MM mechanical prototype

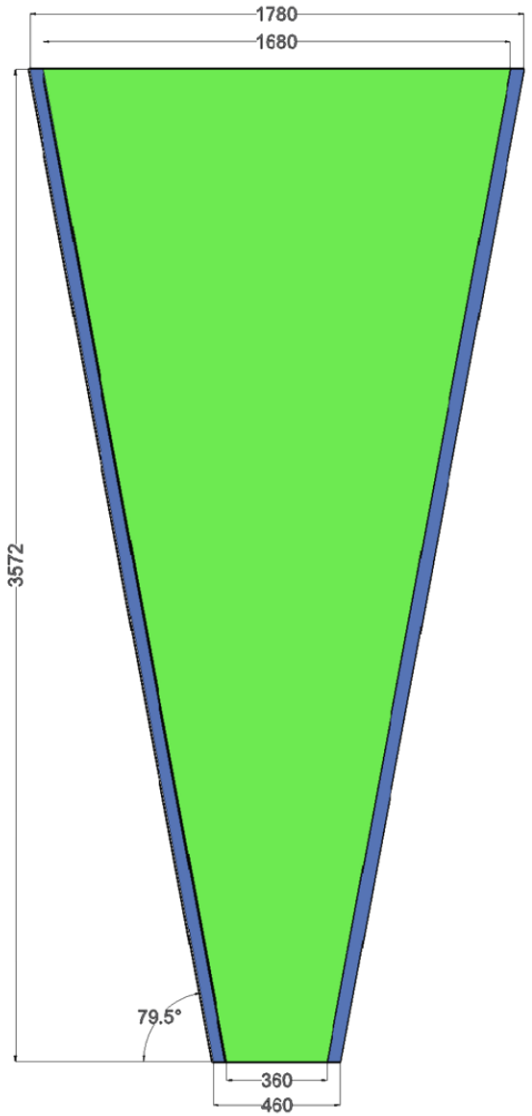
Work progress at CERN

Purpose

- Demonstrate feasibility
- Setup of basic infrastructure
- Gain experience with
  - Materials
  - Construction/assembly ideas/schemes
  - Procedures
  - Precision (panel planarity, parallelism of skins, …)
- Produce objects that can be measured

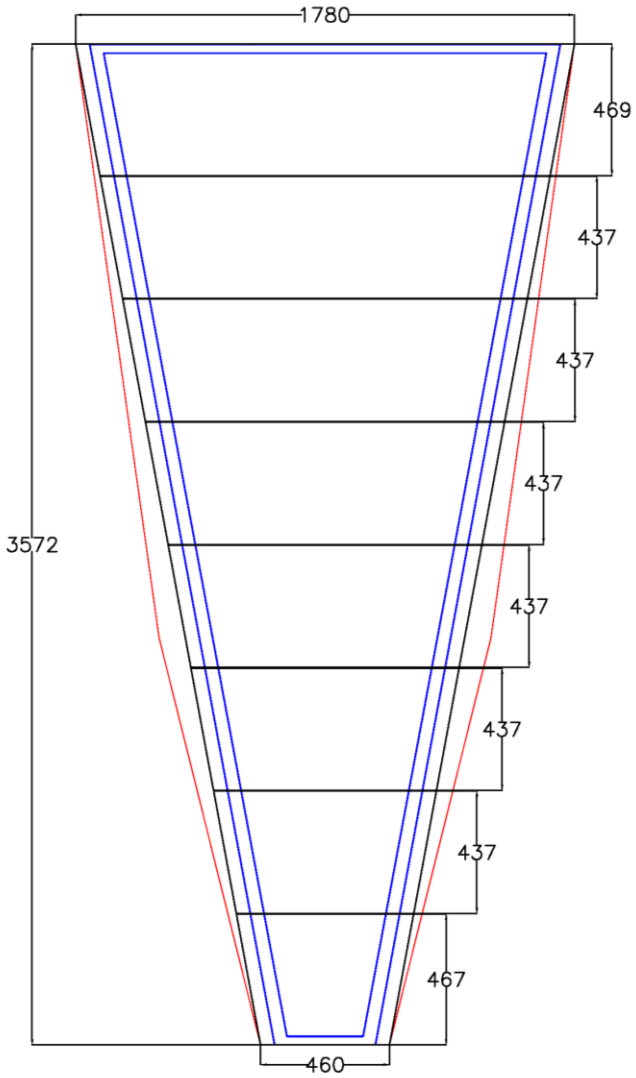
CERN mechanical prototype (1)

- Full-wedge small sector quadruplet
  - Eta and stereo doublets
- Drift gap – 5 mm
- Total thickness ~80 mm
- Support frame (spacer)



CERN mechanical prototype (2)

- All panels of equal thickness ~12 mm
  - Frame of standard 10 mm Al profiles
  - 0.4 mm plastic mesh
  - 9.5 mm foam panel
- Skins – 0.5 mm FR4 segmented into the 8 parts
- Glue – Araldite 2011
  – Araldite AY 103-1 + HY 991
  – Scotch-Weld DP490

