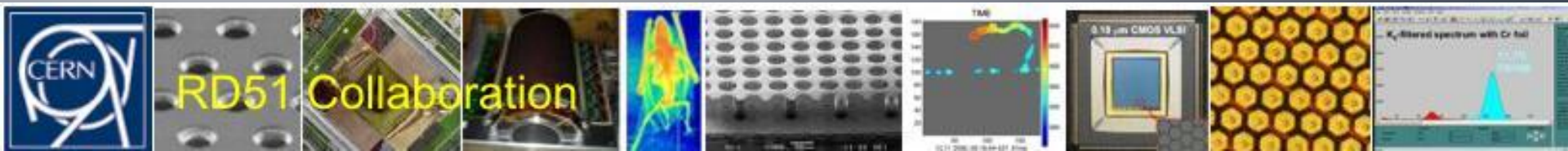


# FREIBURG 24-04-10



## Resistive protections for Bulk Micromegas

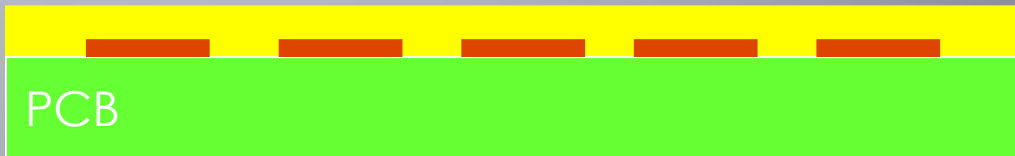
Rui de oliveira, Joerg Wotschack

Venetios Polychronakos

# Summary

- ▣ Resistive spark protection
  - Different structures R1 to R11
  - R11 results

# R1-R2-R3



-Resistor 50um thick

-Vertical value:

20 G-Ohms

10 M-Ohms

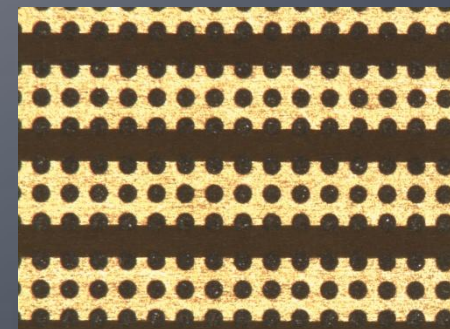
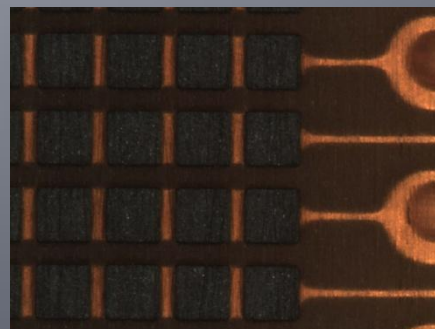
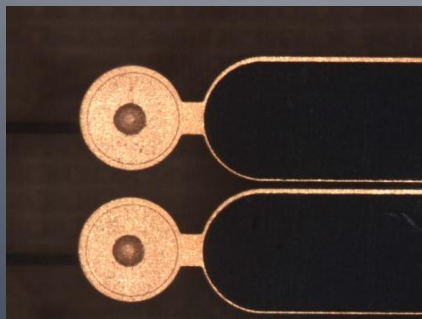
100 K-Ohms

-Gain -20% versus STD bulk

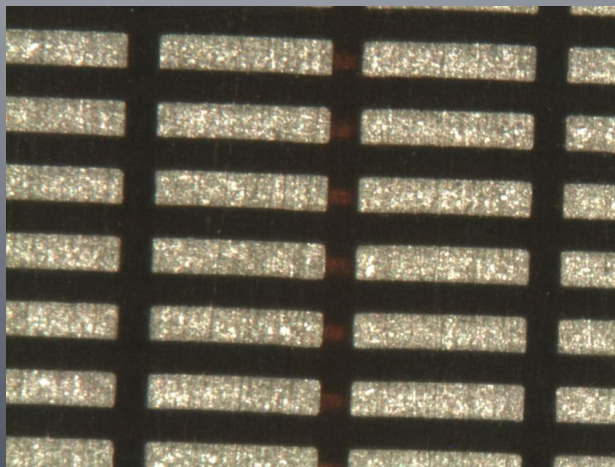
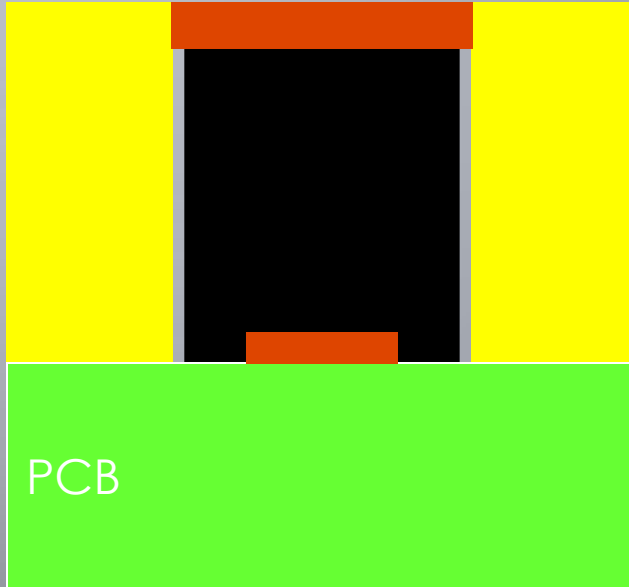
-The spark protection is not reliable

-The resistors are seeing HV

-Vertical HV breakdown through the resistive layer during sparks

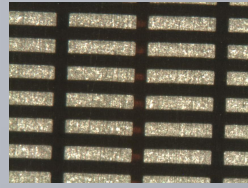


# R4

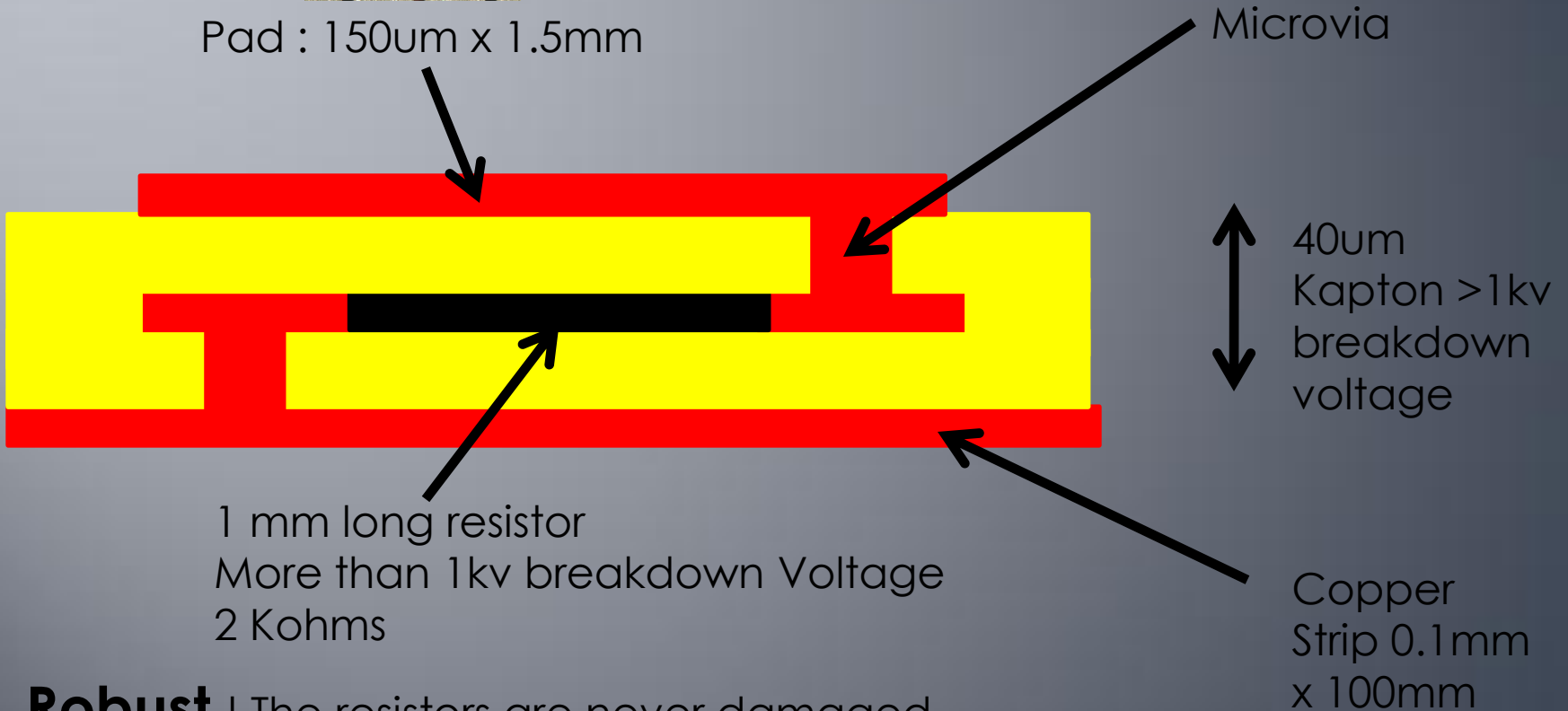


- Thicker resistor 150um
- Top metal layer ( trying to limit current density)
- Thinner strip
- Still rapidly damaged
- Still Resistor HV breakdown
- Lower Gain -30% ??

