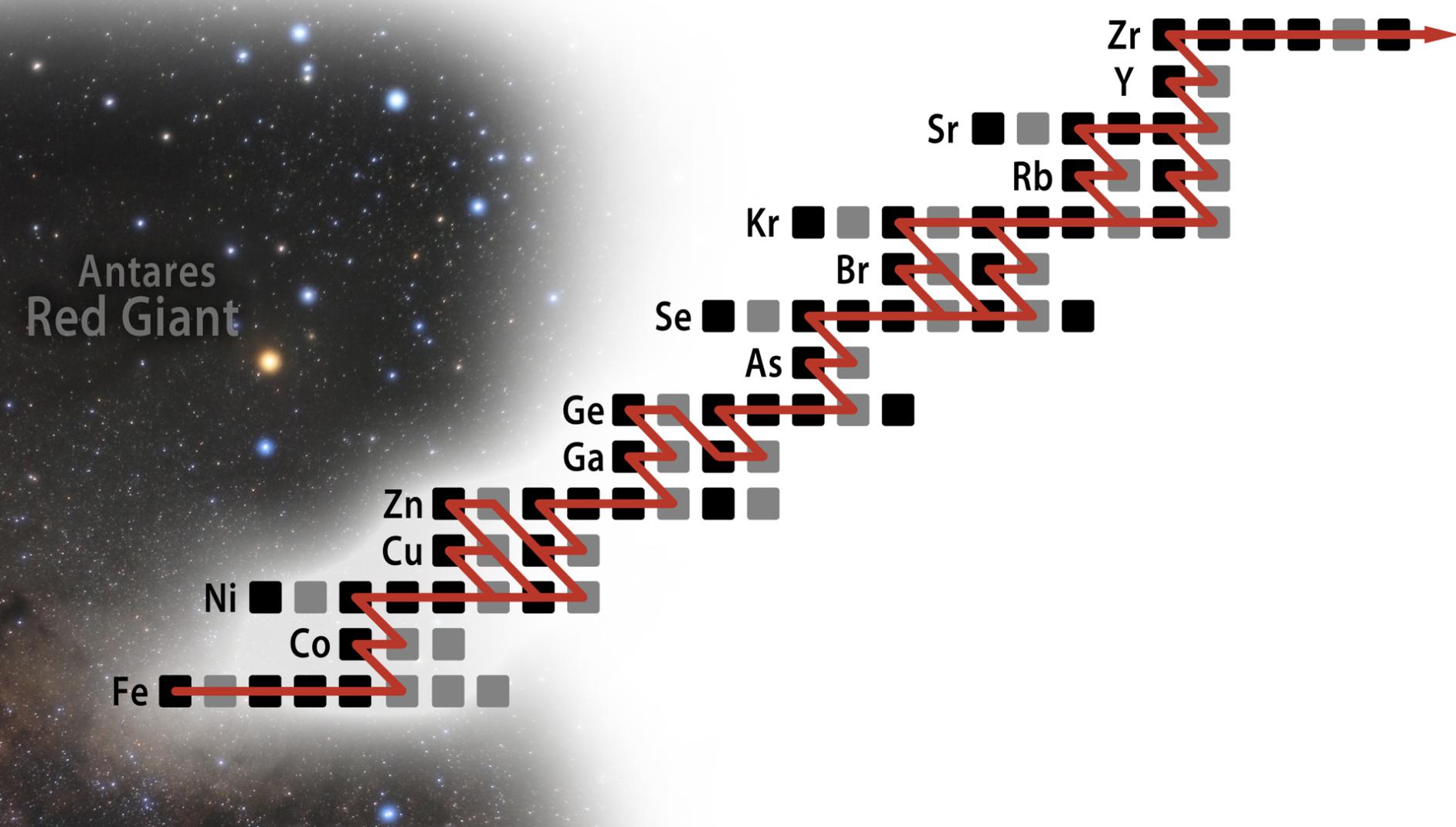


Van-de-Graaff @ Goethe-University Frankfurt

Tanja Heftrich & René Reifarth for the exp-astro working group

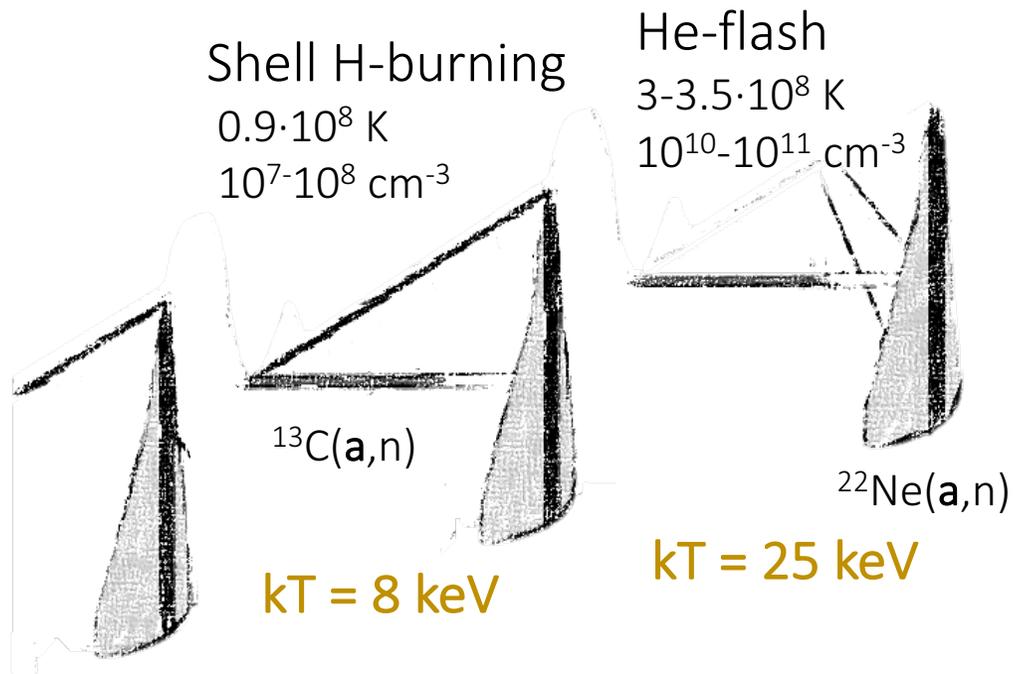
n-induced nucleosynthesis



Main s-process

$90 < A < 210$

TP-AGB stars $1-3 M_{\odot}$