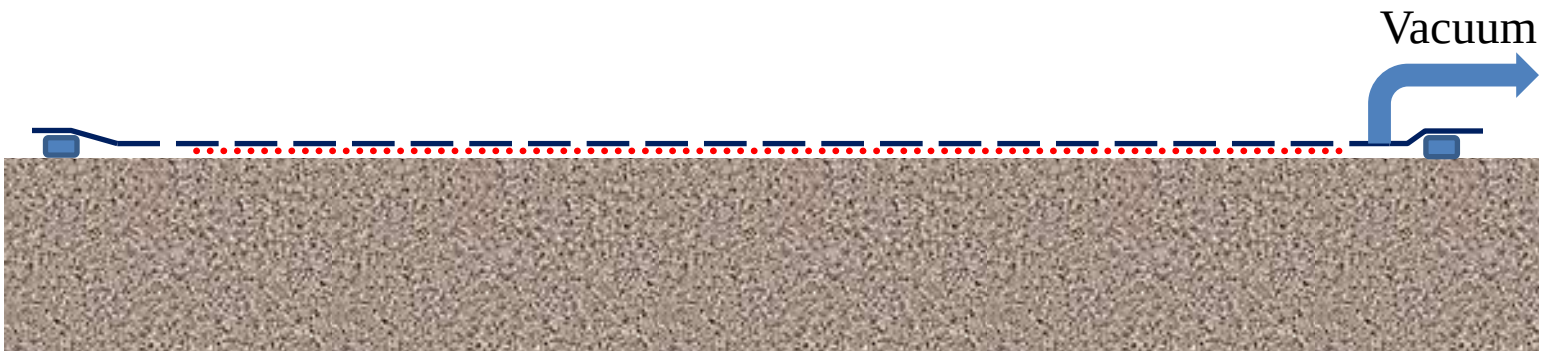


Assembling site

- We get new space at Bld. 153-R-030
- Iron table 4 x 2.5 m^2
- Flatness $\leq 20\mu m$

Vacuum table

- On the table was placed
  thin plastic mesh for pressure distribution
- Mesh was covered by 175 μm Mylar foil with the holes

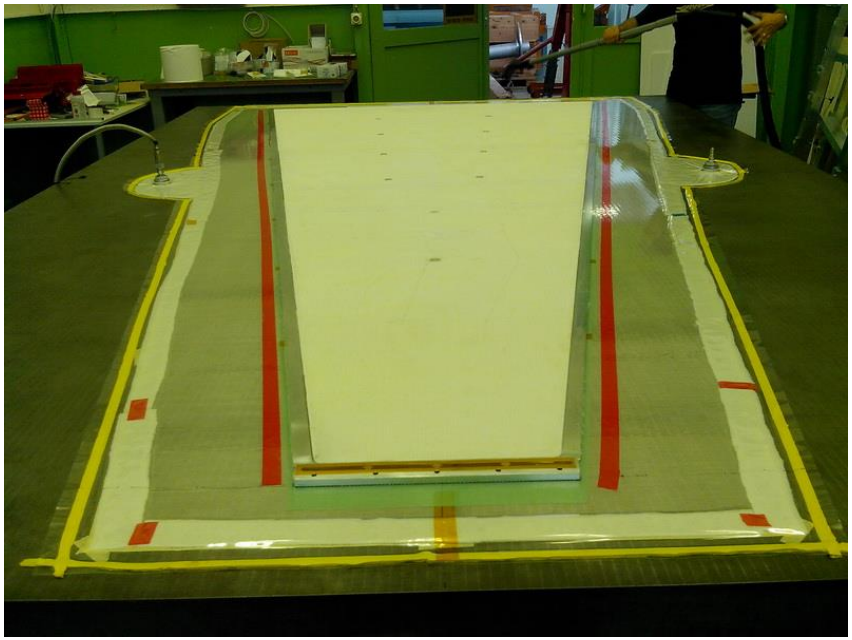


Vacuum table

- On the Mylar was placed 8 pieces of FR4 skin joined by 60 μm Kapton scotch
- Skins were sealed with the tape along the perimeter and sucked to the table

Gluing (1)

