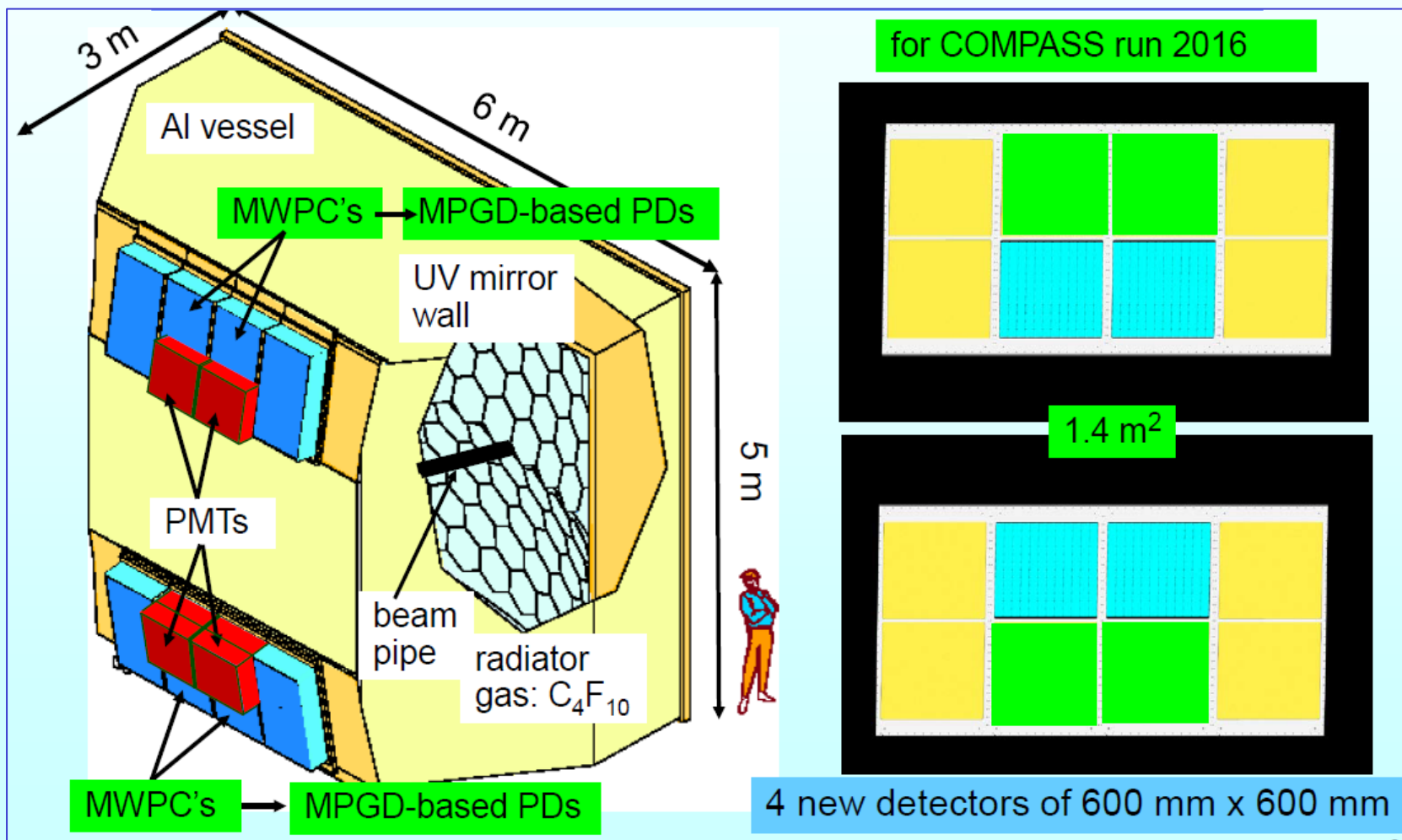


# Construction and assembly of the novel MPGD-based PDs for COMPASS RICH-1





# We are very grateful to ...

- **Thomas Schneider**
- **Miranda Van Stenis**

For their dedication in the long job of the photocathode coating

- **Rui De Olivera**
- **Olivier Pizzirusso**

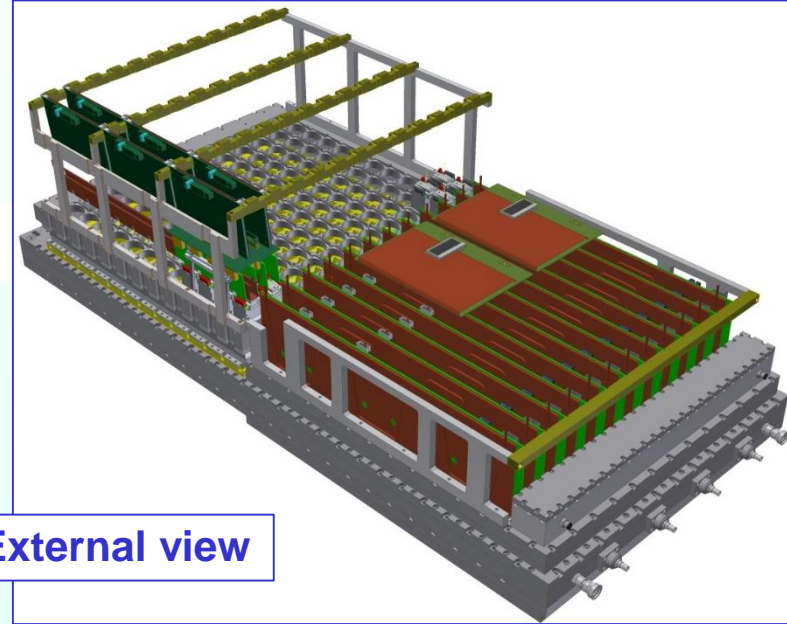
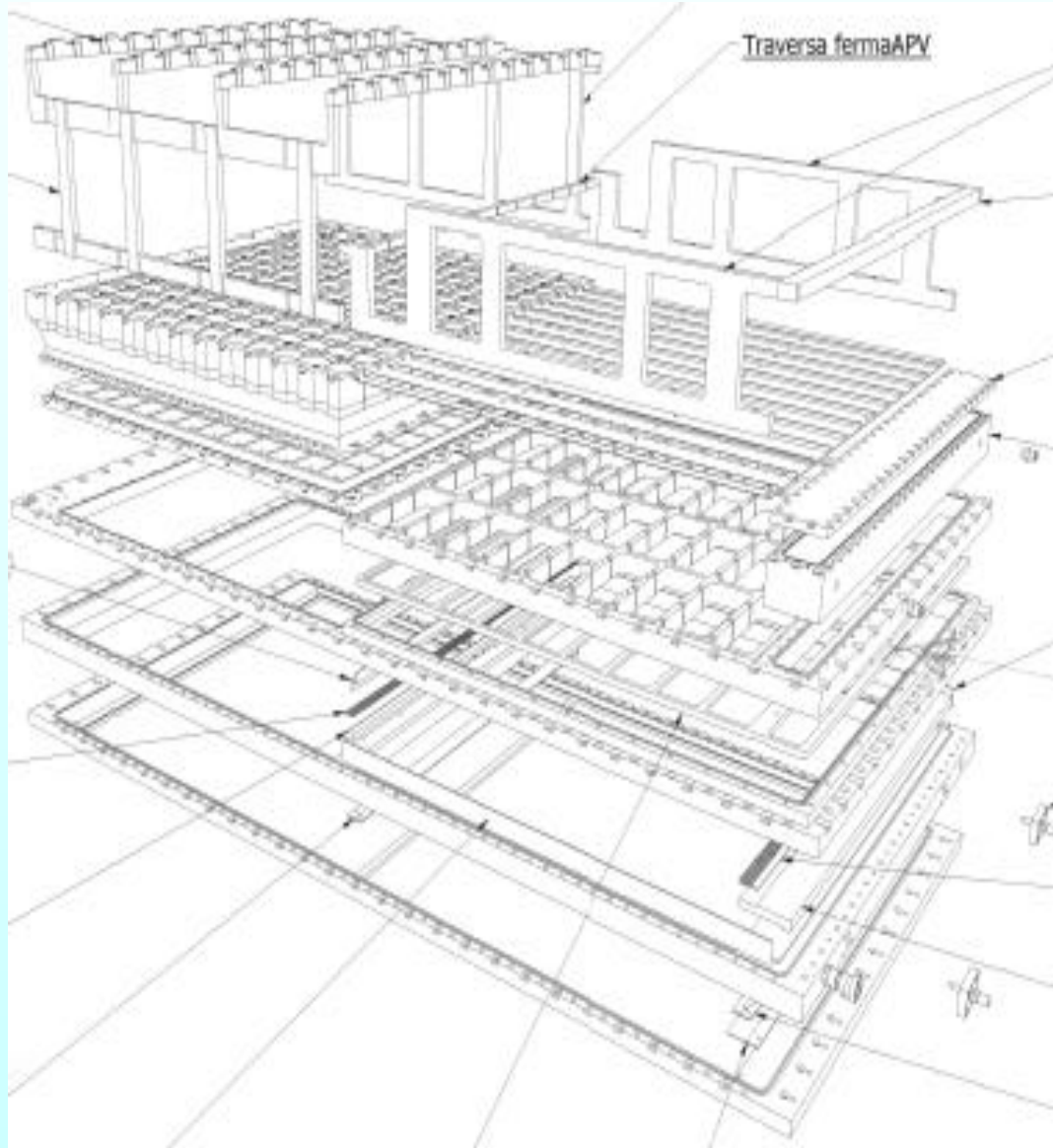
