

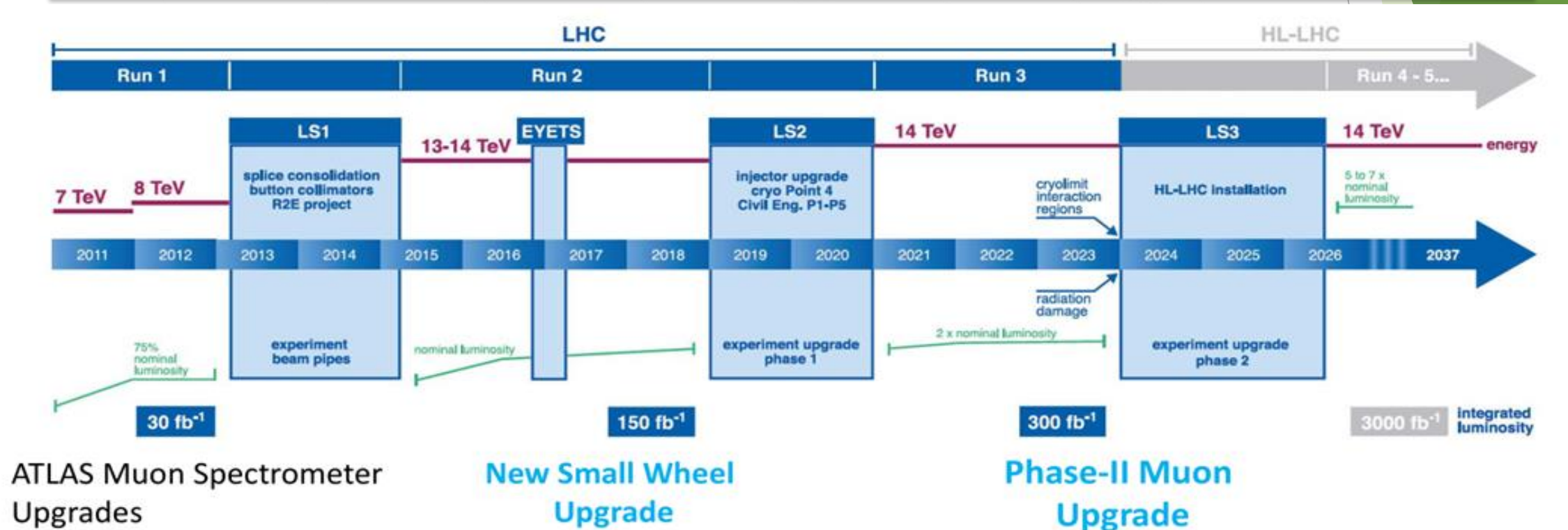
Winter meeting of the PAC for Particle Physics Feb 2022

