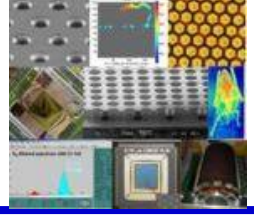
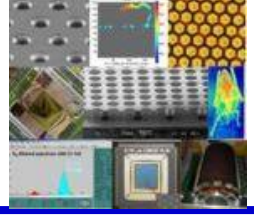


DISCHARGE STUDIES BY THE TRIESTE GROUP

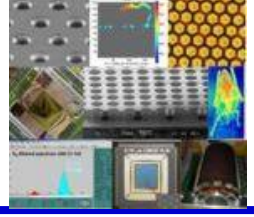
S.Dalla Torre, S. Dasgupta, G. Hamar, S. Levorato, A. Mucchietto, F. Pereira, C. Santos, F. Tessarotto



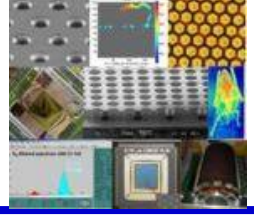
OUTLOOK

A COLLECTION OF DATA ACCUMULATED OVER YEARS

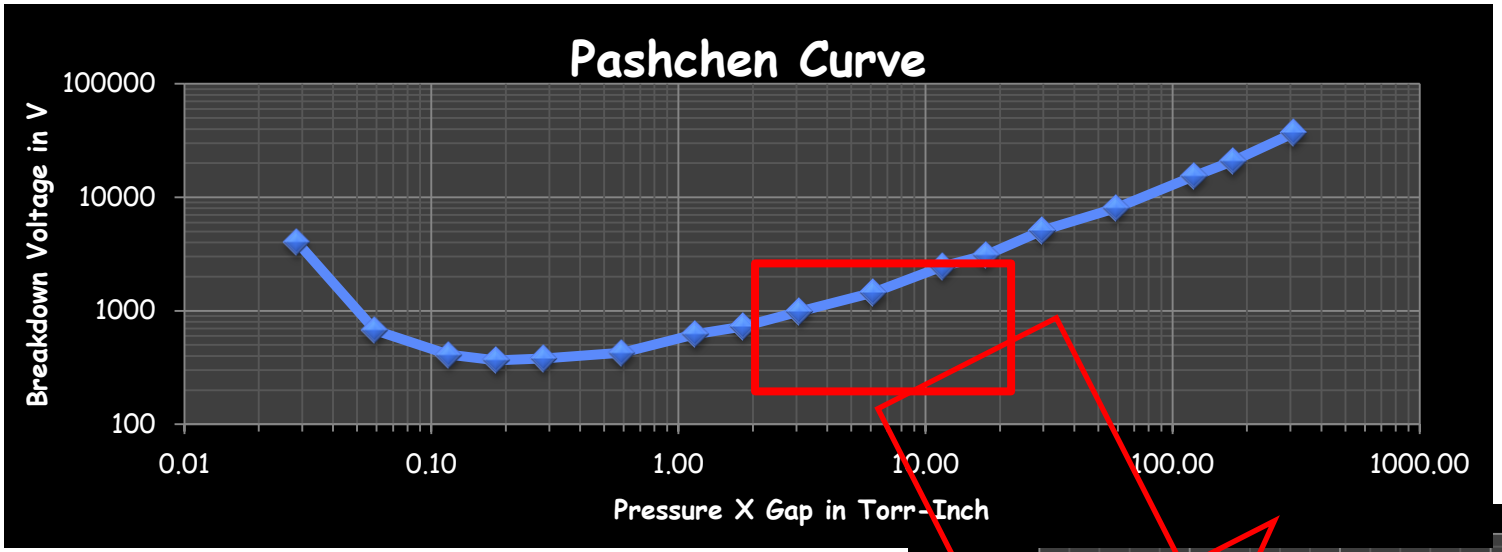
- **DISCHARGES IN THGEMs**
  - The PASCHEN TEST tool
  - PASCHEN test vs detector discharges
  - The role of the PCB quality in discharge rates
  - The discharge cross-talk of the sectors of a large THGEM
- **DISCHARGES IN RESISTIVE MICROMEGAS**
  - Space, time correlations
  - Inefficiencies at microscopic time-scale level



THGEM



A conceptual tool: THE PASCHEN CURVE (EMPIRICAL)



