Updates from Pavia

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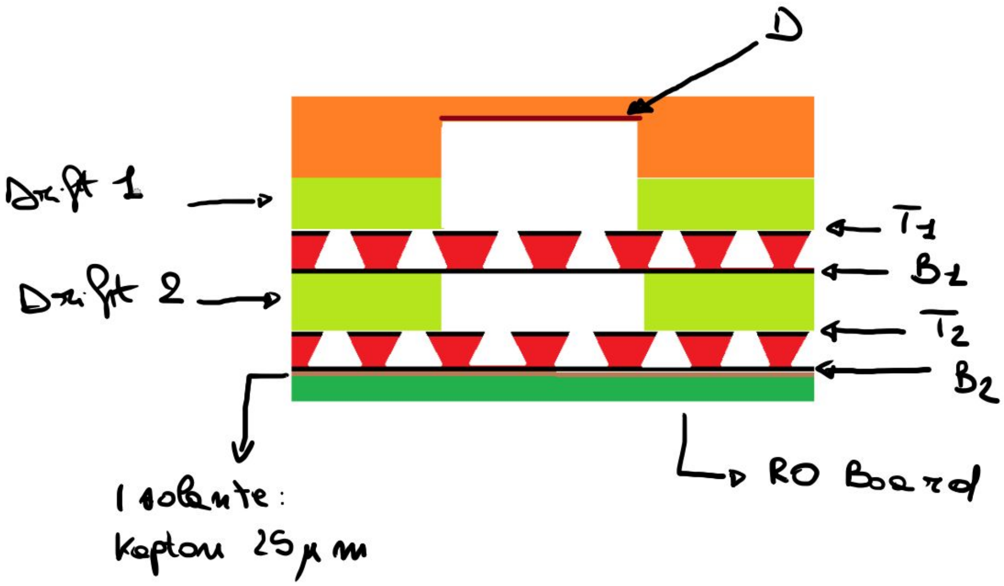
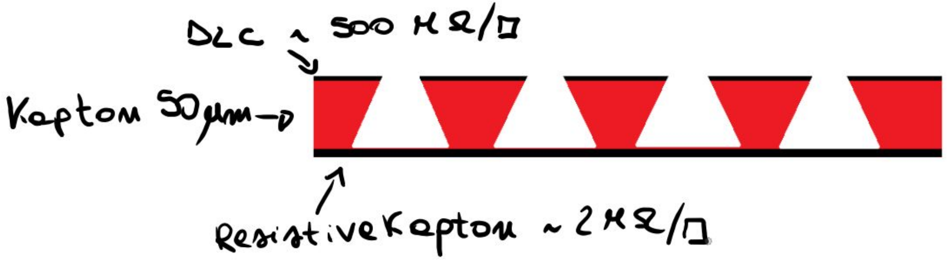
Detector configuration - 1



- Drift 1 = 3 mm
- Drift 2 = 1 mm

Ar/CO2 70/30 - 2 l/h flushed for almost 1 week at the time of the test

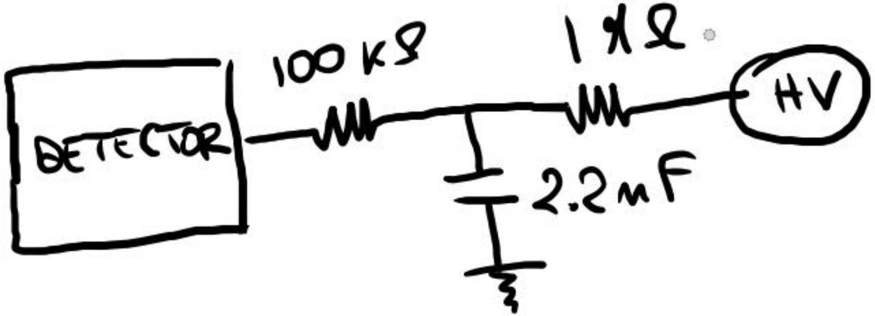
Detector configuration - 2



Amplification layers made of:

- T foils: 50 um-thick Kapton covered with DLC
- B foils: 25 um-thick Resistive Kapton