Step 1 – 400 μm plastic mesh was glued on the skin



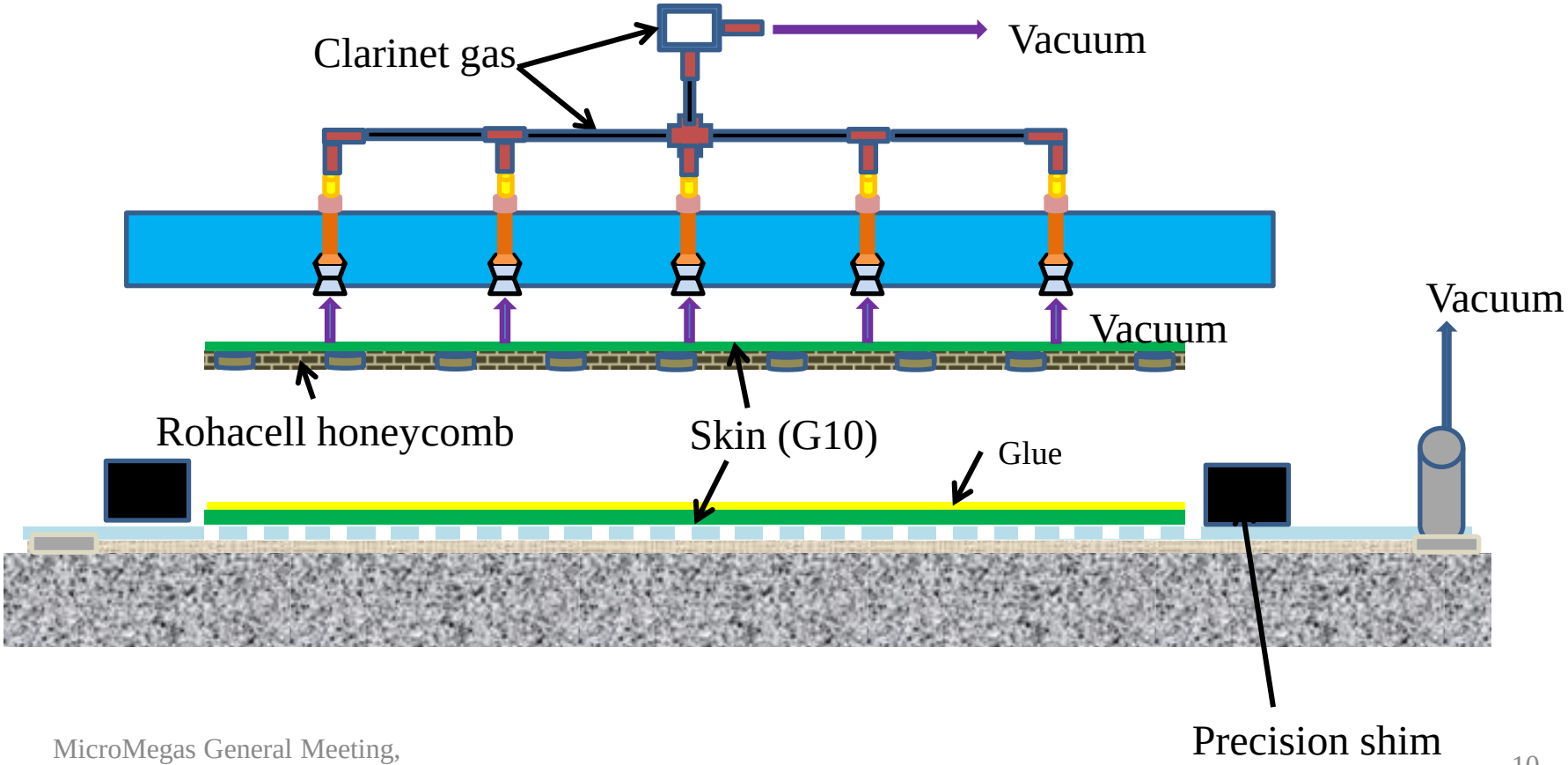
Step 2 – Aluminum frame and foam panels were placed and glued on the mesh

Gluing (2)

- Second skin was placed and sucked on the table
- Glue was distributed on the surface
- Plastic mesh was wetted by glue and placed on the skin
- Prepared “half panel” picked up with the stiff-back structure and placed on the mesh
- Calibrated shims were placed under the stiff-back

Gluing (3)

Using Stiff-back frame



First experience (1)

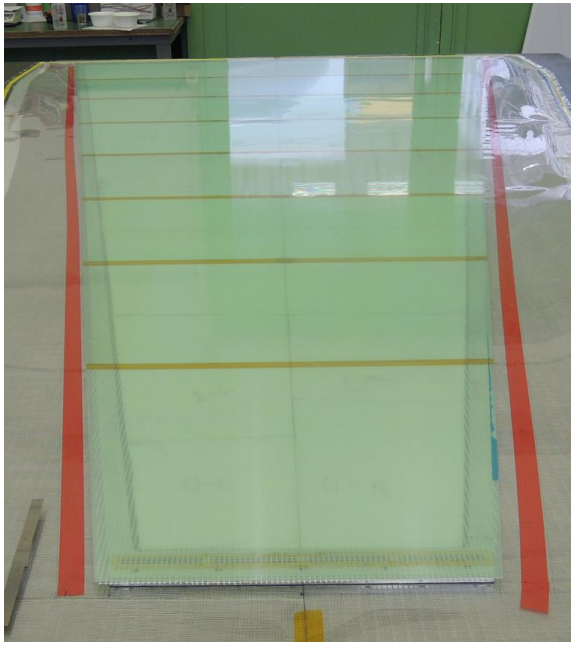
- All 5 full-wedge size panels (2 read-out and 3 drift) were glued using different glues and scheme:

TABLE 1. Details of the panel glueing processes.

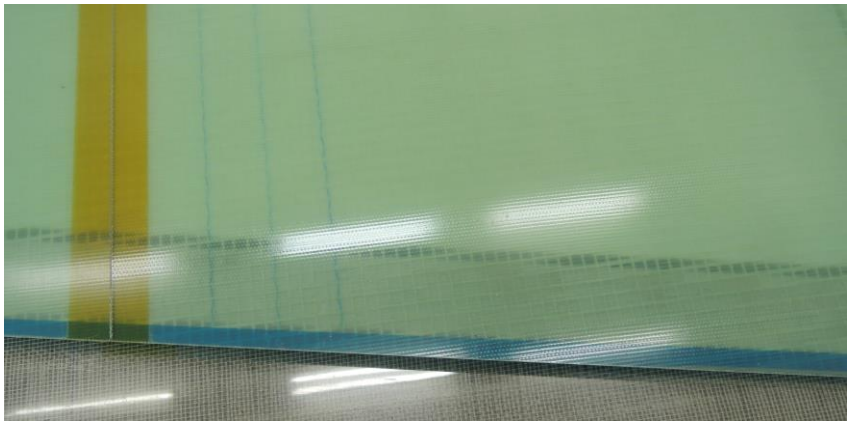
Panel ♯	Glue Face 1	Glue Face 2	Mesh	Foam segmented	Weight during glueing	Shim (mm)
1	Araldite 2011	Araldite 103	1 + 2	No	No	12.0
2	Araldite 103	Araldite 103	1 + 2	Yes	Light Al tubes	12.0
3	Araldite 103	3M DP 490	1	Yes	Panel ♯2	11.4
4	3M DP 490	3M DP 490	No	No	Vacuum bag	12.0
5	Araldite 103	3M DP 490	1	Yes	Vacuum bag	11.6