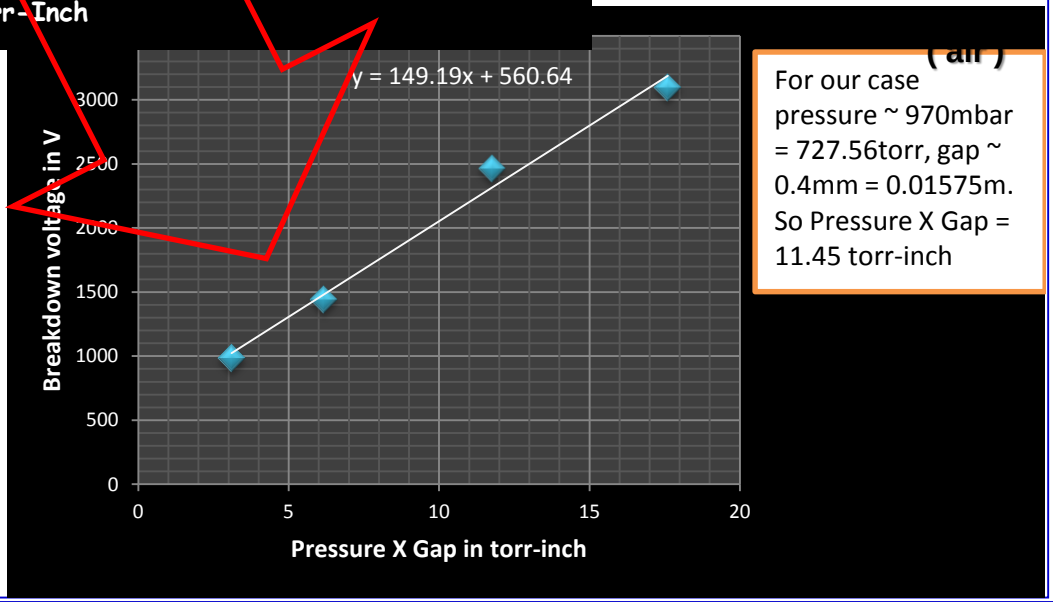
The breakdown V_{bd} depends on

- P
- d (electrode distance)
- the specific gas

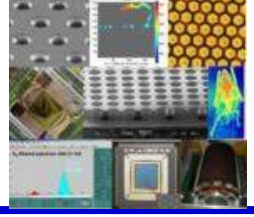
$d = 0.4$ mm → $V_{bd} = 2270$ V

$\Delta d = 20\ \mu m \rightarrow \Delta V_{bd} = 100$ V

$\Delta P = 20$ mbar → $\Delta V_{bd} = 35$ V

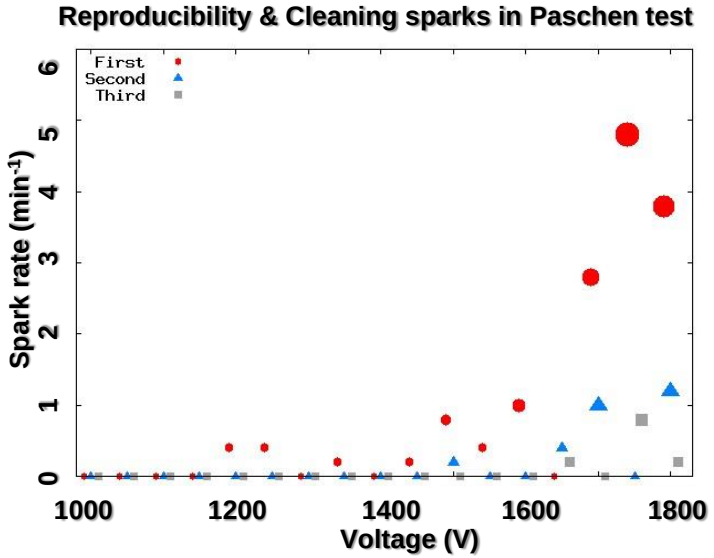


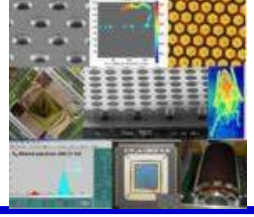
For our case pressure ~ 970mbar = 727.56torr, gap ~ 0.4mm = 0.01575m. So Pressure X Gap = 11.45 torr-inch



THGEM DISCHAGE STUDIES 1/3

- PASCHEN LIMIT
- Paschen measurements in N_2 (expected Paschen limit at ~2250V)
  - The measured limit is set at the HV where discharge rates ≈ 1/min
  - 30 x 60 cm^2 THGEMs:
  - thickness 04. mm, pitch: 0.8 mm, hole diameter 0.4 mm
  - → 325 k holes !!!
  - Note the "cleaning" discharges (at first test)
  - Second and third test: reproducibility