# R5



Pad : 150um x 1.5mm



**Robust** ! The resistors are never damaged  
Large currents during sparks ??  
Looks like a STD BULK (but how can we compare if the  
power supply start to trip)  
0.2pF capacity from pad to line.

# R6-R7-R8

- ▣ Same structure as R1-R2-R3
  - Try to Improve the resistor deposition
  - 100um resistive thickness
  - Other values tested
  - Interesting things with vertical resistivity of 1 M-Ohms
  - Still lower gain
  - Still rapidly damage
  - Still need some more brainstorming!!



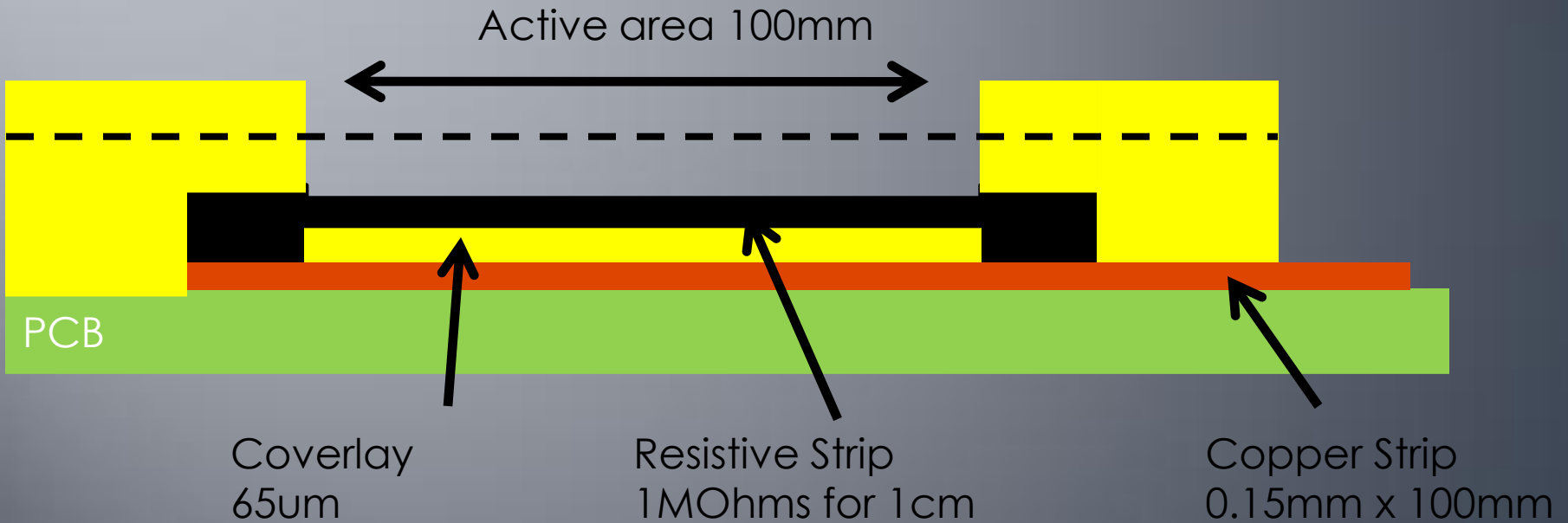
0.15mm



# R9-R10

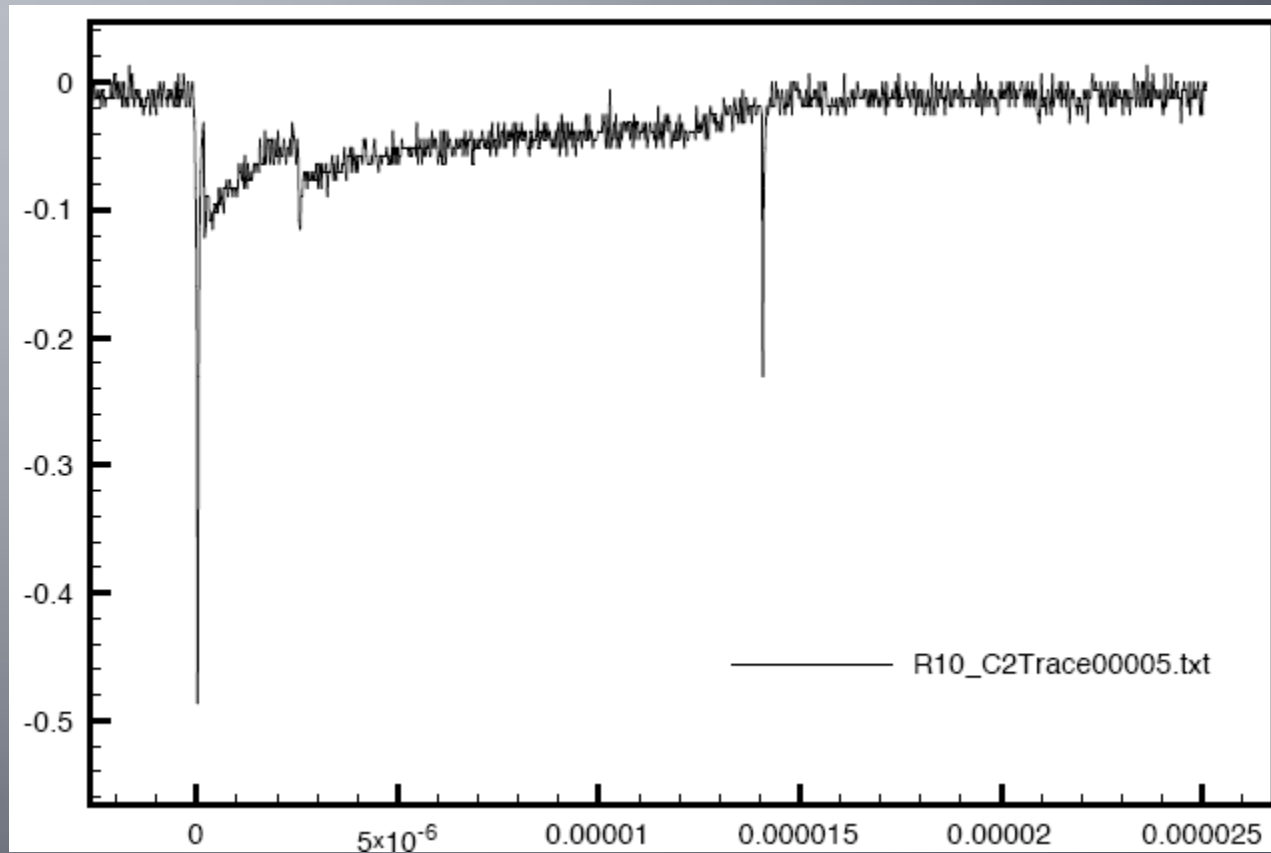


Cross section



Really good results , hard to see the spikes on the power supply

# R10 sparks





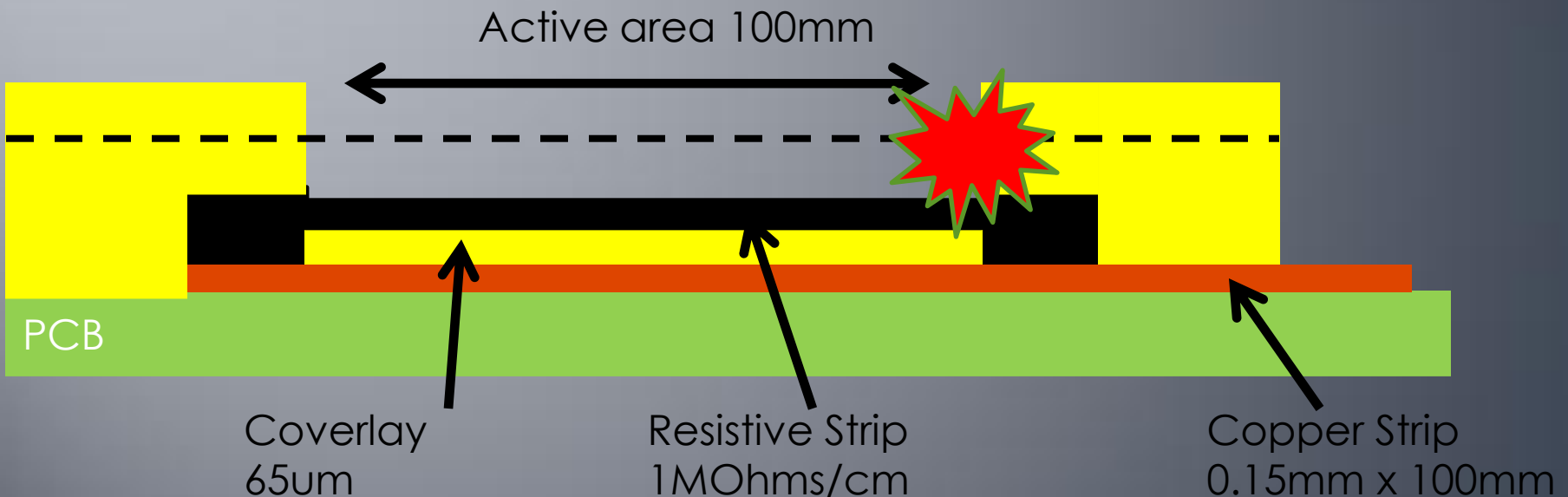
0.15mm



# R9-R10



Cross section



Really good results , hard to see the spikes on the power supply  
We have damage them anyway (a lot more difficult !)

**But** the damages were always at the same place, near the connection to the strip?? ( the damages are related to the R value of the strip or ground ?)

0.15mm



# R9-R10



Cross section

Active area 100mm



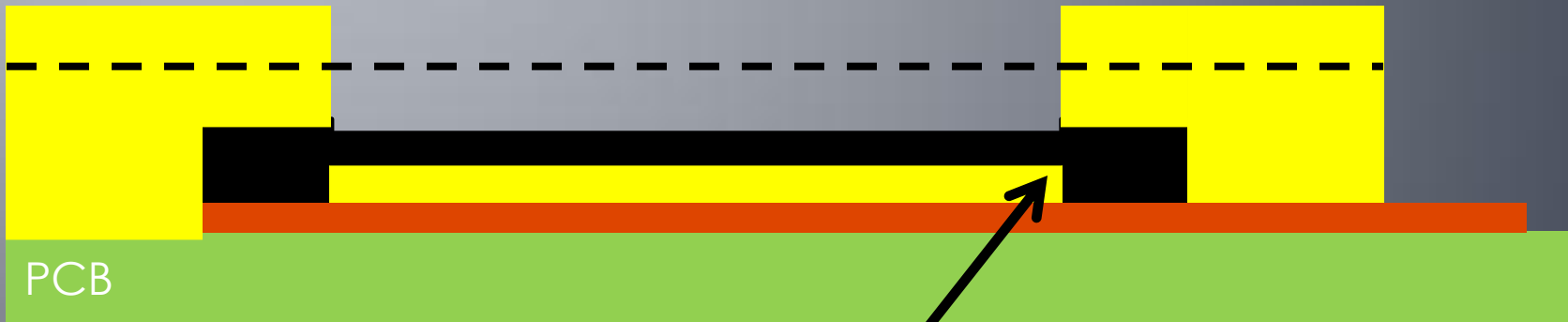
**That's the first time we have seen a defect due to the layout and not due to materials!**

Real

We have damage them anyway !

**But** the damages were always at the same place, near the connection to the strip?? ( the damages are related to the R value of the strip or ground ?)