Weak s-process

$A < 90$

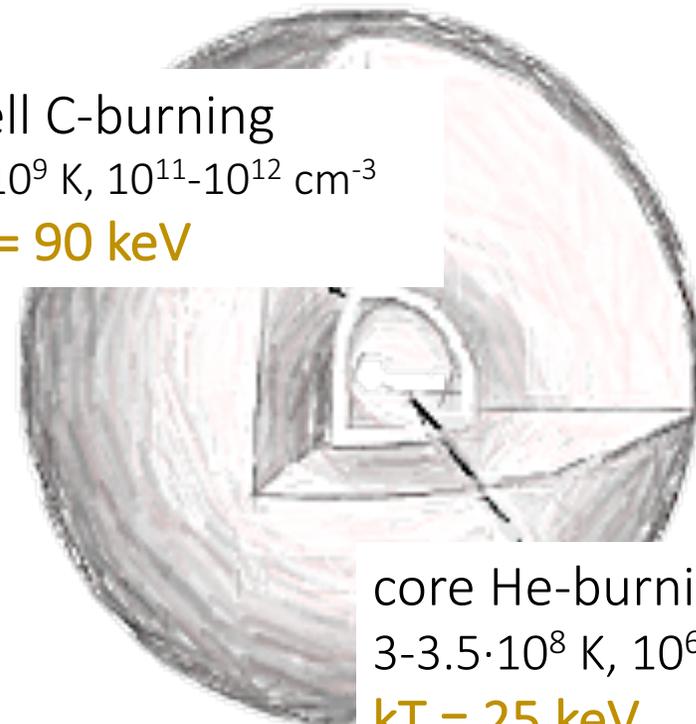
Massive stars $> 8 M_{\odot}$

$^{22}\text{Ne}(\text{a},\text{n})$

shell C-burning

$\sim 1 \cdot 10^9 \text{ K}, 10^{11}-10^{12} \text{ cm}^{-3}$

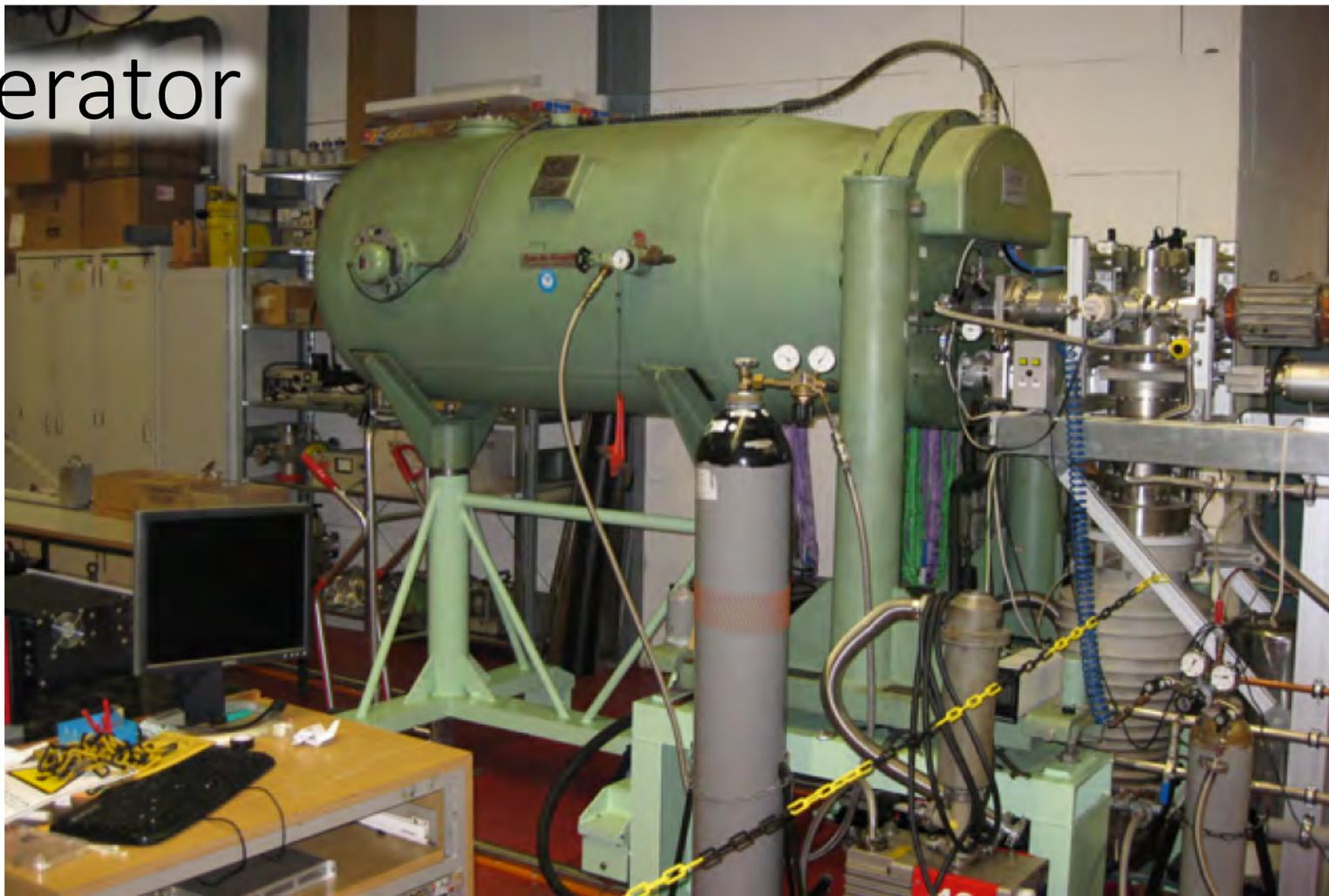