- The planarity of the panels seems good (visually) – to be measured on the laser interferometer
- Araldite AY103 + HY991 seems more comfortable
- When use Scotch-weld DP490 glue no need of the plastic mesh
- Some problems with the gluing
  - Some regions where mesh is not glued to the skin, needed injection of the fluid glue

First experience (2)

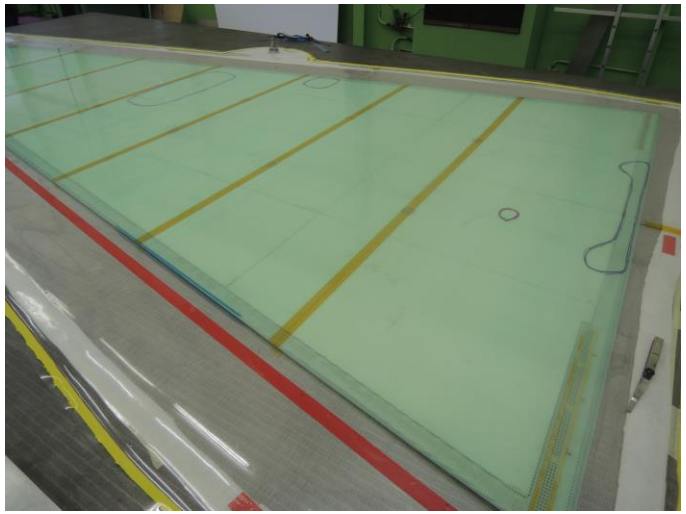


Full panel view