# R9-R10

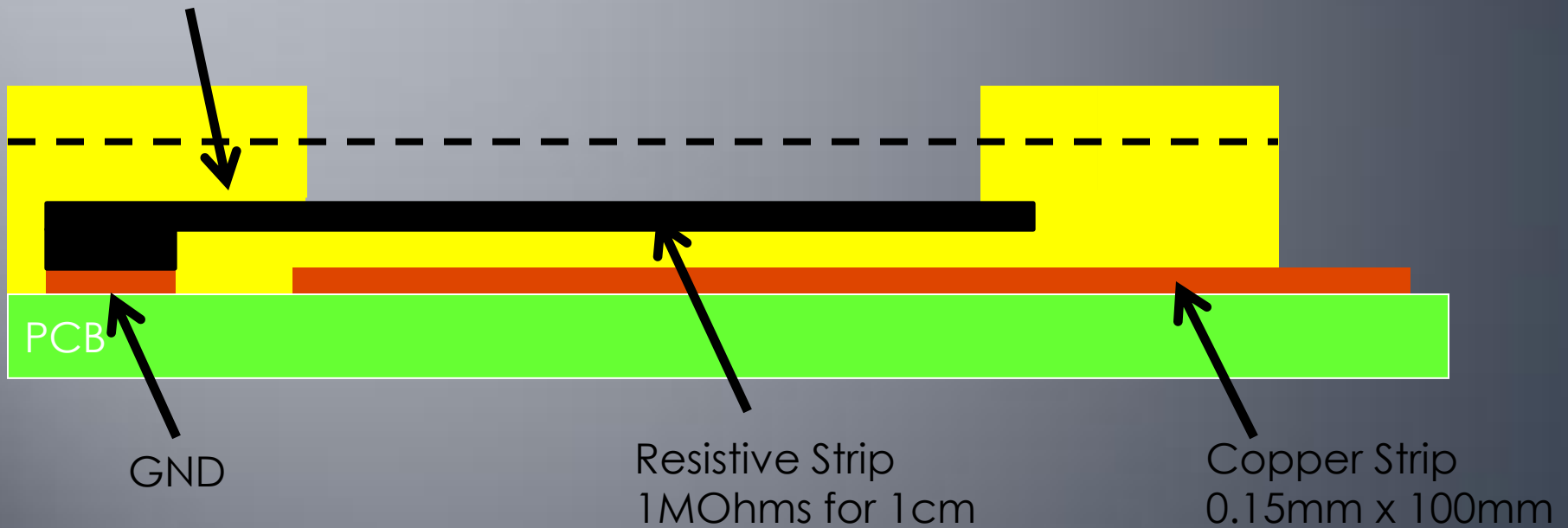


PCB

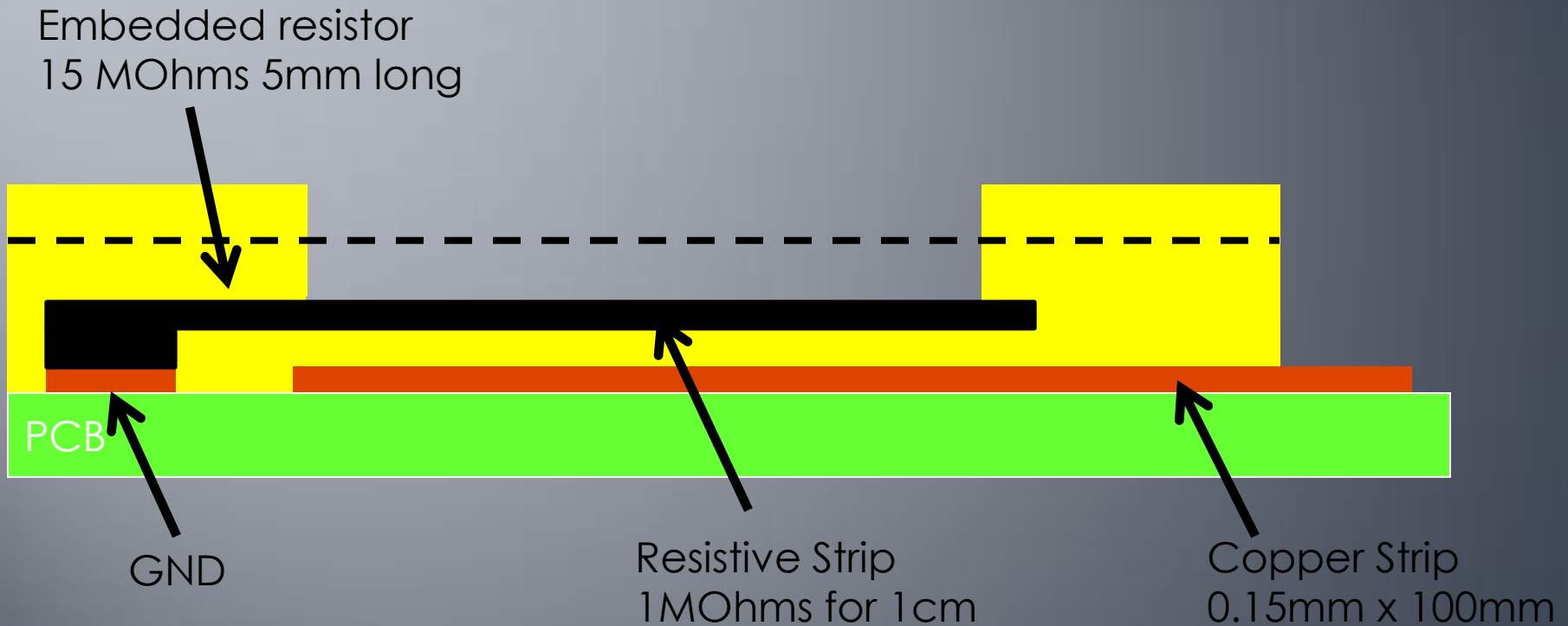
Resistor to ground lowest value in the detector

# R11

Embedded resistor  
15 MOhms 5mm long

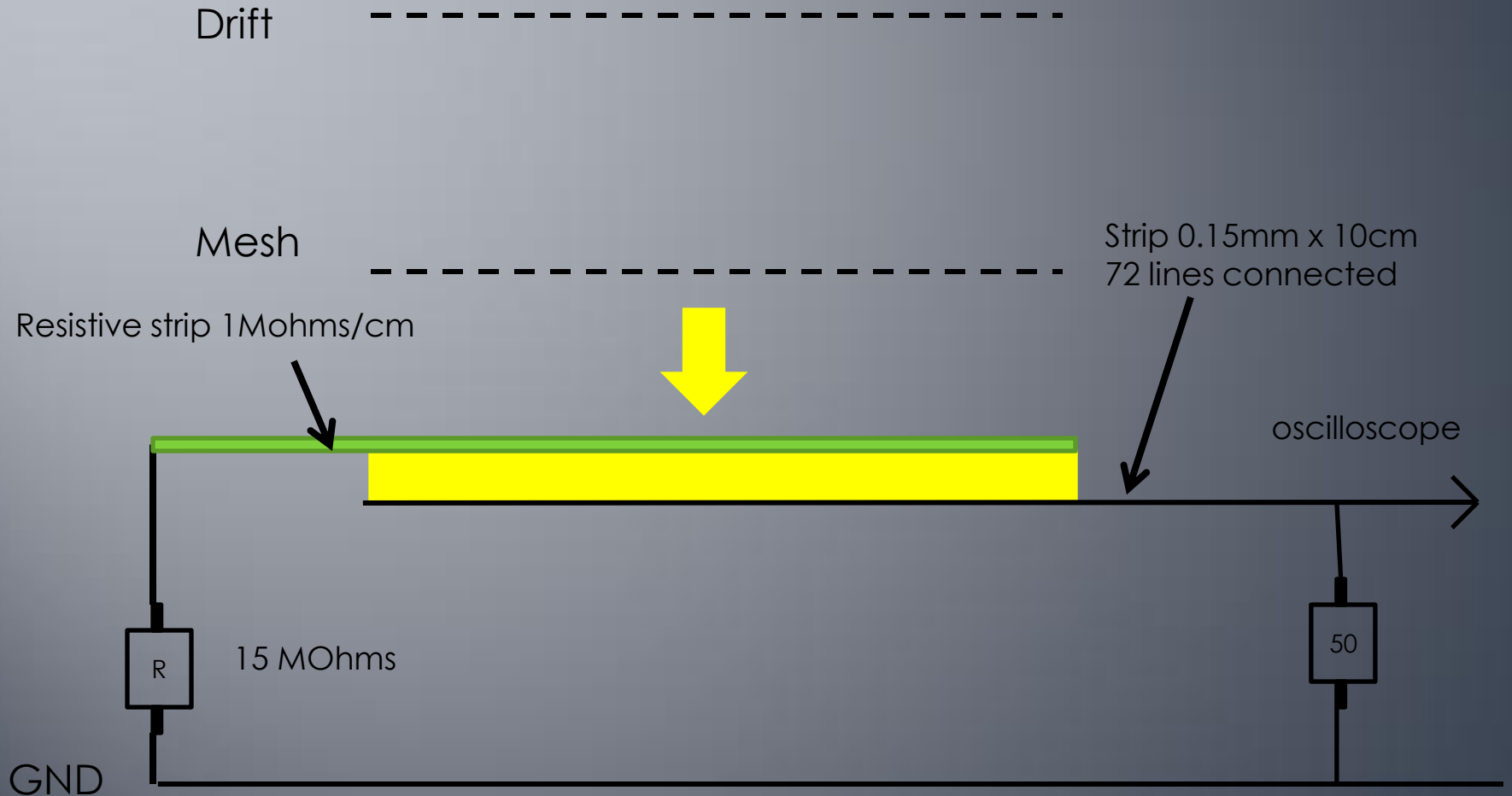