For the excellent quality of the bulk MMs produced for COMPASS RICH-1

## **Manpower for the construction and installation:**

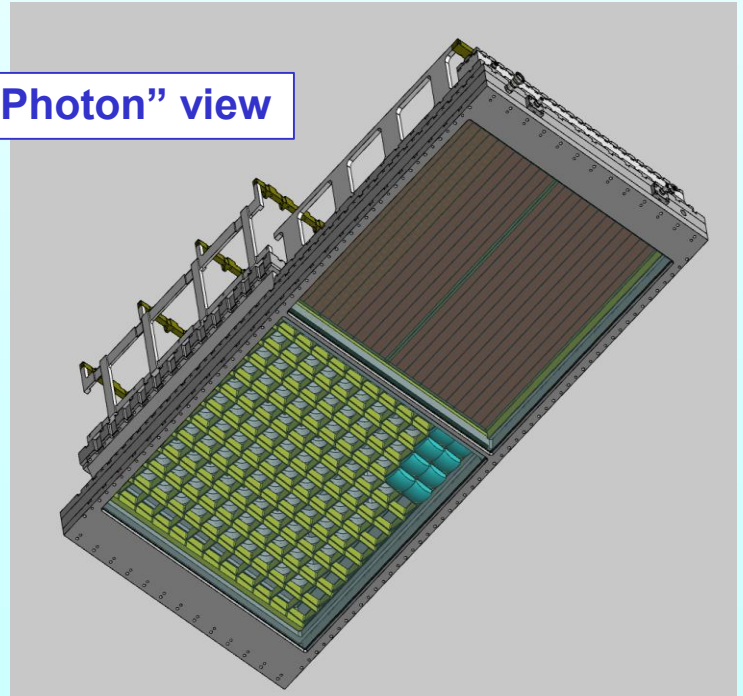
- **Staff physicists: 3 → 2.6 man-years**
  - Fulvio, Stefano, Silvia
- **Postdoc's and PhD's: 4 → 2.7 man-years (arrivals, departures)**
  - Shuddha, Gergo, Fabio, Carlos
- **Technical personnel: 8 → 5 man-years**
- **Undergraduated students: 3 → 0.5 man-years**