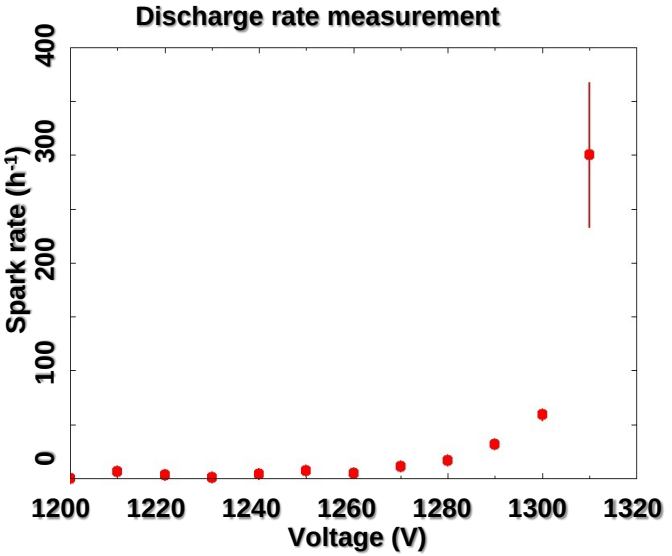


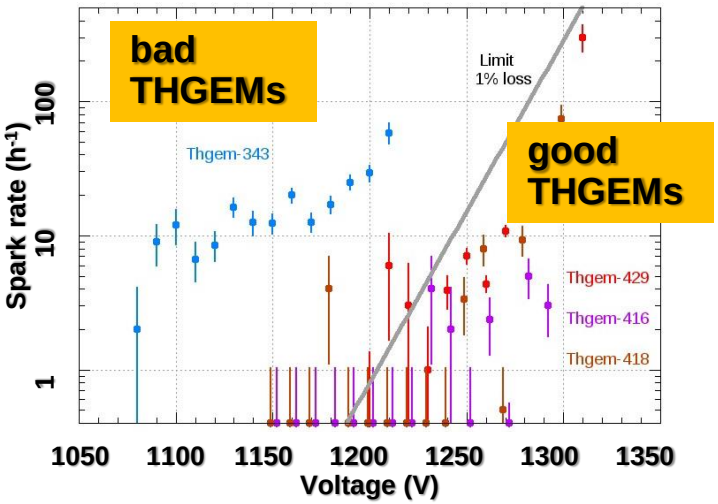
THGEM DISCHAGE STUDIES 2/3

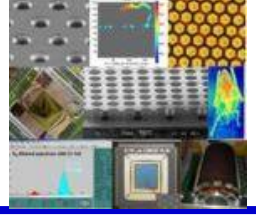
- **DISCHARGE RATES in single layer THGEM**
  - Discharge rates measured in $Ar : CO_2 = 70 : 30$
- **Which operation voltage (i.e. which gain)?**
  - Gain (single layer) 20 → voltage 1125 V
- **Tolerable discharge voltage ?**
  - ARBITRARY fixed at 1% DEAD TIME for a total surface of 3 m^2
  - Recovery time after a trip : 1 min

→ 1 trip/d for a 30x 60 cm^2 THGEM

→ Non directly measurable: EXTRAPOLATION down to 1125 V

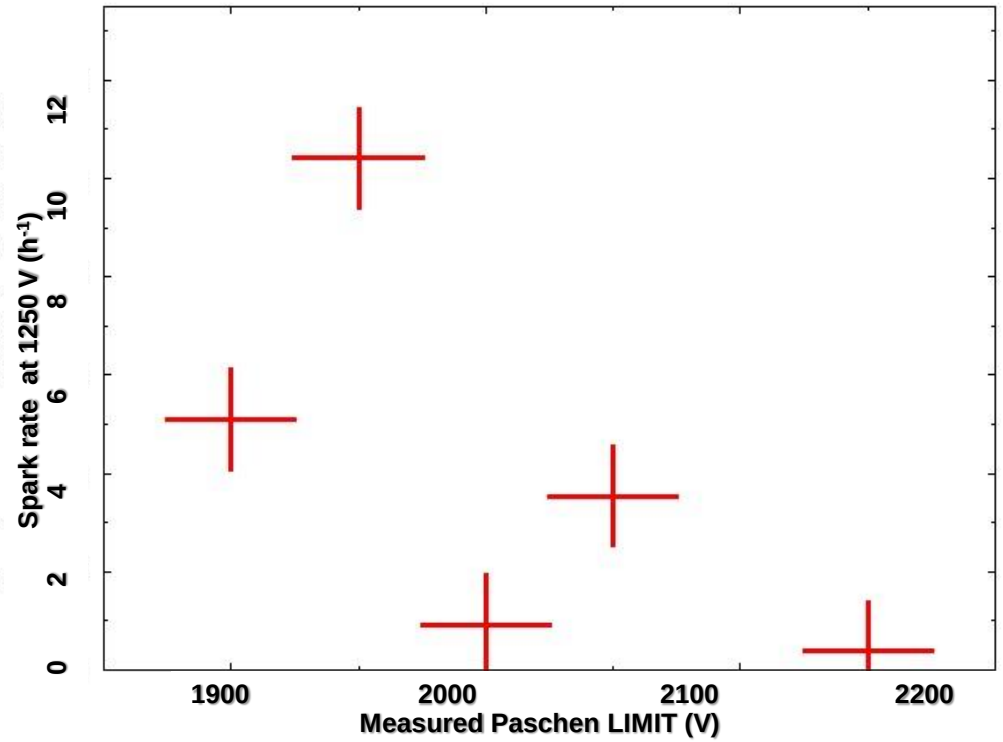






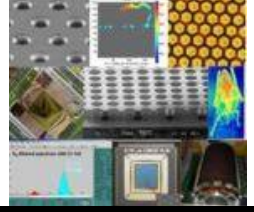
THGEM DISCHAGE STUDIES 3/3

- **Correlation of PASCHEN LIMIT vs SPARK RATES**
  - Each point in the plot is a 30 x 60 cm^2 THGEM