# R11

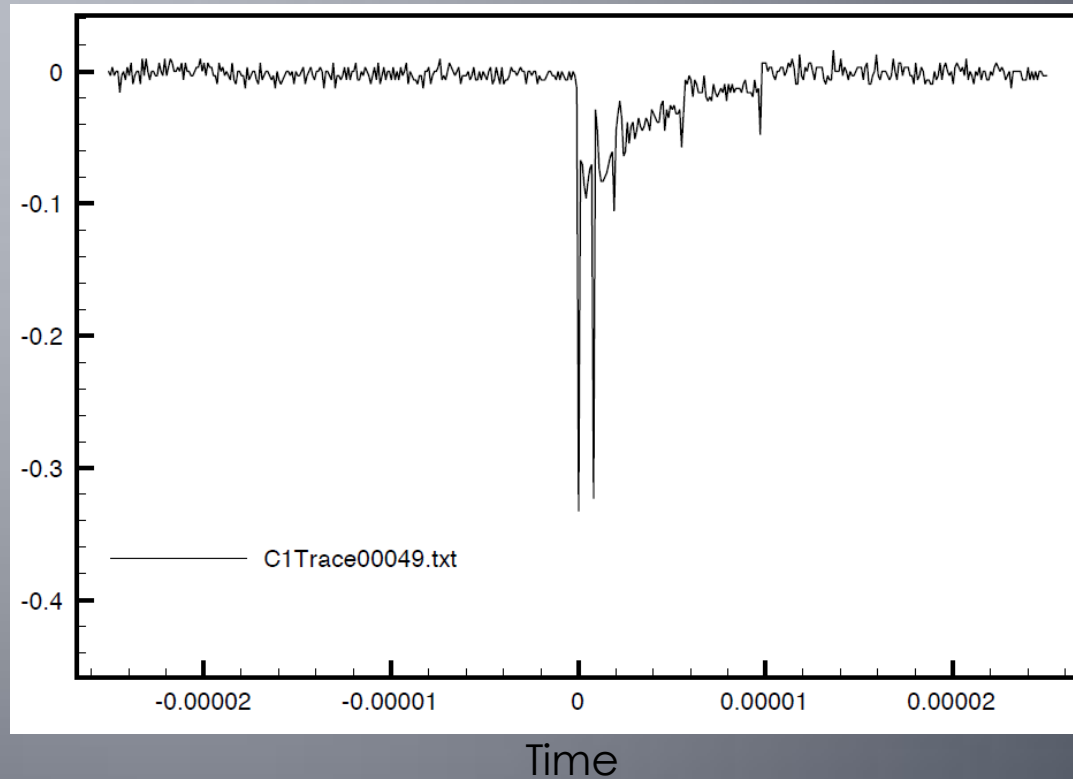


**Seem to be perfect, robust and really mild sparks, no channel up to now have been destroyed even in really strong conditions .  
Let's look at the results**