# Detector Structure

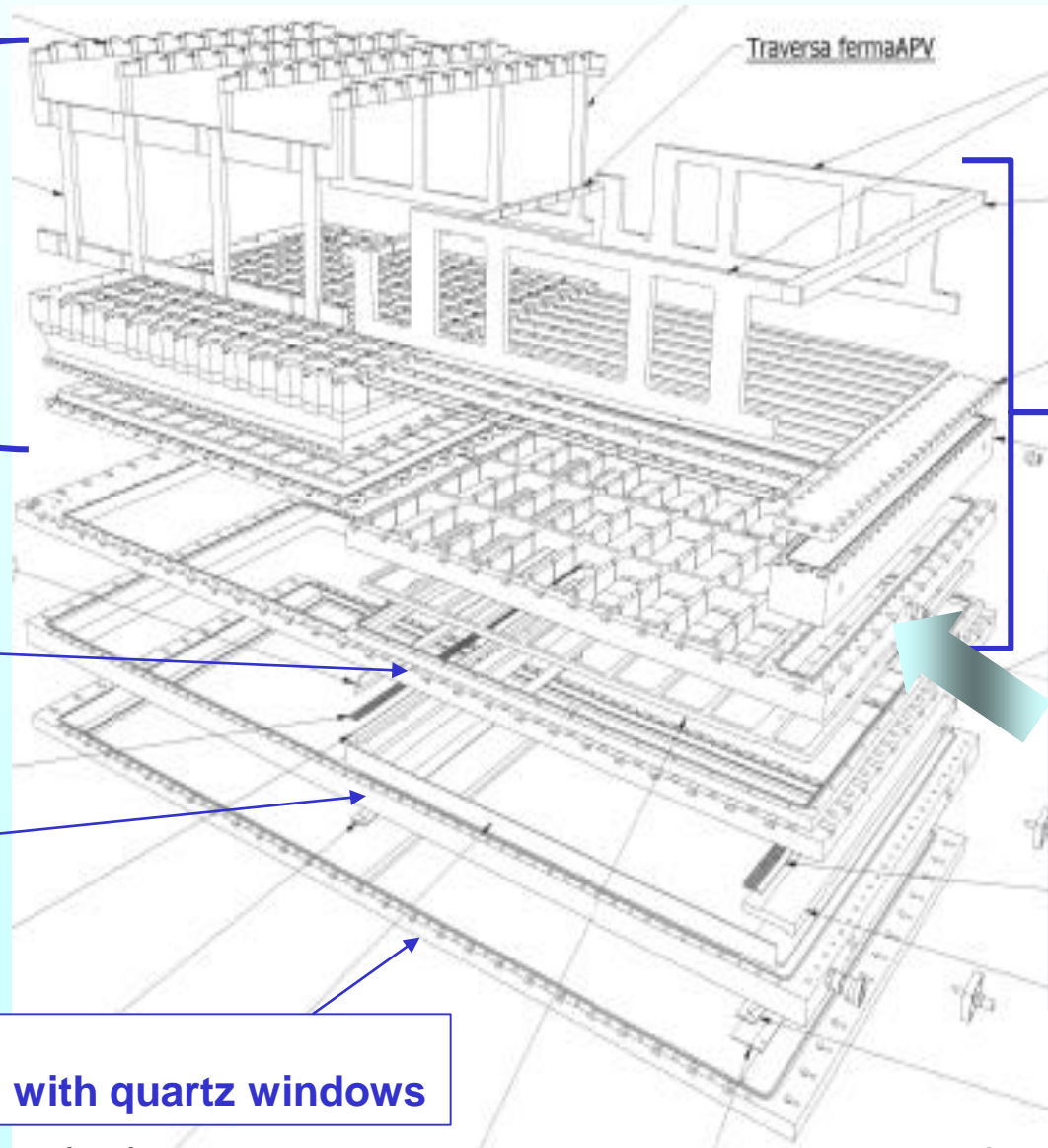


External view



"Photon" view

# Detector Structure



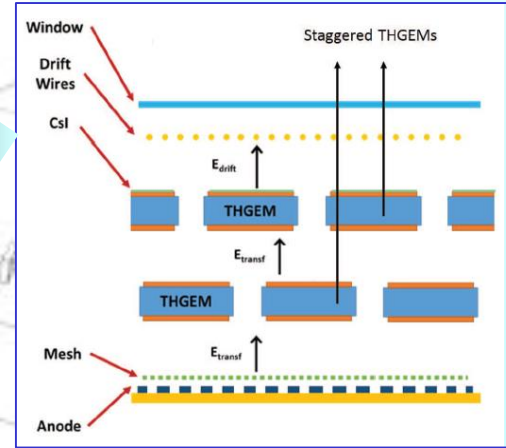
**OLD:**  
Lens telescopes  
and MAPMTs  
+ electronics  
support

**NEW:**  
Hybrid detector:  
2 THGEM planes  
(1 with CsI)  
and a MM  
+ electronics support

**NEW:**  
Distance  
frame

**NEW:**  
Support of  
2 wire planes

**OLD:**  
frame with quartz windows



## 2 options:

### 1. Opening the RICH vessel (as for the upgrade in 2005-06)

#### • STEPS

- Remove from the RICH the whole TOP and BOTTOM frames
- assembly the detectors in Clean area
- Mount the detector frames onto the RICH vessel

#### • PRO

- Easier detector assembly
- Procedure already tested

#### • CONTRA

- Vessel opening: dust, mirror ageing, gas pollution, lack of experienced personnel, confined space safety issues



DECEMBER 2016

### 2. W/O Opening the RICH vessel (new procedure)

#### • STEPS

- Remove only the detectors to be replaced, leaving the quartz windows in place
- Only partial assembly in lab
- Assembly the detectors directly onto the RICH vessel

#### • PRO

- No risks for vessel pollution and mirrors
- Avoid the amount of work related to vessel opening

