# CBM GEM Muon detector assembly and discussion on the opto-coupler based HV system

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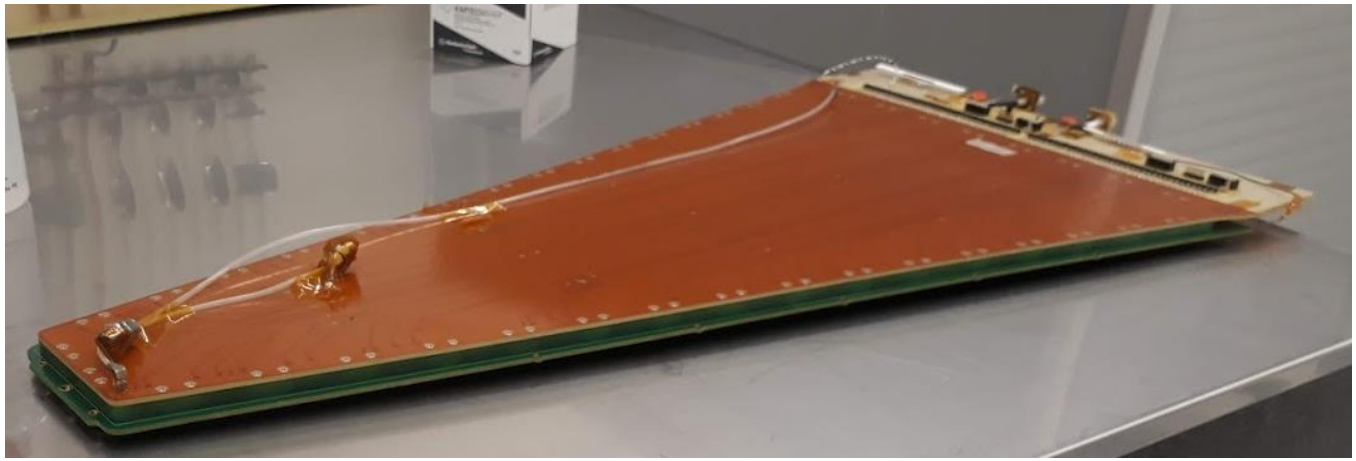
(For MUCH-INDIA collaboration)

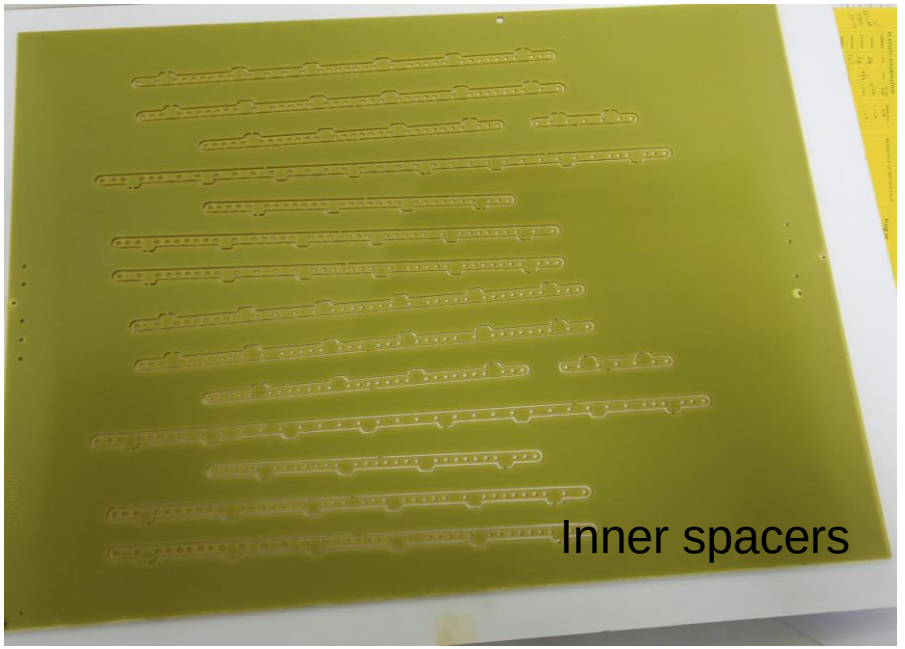
# Trapezoidal GEM chambers for CBM-Muon Chamber(MUCH)



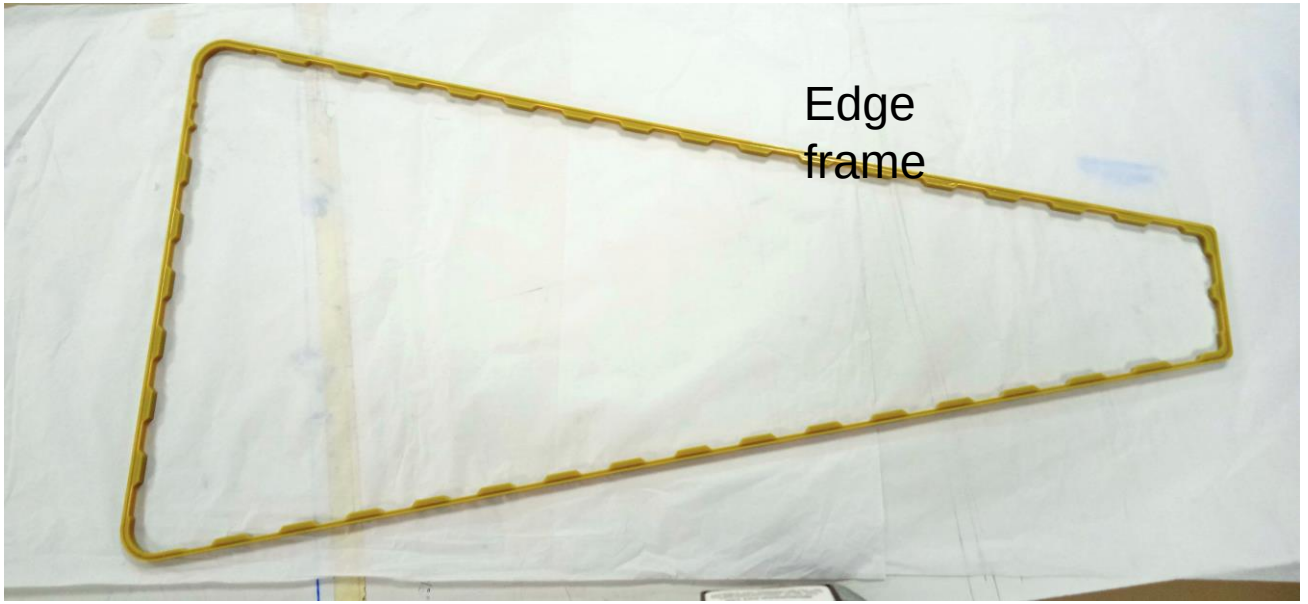
GEM modulles  Fabricated based on NS2 stretching technique