Inner structure

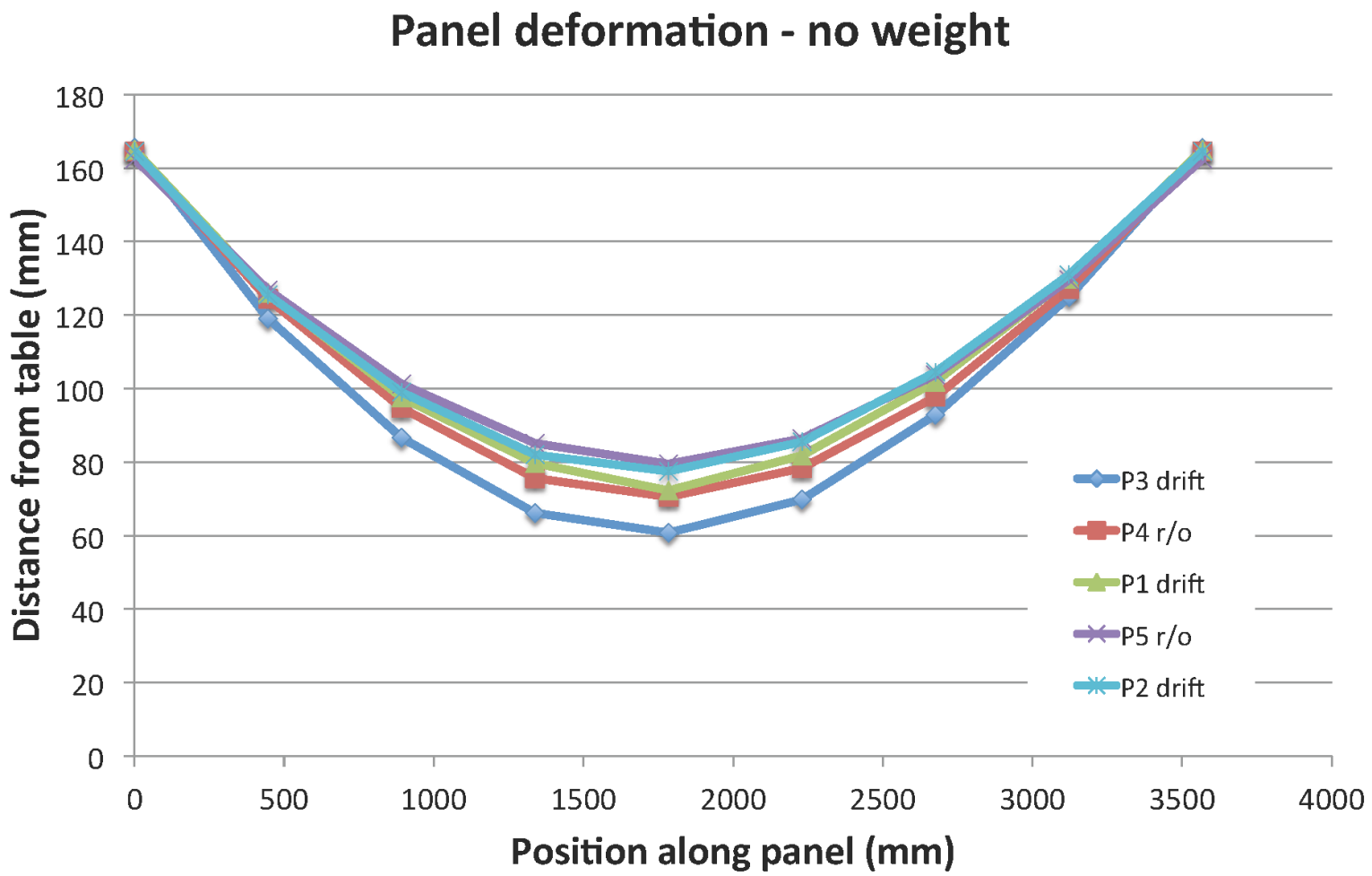
Problematic regions



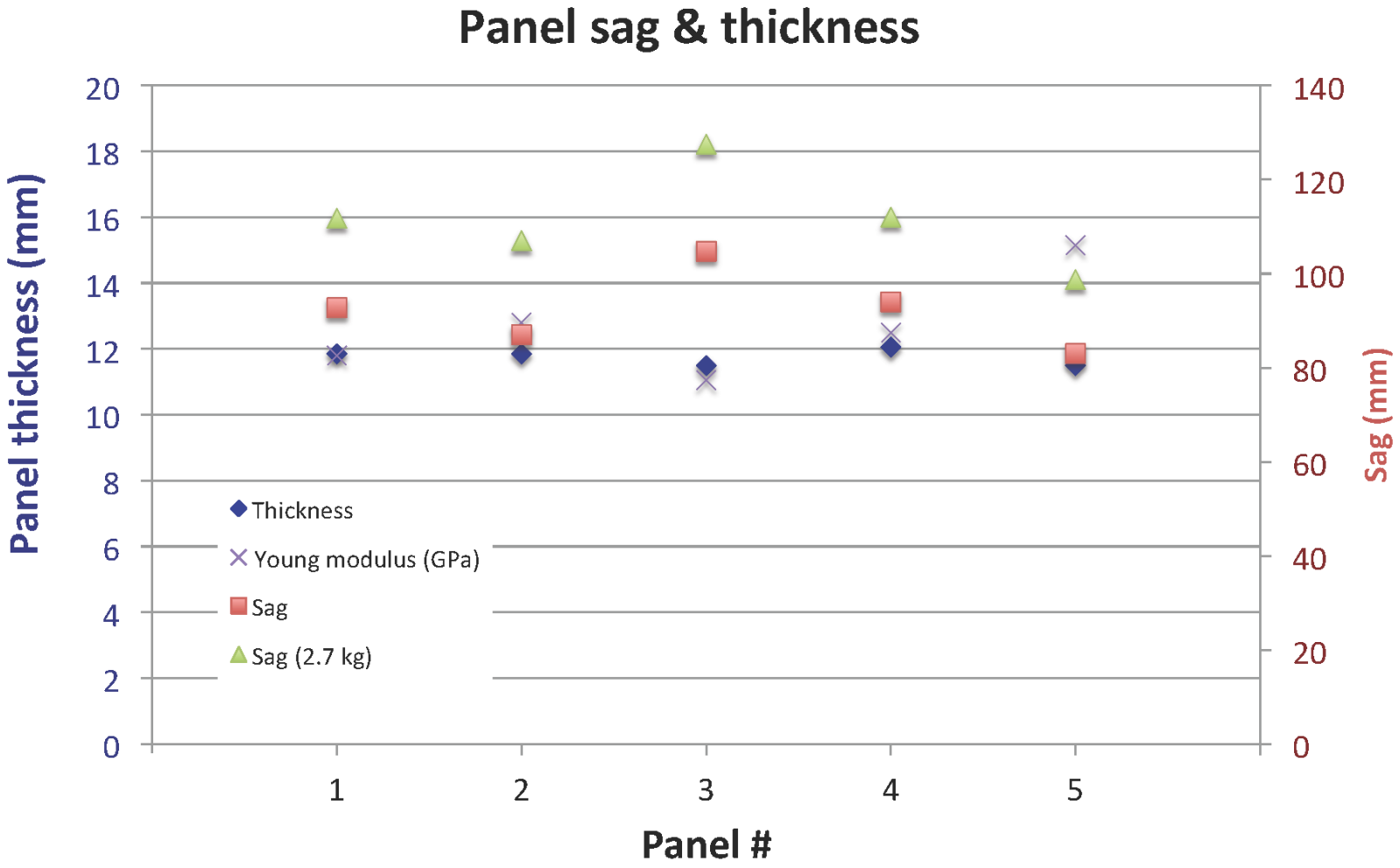
Panel sag measurements (1)

- To measure the sag of the panels, they were places on two ends
- The measurements were done for each panel separately with and without additional weight (2.7 kg)
- Same measurements were done also for the combination of 2, 3, 4 and 5 panels assembled together