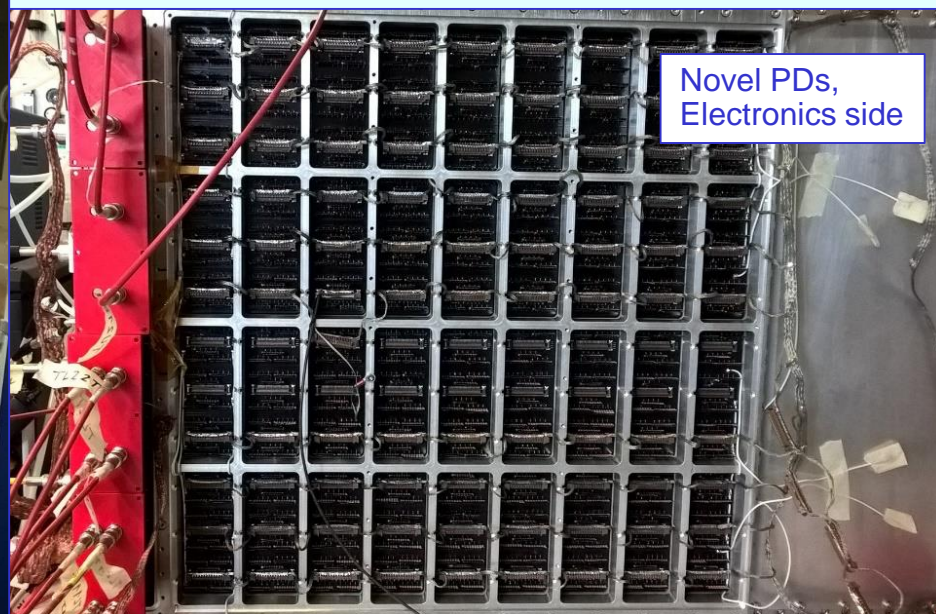
#### • CONTRA

- More complex detector assembly directly onto the RICH vessel



PROCEDURE no 2  
SELECTED

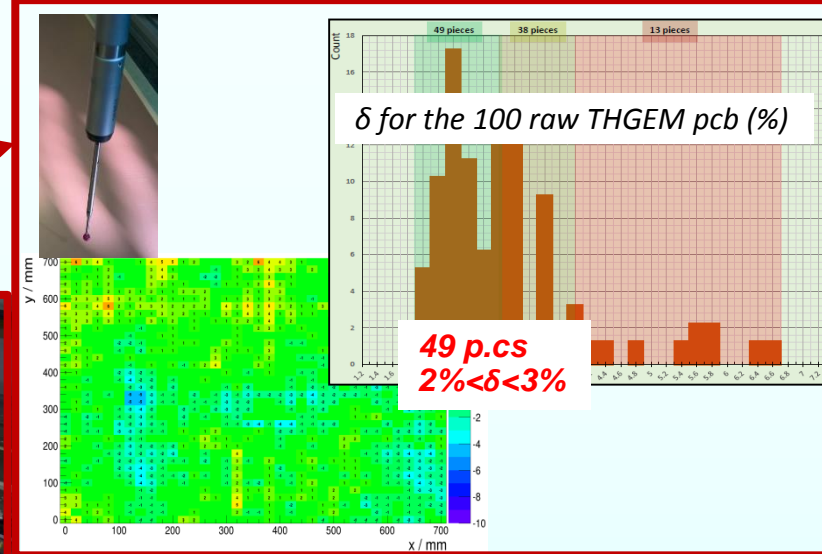
- **In Trieste**
  - **Assembly of each of the 4 detectors**
    - w/o CsI THGEM
    - w/o MAPMTs and lenses
    - on a temporary frame replacing the quartz frame  
(the quartz windows stay on the vessel to close its volume)
  - **Detector test**



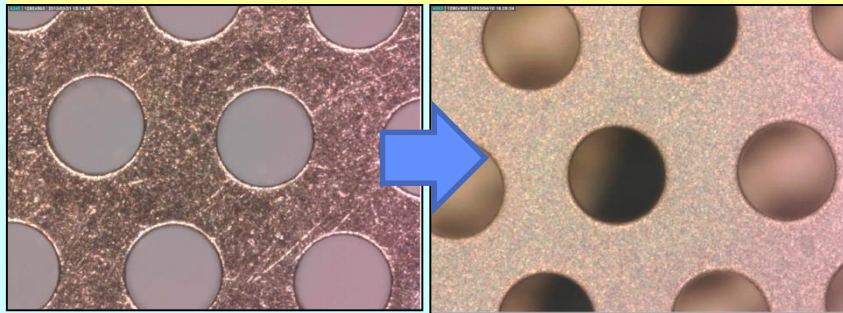


# THGEMs

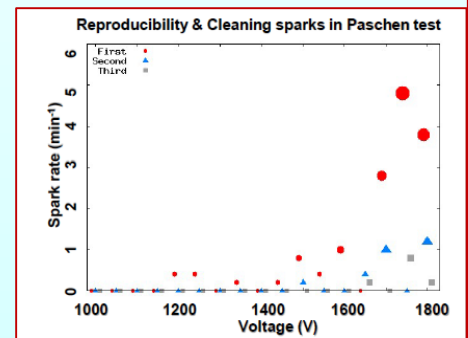
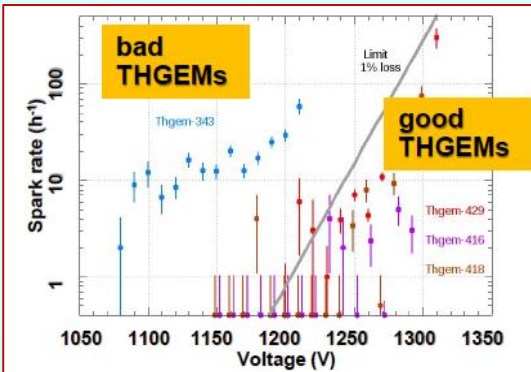
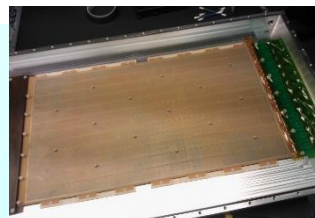
- Material selection
- Industrial production
- Polishing
- QA
- Au-coating
- QA



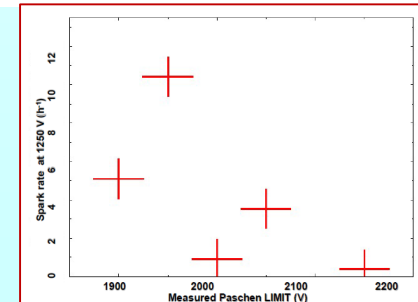
@Trieste lab, a specific cleaning procedure is applied : (1) polish with fine grain pumice powder, (2) pressure water cleaning, (3) ultrasonic Bath with Sonica PCB solution (PH11), (4) distilled water rinsing and (5) oven



## DISCHARGE RATES in single layer THGEM



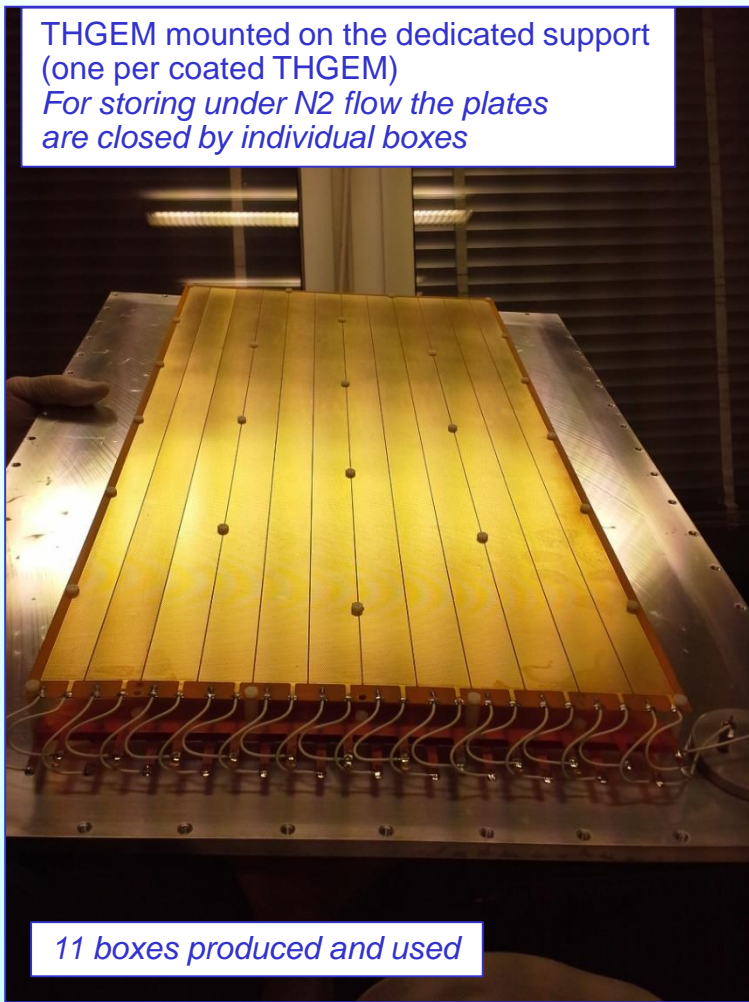
## Paschen measurements in N<sub>2</sub>