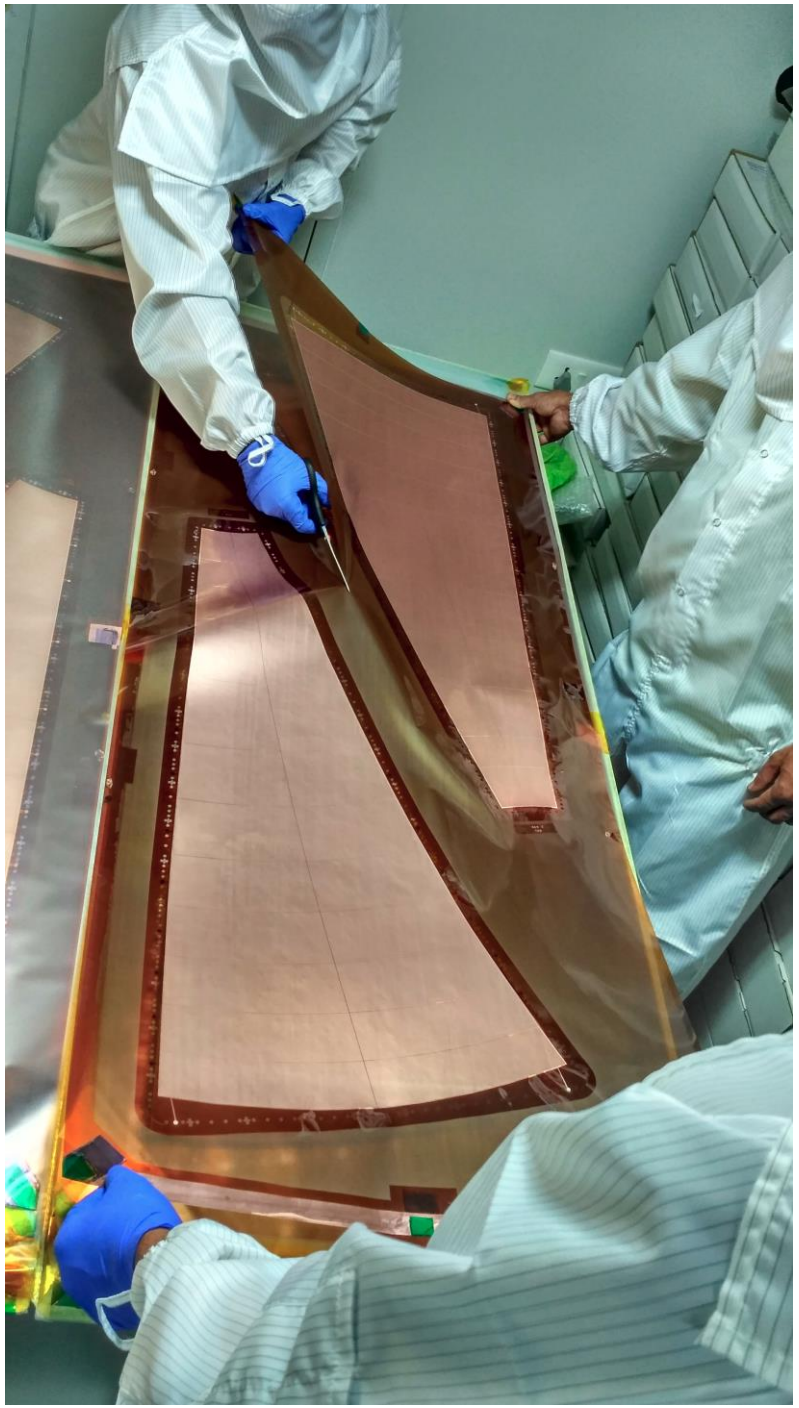
The detector Components

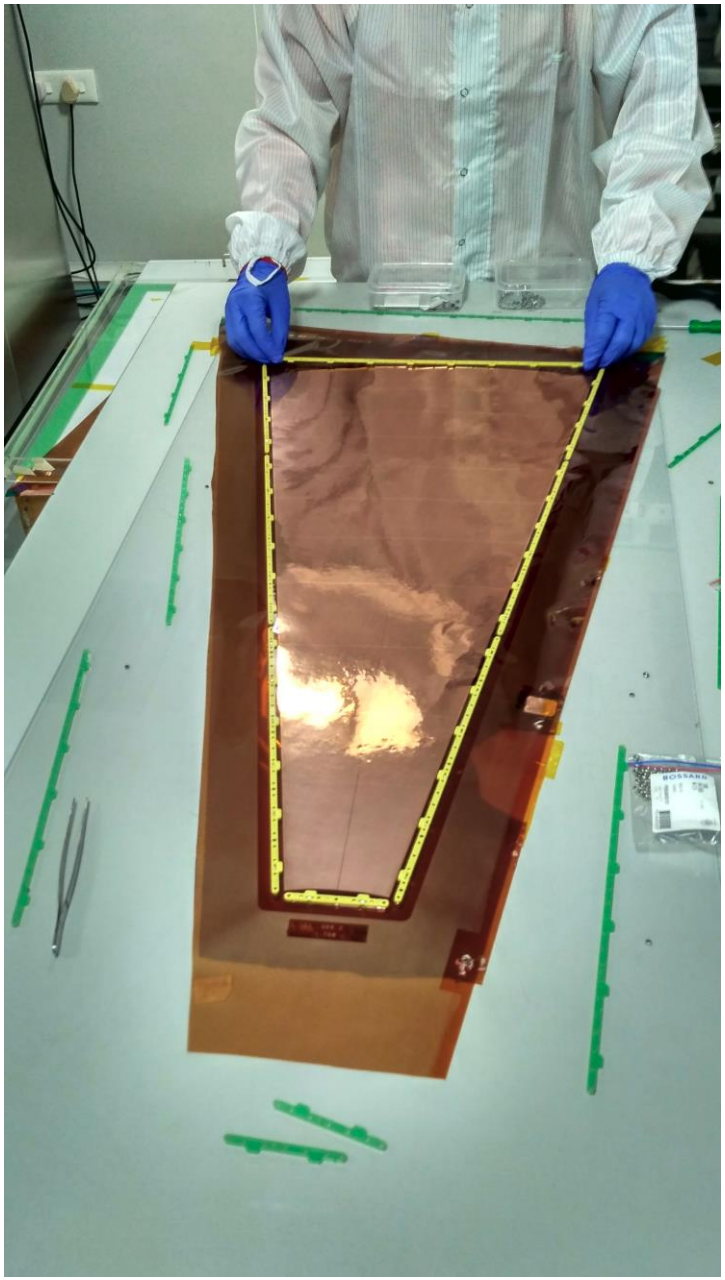
(these ones fabricated in India
Yet to build a full module using
These indegenous parts)

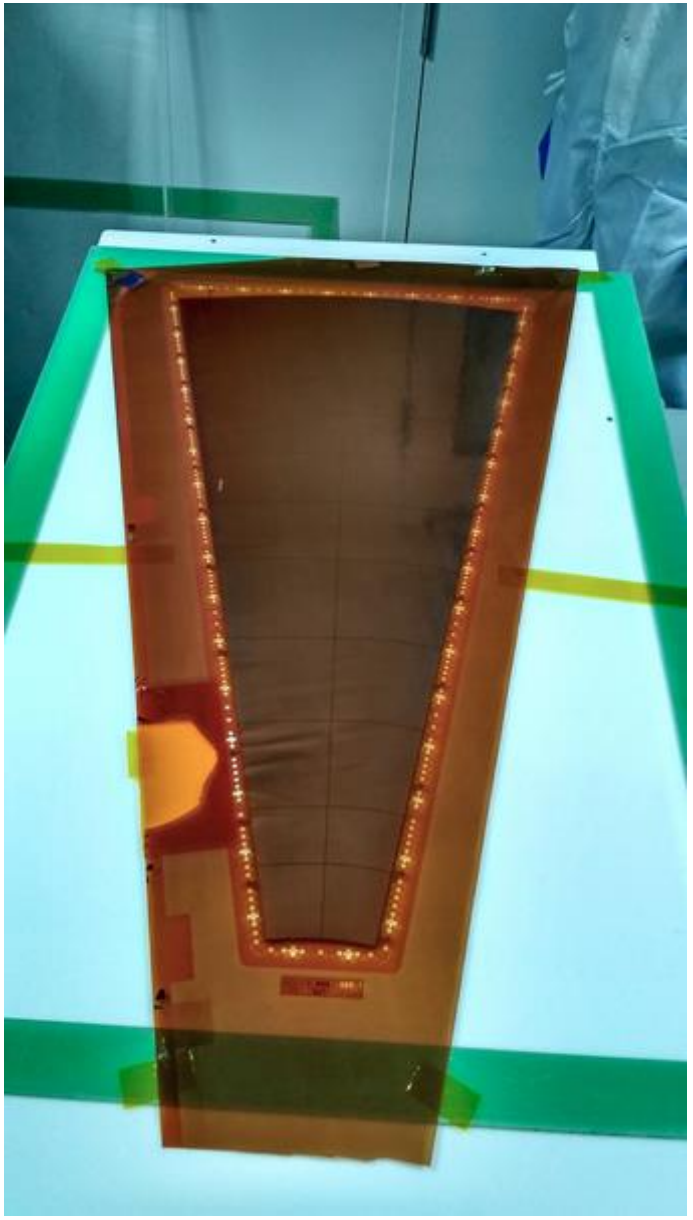



The first set of components designed and fabricated by Rui's team, CERN.



