

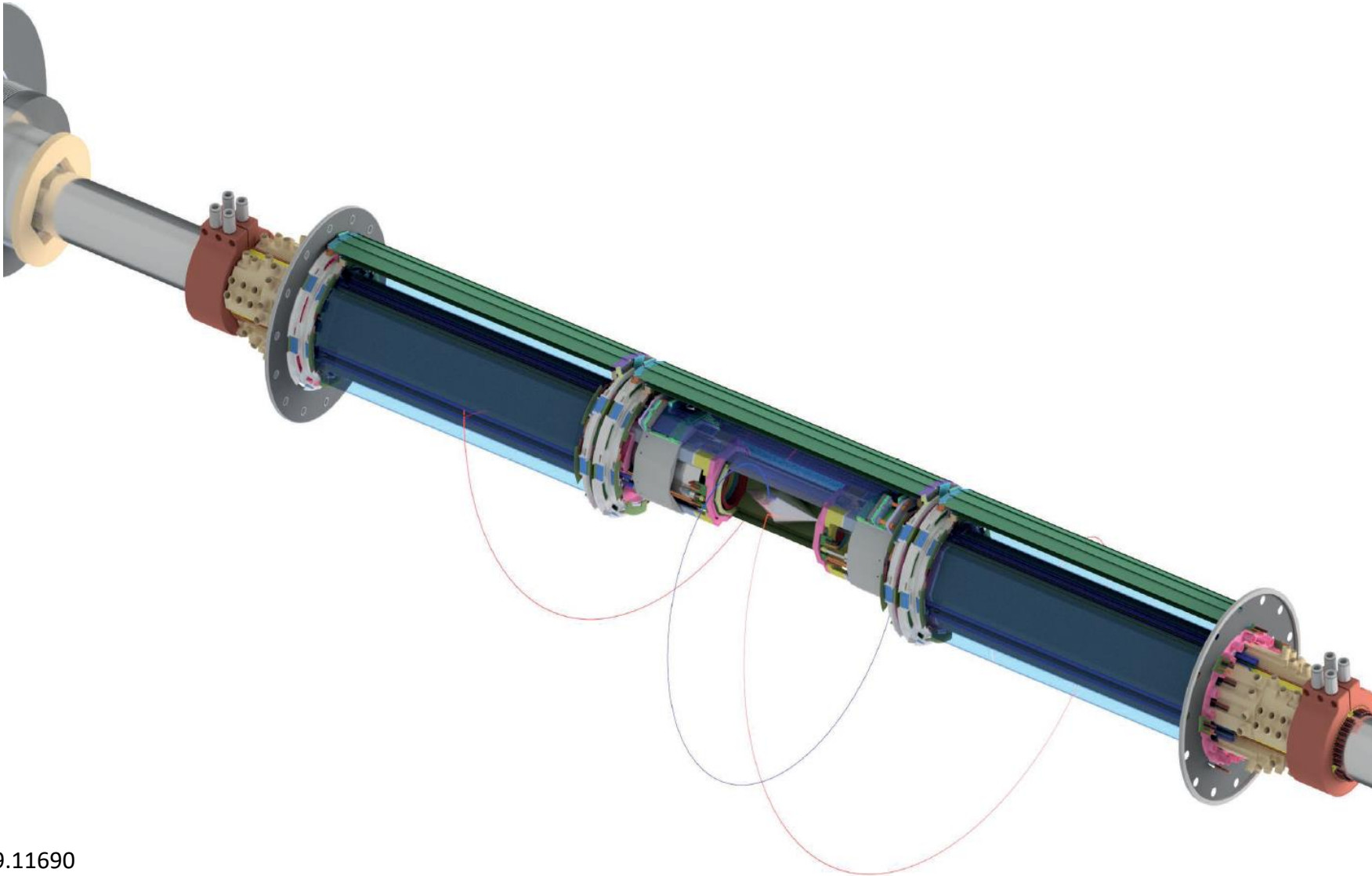
Radiation hardness of Kapton in a helium atmosphere

Gian Luca Caratsch

LTPHD Seminar

19.06.2024

The Mu3e experiment



The background

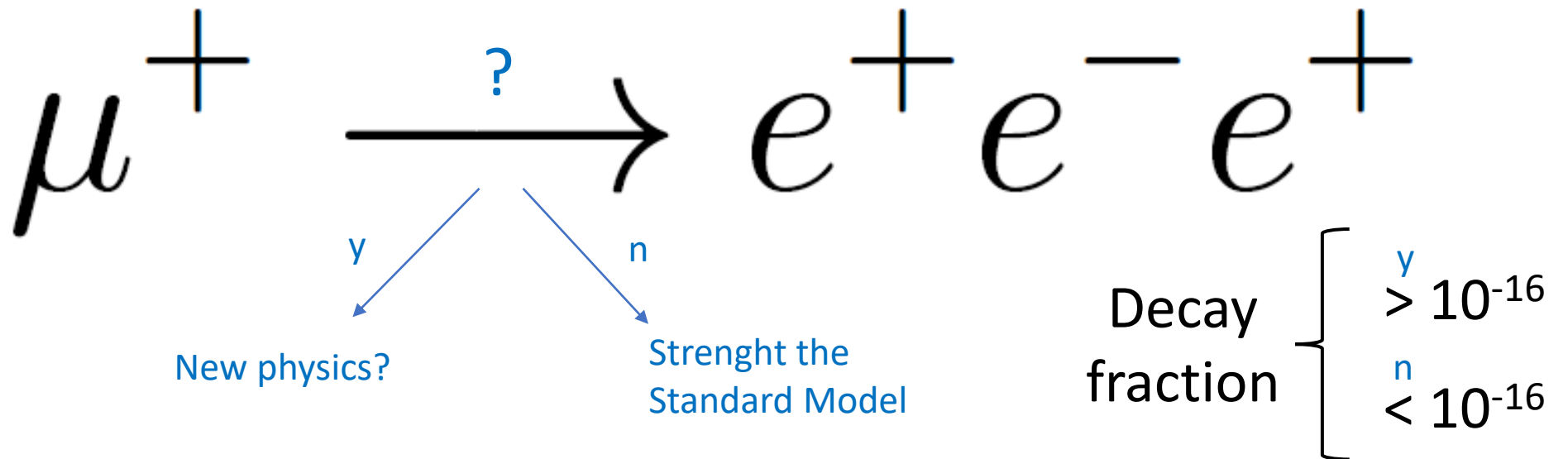
- Observation: lepton family numbers (L_e, L_μ, L_τ)
 - Three lepton families