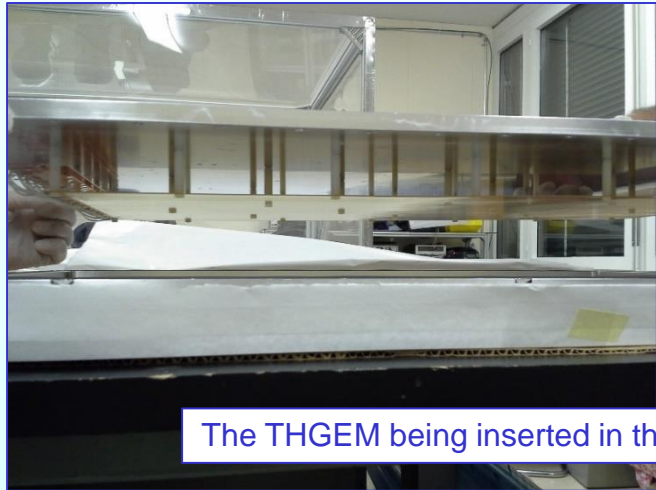
## Correlation of PASCHEN LIMIT vs SPARK RATES

**REMINDER: 1 coating per week!**  
 Including tests, mistakes, ... 5 months of work: Oct/15-Feb/16

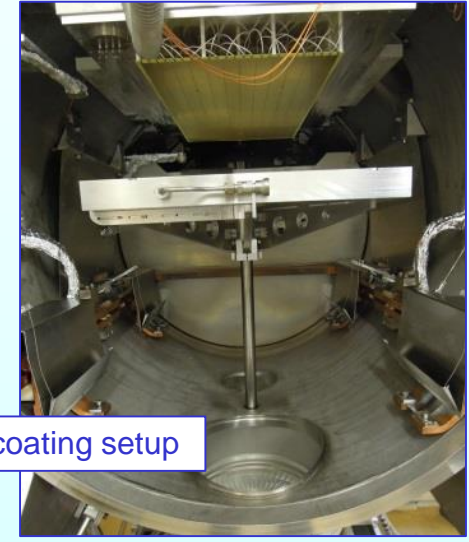
THGEM mounted on the dedicated support (one per coated THGEM)  
 For storing under N2 flow the plates are closed by individual boxes



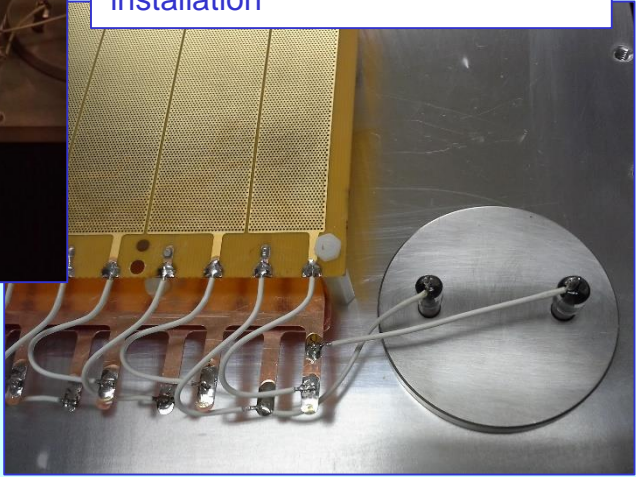
11 boxes produced and used



The THGEM being inserted in the coating setup



Detail of the electrical connection to monitor QE inside the coating installation