# Detector connections

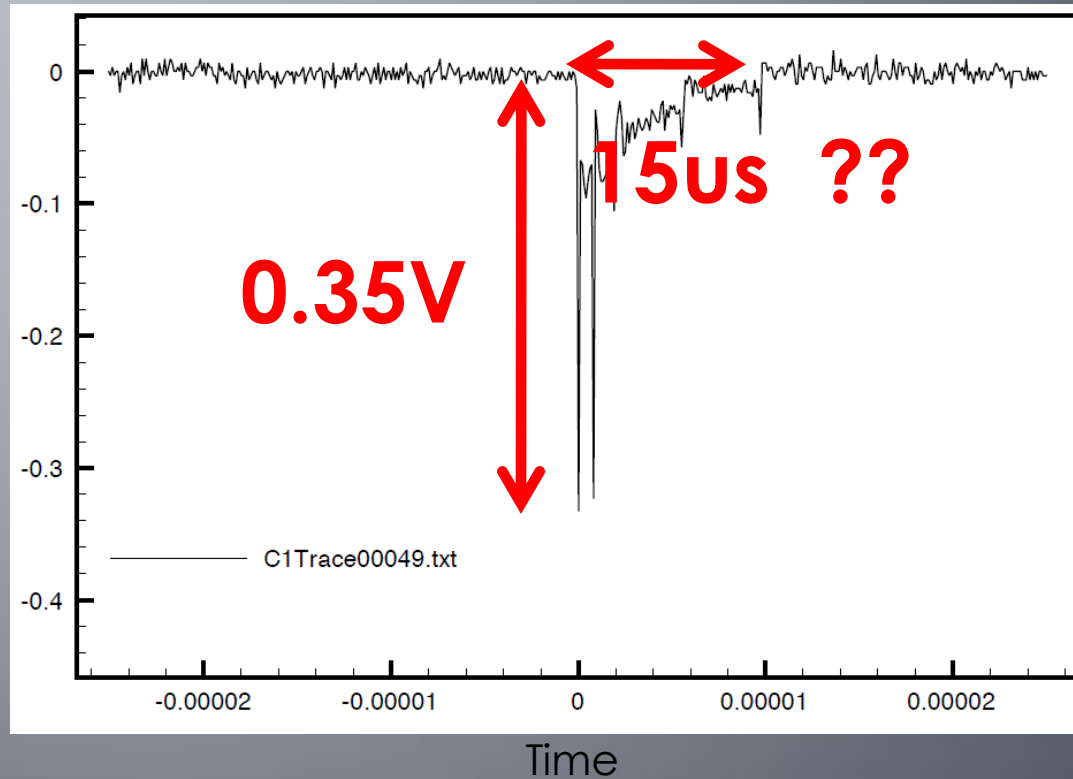


# Spark effect



Sparks triggered by :  
Gain from 20 000 to 50 000 with fe55  
Radon in the Gas  
Neutron beam

# Spark effect

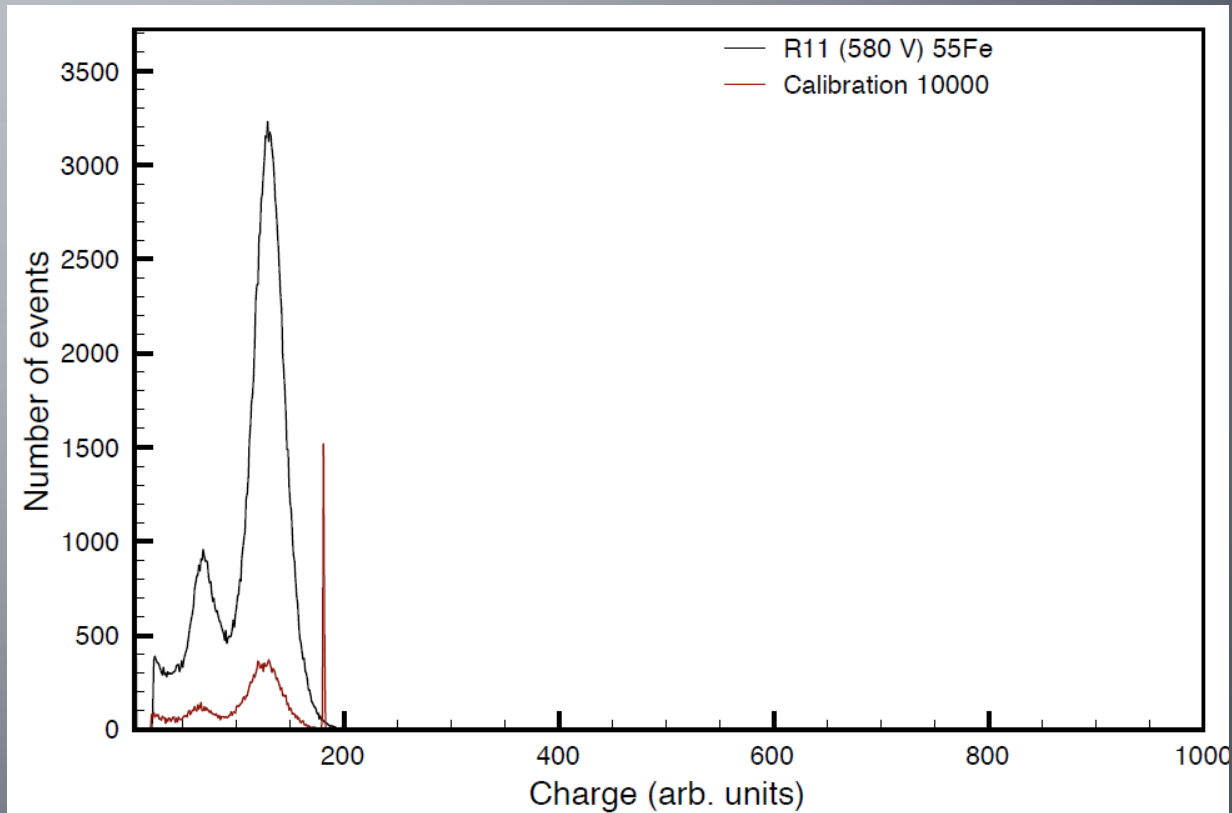


Sparks triggered by :  
Gain from 20 000 to 50 000  
Radon in the Gas  
Neutron beam