$$L_e = \sum (e^- + \nu_e) - \sum (e^+ + \bar{\nu}_e)$$

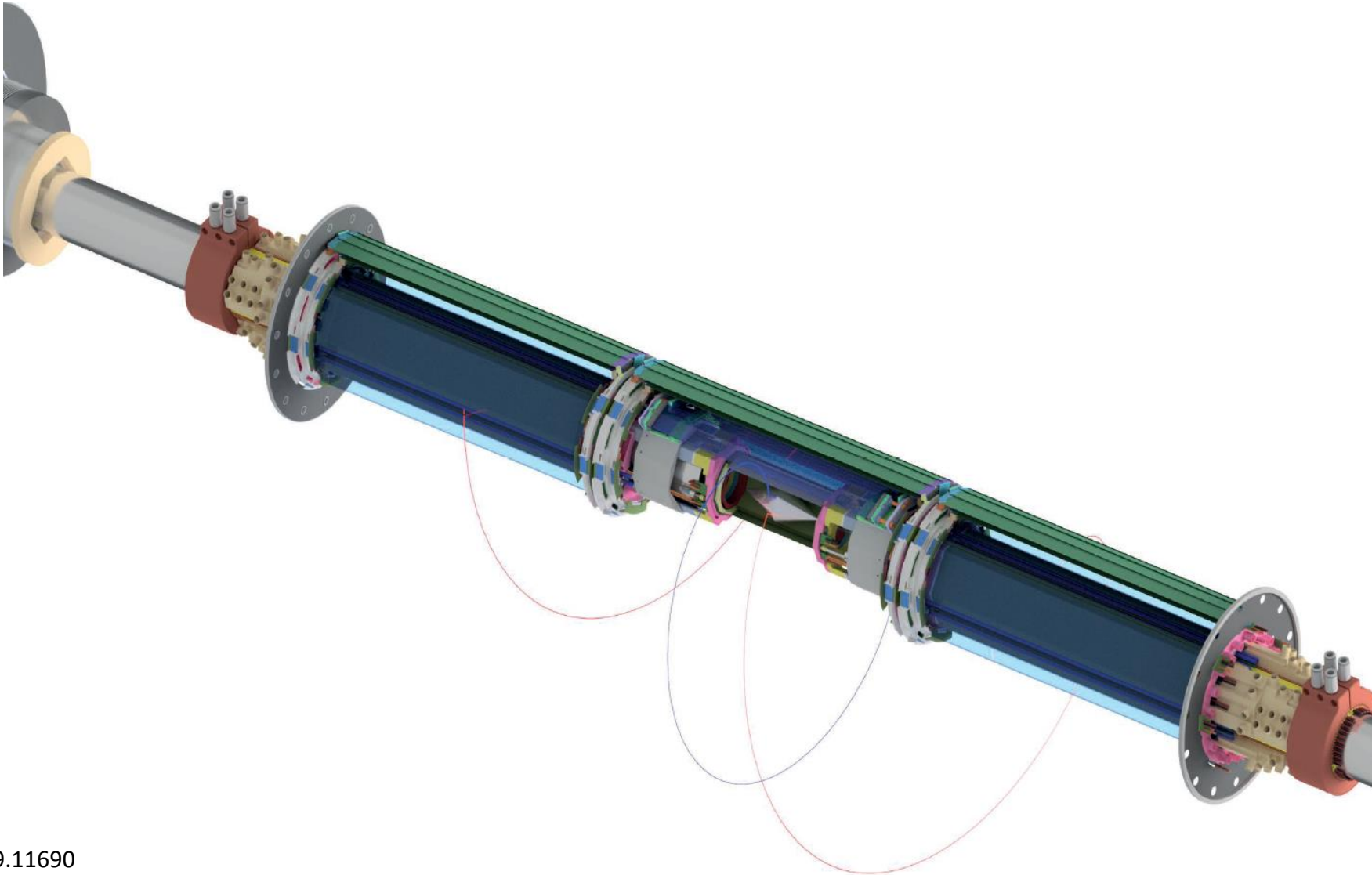
- **Almost** always conserved
- Are there any other L_i violating processes?

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 - Three lepton families
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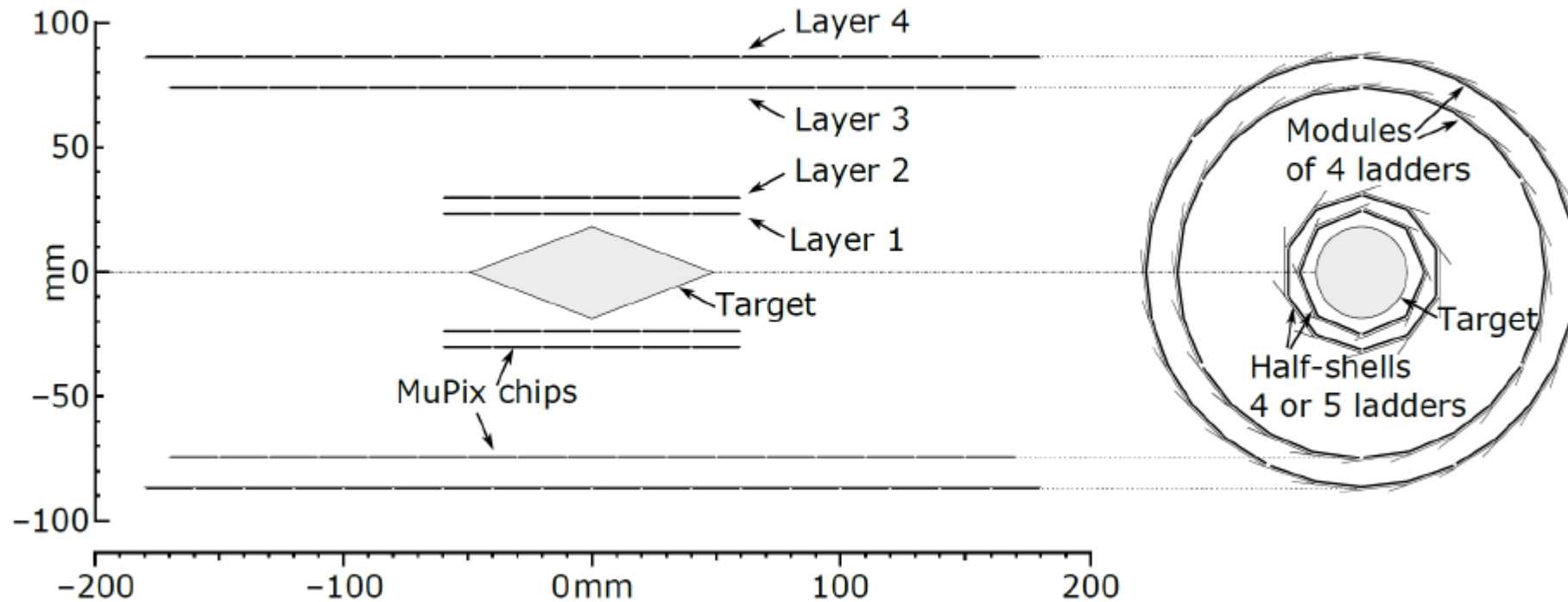