LM2 Micromegas chamber production and test for the NSW ATLAS upgrade at the

DLNP JINR

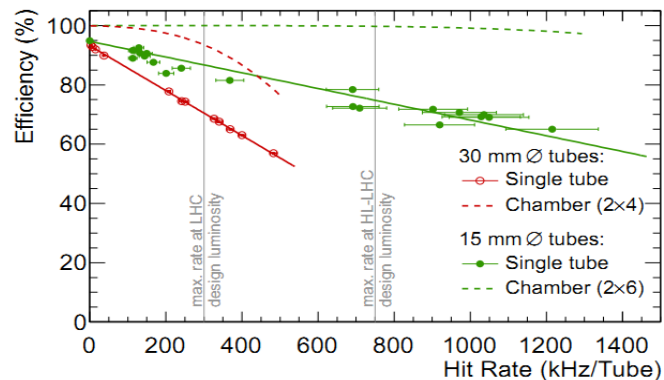
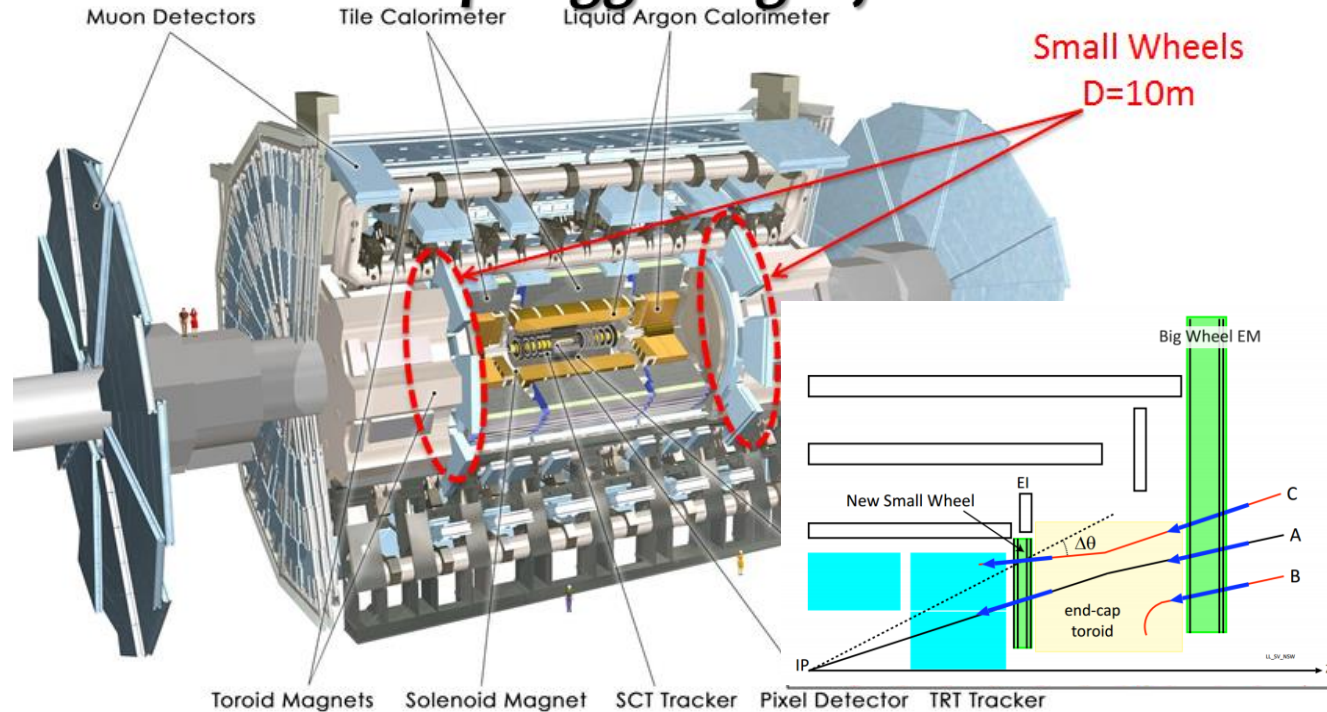
Minashvili Irakli