$kT = 90 \text{ keV}$



Goethe-University Frankfurt



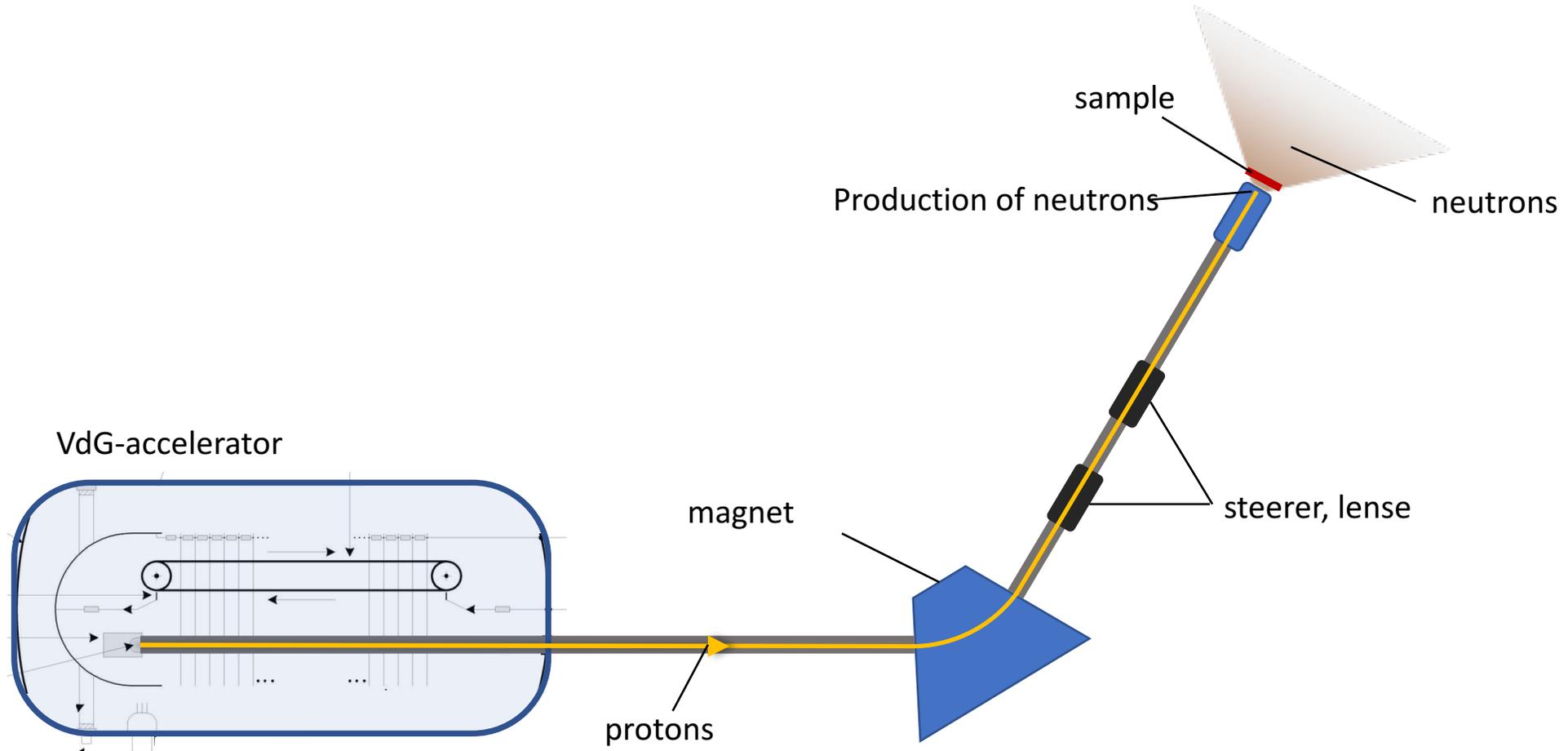
Van-de-Graaff accelerator

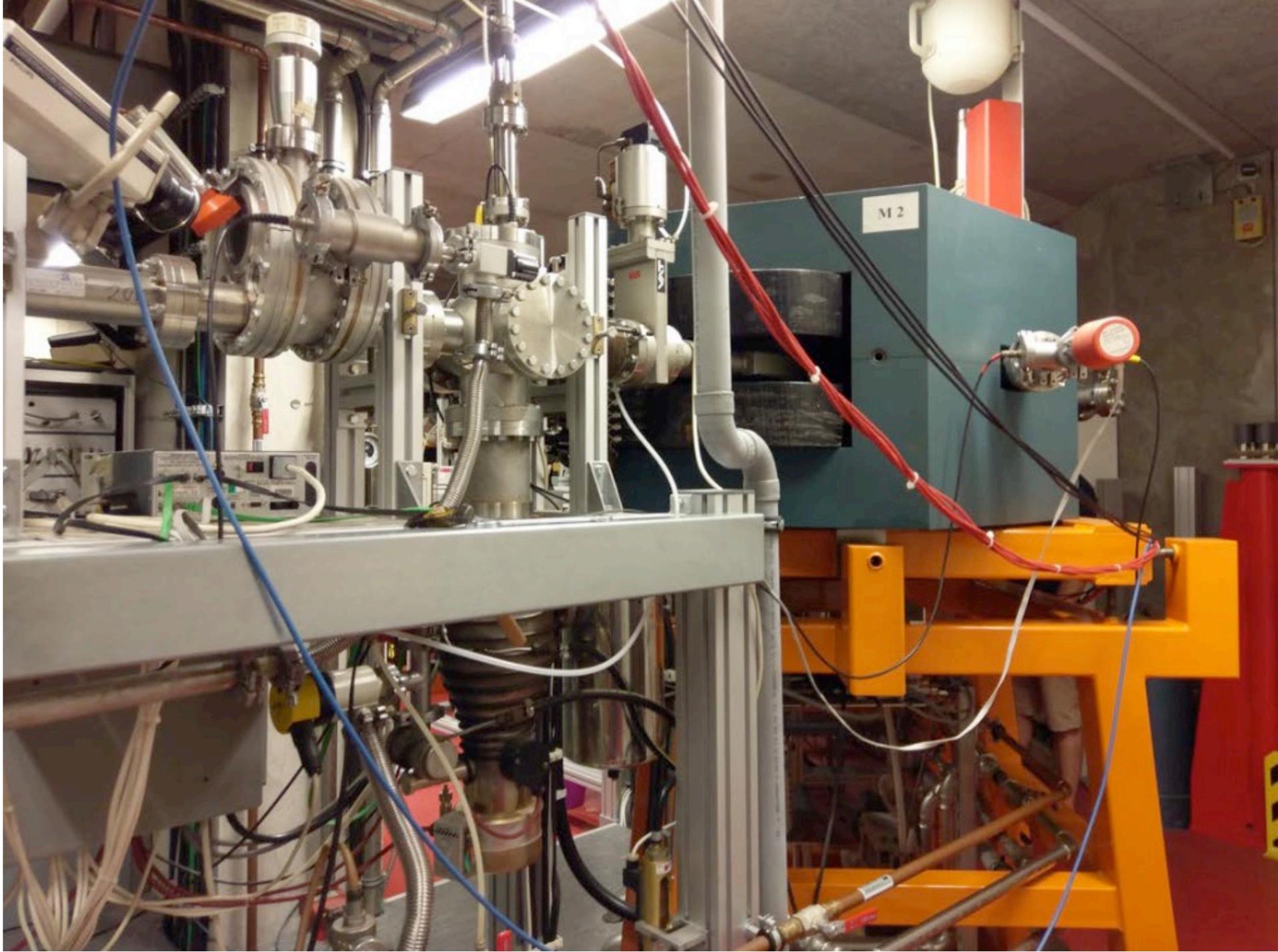


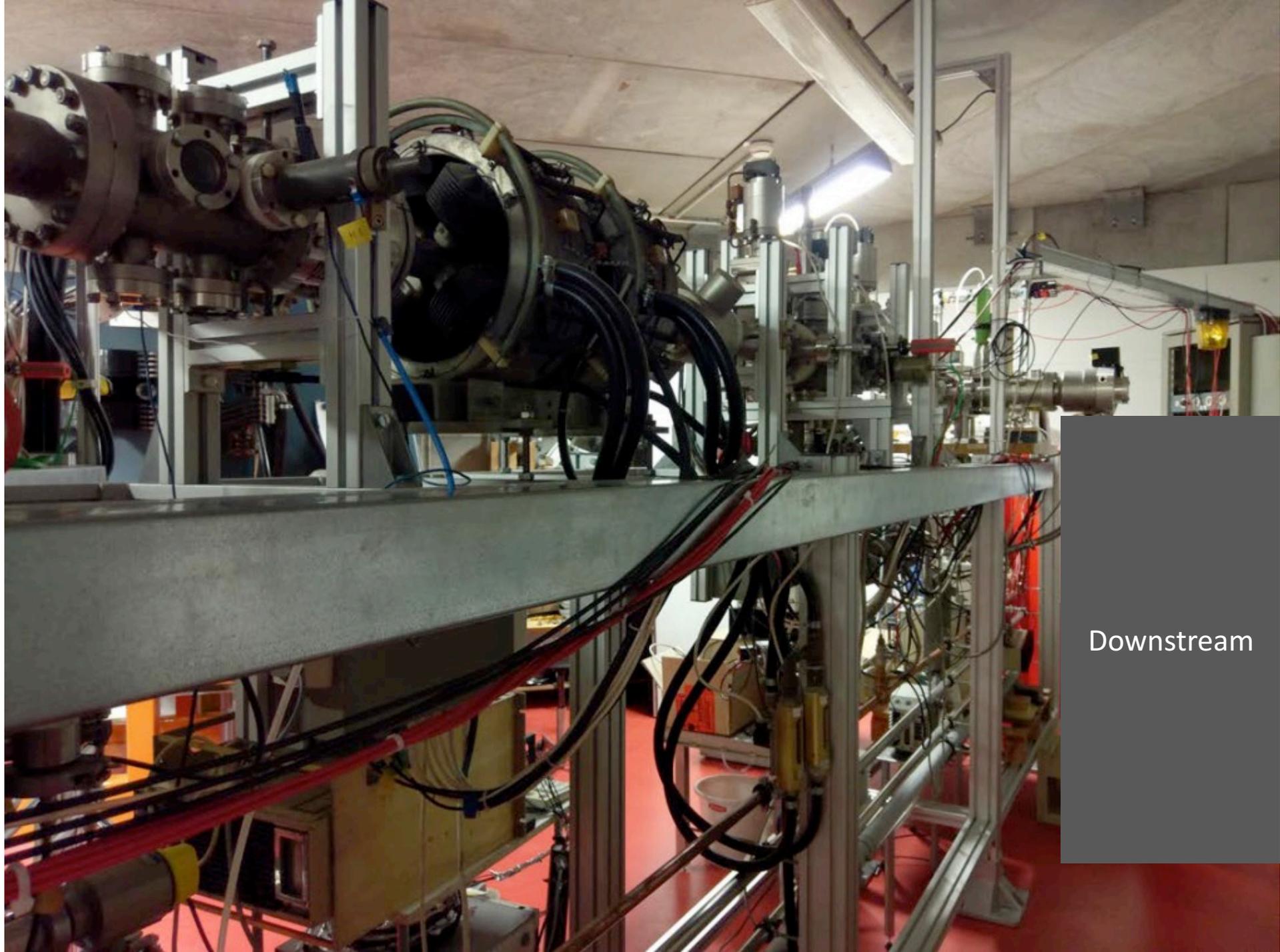
- DC proton or alpha beam up to $10 \mu\text{A}$
- terminal voltage 1 to 2.5 MeV