The Mu3e experiment



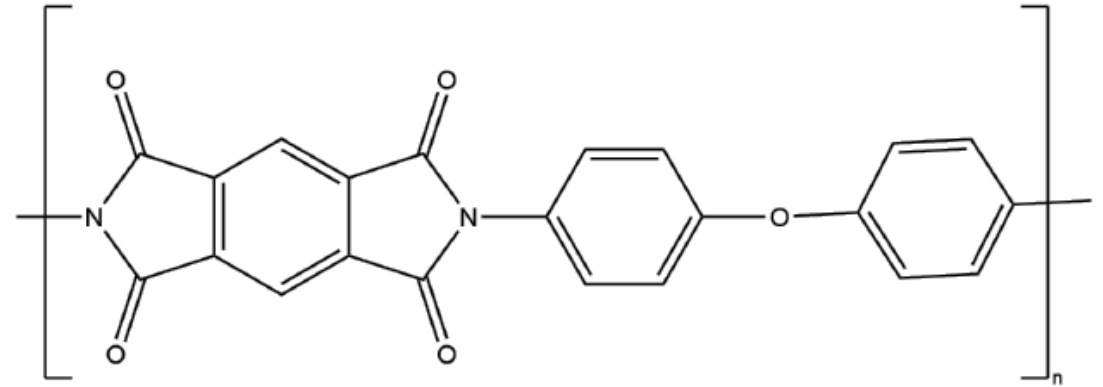
The Mu3e experiment

- Cooling of the sensors → Helium atmosphere
- Insulation and support structure → Kapton



Kapton

- Synthetic polymer



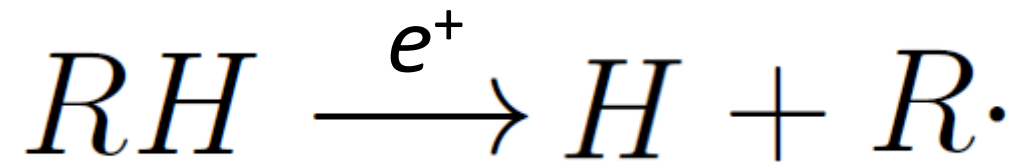
- Interesting properties for a detector
 - Rip resistance: 231 MPa at room temperature
 - Temperature resistance: -269°C to 400°C
 - Elasticity up to 70% at room temperature

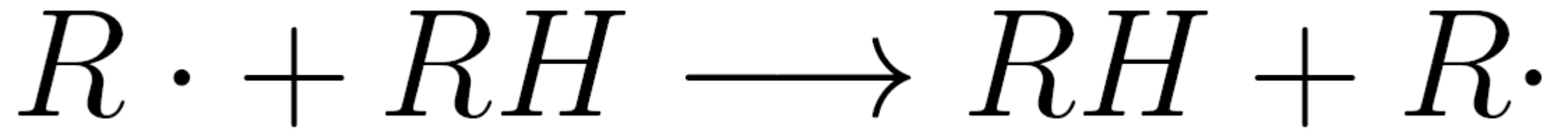
- High radiation resistance
- Form conservation
- Low moisture absorption
- Dielectric constant lower than 3 → flexible printed circuits

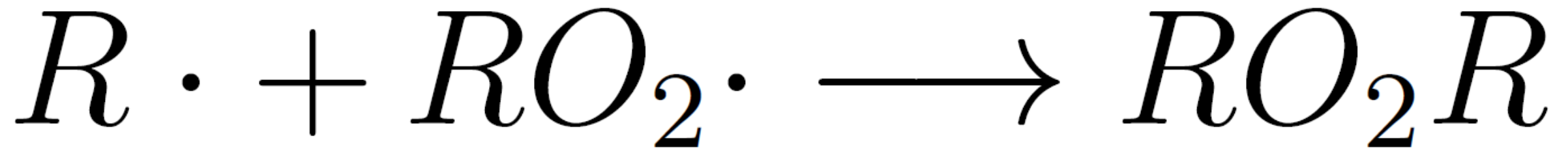
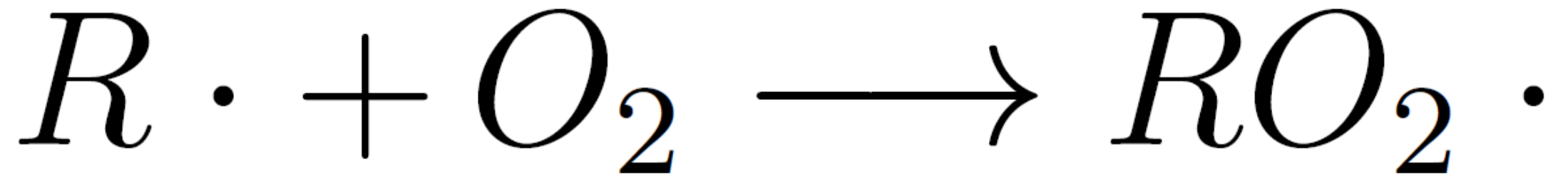
Kapton experience

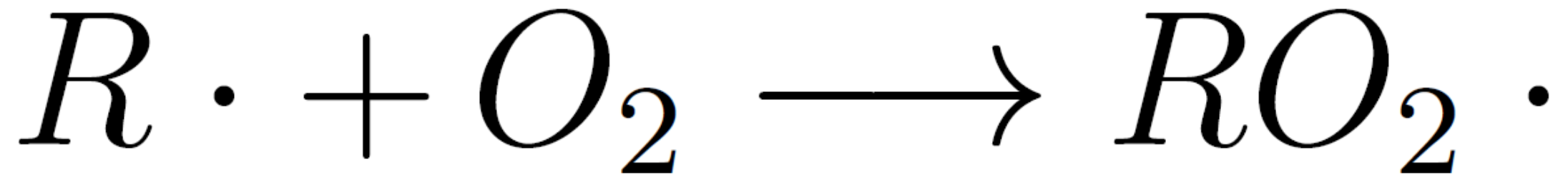
Kapton in the Mu3e experiment: a good choice?

- Phase I part:
 - $10^{16} e^+/\text{m}^2$
 - Often MeV positrons \rightarrow ionizing radiation
- Kapton in oxygenless atmosphere: a problem?