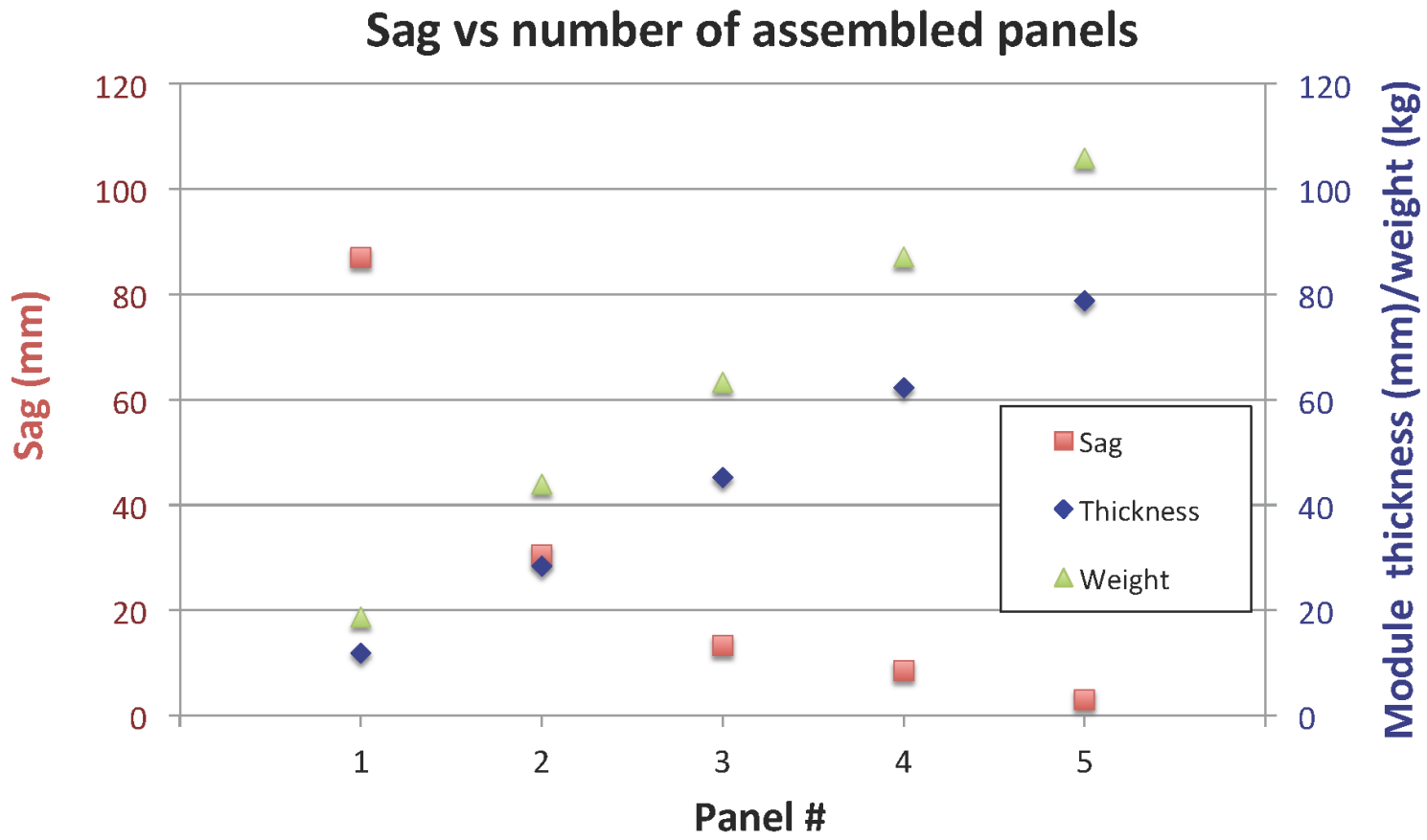
Panel sag measurements (2)