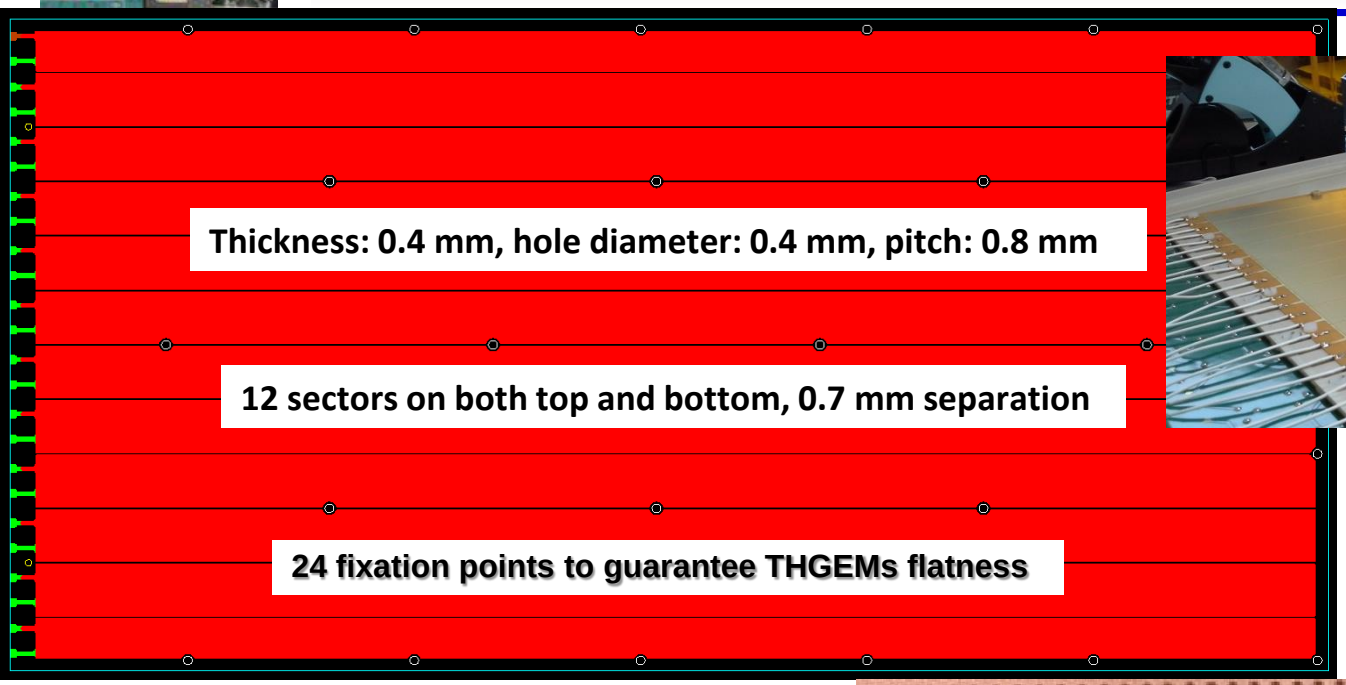


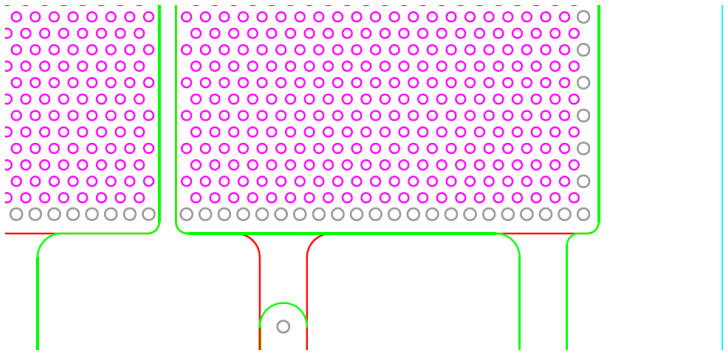
→ The simple PASCHEN test is a valid tool for THGEM QC

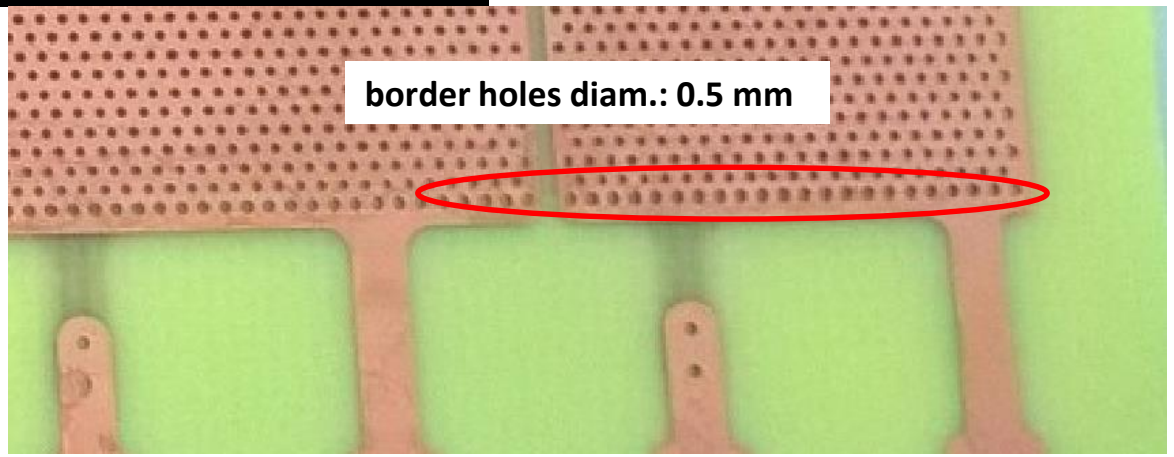
→ Large surfaces with very low dead time rate can be instrumented