**No protections needed  
for the amplifiers ?  
Does this kind of signal affect  
the detector performances?**

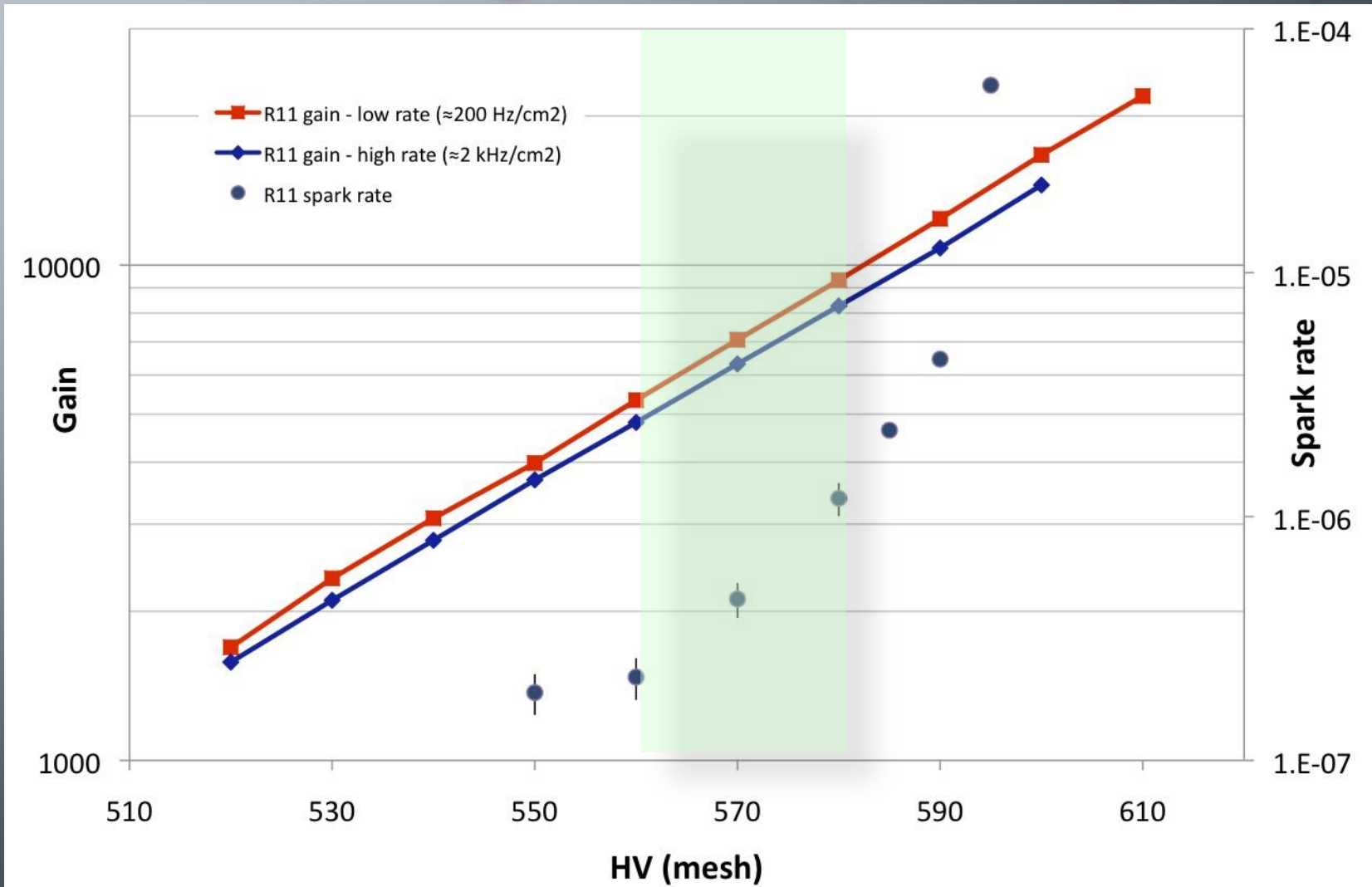


# Energie spectrum

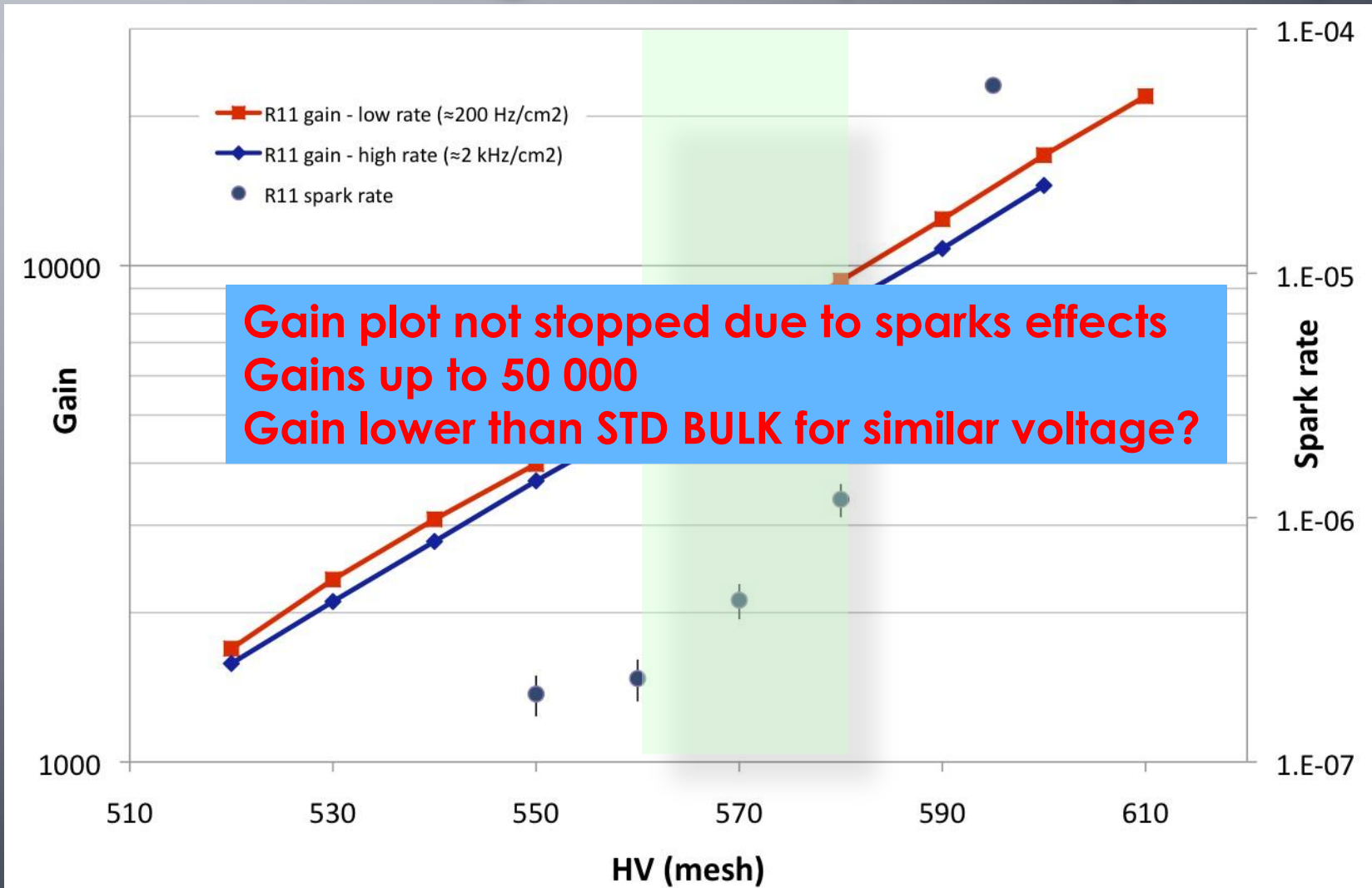


**Not remarkable but similar to std BULK**

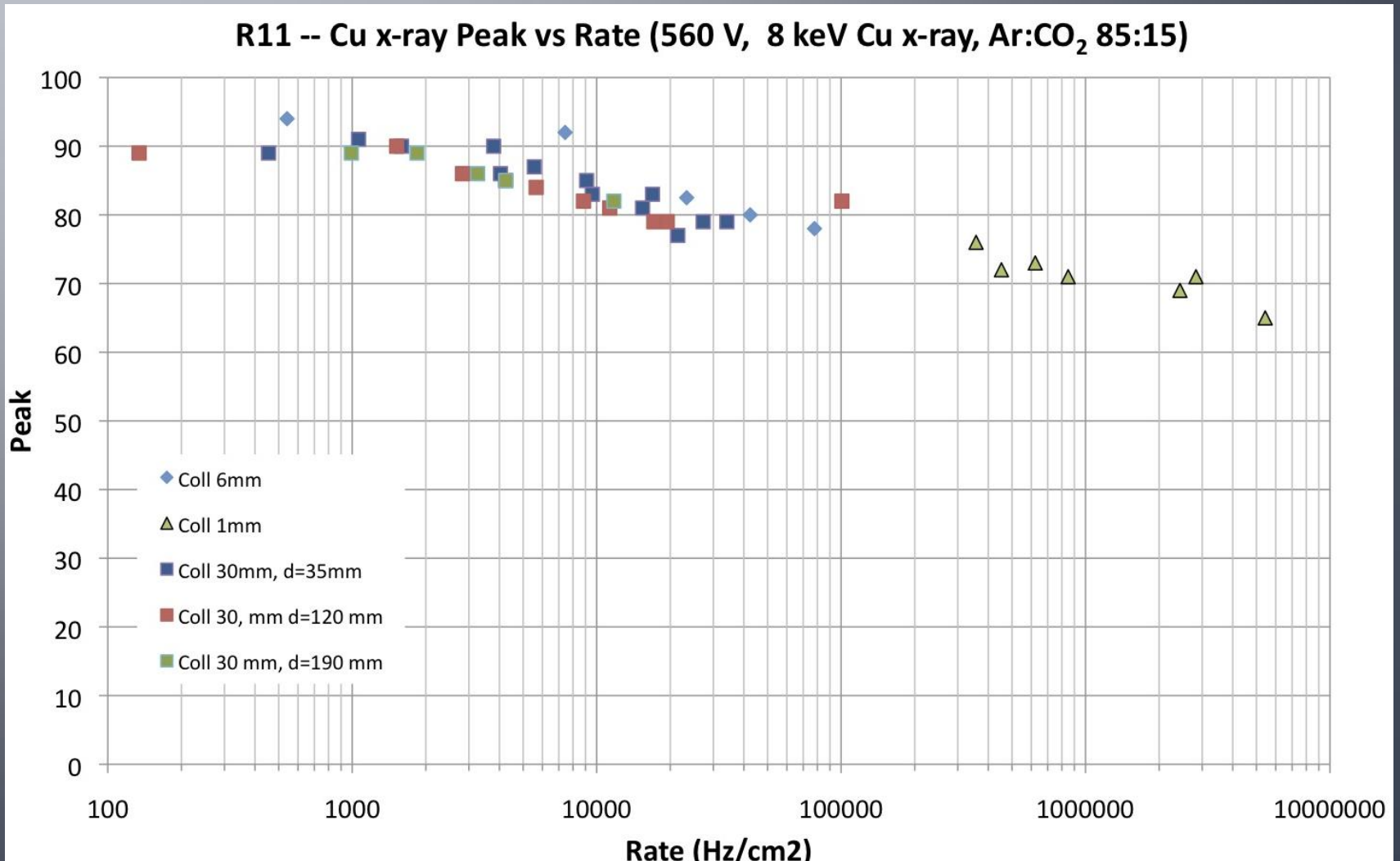
# R11 Gas gain & sparks ( $^{55}\text{Fe}$ )



