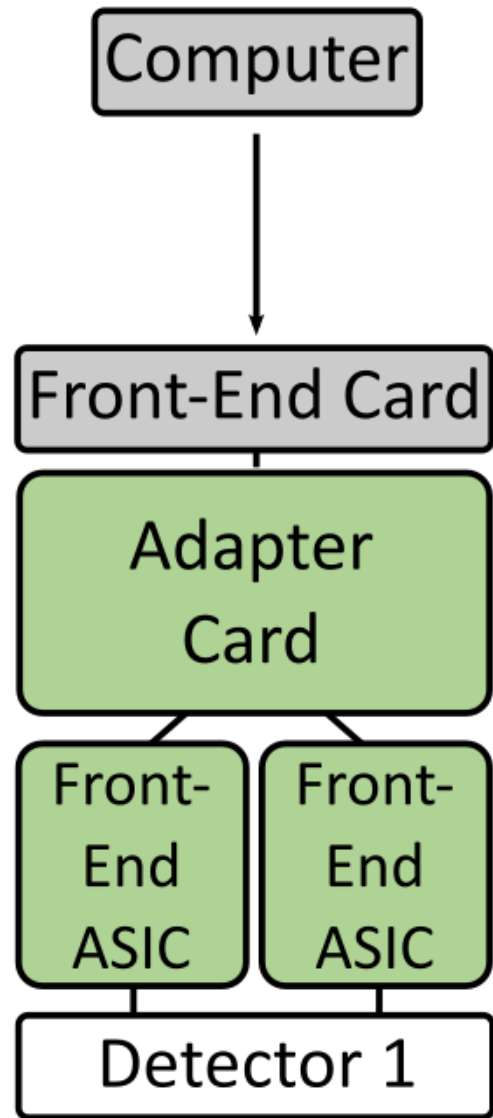


$\sim 5 \text{ mV}$

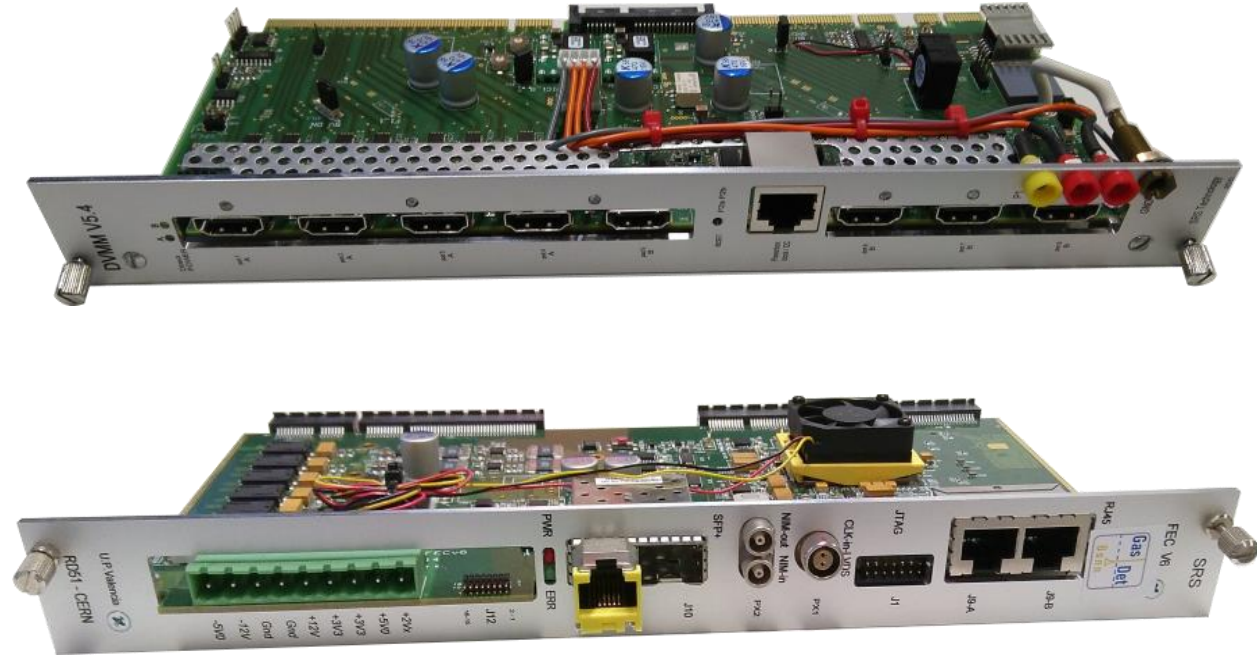
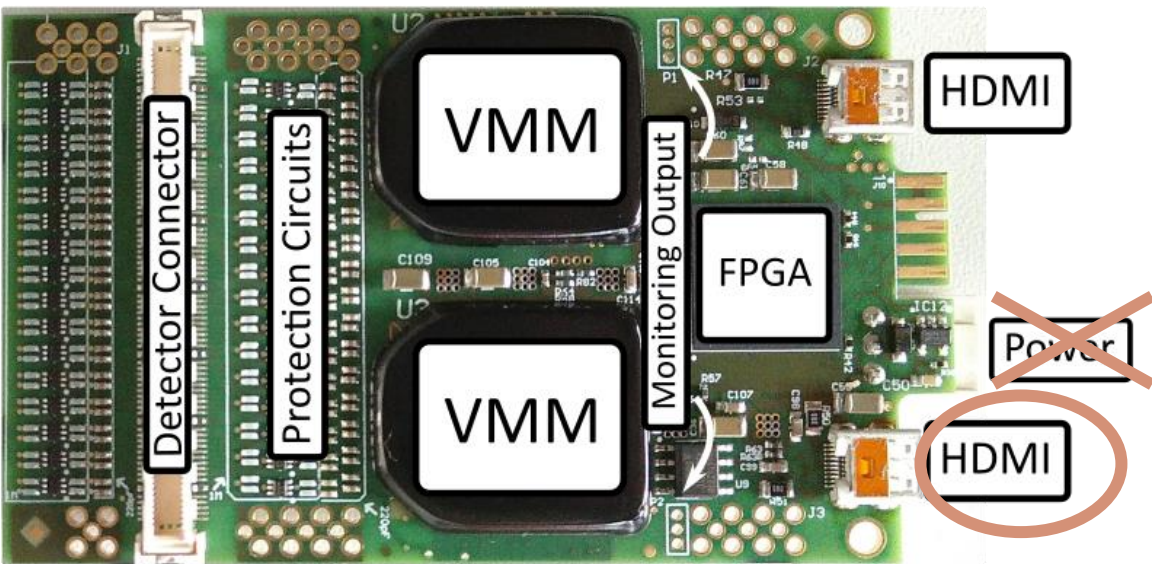
# The Scalable Readout System



# The Scalable Readout System



# Test Layer Preparations: Powering (6 VMM Hybrids)



Not sufficient for large number of hybrids!

# Gaseous Detectors