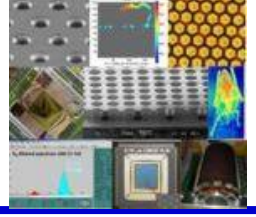


THGEM LAYOUT & DISCHARGES







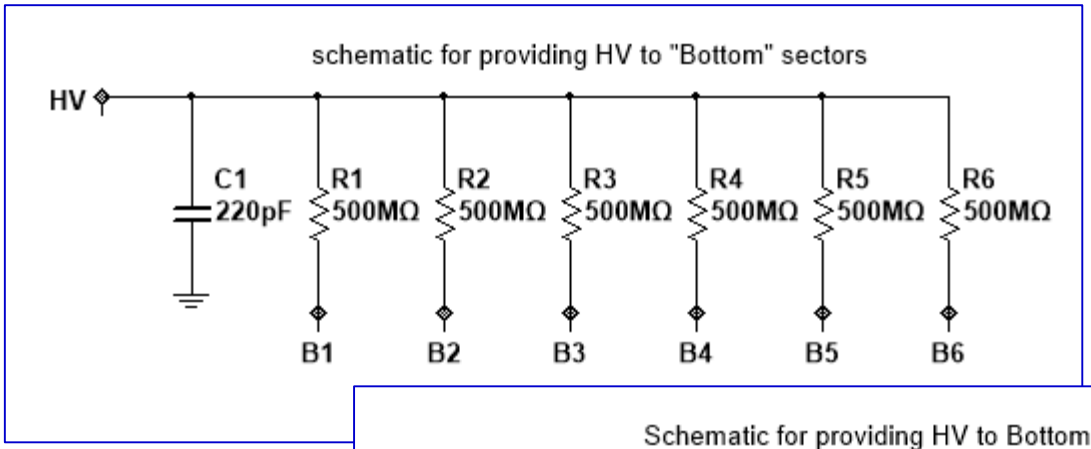


DISCHARGE PROPAGATION WITHIN A THGEM

Discharge propagation from one sector to others (also non adjacent ones!)

→ HV distribution suspected, in particular to THGEM bottom

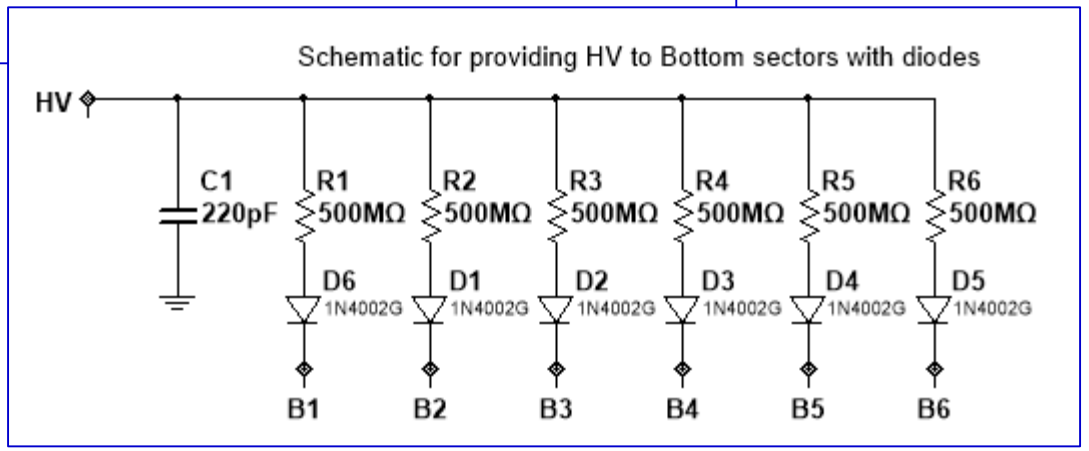
INITIALLY:



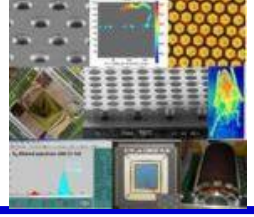
THEN:

Cross-talk is eliminated !