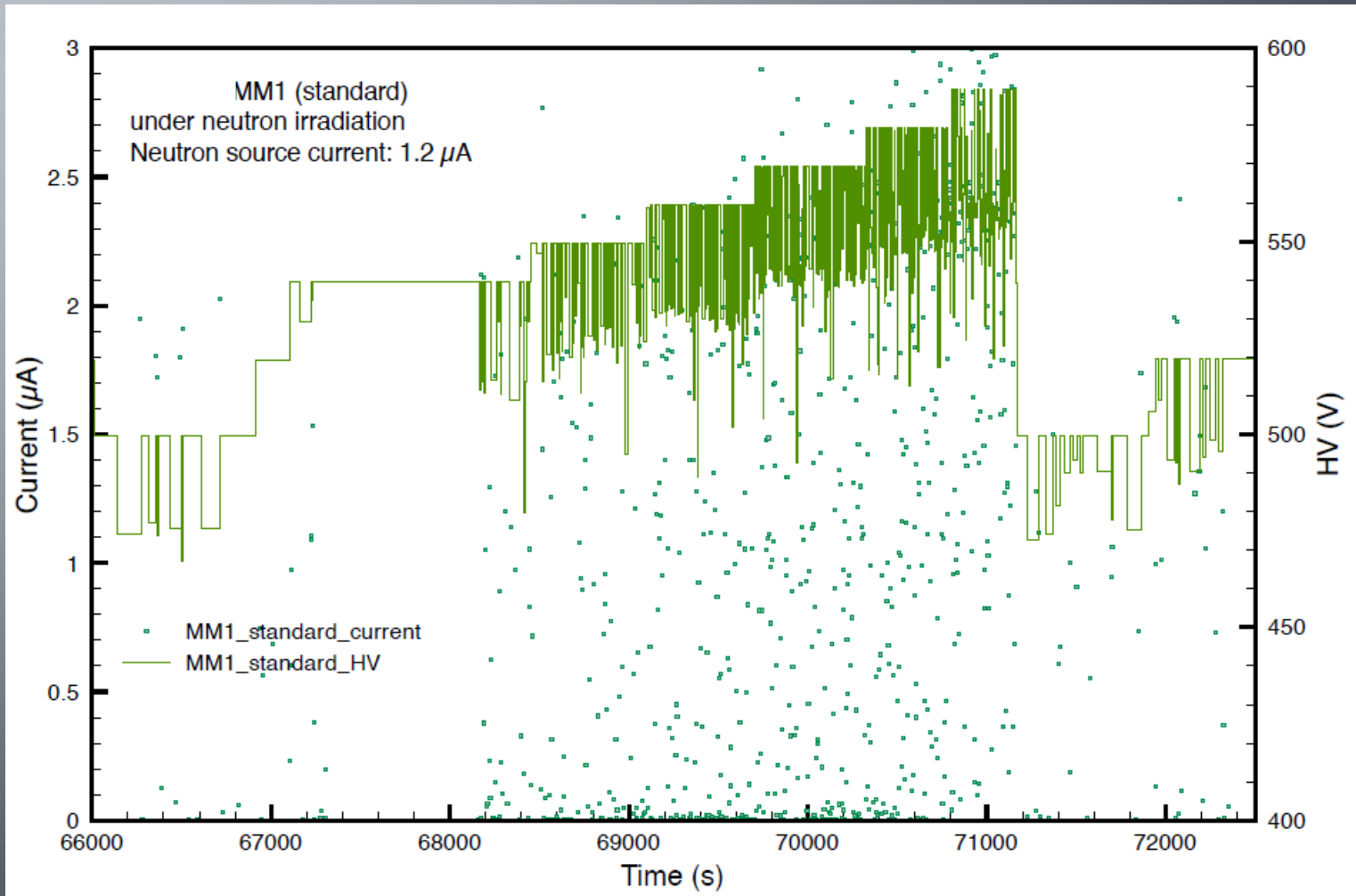
# R11 Gas gain & sparks ( $^{55}\text{Fe}$ )