Van-de-Graaff accelerator

activation for the s-process

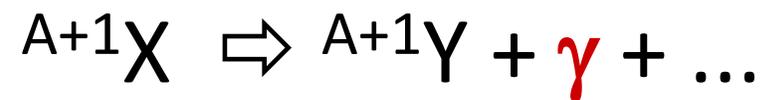






Downstream

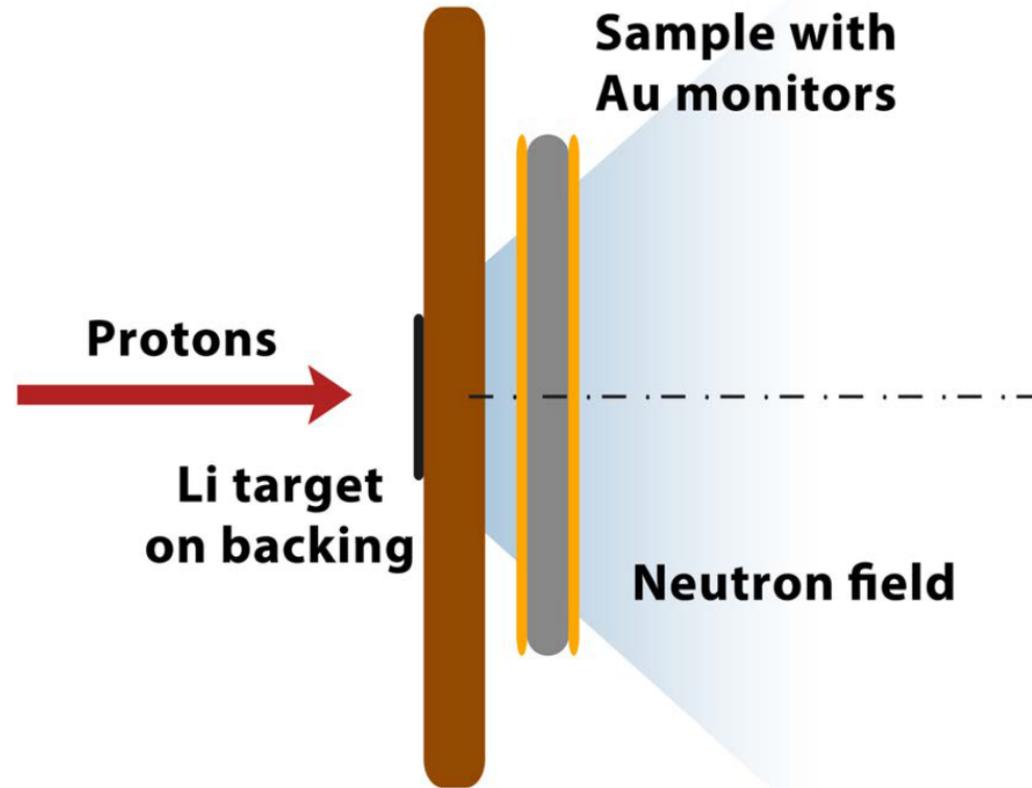
Idea of activation

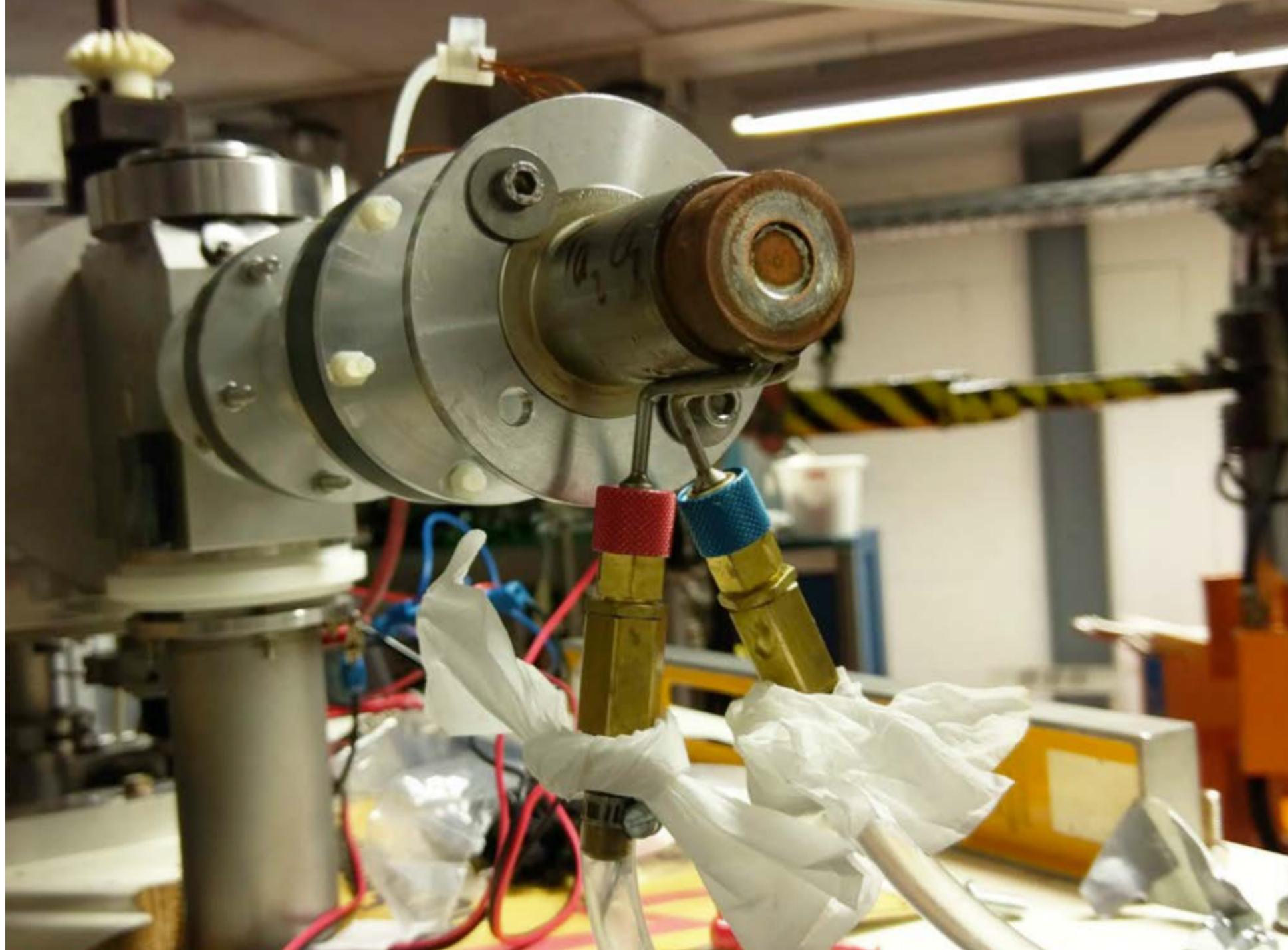