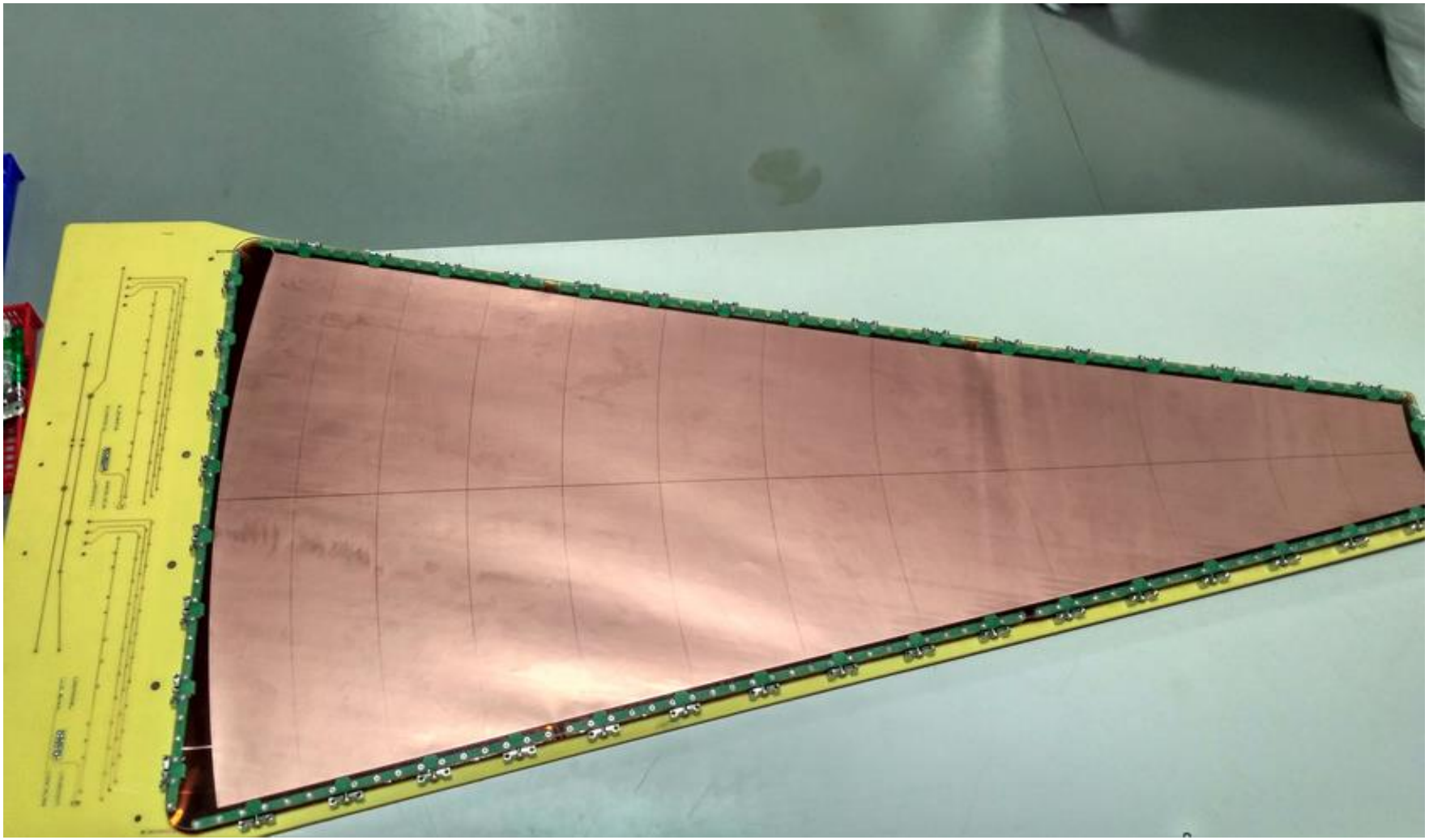


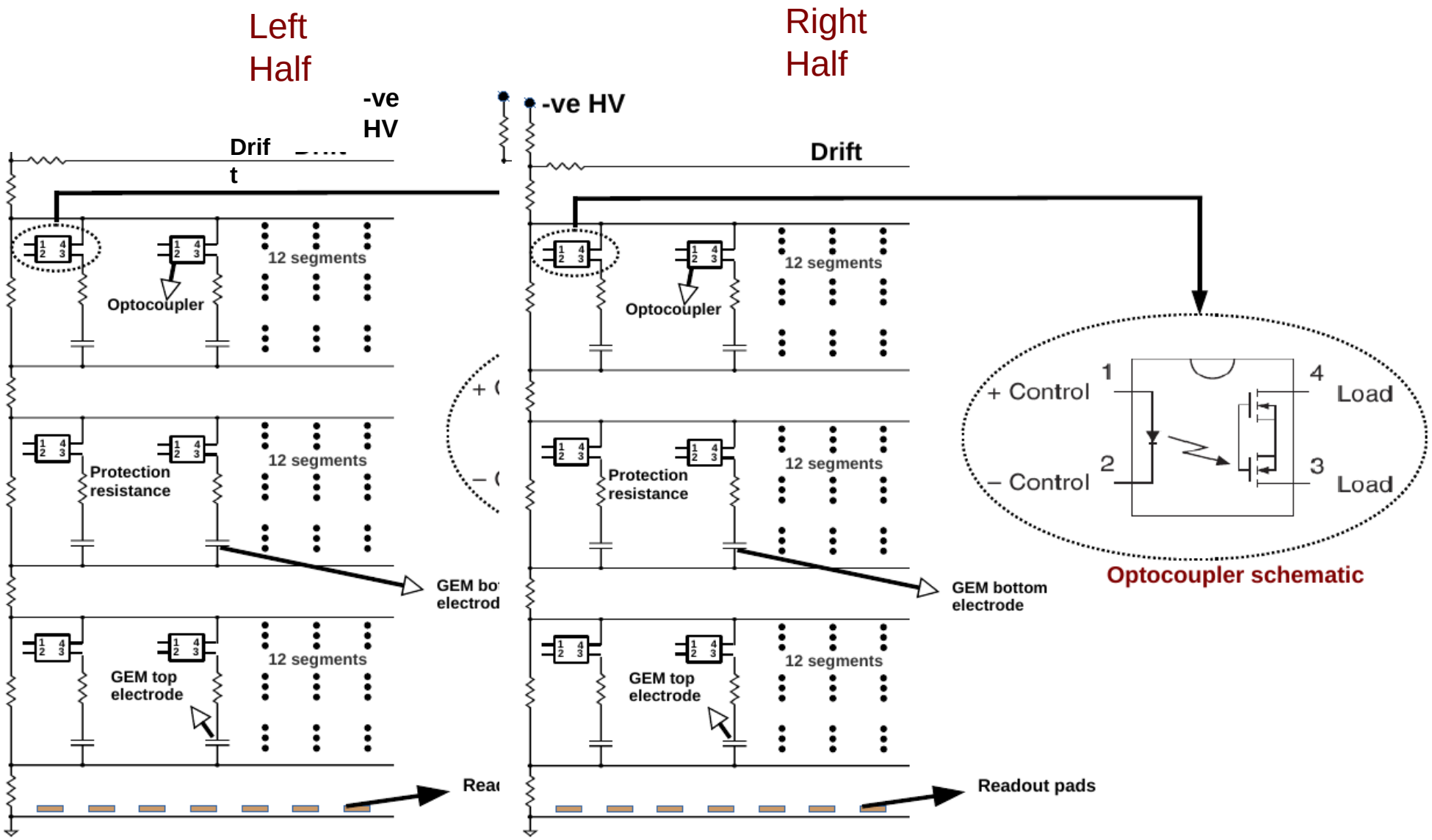




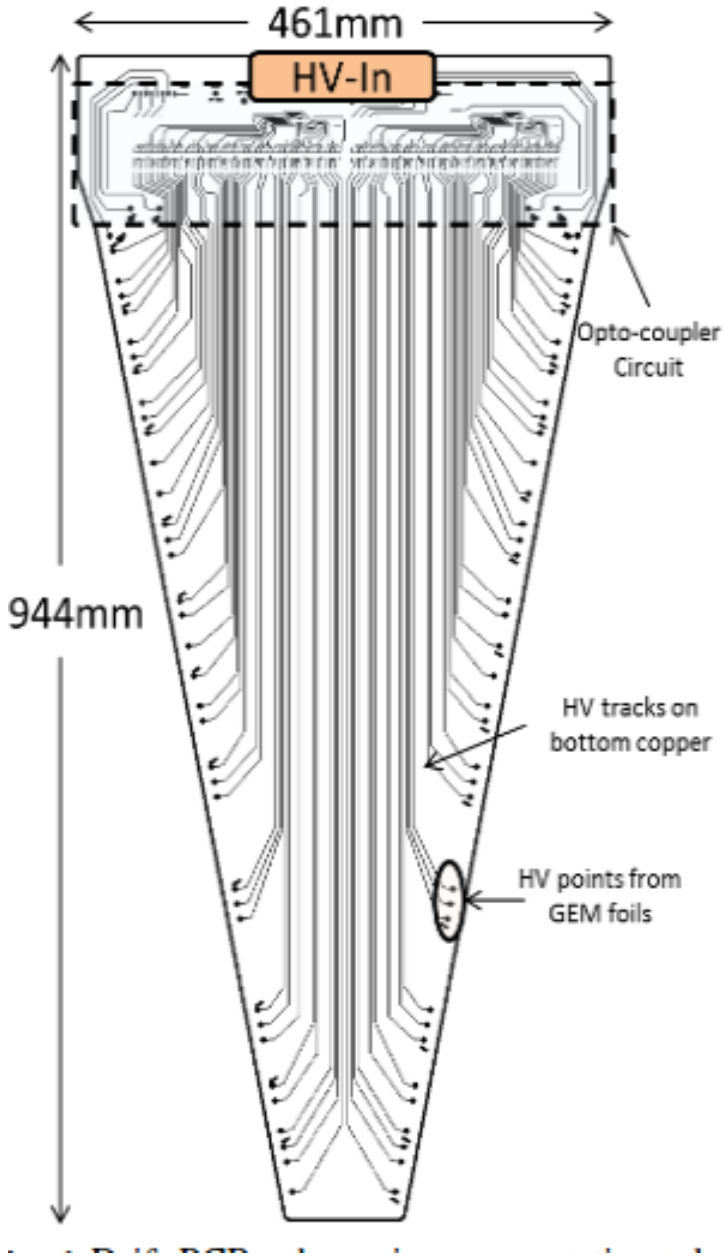
Readout PCB with Projective geometry

Triple GEM stack on the drift board.






Opto Coupler Scheme for biasing triple GEMs in the trapezoidal module




The HV scheme

An optocoupler based HB biasing
For triple GEMs

-- 24 segments per GEM layer
-- 72 optocouplers used

# The mMUCH modules @mCBM

**1. Two trapezoidal shaped GEM detectors commissioned in 2018.**

MV2 type : gap configuration of 3/2/2/2.
GEM2 with newer version of Readout in Dec-2019 run.

**2. Active area of modules --** 2000 sq. Cm

The readout pads have progressively increasing pad sizes from 3 mm from the smallest to 17 mm for the largest size.

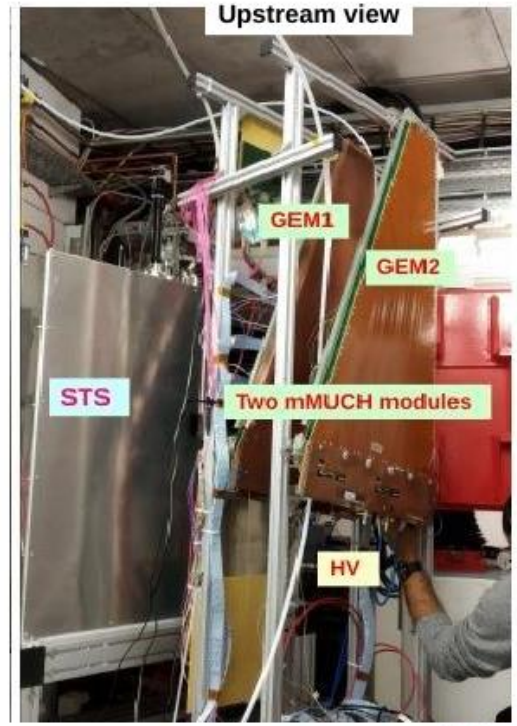
**3. Read out and Electronics :**

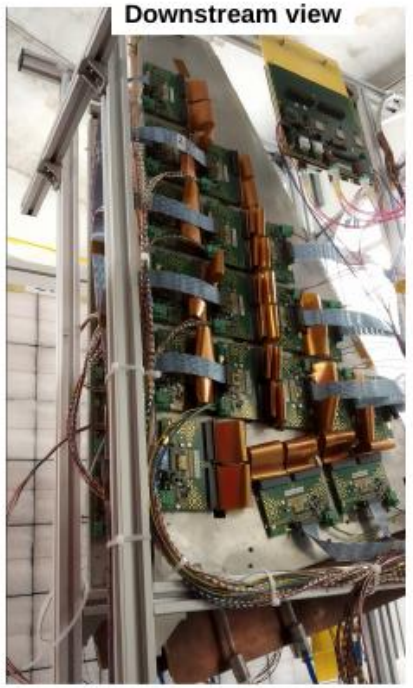
For mCBM 2018
and March 2019