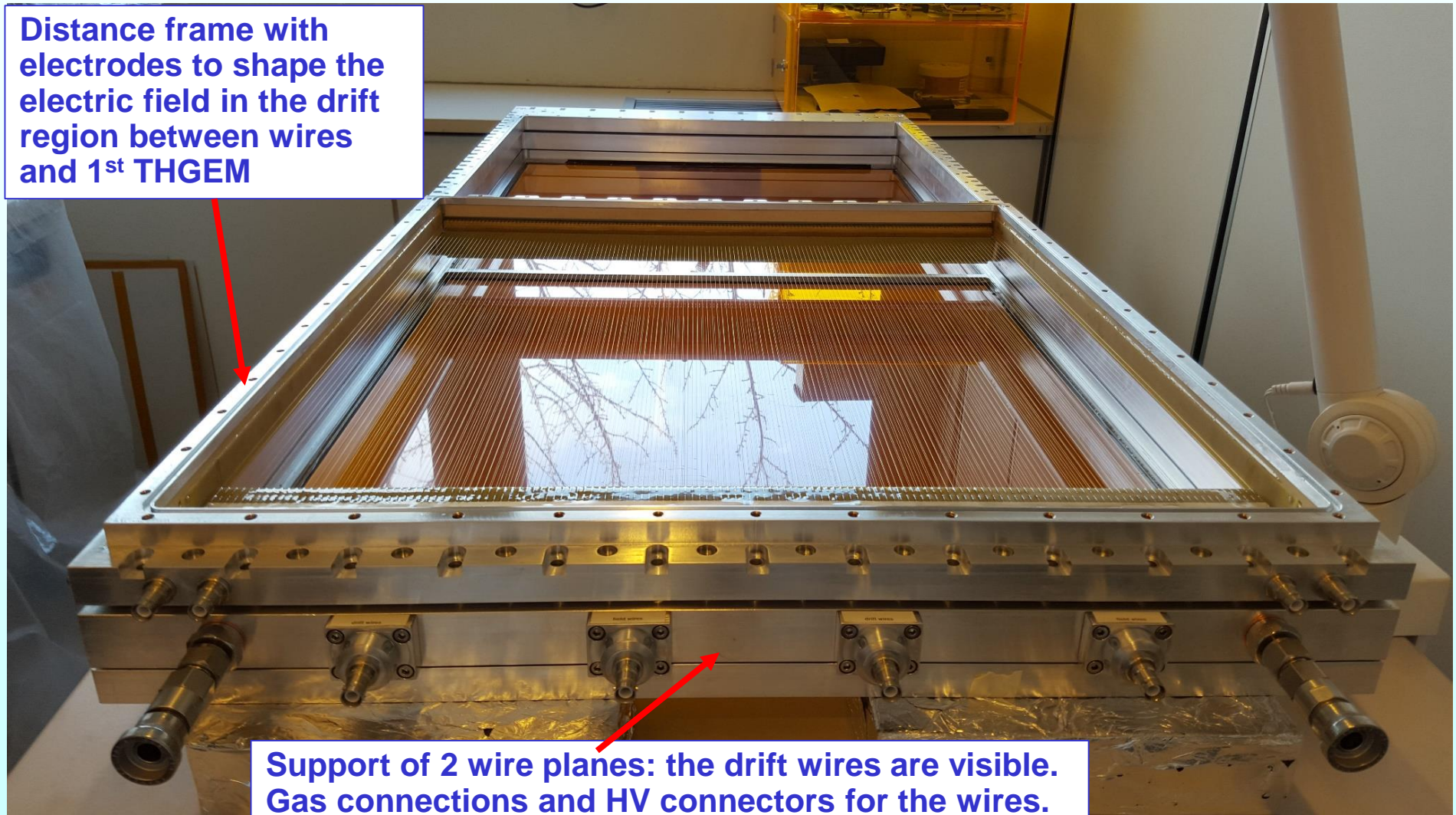


These measurements indicate for our photocathodes  
 QE = 0.7 ÷ 1 x (max CsI QE)  
 with an increasing trend during the production

preliminary

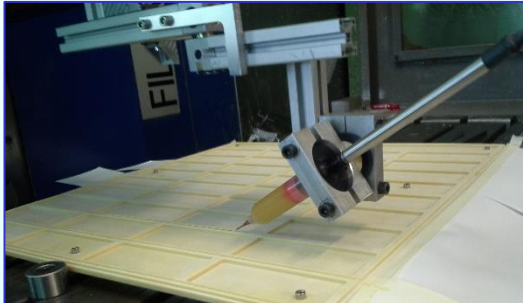


Distance frame with electrodes to shape the electric field in the drift region between wires and 1<sup>st</sup> THGEM



Support of 2 wire planes: the drift wires are visible. Gas connections and HV connectors for the wires.

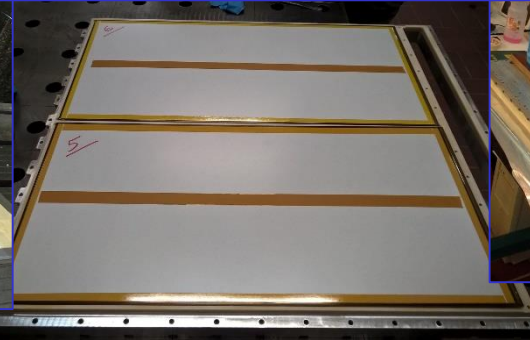
# MICROME GAS



Glueing the insulator frame onto the Al frame that ensures the MM rigidity



Glueing the Bulk MM onto their frame



Insulator frame in place



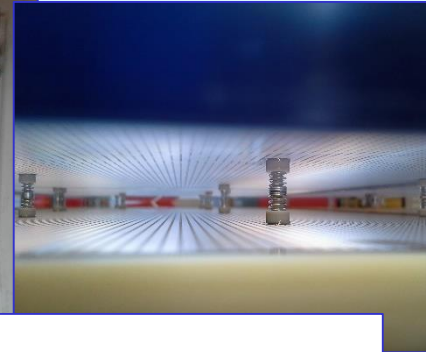
Insulator frame black painted



Stripping out the MM protection

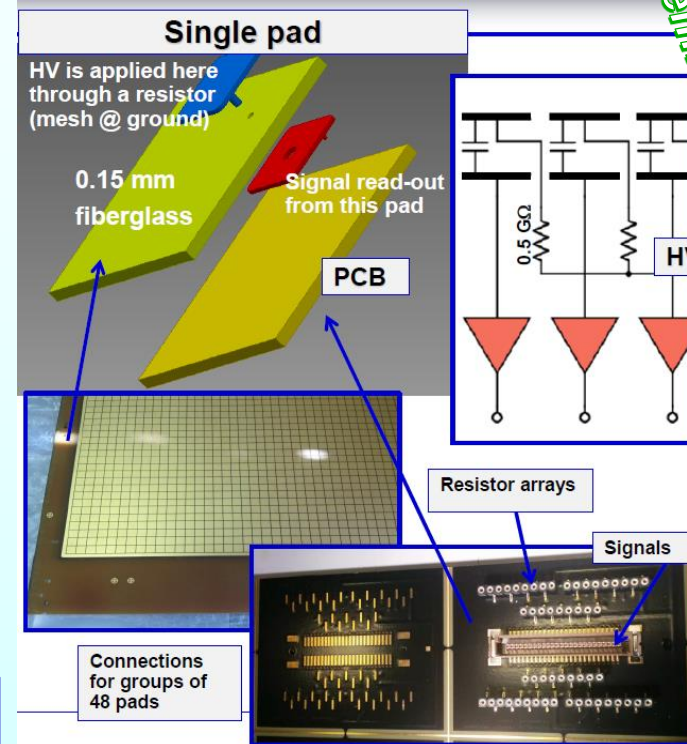
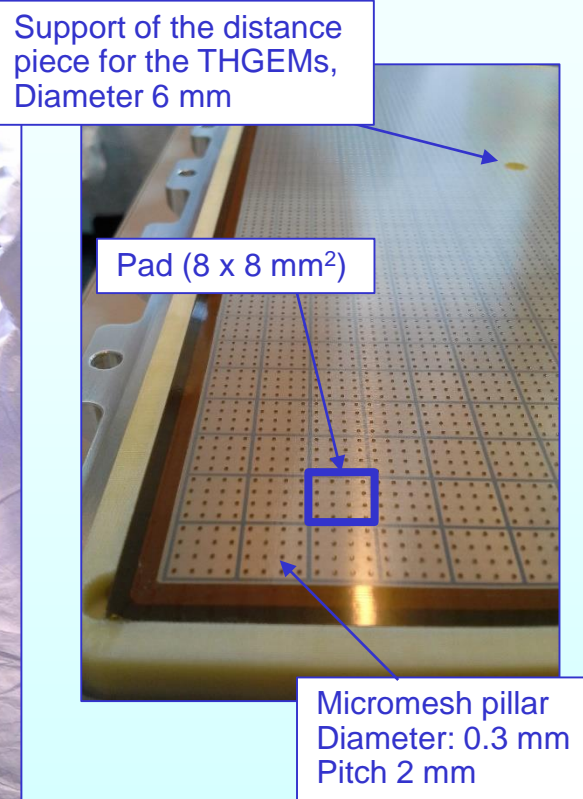