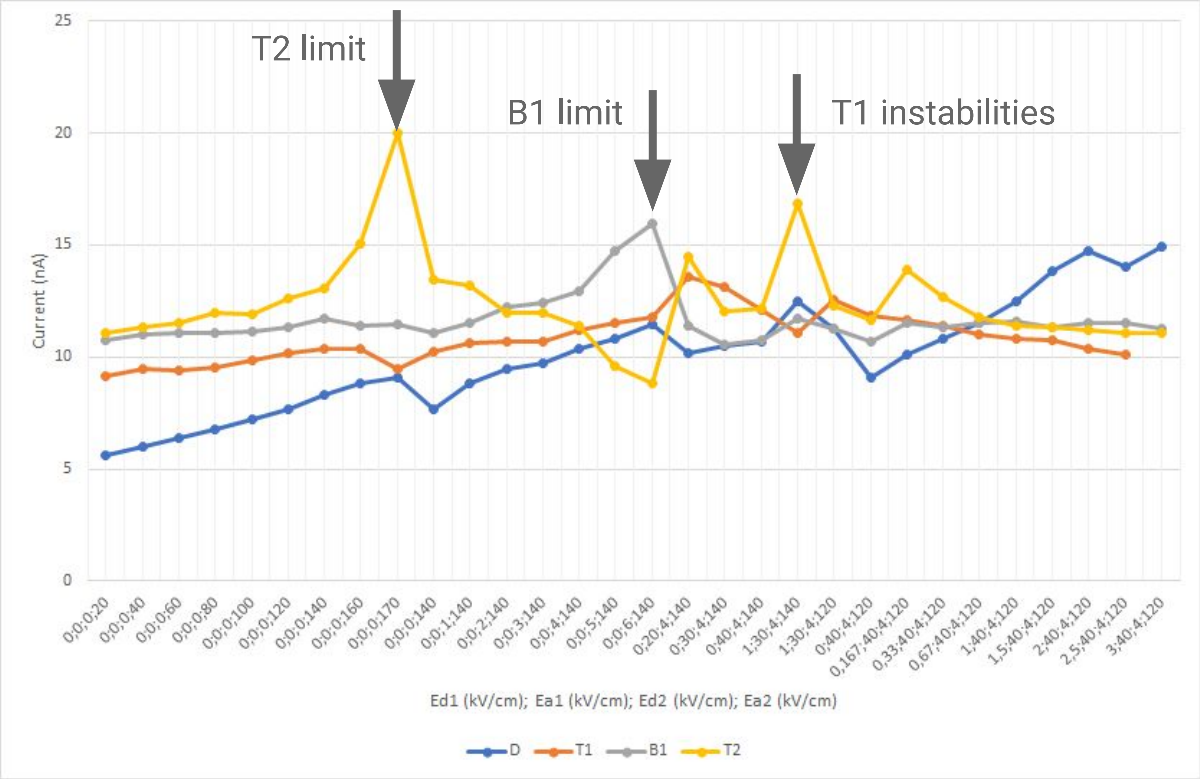
Detector configuration - 3



HV filter mounted on each HV channel

B2 intially not connected to the power supply and floating (no HV filter installed).

HV stability – Part 1



Powering strategy:

channels are in cascade, then we started to power the T2 (with B2 floating) keeping B1 and T1 at the same voltage → only the field between T2 and B2 is ON.

Once we reached the max value, we stopped raising T2 and we started to raise B1 and so on..

HV stability – Part 1

- T2 stable up to 700 V → E_{A2} = 140 kV/cm: ***OK***
- B1 stable up to 1300 V (700 V + 600 V) → E_{D2} = 6 kV/cm: ***OK***

→ Fix the configuration of the second layer at:

- T2 = 700 V → E_{A2} = 140 kV/cm
- B1 = 1100 V → E_{D2} = 4 kV/cm

But when we start powering also the first layer:

- T1 unstable already at 1300 V (1100 V + 200 V) → E_{A1} = 40 kV/cm: ***NOT OK!***

HV stability – Part 1

Over-lunch temporary stable configuration:

HV Channel	***Voltage (V)***	***Field Name***	***Field Value (kV/cm)***
D	2100	***Drift 1***	3
T1	1200	***Amplification 1***	40
B1	1000	***Drift 2***	4
T2	600	***Amplification 2***	120

Trying to improve the situation...

- checking all the resistors in the filters
- searching for shorts between the layers with the tester
- adding an additional ground connection to all the HV paths not used
- adding the readout circuit to B2 (previously floating)
- cleaning everything

But the situation didn't improve, actually it got worse...

HV stability – Part 2

..when we repower the detector, already in the configuration:

- V(D) = 700 V
- V(T1) = 700 V
- V(B1) = 700 V
- V(T2) = 600 V

T1 starts to draw a current of the order of 5-10 uA!

Note that T1 is at the same voltage of the two adjacent channels, i.e. no nominal electric field around it!