--> STS/MUCH XYTER V2.0

For mCBM Nov/Dec-2019
and Mar-May 2020
--> STS/MUCH SYTER V2.1

In December 2019 -- "almost" full coverage
For the first time with V2.1.

**4. Gas mixture –** Ar/CO2, 70/30




FEBs attached to the Al-cooling plate


FEB

LVDB

**GEM chambers at mCBM**
**-- detectors of Station1 type**

- The modules took good data for the entire run period.
- However, one observation :
- There was occasional elink-loss at high GEM voltages – also called as link-break problem. (4600 or higher)
- It was attributed to some spikes coming from the detector.
- The situation worsened with high intensity beams, the system could not remain stable for more than few minutes.
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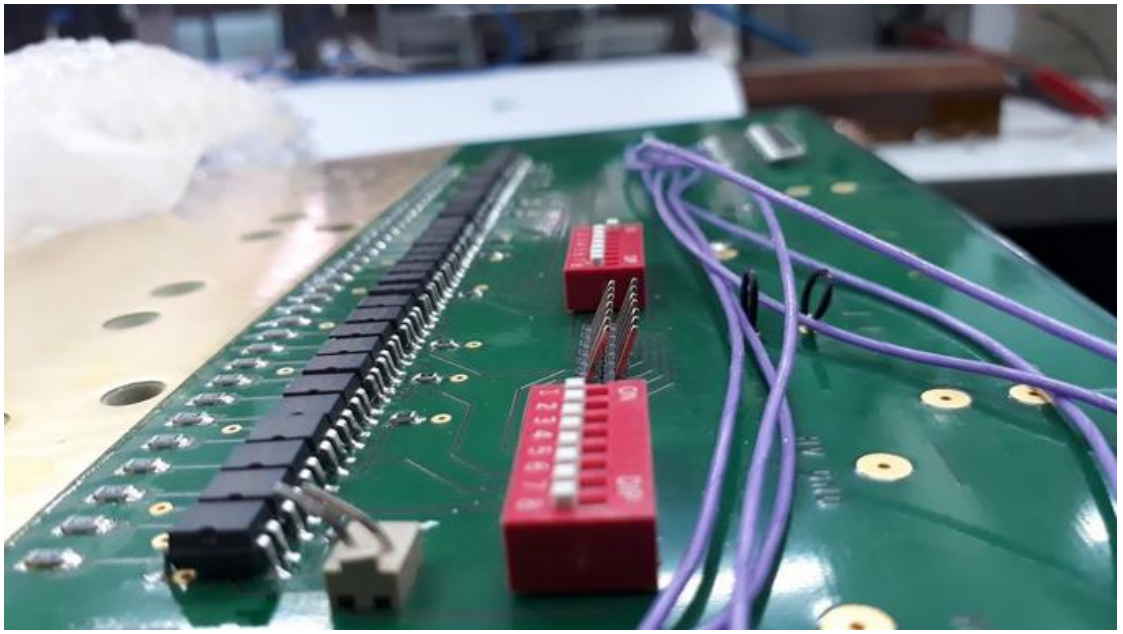
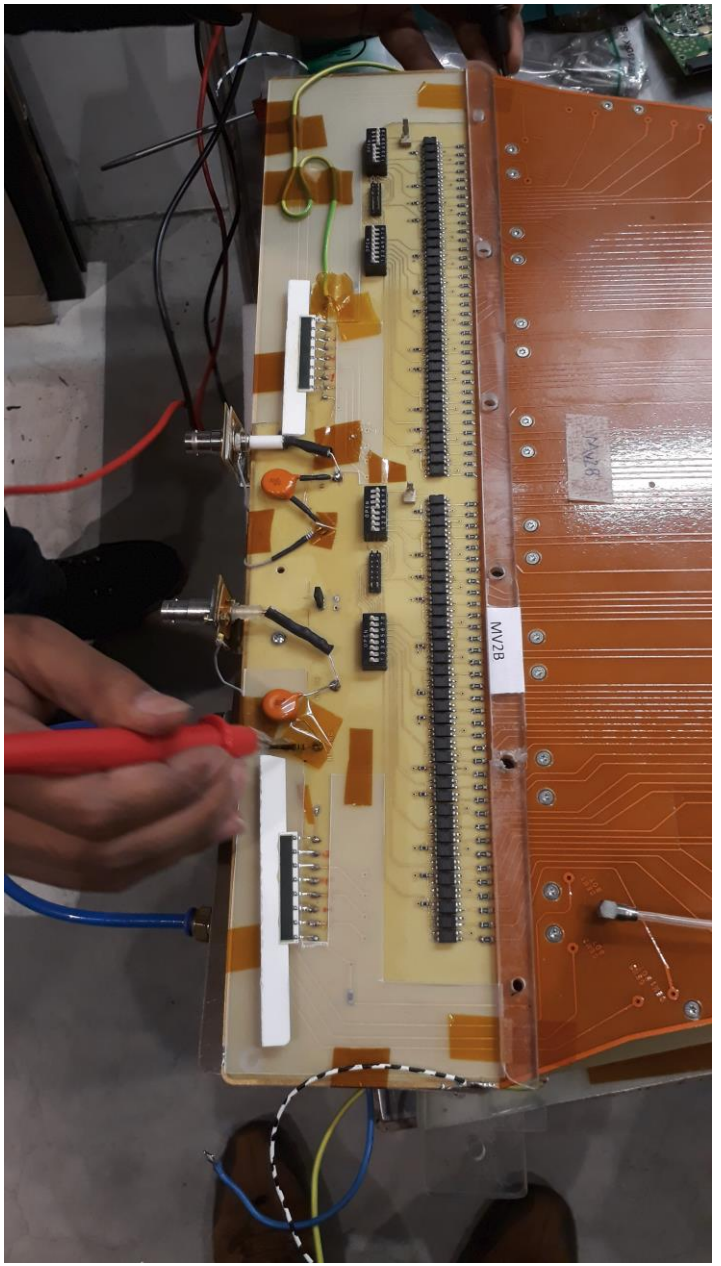
- But there were several occassion where the detector handled 4900 V upto one hour without any link-break