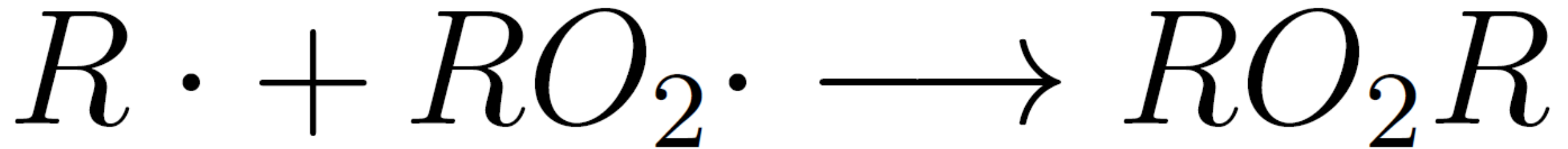






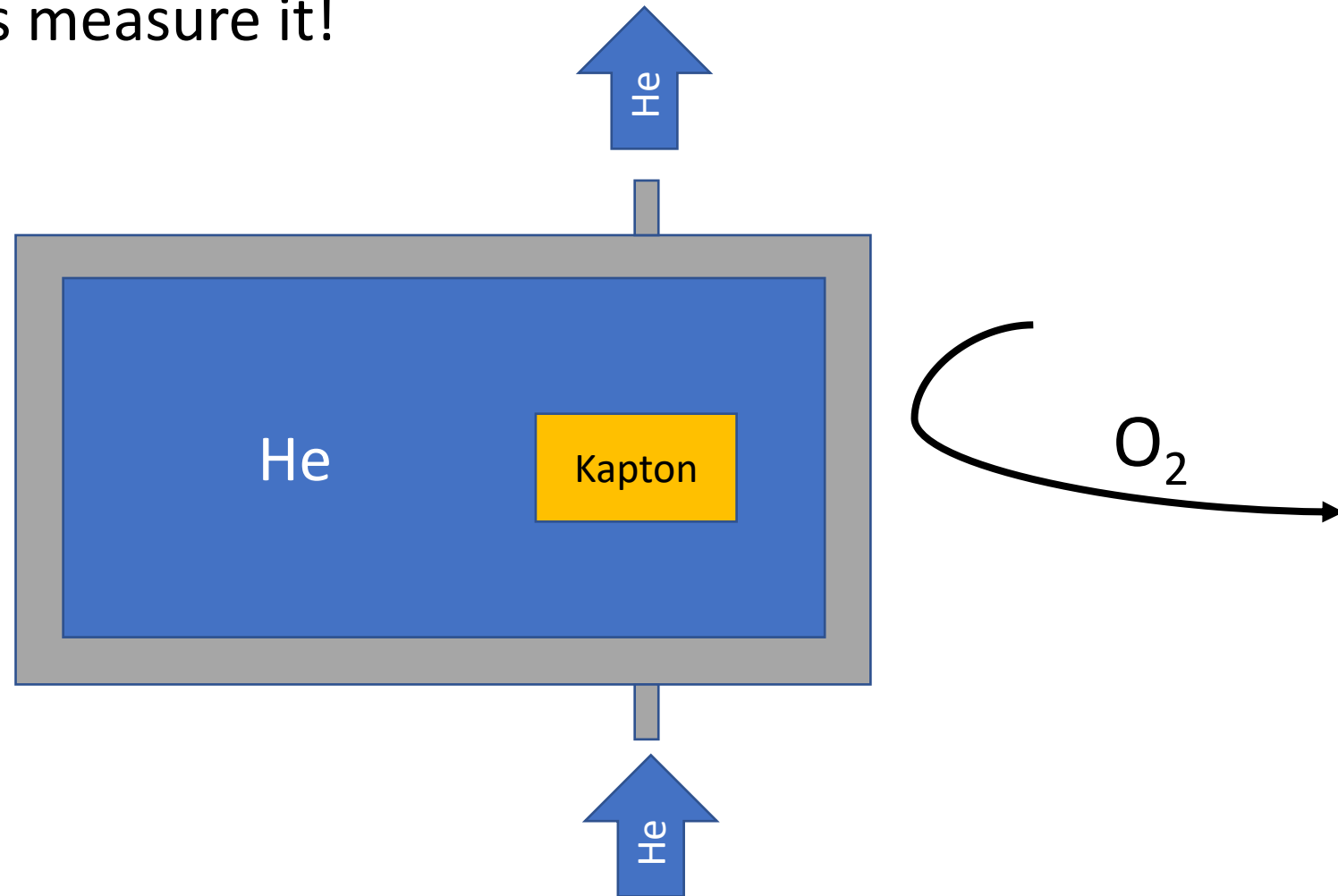


No oxygen around the Kapton layers in Mu3e!



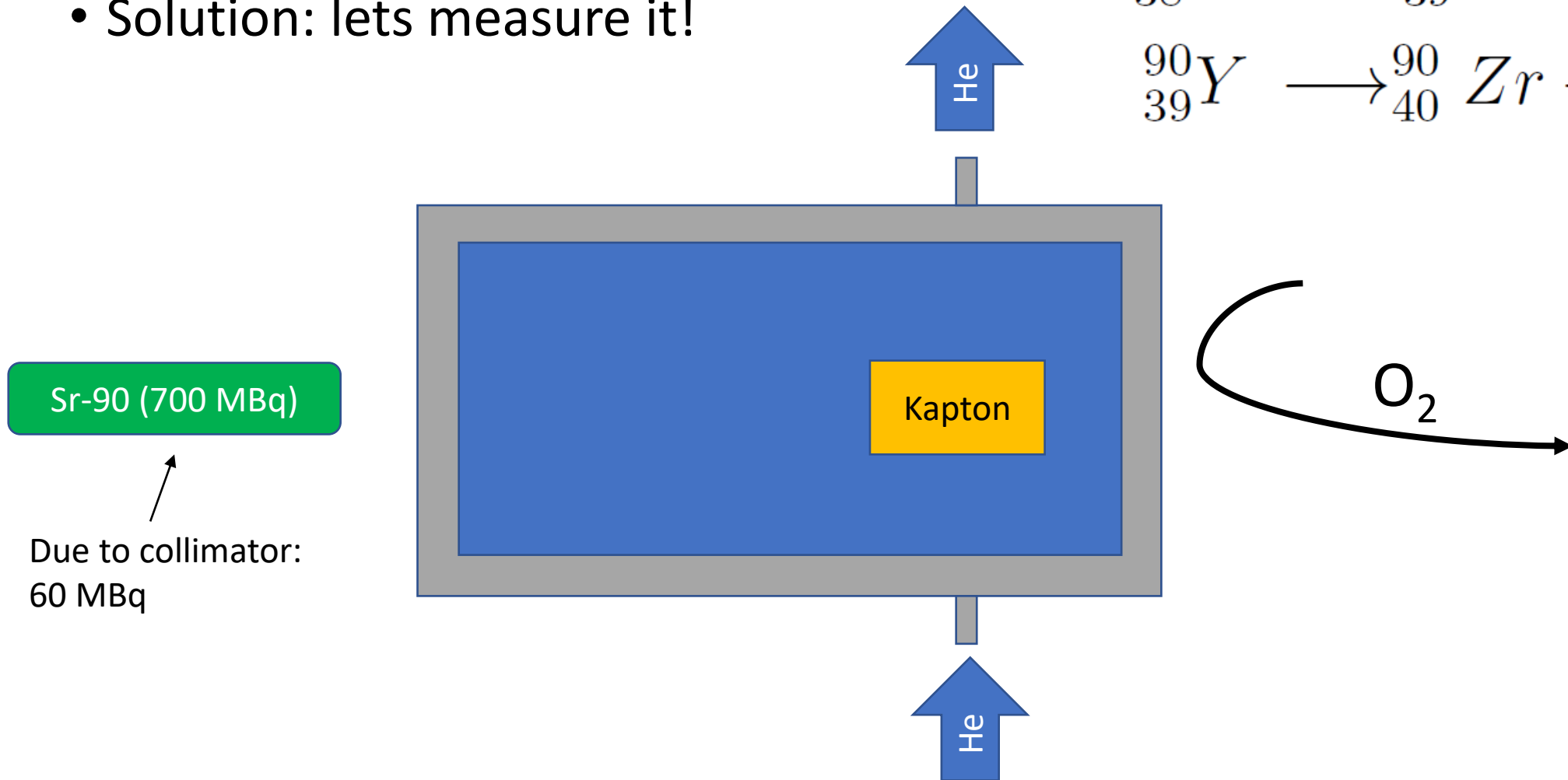
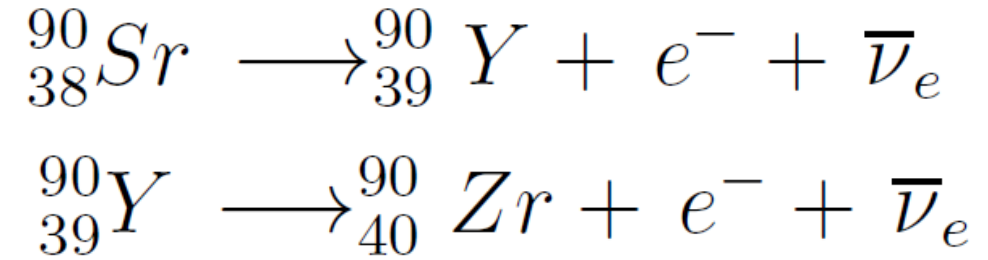
Design of a small experiment

- Solution: lets measure it!