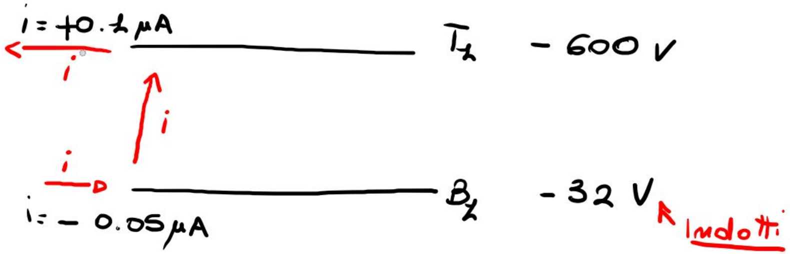
HV stability – Part 2

Additionally, in the configuration:

- V(D) = 0 V
- V(T1) = 600 V
- V(B1) = 0 V
- V(T2) = 0 V

on B1 we measure an induced voltage of the order of 30 V, while if we have a look at the currents:

- i(T1) = 0.1 uA
- i(B1) = -0.055 uA



Debugging again...

- Checking again for shorts with the tester
- Changing HV cable/channel to exclude a problem in the cable itself/module
- Removing the additional grounding path to the not-used HV paths
- Checking again the HV filters in detail
- Removing B2 readout circuit
- Adding an HV filter also to B2 in order to connect it to the HV power supply and analyze its behaviour...

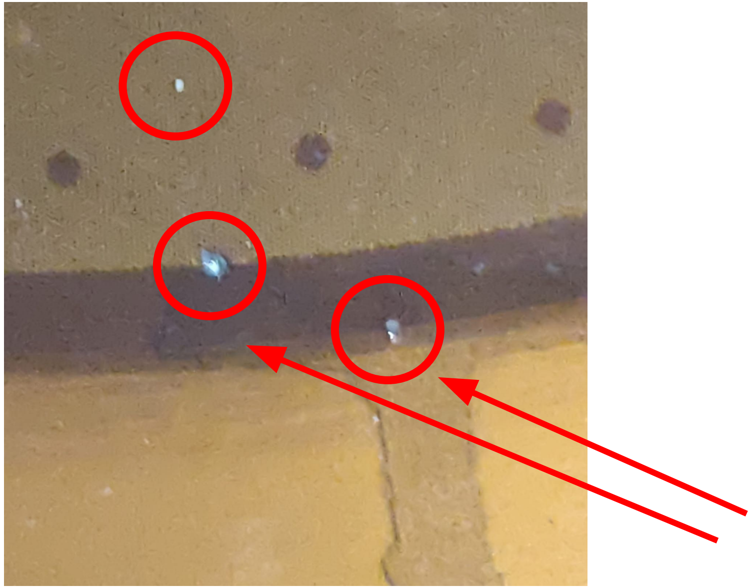
HV stability – Part 3

...and indeed we found that in the configuration:

- V(D) = 0 V
- V(T1) = 0 V
- V(B1) = 0 V
- V(T2) = 600 V
- V(B2) = 0 V

on B2 we measure an induced voltage of the order of 30-50 V, while if we have a look at the currents we have values similar to those observed with layer 1.
Also, if we power B2 while T2=0, we observe an induced voltage on T2 and a current flowing in the opposite direction.

Few observations from the foils – 1



Really close to the HV path!

Few observations from the foils - 2

The conducting paste seems to have pierced the kapton foil → there’s a short that we couldn’t see with the tester but we can observe here with the megger

→ the same problems are present in all the T-type foils we currently have in Pavia (4)

Summary...

The detector couldn't be operated due to serious issues detected in the T-type foils, in particular:

- diffused damages
- problems with the HV paths and the conducting paste as shown in the video

The consequence is that the T-type foils are not well insulated from the B-type, i.e. a stable and sufficiently high electric field cannot be established in the amplification regions.

All the foils seems to suffer more or less from these kind of issues, then ***we cannot perform further tests in Pavia.***

..and proposals

Review the design of the detector:

1. ***Move to a simpler readout board***
   a. designed to host only 2-3 foils
   b. no strips, just one big readout pad
   c. no samtec connectors, just a simple LEMO
2. ***Produce new T-type foils***
   a. avoid the usage of conducting paste for the HV paths
   b. is it possible to create a mask of the shape of the HV path so that when the copper is chemically removed we keep the HV path "visible"?
3. ***Need to have a couple of GEM foils that can be exchanged with the FTM foils for debugging purposes***

Could we for example use a 10x10 Triple-GEM kit as baseline and produce the FTM foils to fit into it?