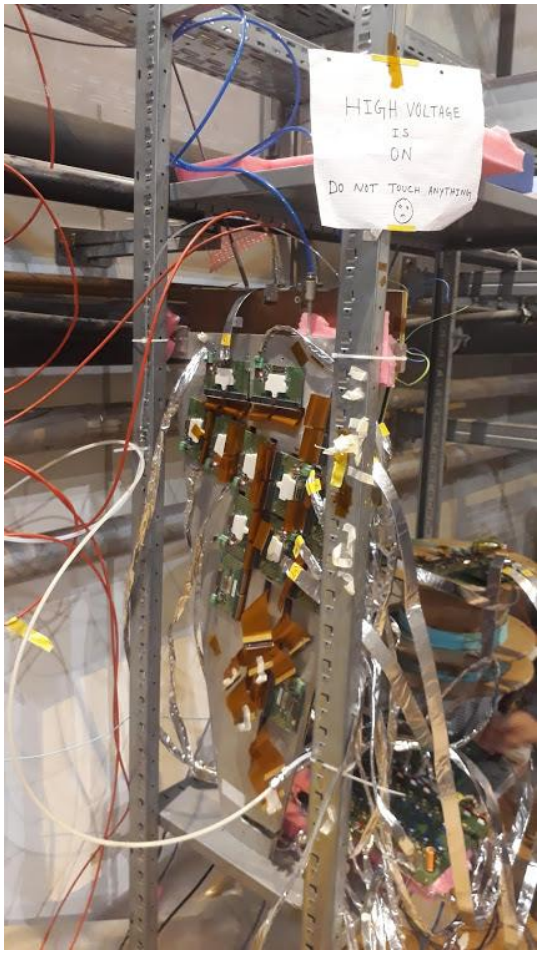


**The Optocouplers as soldered on the drift PCB**

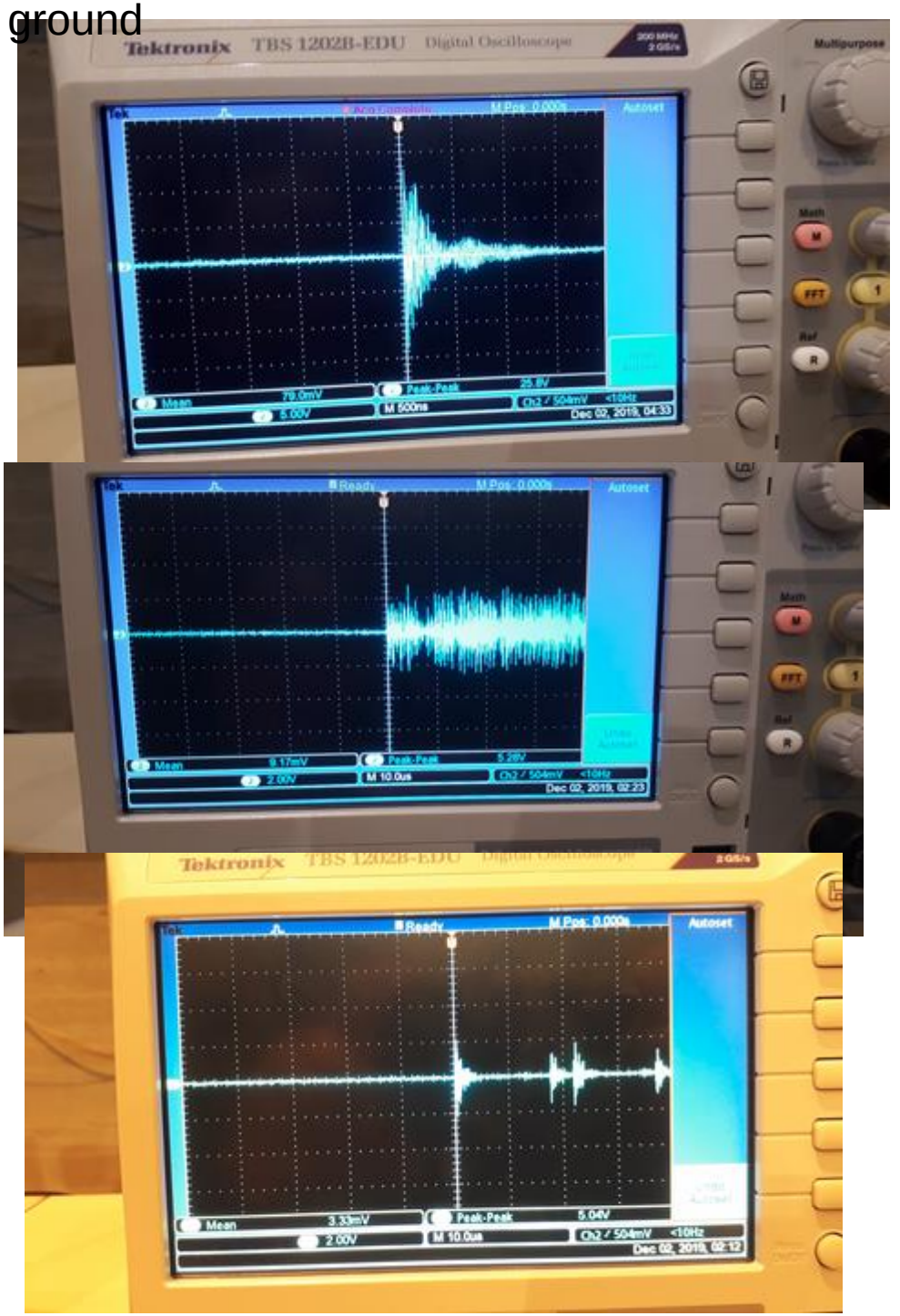
## Picture of the The HV Portion of the detector