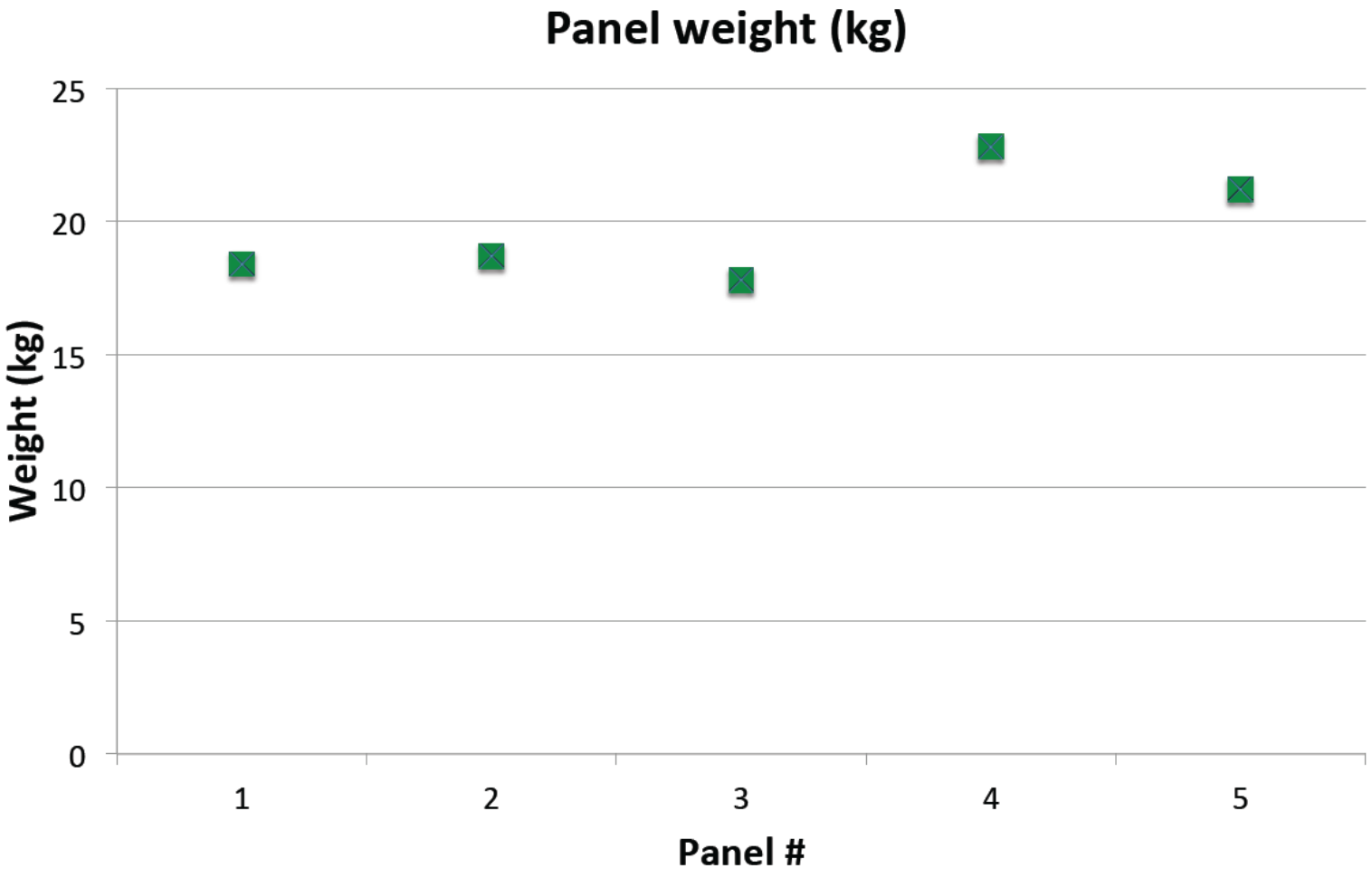
Panel sag measurements (3)



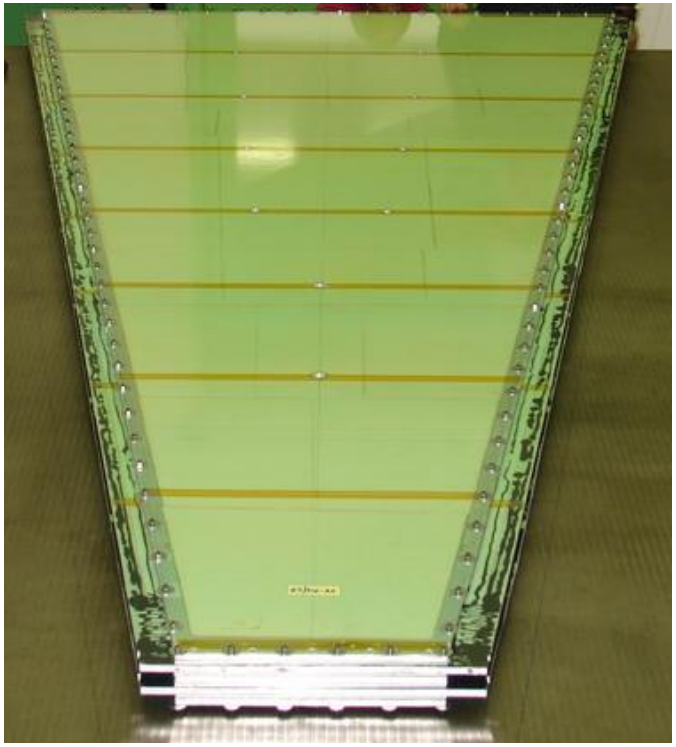
Panel sag measurements (4)