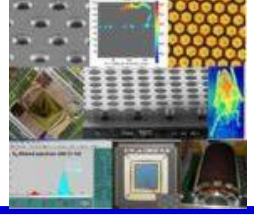
Analogous scheme also for the top



Diode: VS-20ETS High Voltage, Input Rectifier Diode



MICROMEGAS



RESITIVE MM BY DISCETE ELEMENTS

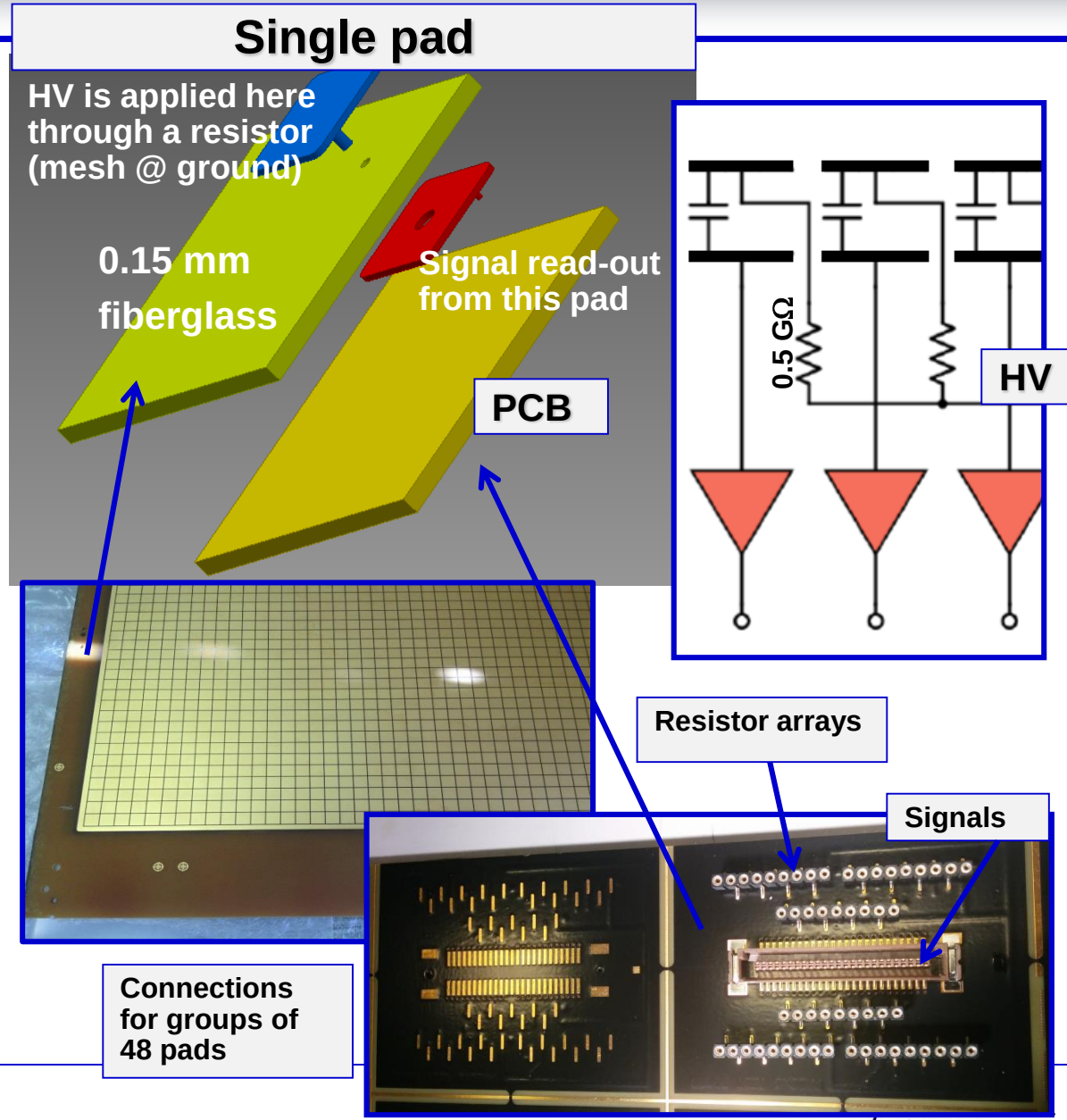
Resistive elements:

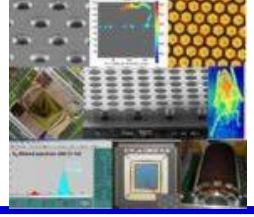
a decision made because we have to be on the floor in 2016

Our MM:

- **Standard bulk, built at CERN**
- **Gap: 128 μm**
- **Pad geometry: squared, pitch 8 mm, clearance 0.5 mm**
- **Gas mixture for the tests:**

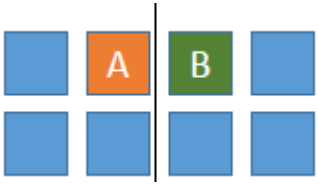
$$Ar : CO_2 = 70 : 30$$

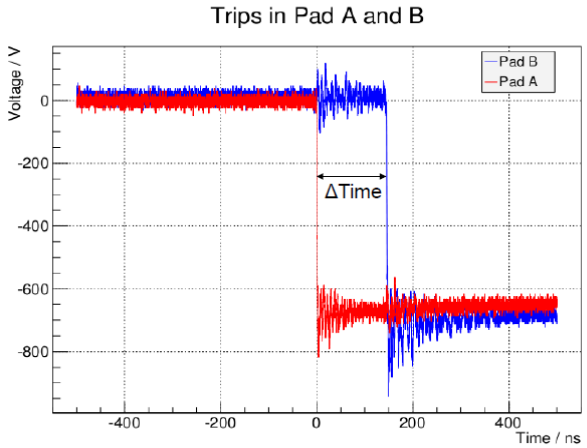


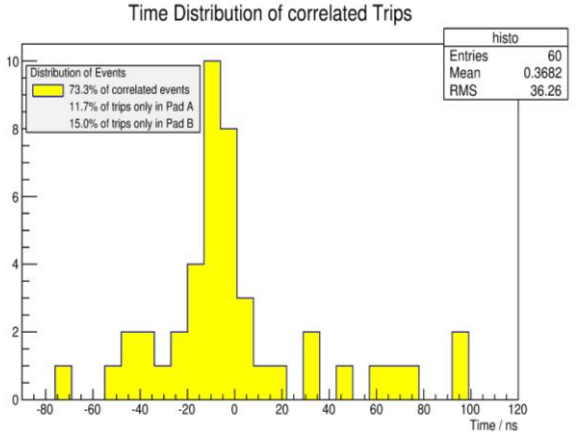


NO TRIP CROSS-TALK VIA PCB !