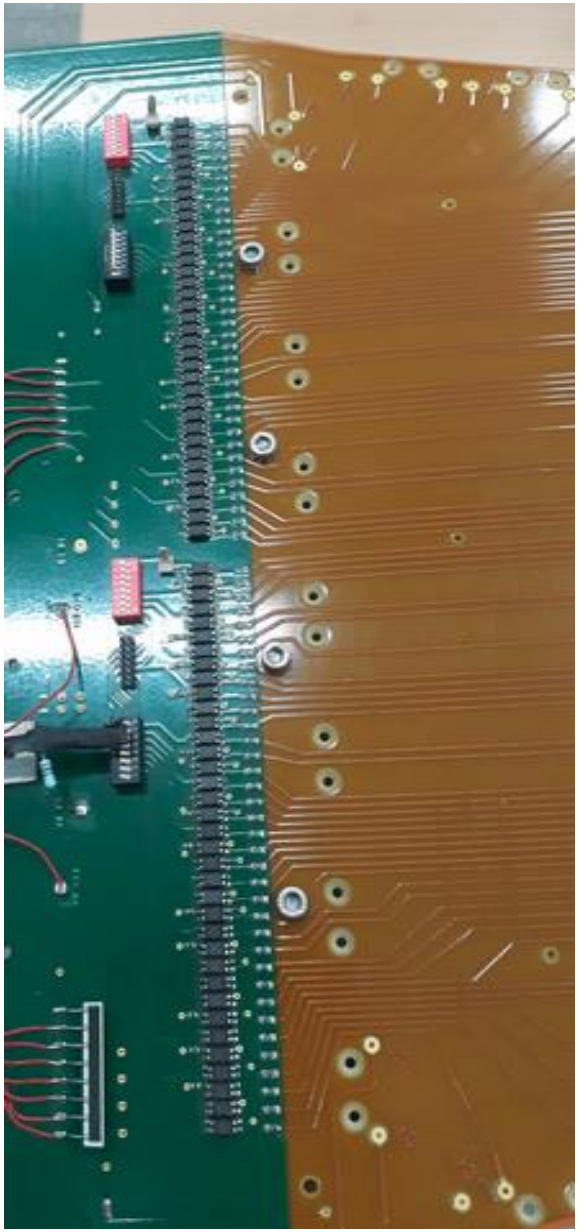
Test Setup at GSI,
---> outside the cave




Spikes seen from the probes at LV ground

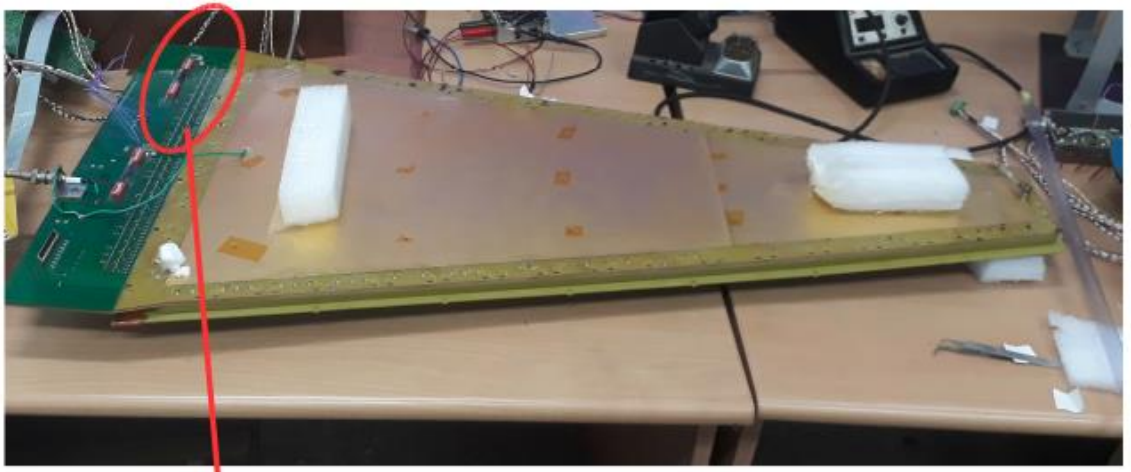


# Investigation into the layout to identify any leaky path

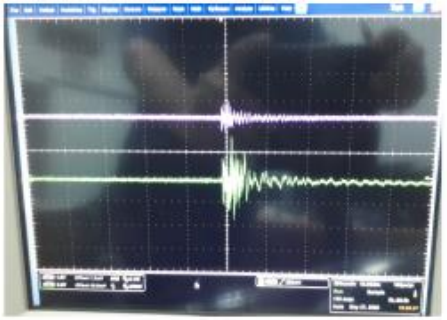



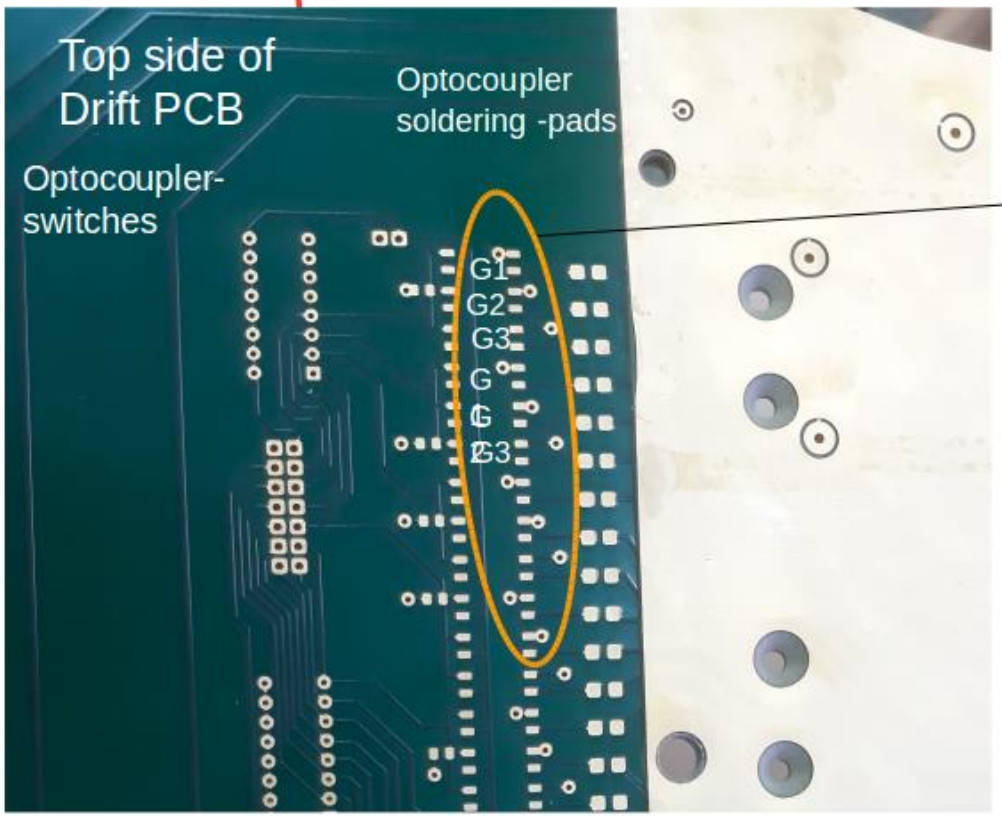
# Investigation of Link-break using a detector assembly without GEM foils

**Occasional to Frequent spikes seen on the scope**



-- frequent at higher humidities.