Produced activity:

$$A \propto \frac{{}^A N \cdot \Phi_n \cdot \sigma}{t_{1/2}} \cdot t_a$$

Activation setup



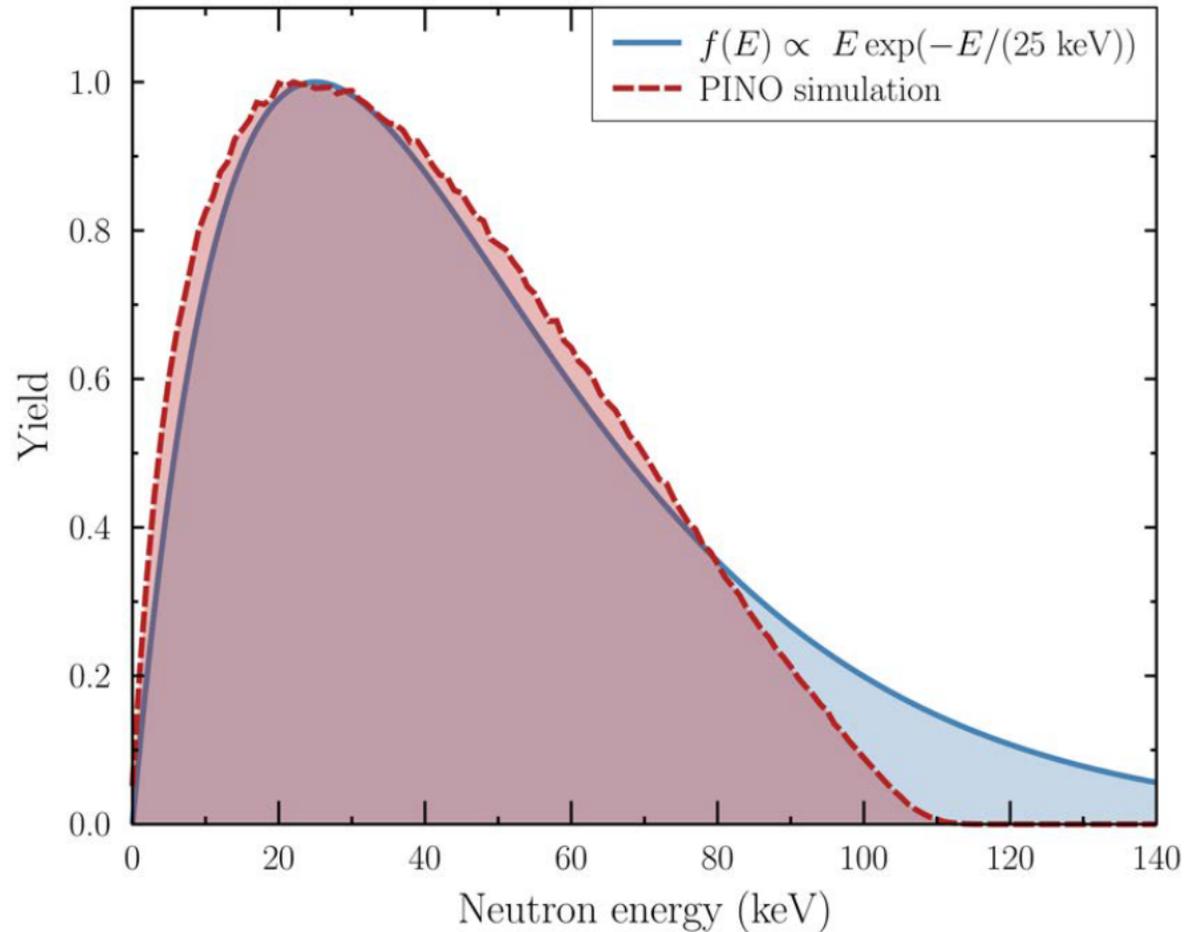




Working horse ...