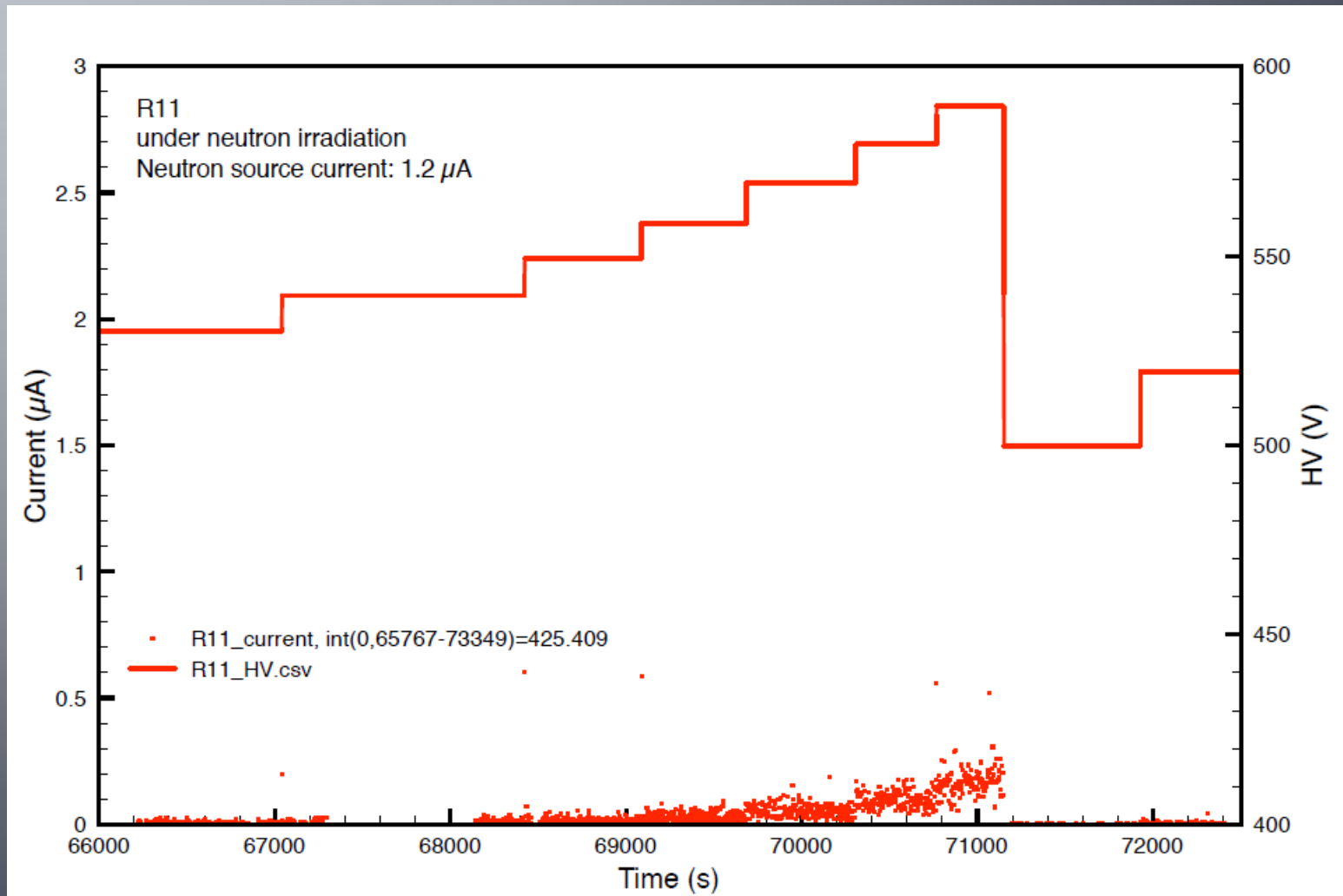
# R11 - High-rate performance



# Neutron irradiation std BULK



# Neutron irradiation R11



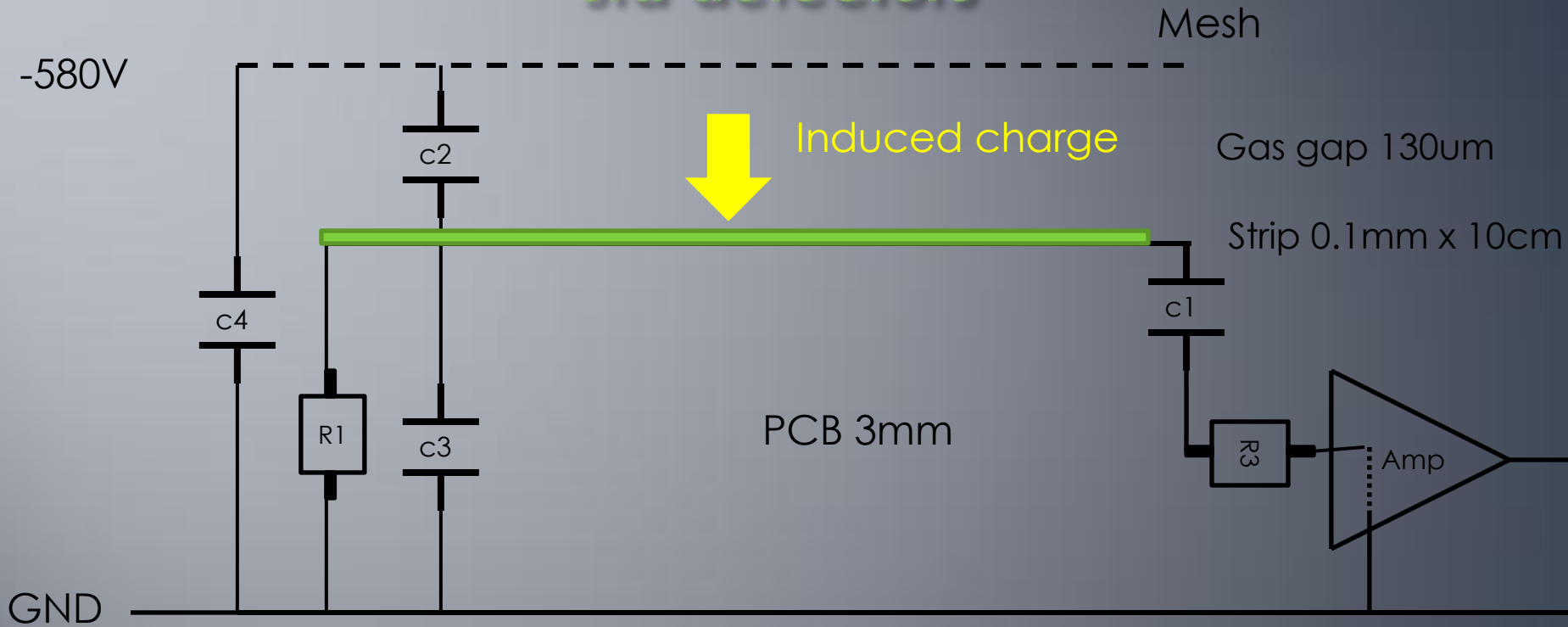
# What's missing?

- ▣ Define the 'mild spark' rate during Neutron irradiation
- ▣ Study the impact in the efficiency
- ▣ Study the dead area during 'mild sparks' and dead time
- ▣ Run tests with high 'mild sparks' rate to study the long term stability.
- ▣ Run the detector with the real electronics
- ▣ Run the detector with a representative mix of 'mild sparks' and normal signal (ATLAS future conditions)

Tomorrow (in WG6) the read-out  
board role through 2 simplified  
models



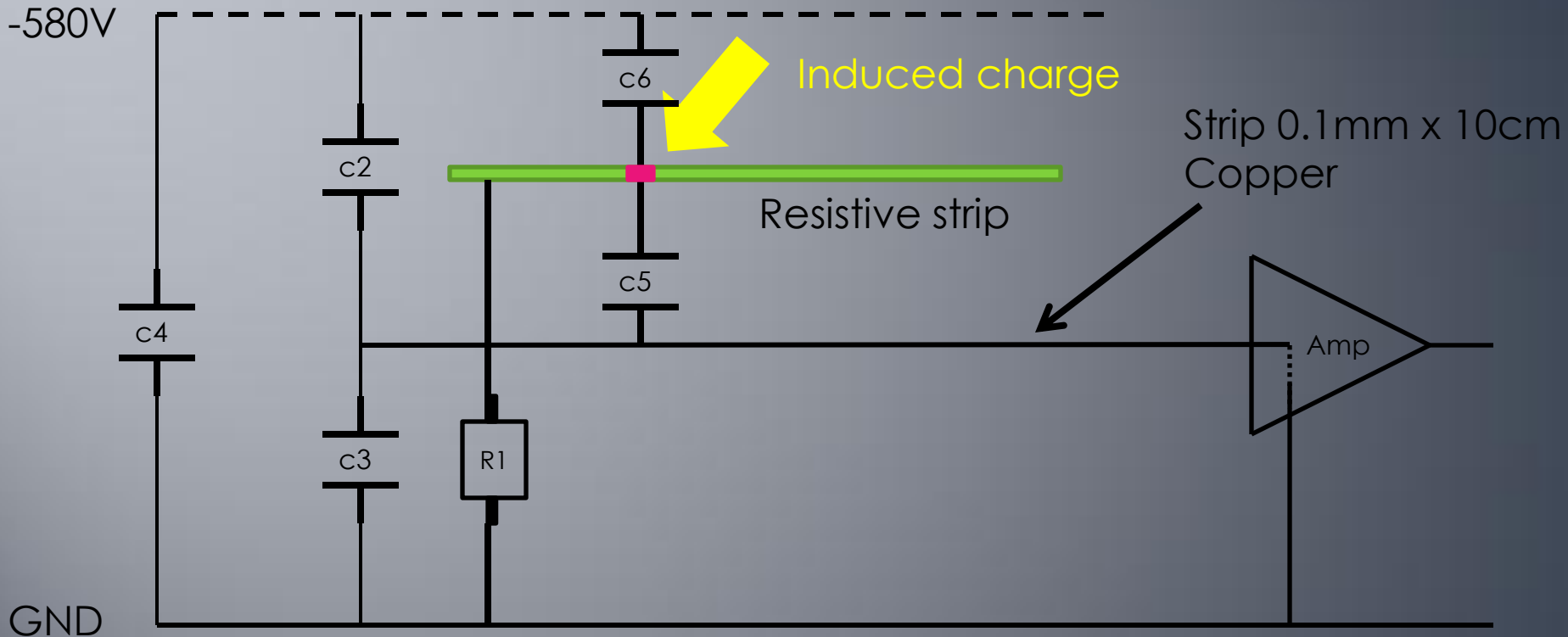
# std detectors



C2 : in the range of 5pF  
C3 : in the range of 1.5pF  
C4 : in the range of 1nF  
R1 : ? 1M0hms  
R3 : ?  
C1 : ?

Parasitic capacitor mesh to strip  
Parasitic capacitor strip to GND  
Parasitic capacitor mesh to GND  
Resistor to discharge strip  
Resistor for spark current limiting  
Spark current limiting

# R11



C2 : in the range of 5pF  
C3 : in the range of 1.5pF  
C4 : in the range of 1nF  
C5: ?  
C6: ?  
R1 : 20 MOhms

Parasitic capacitor mesh to strip  
Parasitic capacitor strip to GND  
Parasitic capacitor mesh to GND  
Parasitic capacitor R-strip to GND  
Parasitic capacitor R-strip to read-strip  
Resistor to discharge R-strip