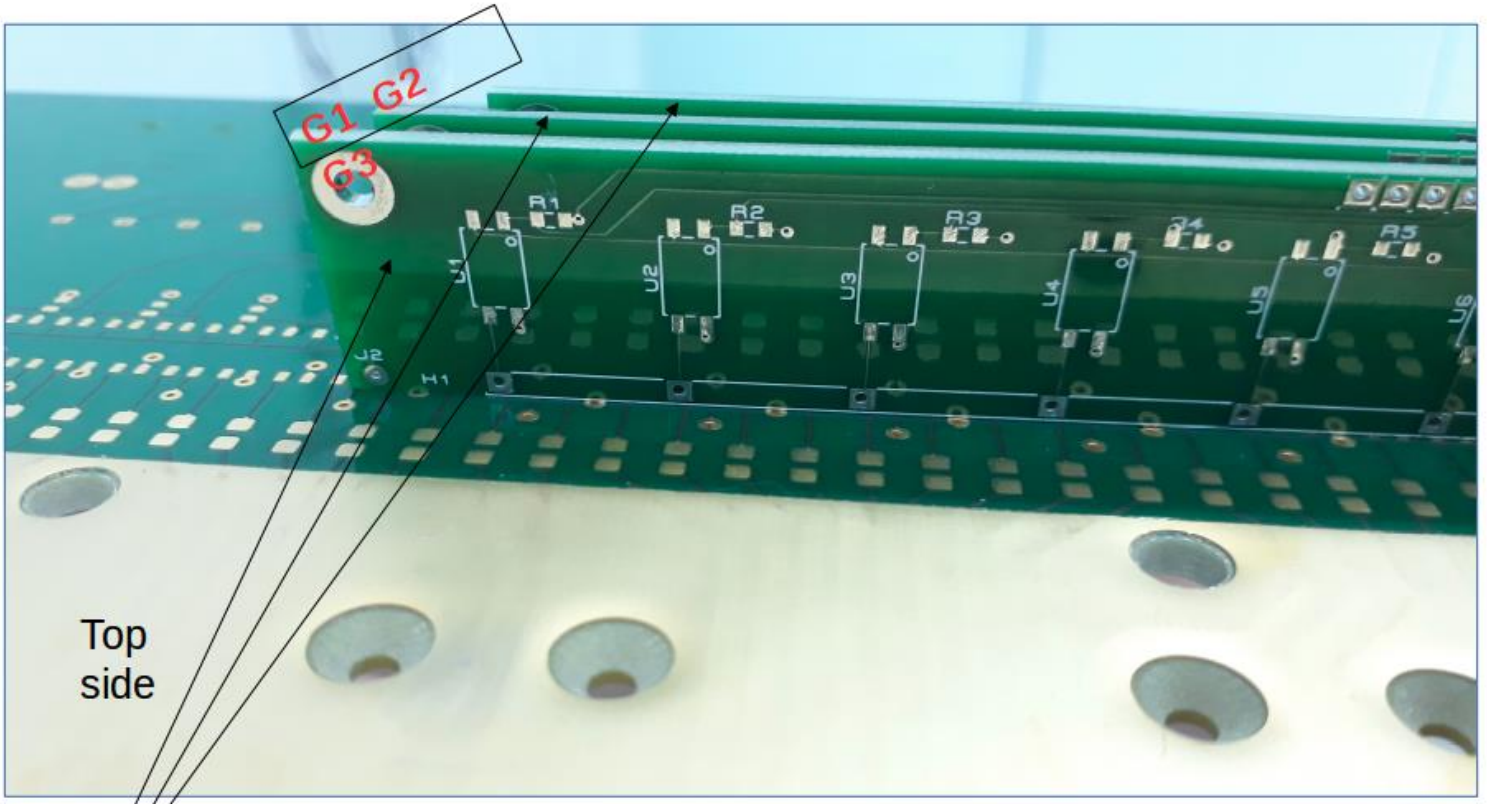



On replacing the opto-couplers with simple SMD resistors, the system ran smoothly without any link break for several hours at 4900V.

One reason could be :

too close proximity of the optocouplers of GEM1, GEM2 and GEM3.

Can we increase the separation ?
-- we make use of three separate planes, where the optocouplers will be mounted.

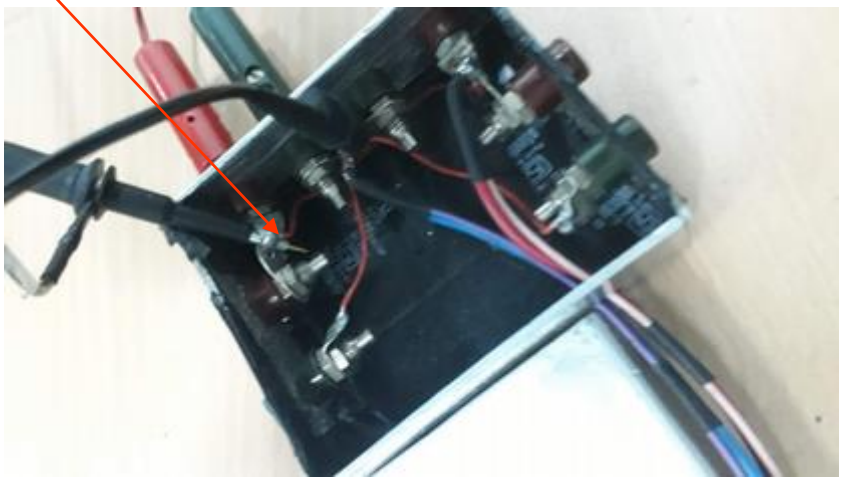



**PCB arrived On 06-07-2020**

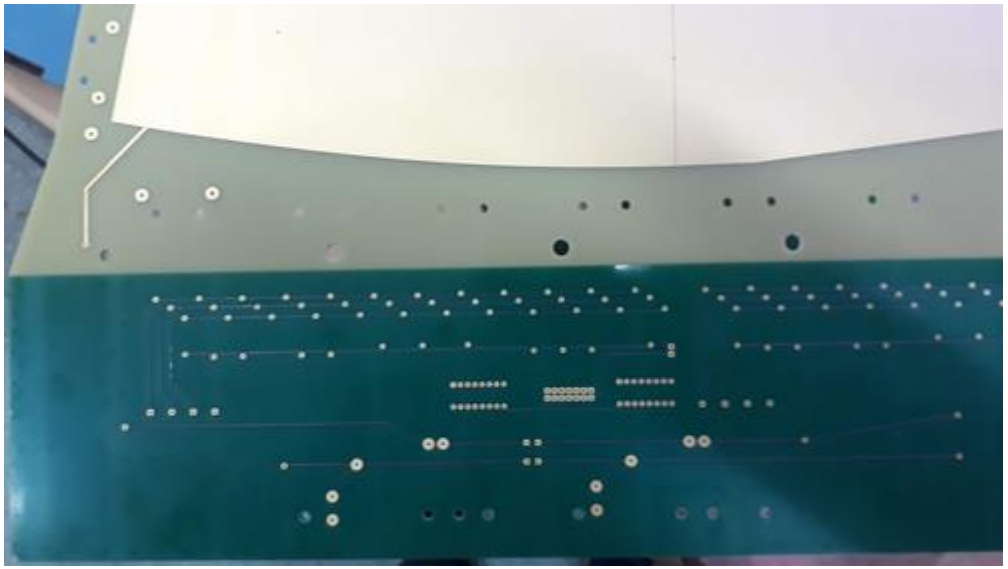
The optocouplers will be mounted on three different planes, and the extra pads and the PTHs on the present Drift PCB will be scraped off.

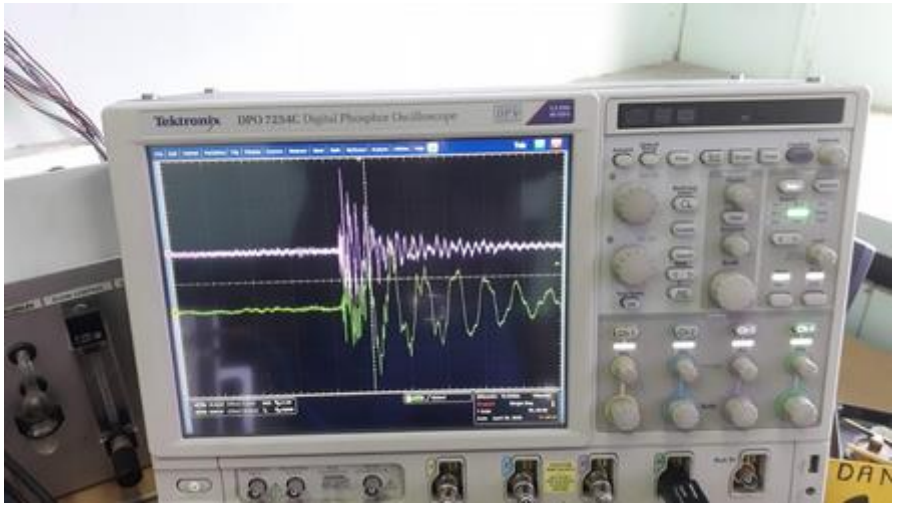
If this arrangement is successfull, the drift PCB will be modified.