➔ <https://exp-astro.de/pino/>

Neutronspectrum for $kT \approx 25$ keV



$E_p = 1912$ keV

BEGe
Broad Energy Germanium Detectors



BEGe
Broad Energy Germanium Detectors

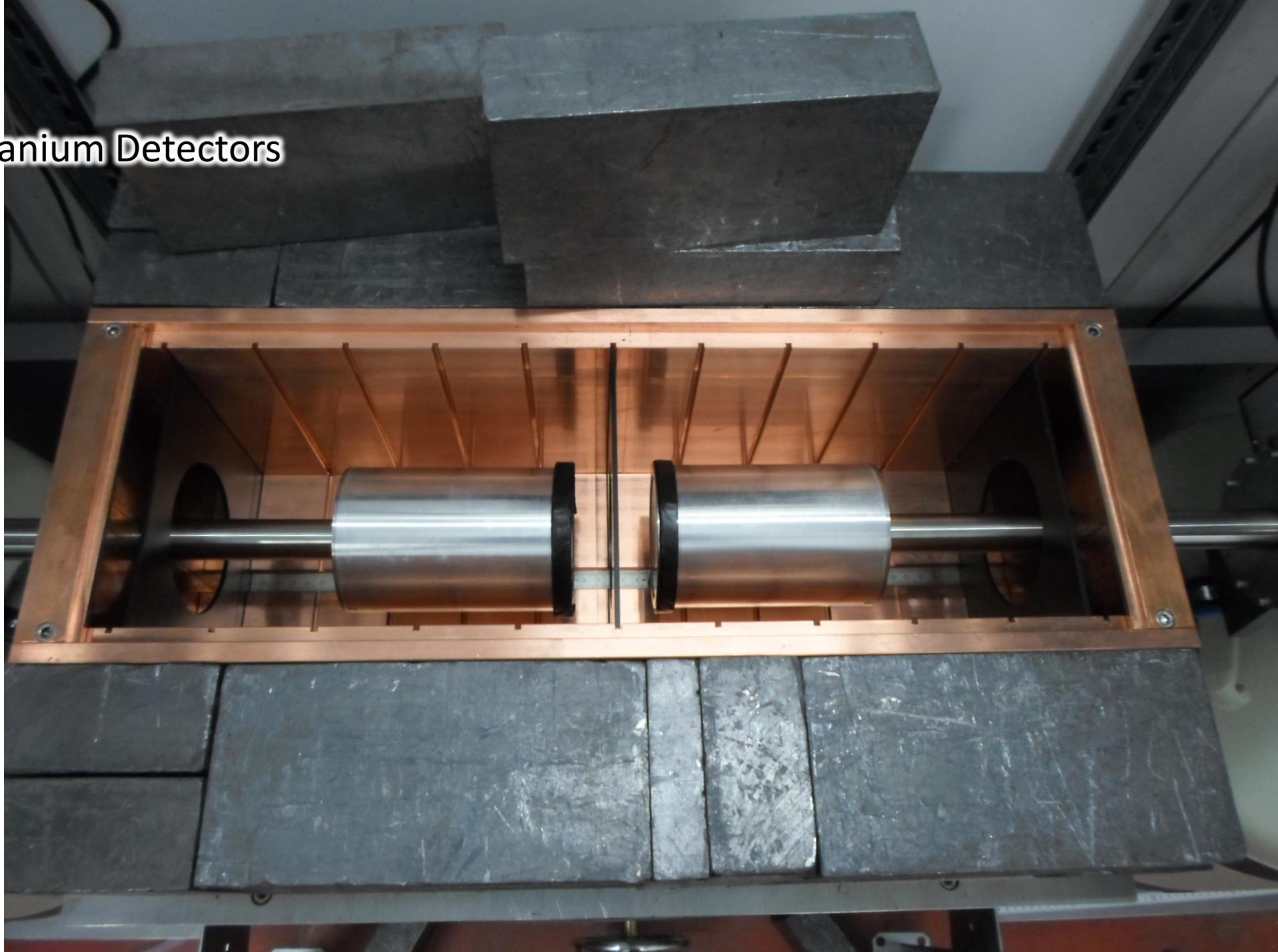
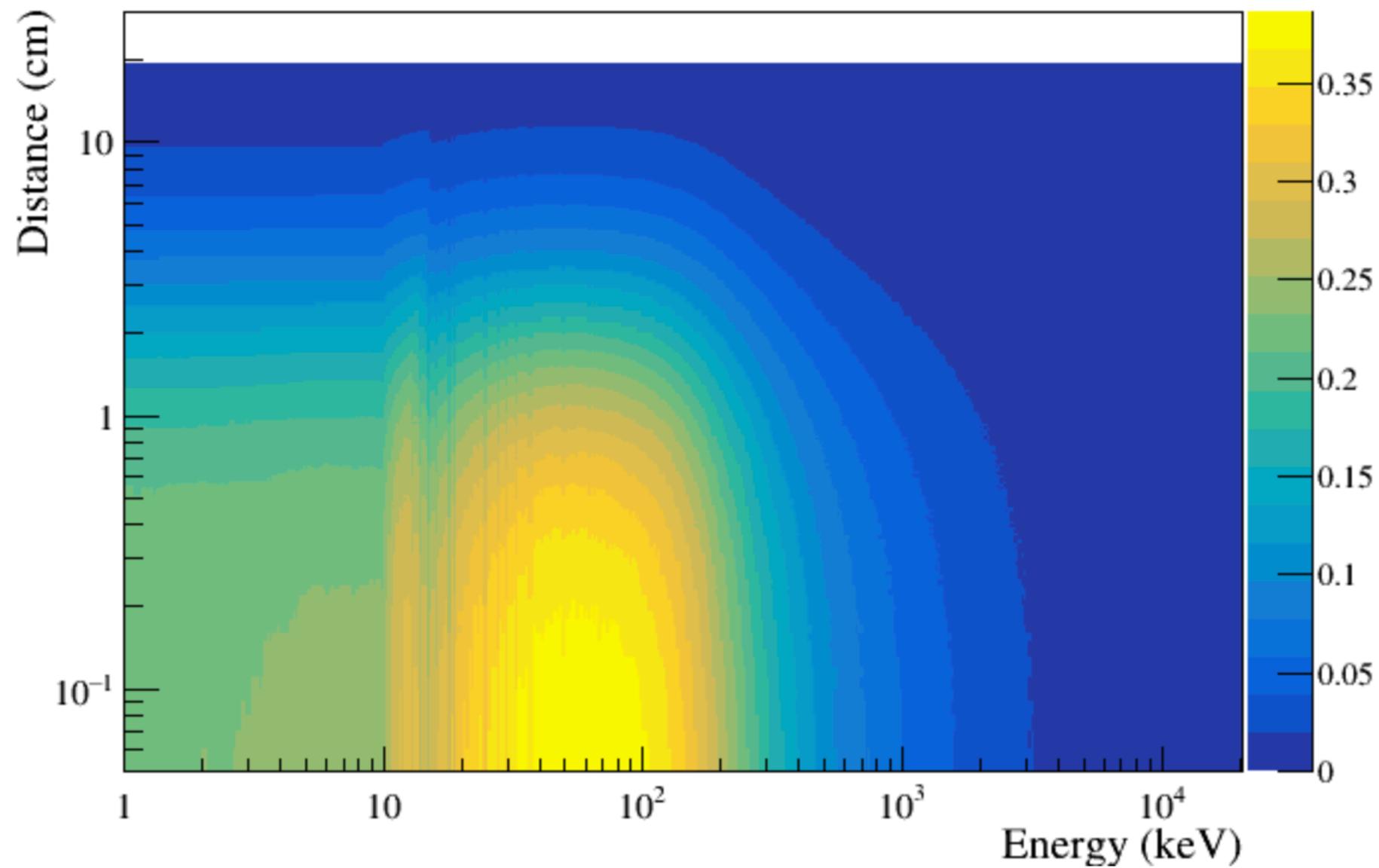
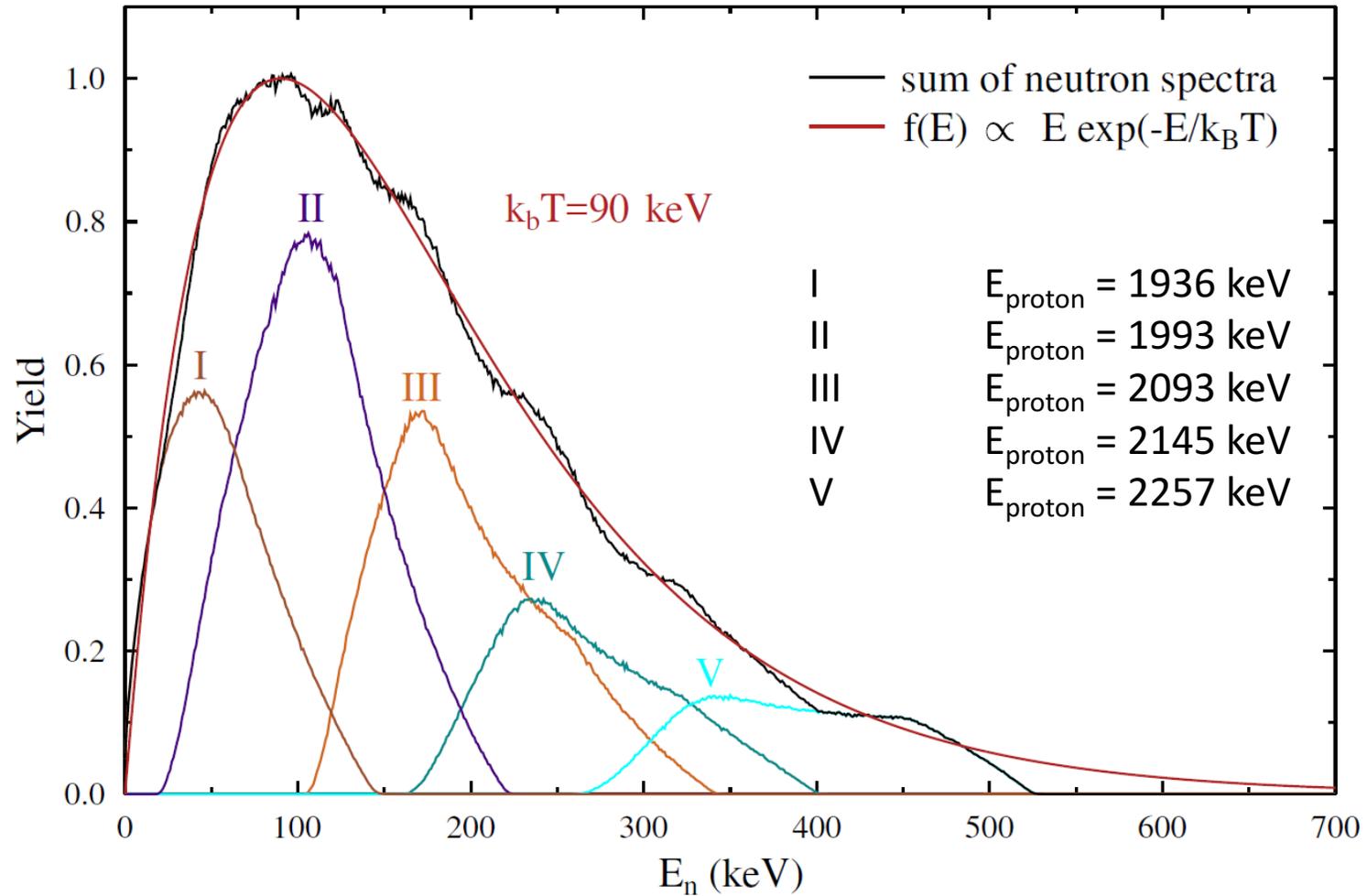