Glueing onto the MM the distance pieces that will ensure the correct distance between MMs and THGEMs



Fulvio TESSAROTTO

# MICROME GAS

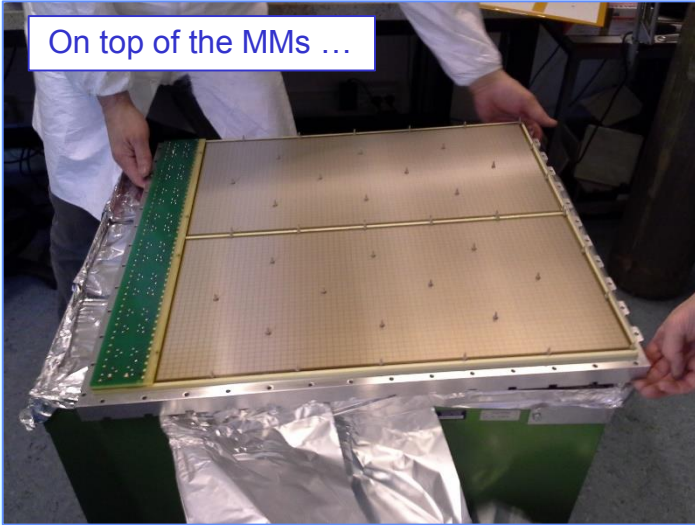


reminder

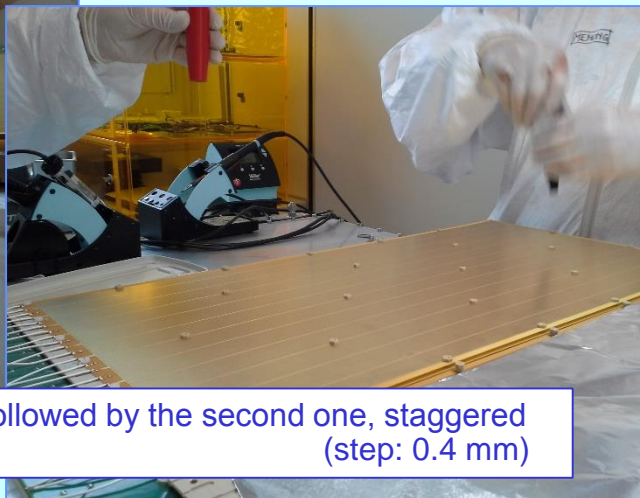
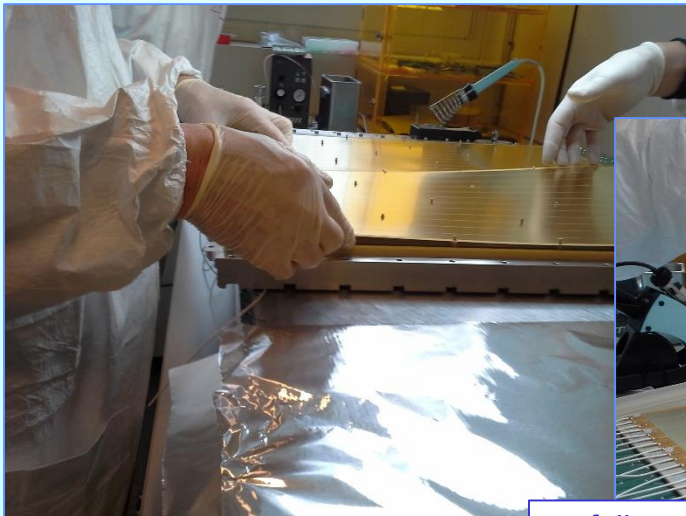
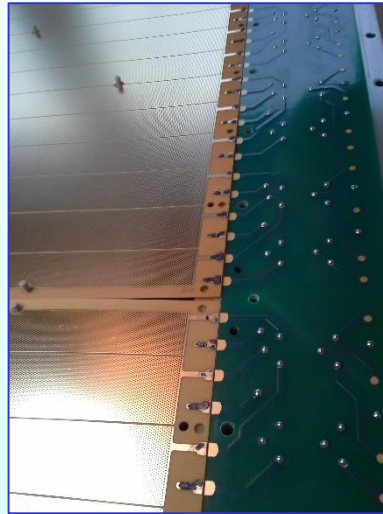
**Test of the (4 x 2) 30 x 60 cm<sup>2</sup> MMs**  
 [in total: 1.4 m<sup>2</sup>, 19040 pads]:  
 2 pads with shorts  
 1 pad: no read-out connection  
 → 3 bad pads out of 19040

# Assembly of the hybrid detector

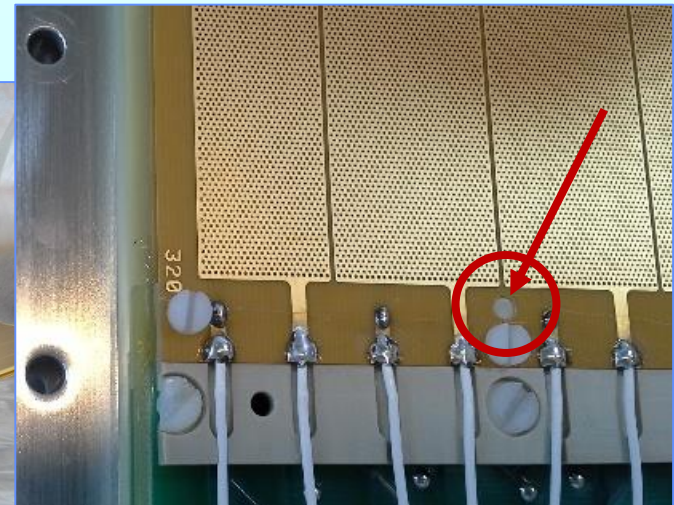
On top of the MMs ...