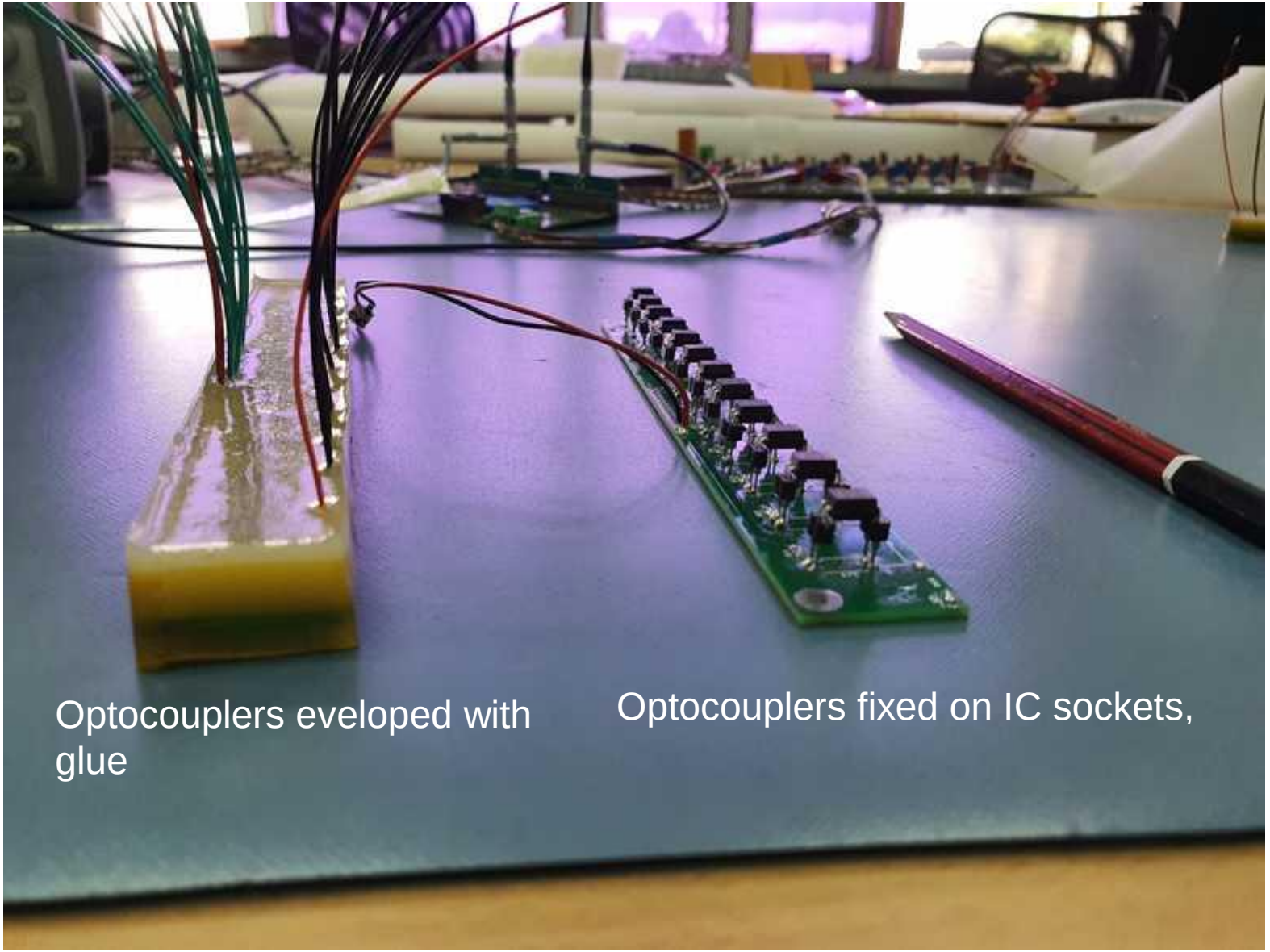
Position of the probe for sensing the spikes - - at the optocoupler- LV point.



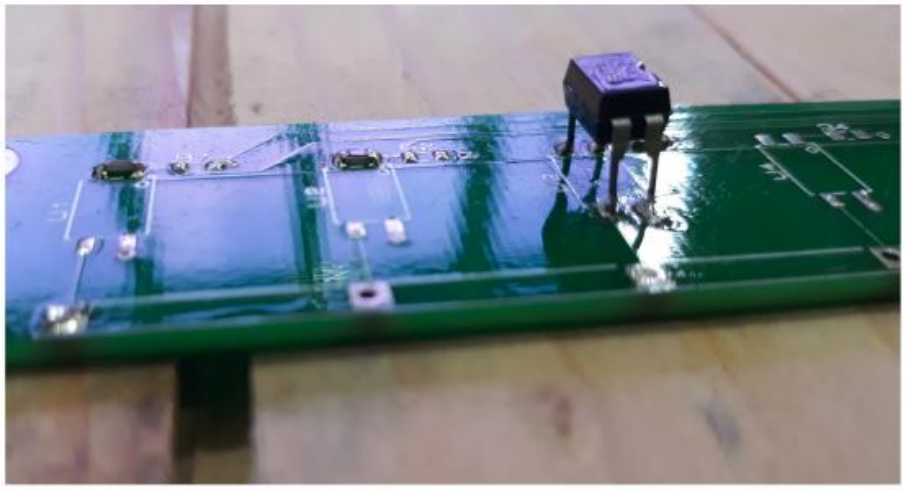
Filters introduced at LV point







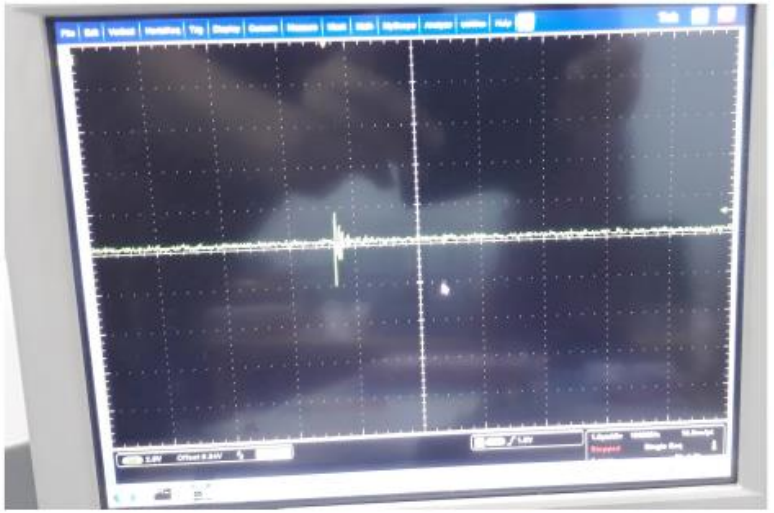

Those fixed on IC-sockets were found to be relatively more stable under HV

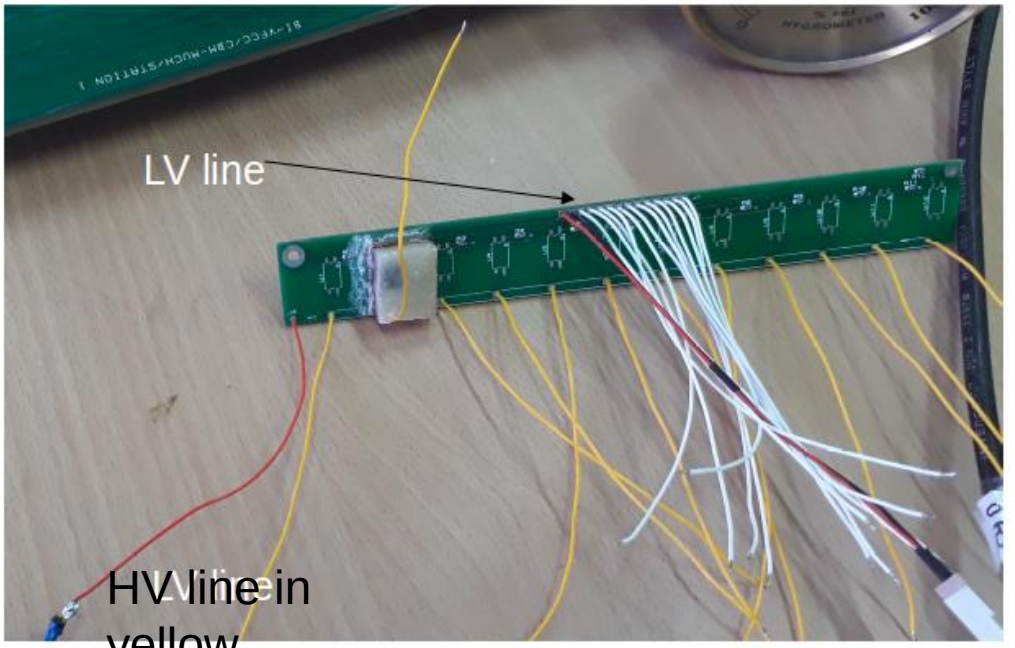


Testing with
Single OptoCouplers

← Without glue-cover

With glue-cover ↓






Spikes still observed, just that they are now mostly confined to ~4V, as Compared to occasional 20 V, with 12 optos

Some cleaning procedure incomplete,
Discussion ongoing with Rui

## Summary:

- We have assembled two triple GEM detectors based on the
- Optocoupler biasing scheme
- 
- Occassional e-link loss observed during data taking. Was mostly due to spikes from the detector.
- 
- Observed issues of intermittent spikes on bare PCB on applying HV. Even with single optocouplers.
- 
- Cleaning seems to be the main issue as per experts
- 
- More investigations underway
- 
- Further inputs or ideas needed from experts to understand
- the reasons for these spikes.
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*Thank You*