LHC Upgrade

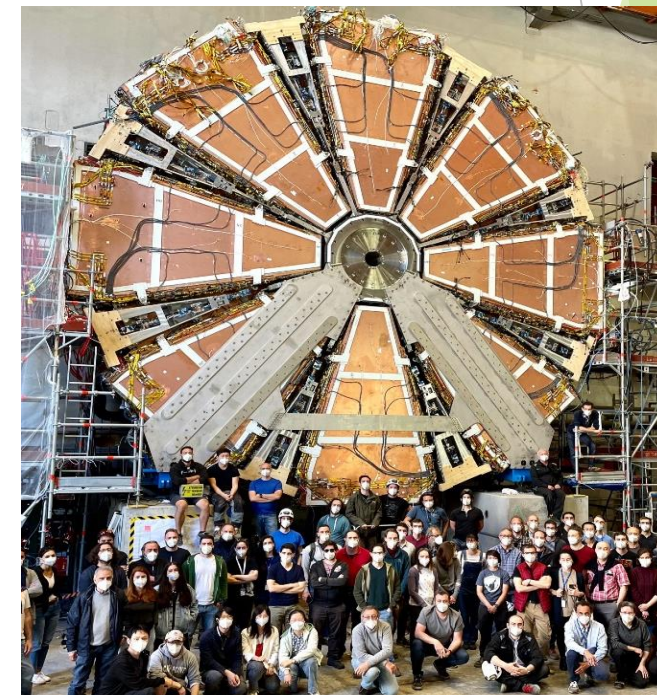


ATLAS Small Wheel upgrade motivation

- MDT performance degradation
- Present endcap trigger high fake rate



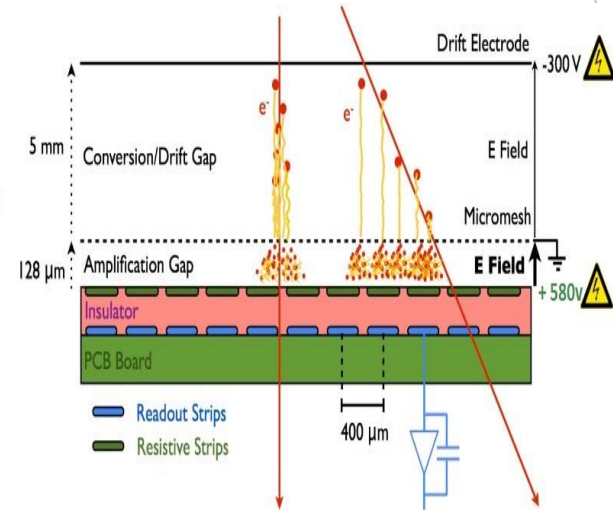
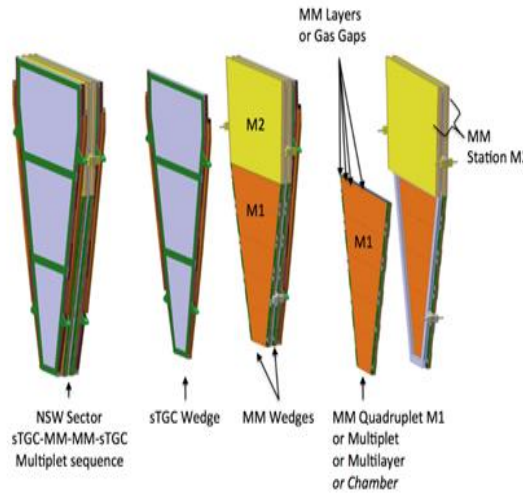
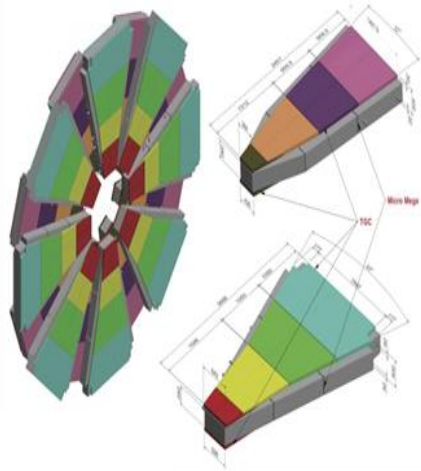
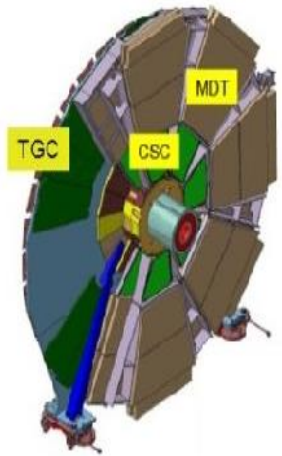
Old SW
(CSC, MDT,
TGC)



New NSW
(MM, sTGC)

Operating principle of Micromegas

Present Small Wheel New Small Wheel (NSW) NSW Sector



- Gas gain up to $\sim 10^4$
- Fast signal $\sim 100\text{ns}$
- Conv. gap 5mm
- Ampl. gap 120 μm
- $E_C \sim 0.6 \text{ kV/cm}$
- $E_A \sim 40 \text{ kV/cm}$

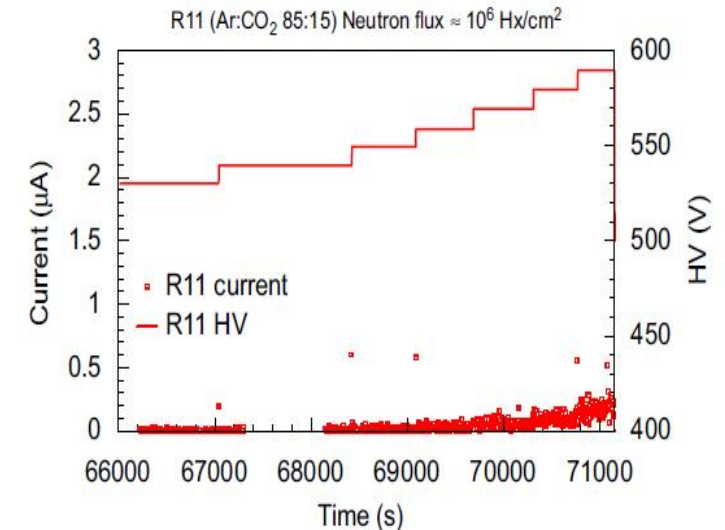
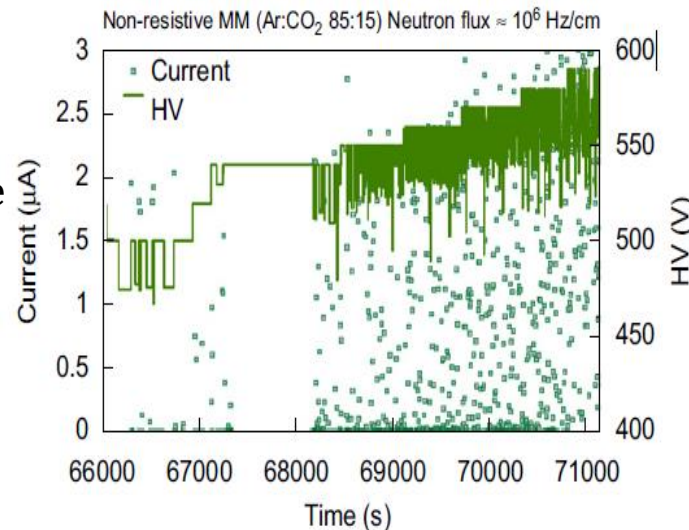
Spark protection with resistive strips:

Many good characteristics to fulfill ATLAS specs:

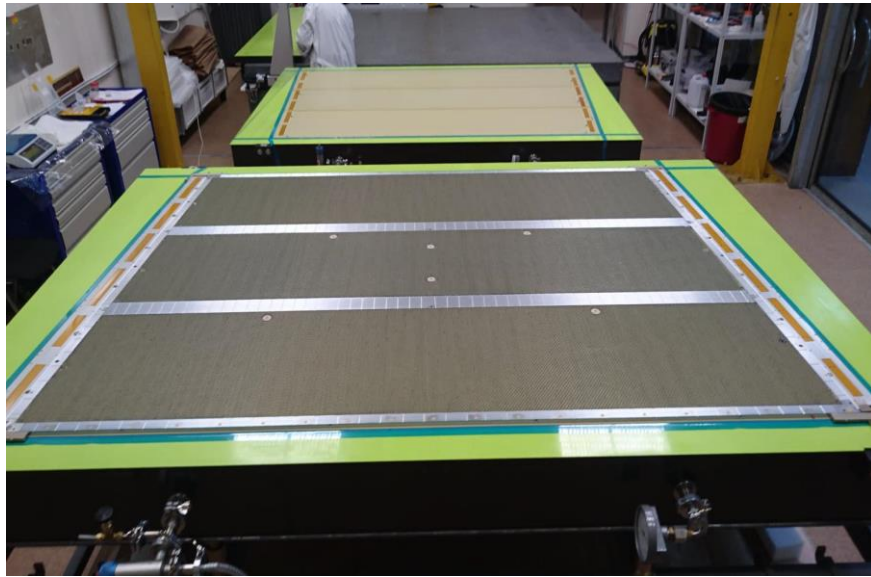
- Able to operate in high rate environment 10 kH/cm^2
- Detector efficiency $\sim 99\%$
- Spatial resolution 60-80 μm at angles up to 45 degree
- Time resolution 5 ns
- 200 kH/cm^2 due to neutrons with $E > 100 \text{ keV}$

Technology challenges:

- Discharges due to heavily ionizing events
- Fabricate large size chambers (3 m^2)
- Frontend electronics 2M channels