Design of a small experiment

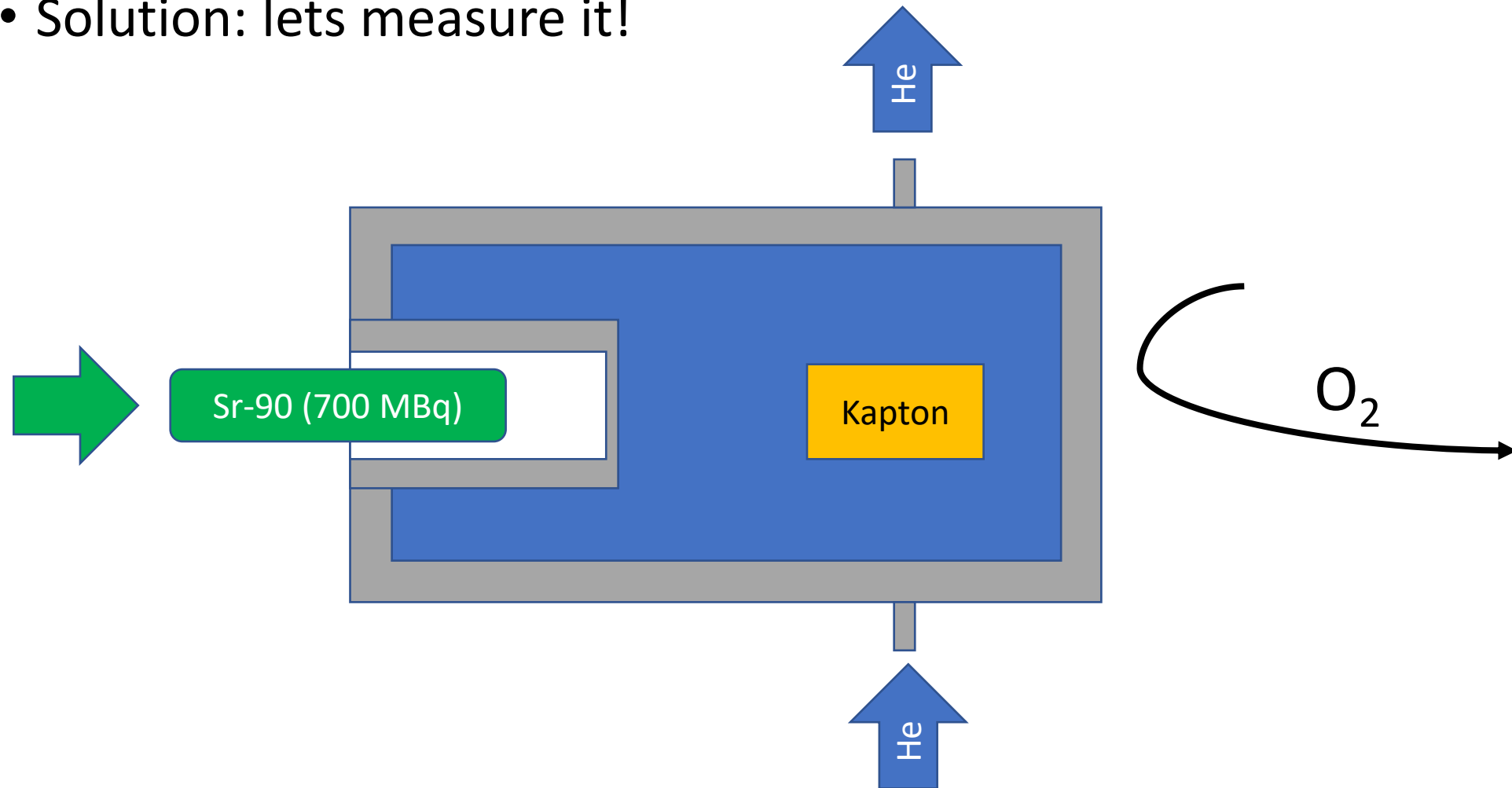
- Solution: lets measure it!