- **Two adjacent pads kept at anomalous high voltage (720 V) to enhance trip frequency (~ 0.1-0.2 Hz)**





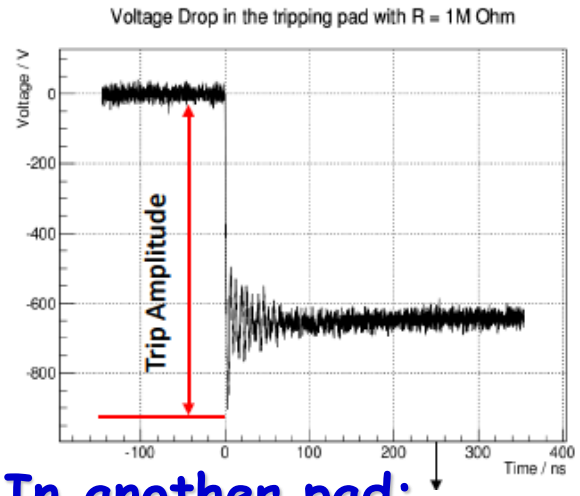


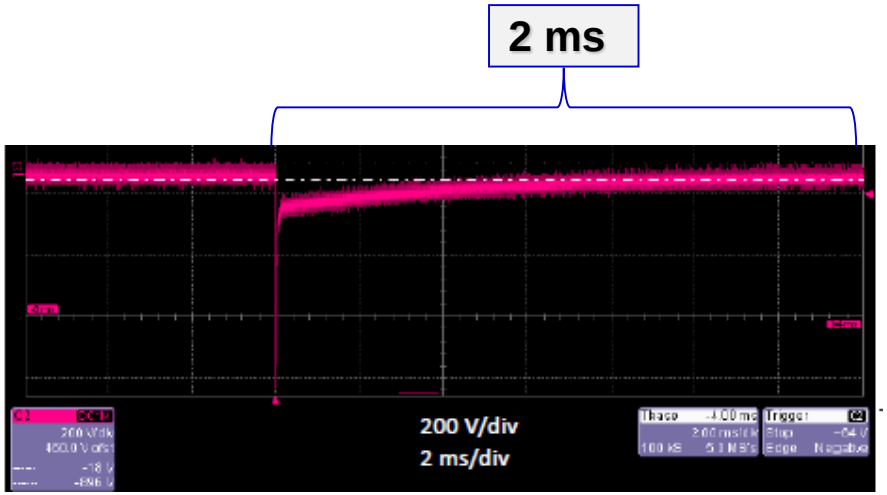
- **One of the 2 pads at standard voltage : no trip observed**

Coupled position	V(A)	V(B)	% correlated events	% only in A	% only in B
AB	720	720	73.3	11.7	15
AB	735	720	90	8.3	1.7
AB	720	735	70.5	1.6	27.9
AB	730	600	0	100	0
AB	600	730	0	0.0	100

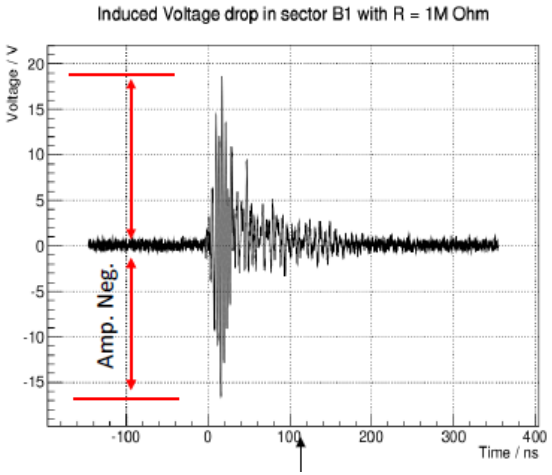
TRIP PICTURES

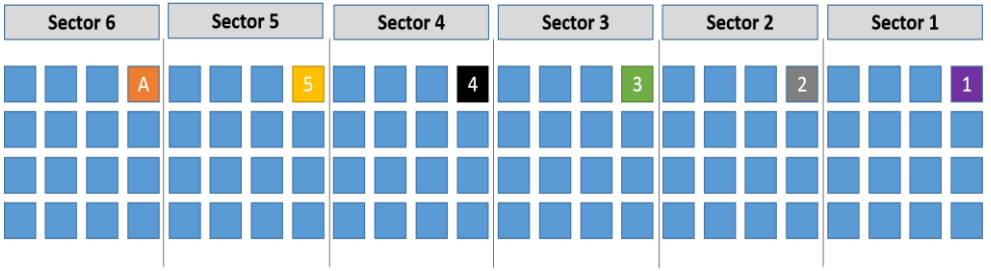
Discharge in Pad A (720 V)



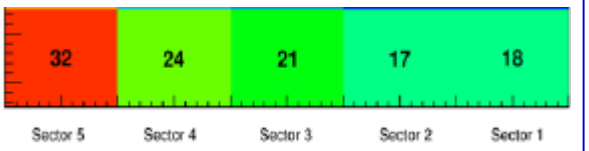


In another pad:



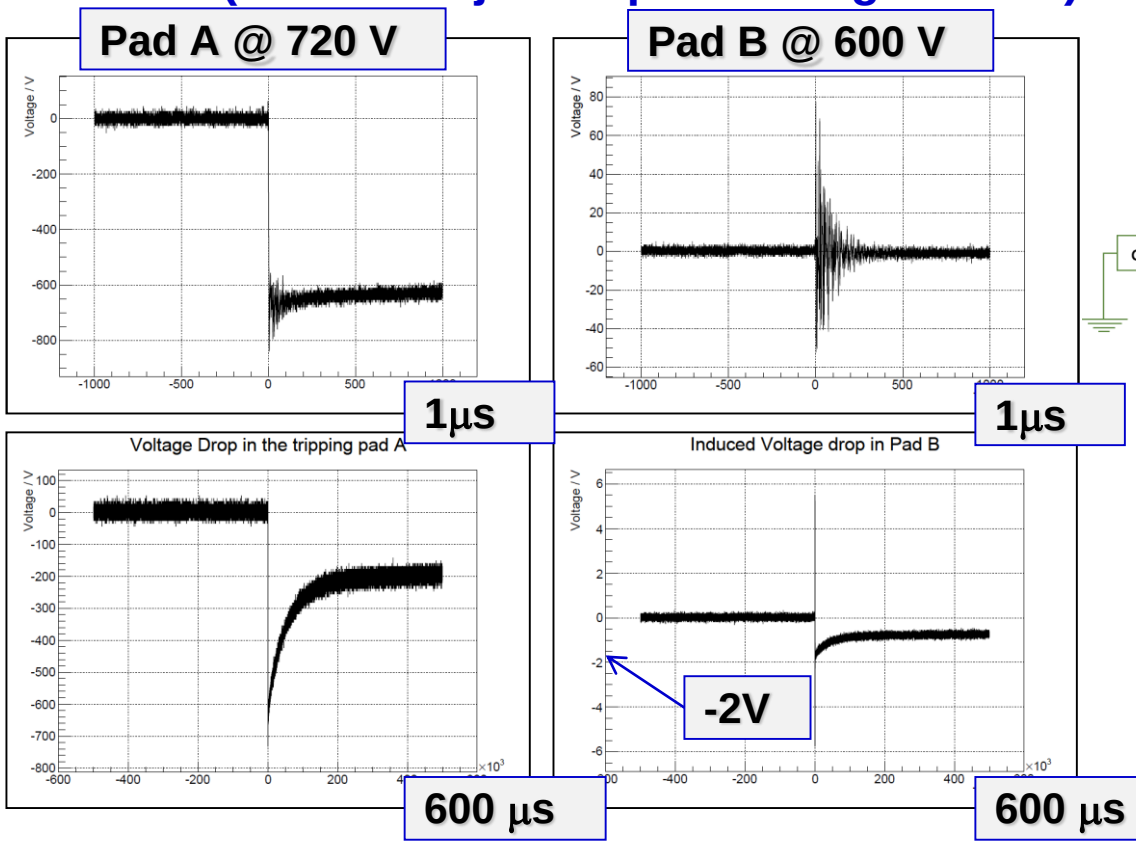


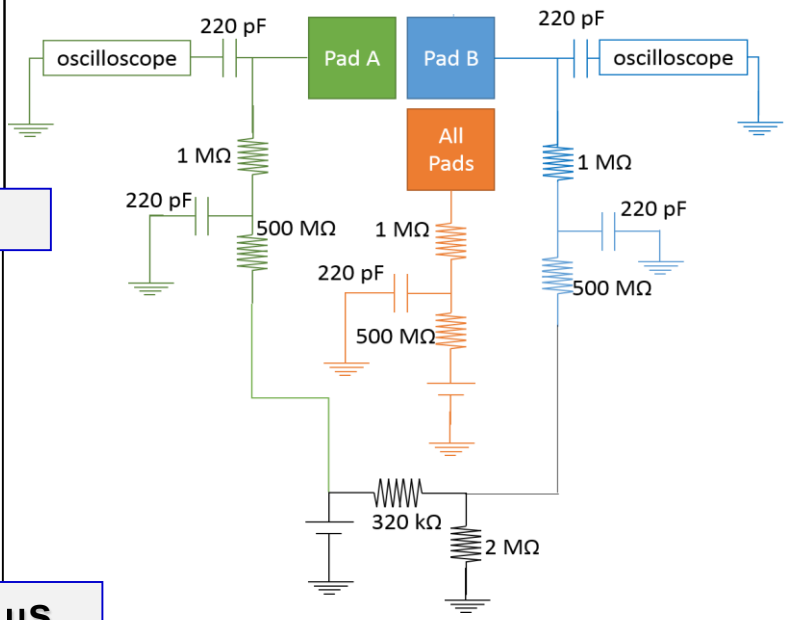
the amplitude decreases with the distance



RESPONSE OF THE NON-TRIPPING PAD

Pads A & B (the two adjacent pads being studied) are powered by the same PS

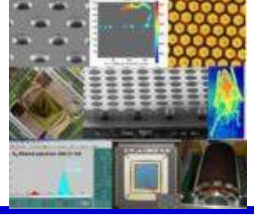




The HV of the non tripping pad is very limited affected:

2V drop → ~4% drop in G

R ~ 0.5 GΩ is preserving the non-tripping pads efficient all the time !

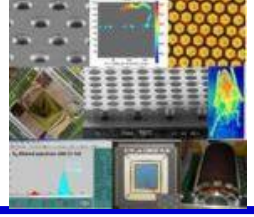


I AM THE ONLY ONE

FROM TRIESTE ATTENDING

THE MEETING

BECAUSE …



THE FIRST LARGE-SIZE MPGD-BASED SINGLE PHOTON DETECTORS ARE COMING !