Read out panel preparation and gluing, Strip alignment

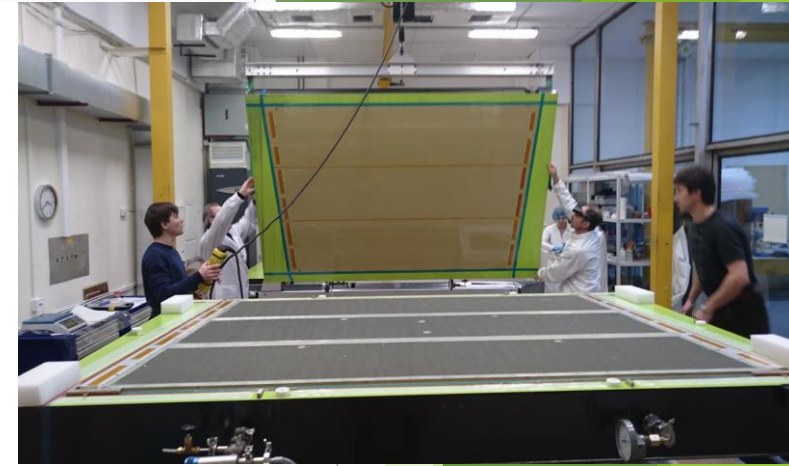


PCB preparation

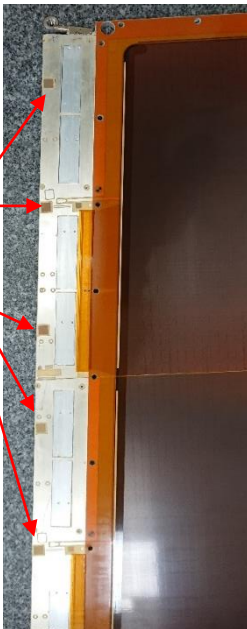
- 2 precise vacuum tables
- 3 PCBs on each of them
- Aluminium frame and Aluminium honeycombs for the hardness

Gluing procedure

- 200 μm glue layer on each side
- Put frame, honeycomb and cooling bars
- Electrical connection between all metallic parts
- Sandwich with precision shims in between

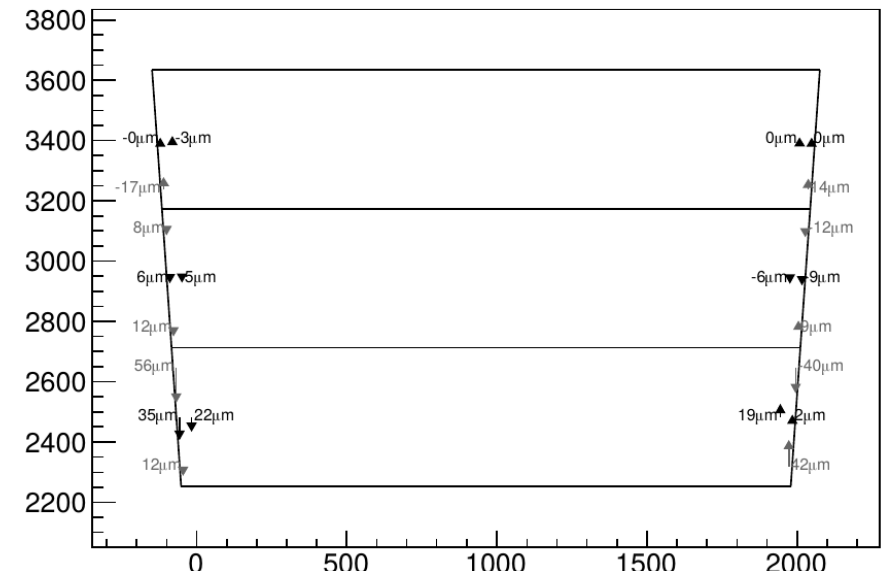
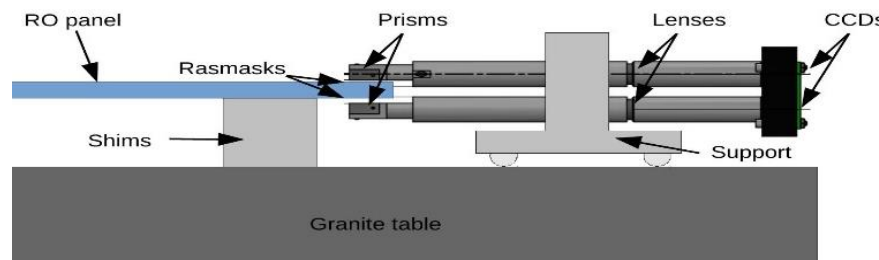


Rasmask

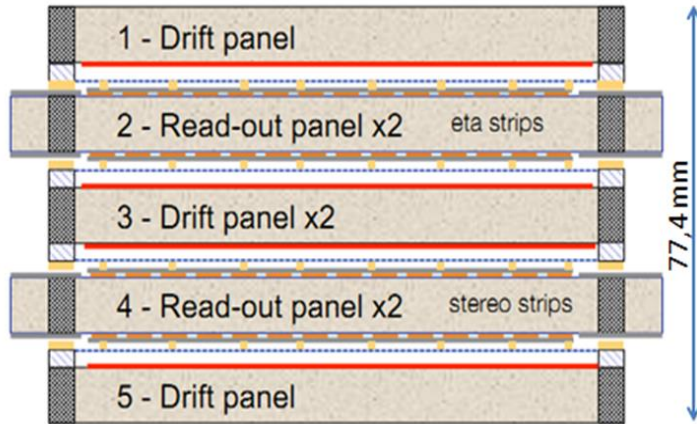


Strip alignment assessment based on rasmask position measurement:

- In-layer alignment
Optical CMM
- Side to side alignment
2 channels Rasfork
- Panel-to-panel alignment
4 channels Rasfork



Quadruplet assembly



3 Drift and 2 RO panels
Before assembly each
panels are washed
dried in the oven



- Quadruplet assembly in the clean room using special station
- HV test during assembly
- Two types of test: dry air and Ar:CO₂ (93:7) gas mixture



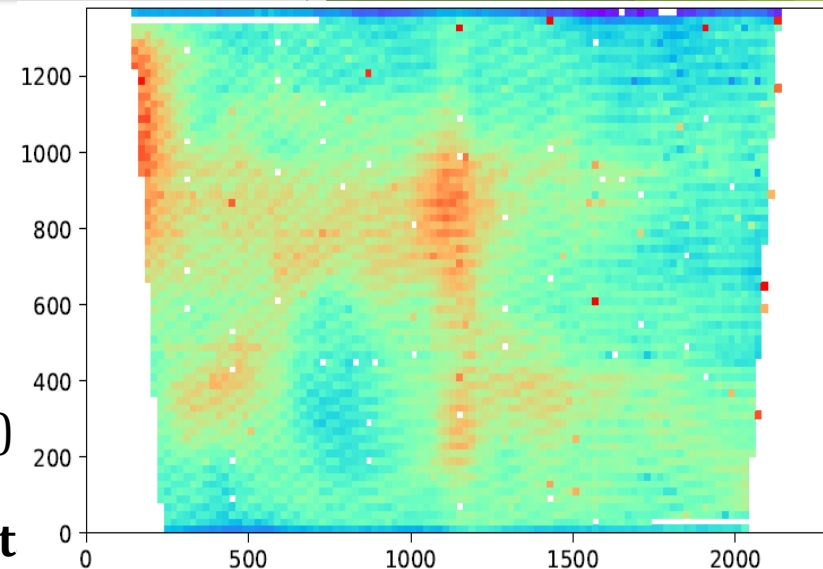
Measurements and tests

Planarity and thickness measurement

- Using granite table and CNC machine with optical head for topology measurements
- Nominal thickness/RMS: 11,43 mm/20 μm

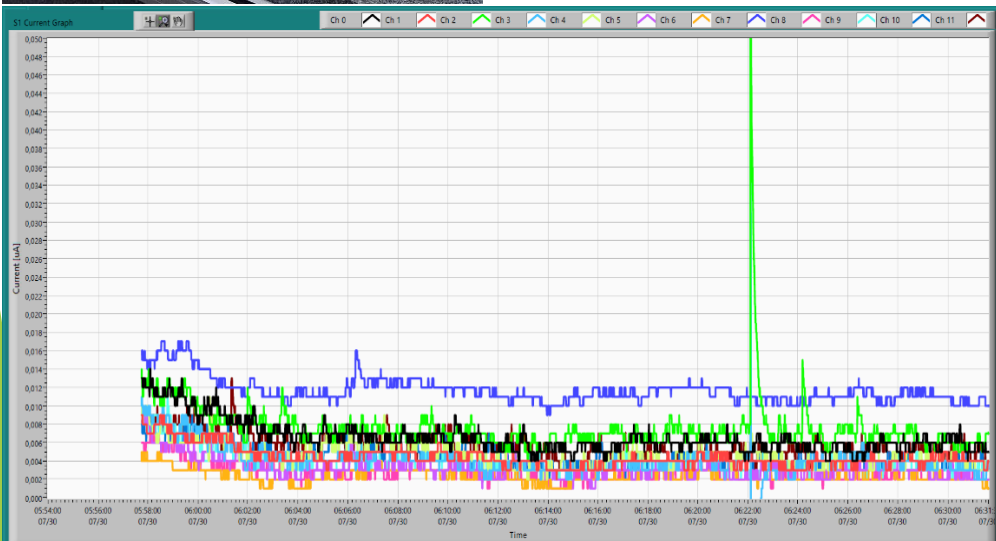
Gas leak

Gas leak 0.2 – 0.3 volume*mb/h (limit - 0,6 volume*mb/h)



High voltage st

- Quadruplet HV tests in dry air at 990 V
- Current recoil and stabilisation after voltage rump up



High voltage stability

- Quadruplet HV tests in gas mixture Ar:CO₂ (93:7) at 580v
- One spark at ch2 but module is stabile