Due to collimator:
60 MBq

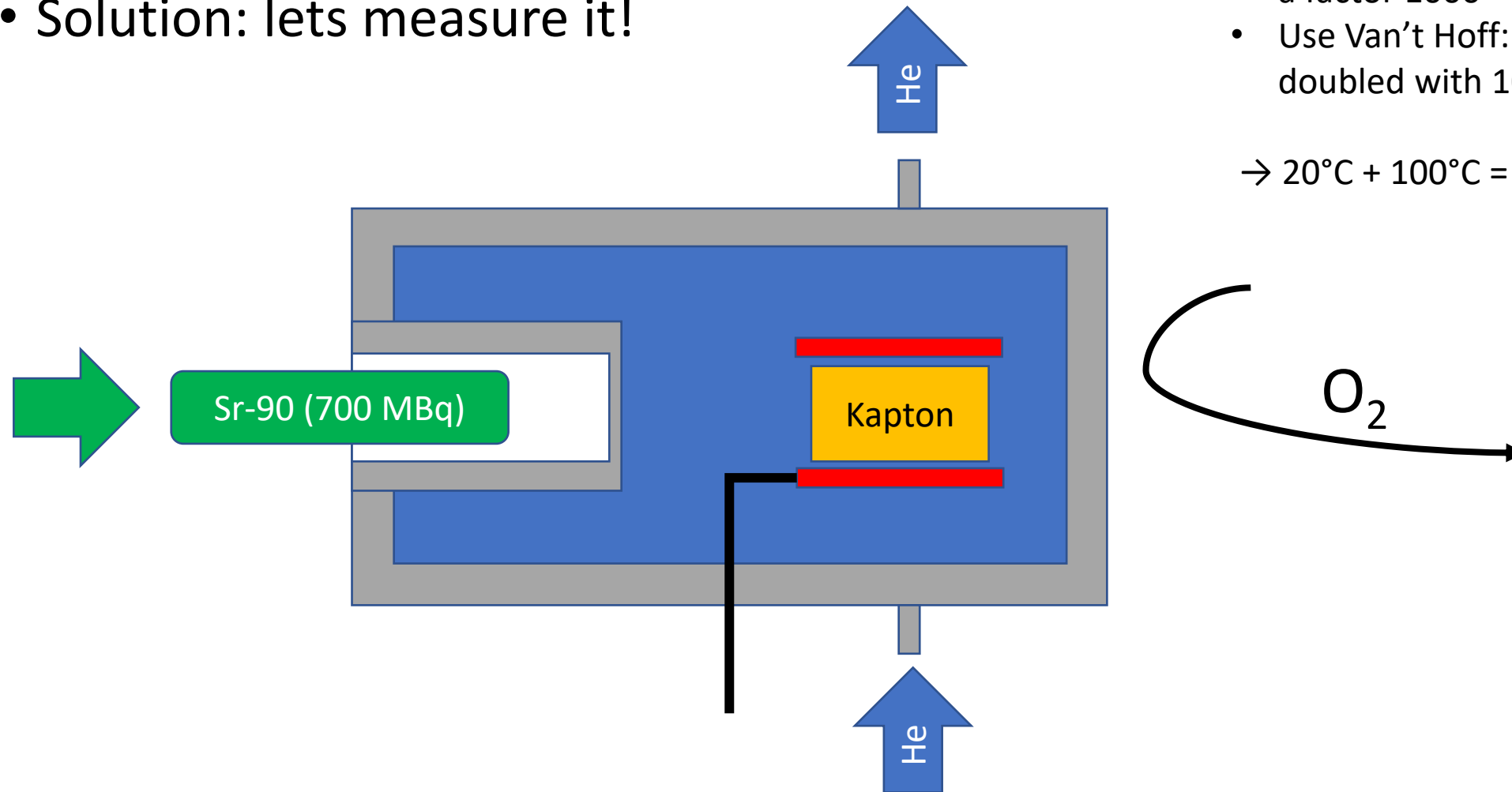
Design of a small experiment

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Design of a small experiment

- Solution: lets measure it!

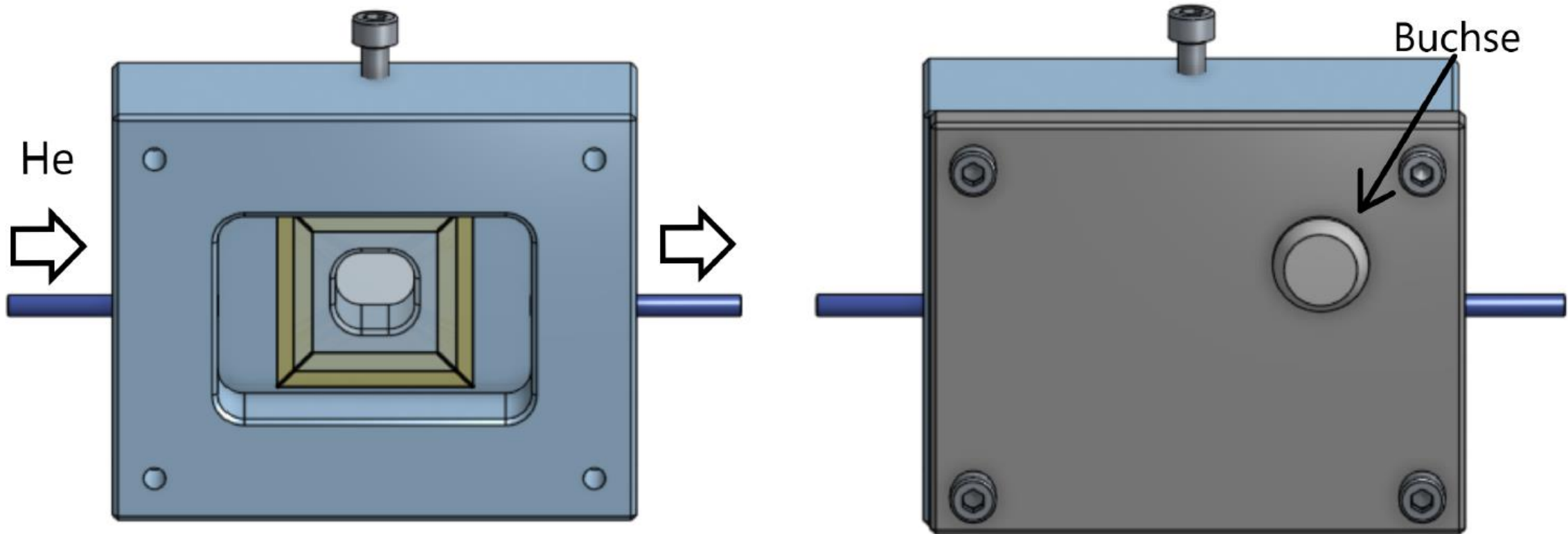


Heat control

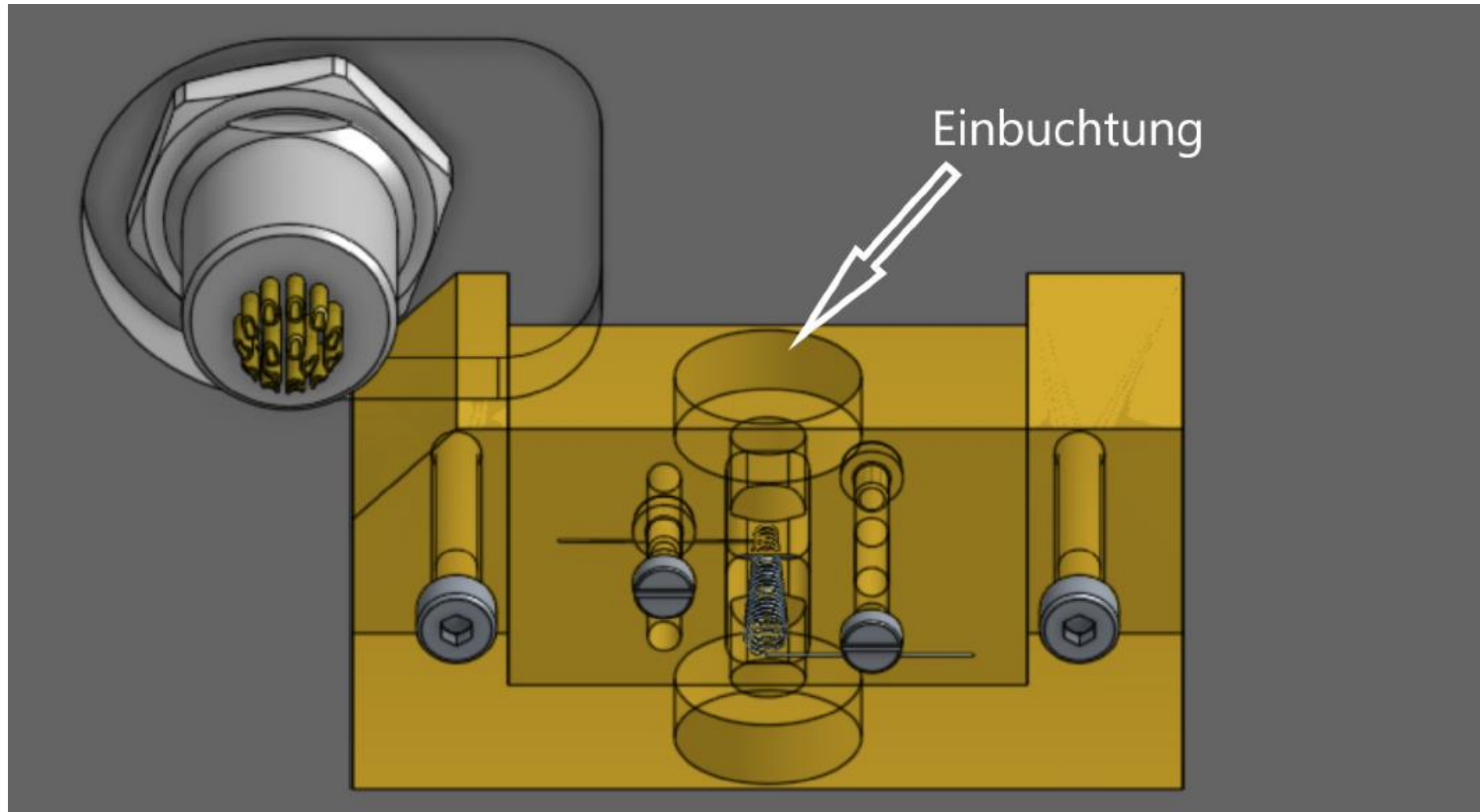
- Accelerate radical diffusion by a factor 1000
- Use Van't Hoff: reaction speed doubled with 10°C more