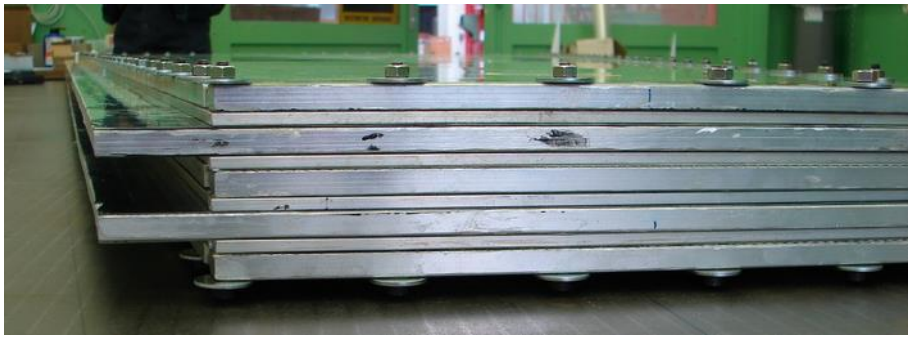
Weight of the panels



Prototype assembling



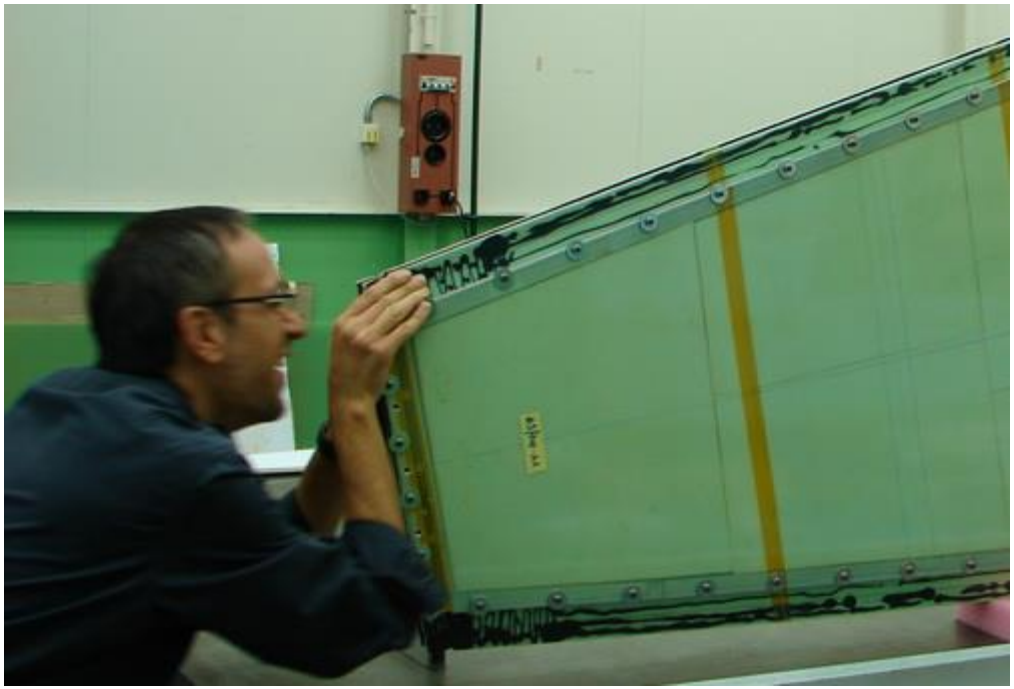
- The panel weight varies between 18 and 22 kg
- The weight of the assembled prototype including the spacer bars and assembling screws and nuts (100 pairs) –107 kg



Prototype test

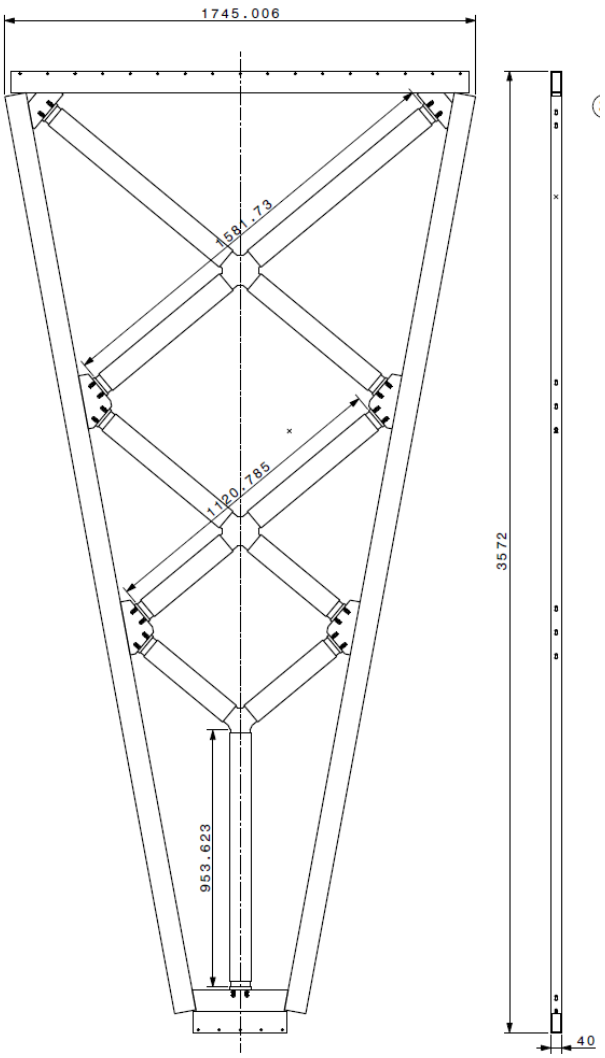
- After applying of “extra weight” of 82.1 kg the sag of the assembled prototype increased by 3 mm
- Sag came back to the previous value when extra weight has been removed

Prototype test



Visual inspection shows rather good planarity, to be measured with more precise devises.

Next step – spacer frame



- The spacer frame has been designed and simulated (G. Spigo & M. Ciapetti)
- Frame under contraction (Naples, CERN)
- From other side of the spacer will be added the dummy wedge with equal weight
- To be assembled and tested with prototype in the different orientation for the mechanical deformation, ect…

Collaborative effort

- CERN, Dubna, Lecce …
- Drawings and calculations: Lecce and CERN
- Infrastructure and tooling: CERN
- Technical work: CERN, Dubna, Lecce, Naples + 3 summer students (2 physicist + 1 engineer)