... the first THGEM layer is mounted ...



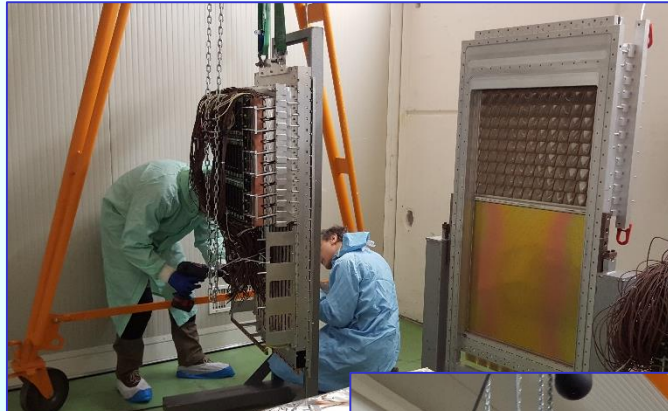
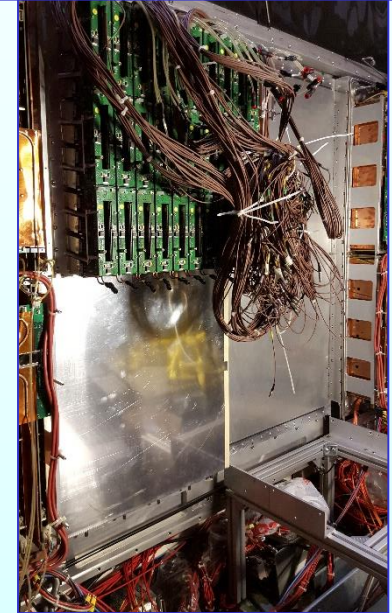
... followed by the second one, staggered (step: 0.4 mm)



# ASSEMBLY, cont.

- @ CERN
  - Mount (MAPMTs + lenses) onto the new mechanics
  - Mount the new mechanics onto the RICH

New frames (with wires)  
Mounted onto the RICH vessel



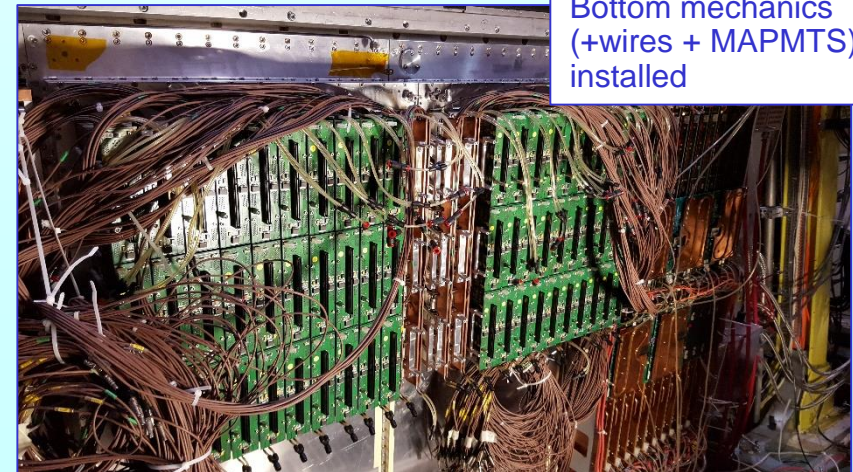
Dismount MAPMTs  
+ lenses from  
the old detectors

New frames (with wires)  
now housing also  
MAPMTs and lenses

mount MAPMTs  
and lenses onto  
the new frames

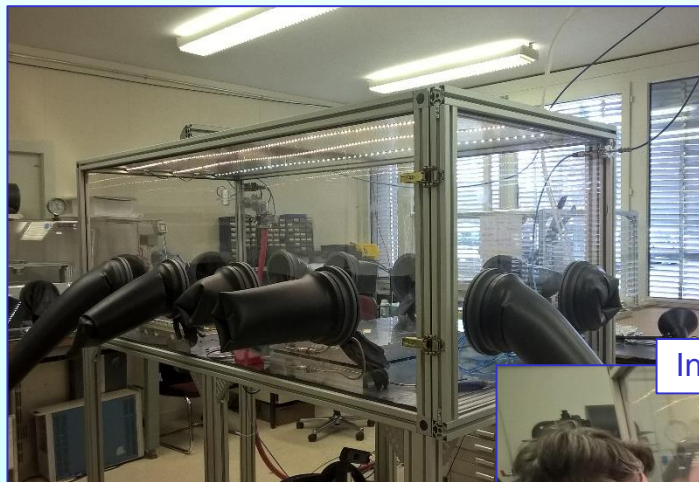


Bottom mechanics  
(+wires + MAPMTs)  
installed

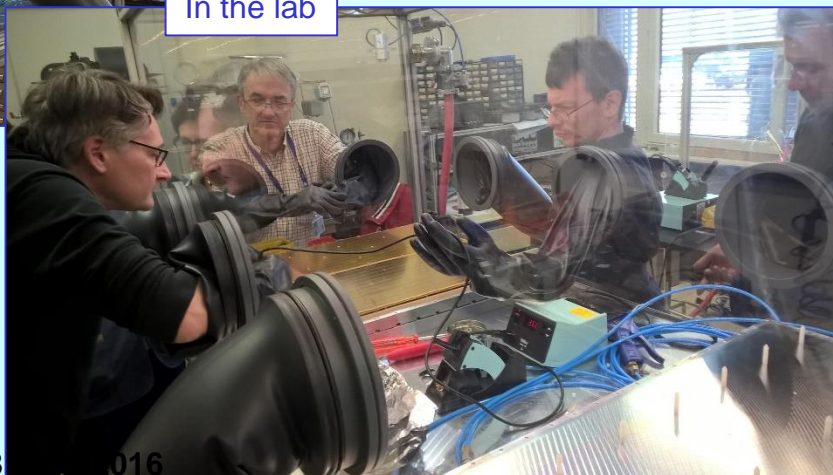


# ASSEMBLY, cont.

- **@ CERN**
  - Assembly the novel detector with CsI photocathode (in dedicated glove box @ 892)
  - Mount the detector onto the RICH (with a different dedicated glove box)
  - Mount the read-out electronics and related cooling system



In the lab



Onto the RICH

# INSTALLATION: COMPLETED COMMISSIONING: STARTED