$$\rightarrow 20^{\circ}\text{C} + 100^{\circ}\text{C} = 120^{\circ}\text{C}$$

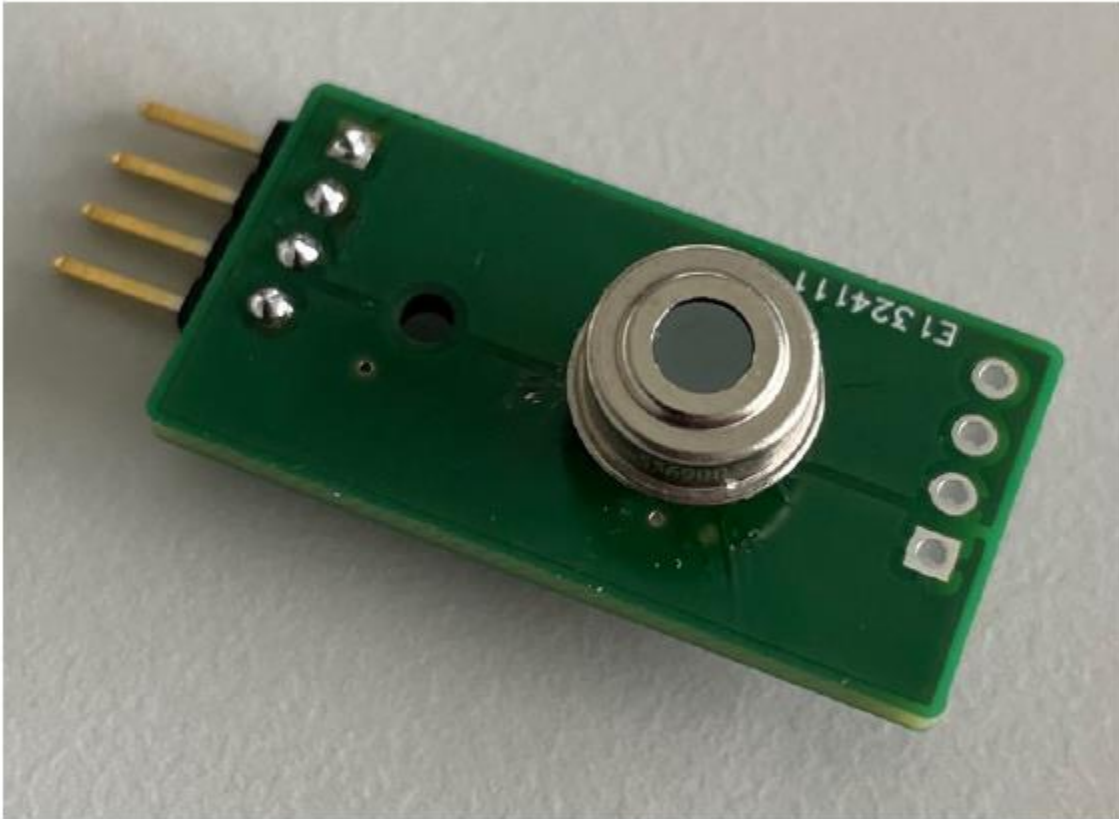
Final design



Final design

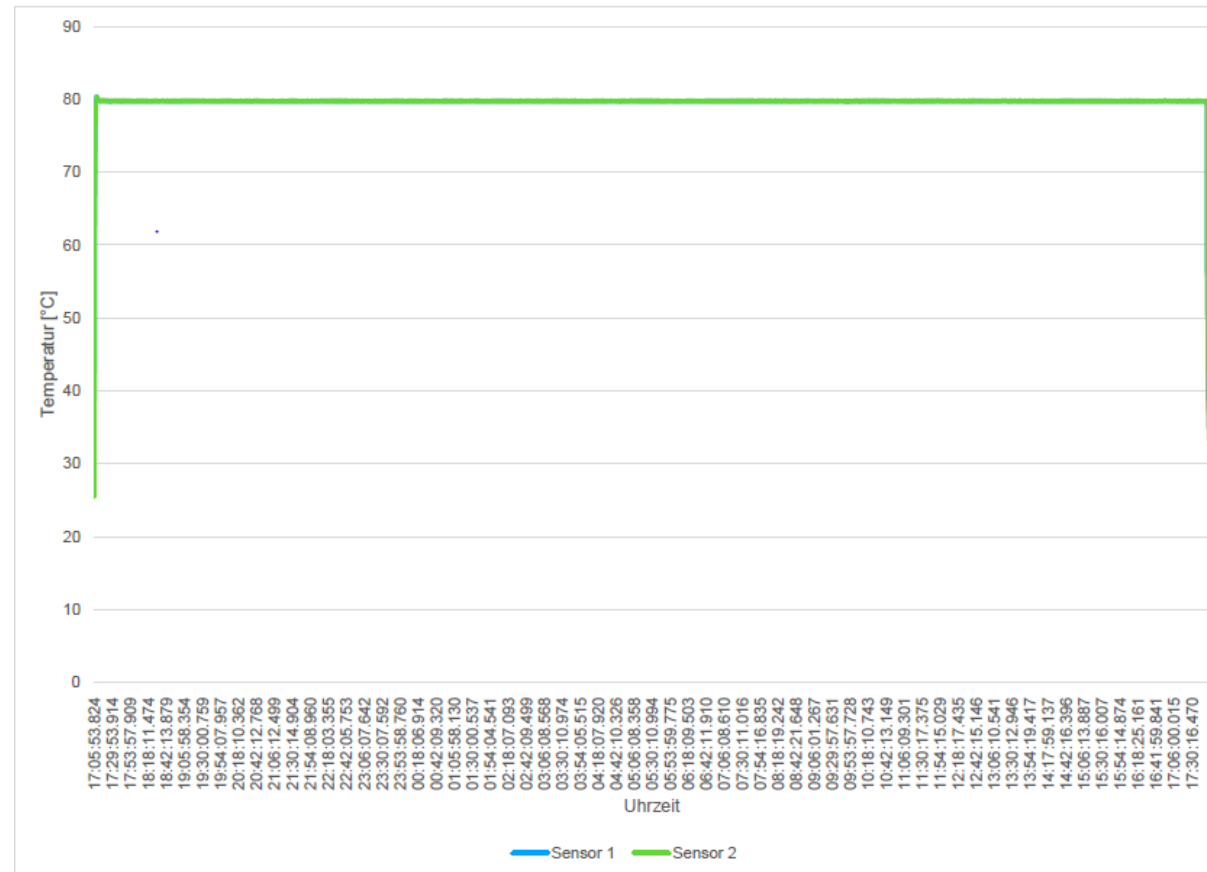


Heat control: the input sensors



The first result and discussion

- Heat control worked as expected



The first result and discussion

- Heat control worked as expected
- Kapton did not showed any damage after > 1 day



- Further plans: extend the measurement for at least ten days

My thanks go to...