Photo-Peak Efficiency Detektor 1



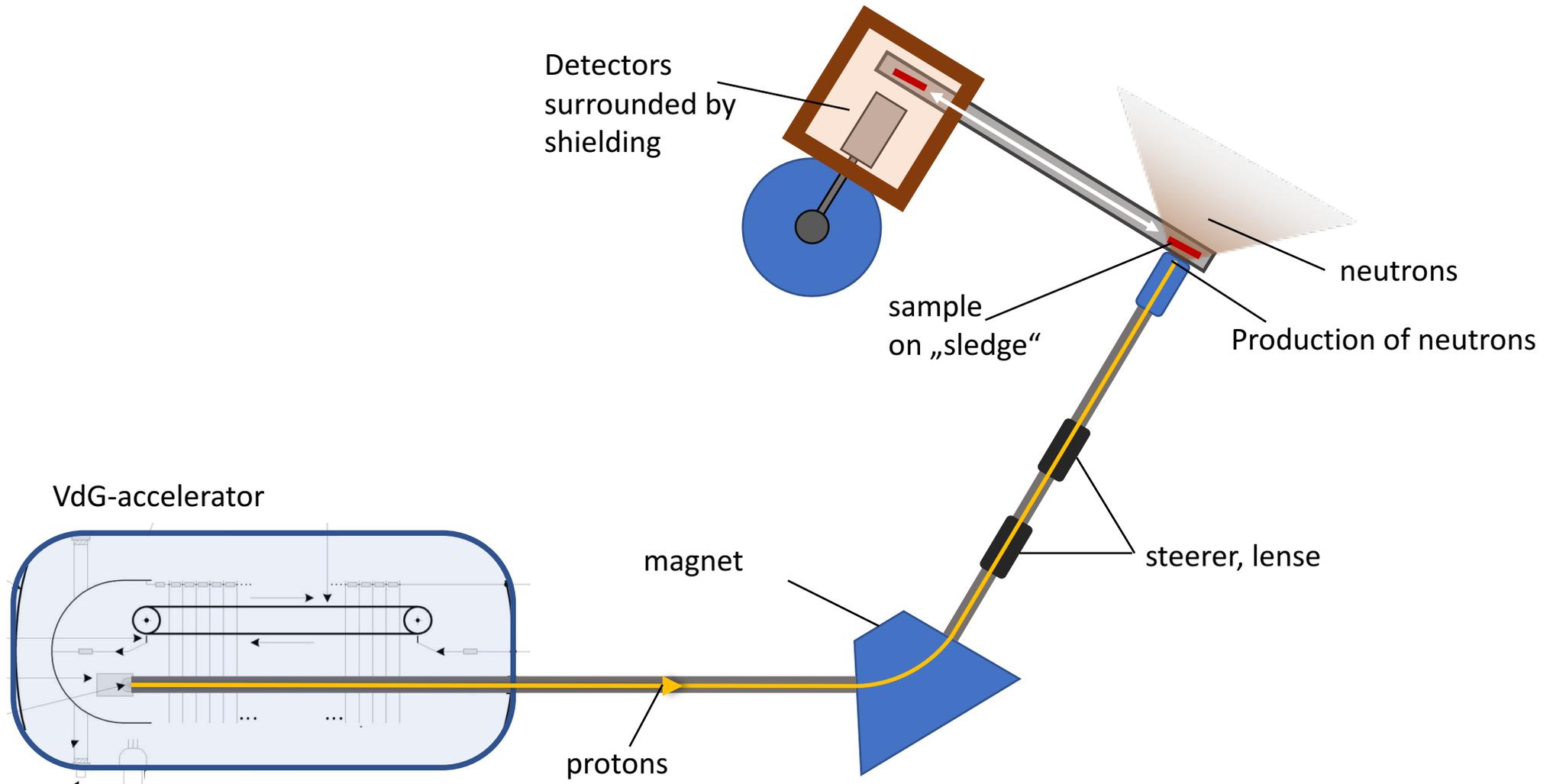
Compose different spectra

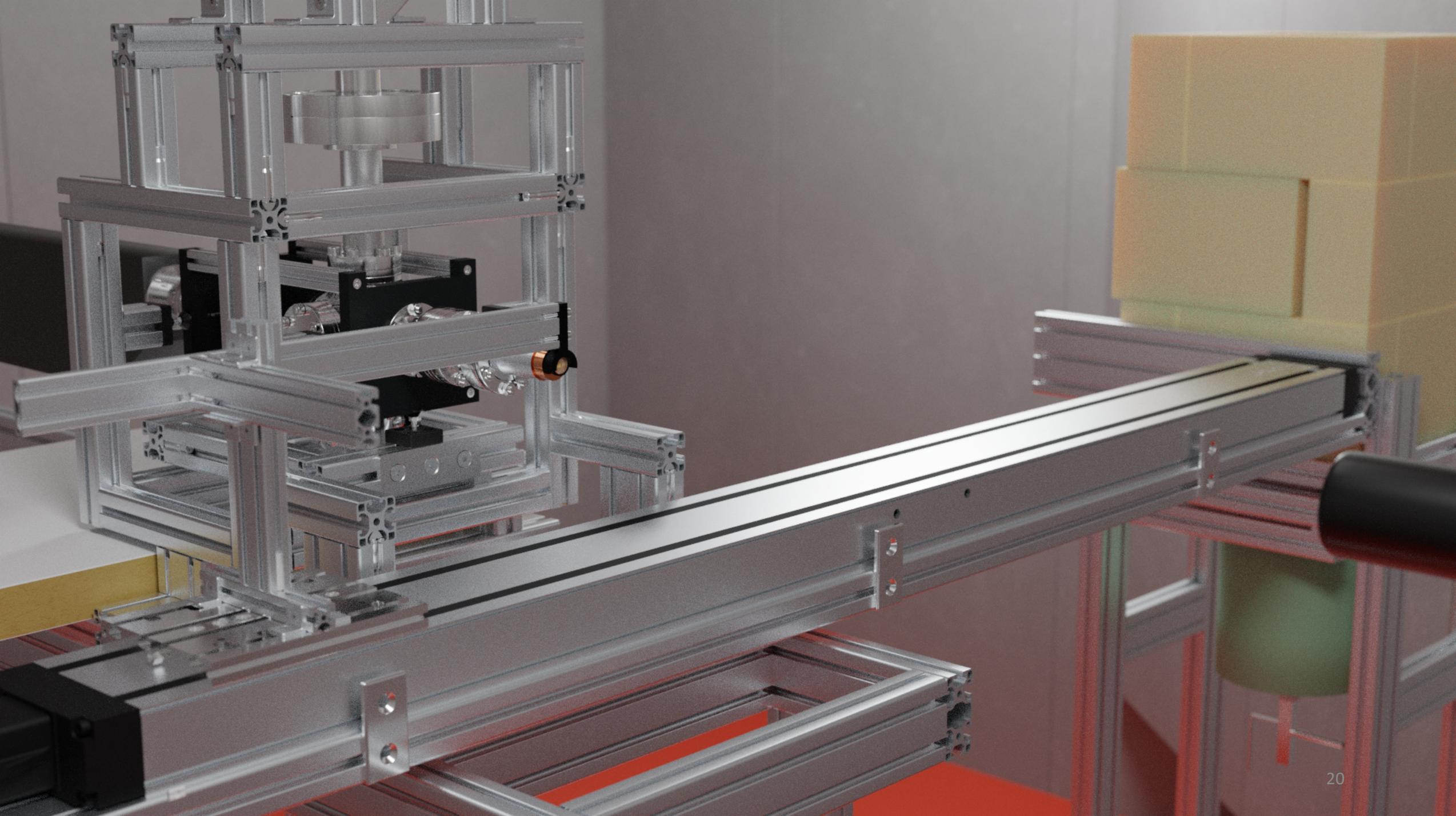


Cyclic activation

	p	γ 1634...	γ 351...	σ_n, α 260	σ 0.43 + 0.1	$\beta^- -6$	136
7 ns	Ne 18 1.67 s β^+ 3.4... γ 1042...	Ne 19 17.22 s β^+ 2.2... γ (110; 197; 1357)	Ne 20 90.48 σ 0.039	Ne 21 0.27 σ 0.7 σ_n, α 0.00018	Ne 22 9.25 σ 0.051	Ne 23 37.2 s β^- 4.4... γ 440; 1639	
/ s	F 17 64.8 s β^+ 1.7 no γ	F 18 109.7 m β^+ 0.6 no γ	F 19 100 σ 0.0095	F 20 11.0 s β^- 5.4... γ 1634...	F 21 4.16 s β^- 5.3; 5.7... γ 351; 1395...	F 22 4.23 s β^- 5.5... γ 1275; 208 2166...	
n	O 16 99.757 σ 0.00019	O 17 0.038 σ 0.00054 σ_n, α 0.257	O 18 0.205 σ 0.00016	O 19 27.1 s β^- 3.3; 4.7... γ 197; 1357...	O 20 13.5 s β^- 2.8... γ 1057...	O 21 3.4 s β^- 6.4... γ 1730; 351 280; 1787...	
6	N 15 0.364	N 16 5.3 μ s 7.13 s	N 17 4.17 s	N 18 0.63 s	N 19 329 ms	N 20 142 m	

Cyclic activation





The exp-astro group @ Frankfurt will be happy to perform experiments with you