... you listeners

... the Mu3e collaboration

... especially my semester thesis advisor Frank Meier

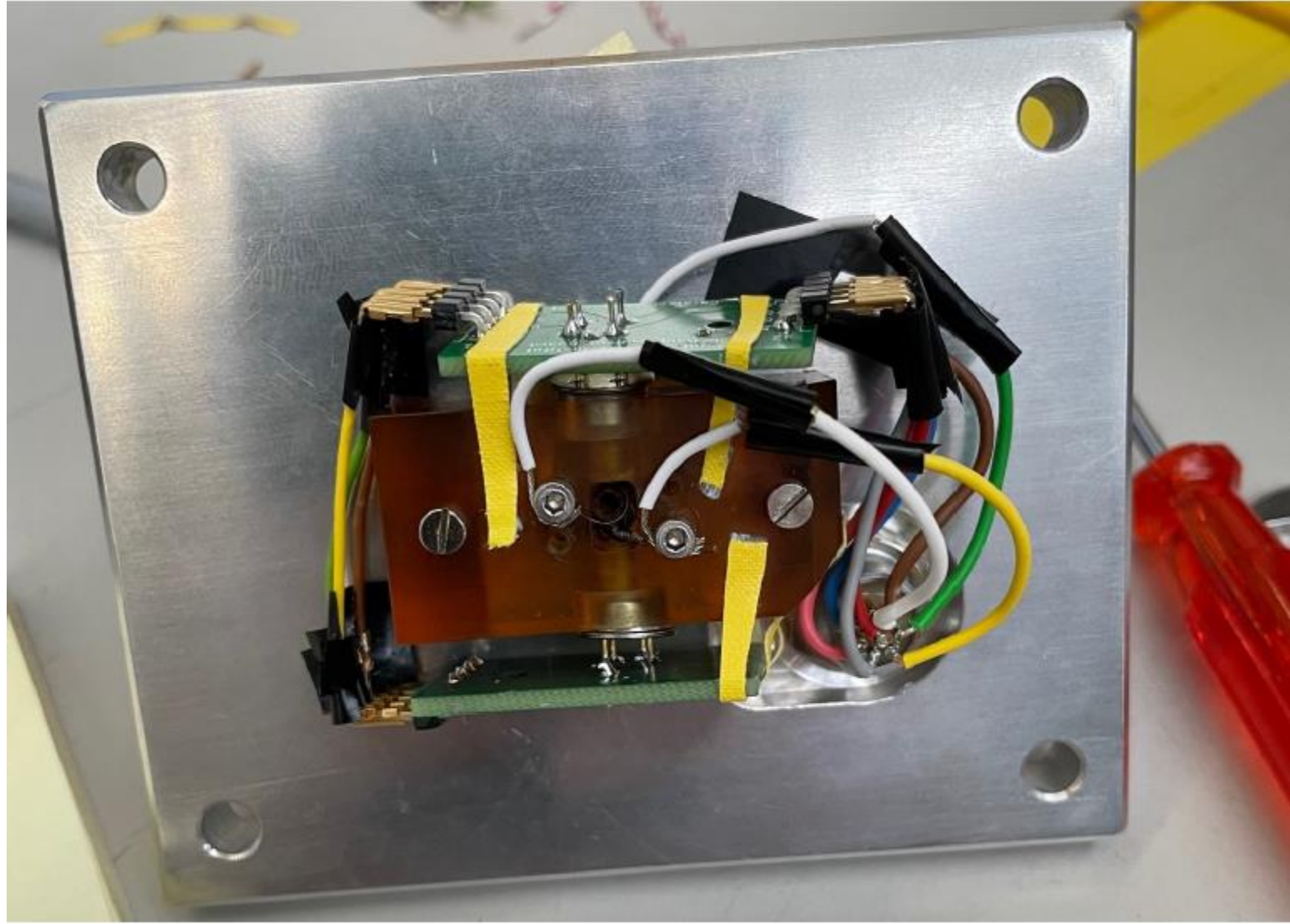
Backup

Caution: cables and wires ;)

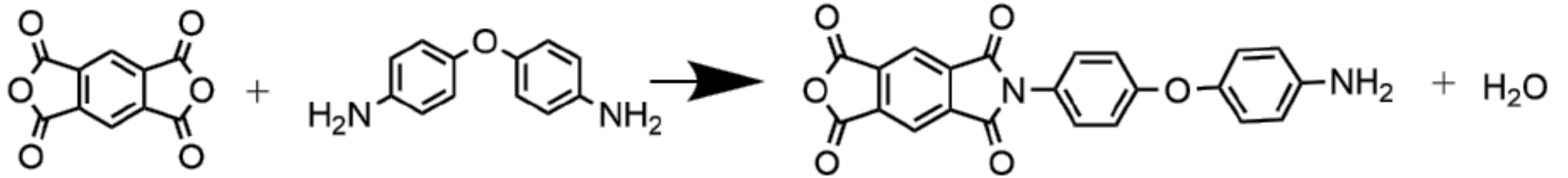


Measurements
in
course!

-D4
bin off

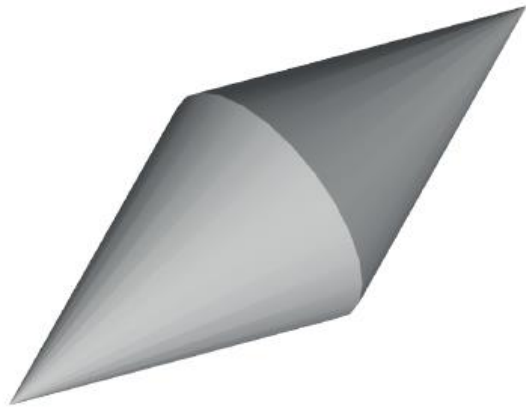


Chemical reaction (Kapton)

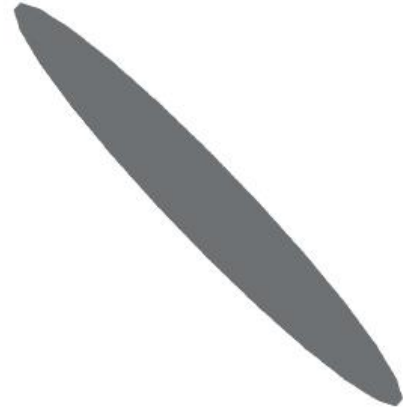


Mu3e Targets

a)



b)



c)



d)



Sensor: MLX 90614

