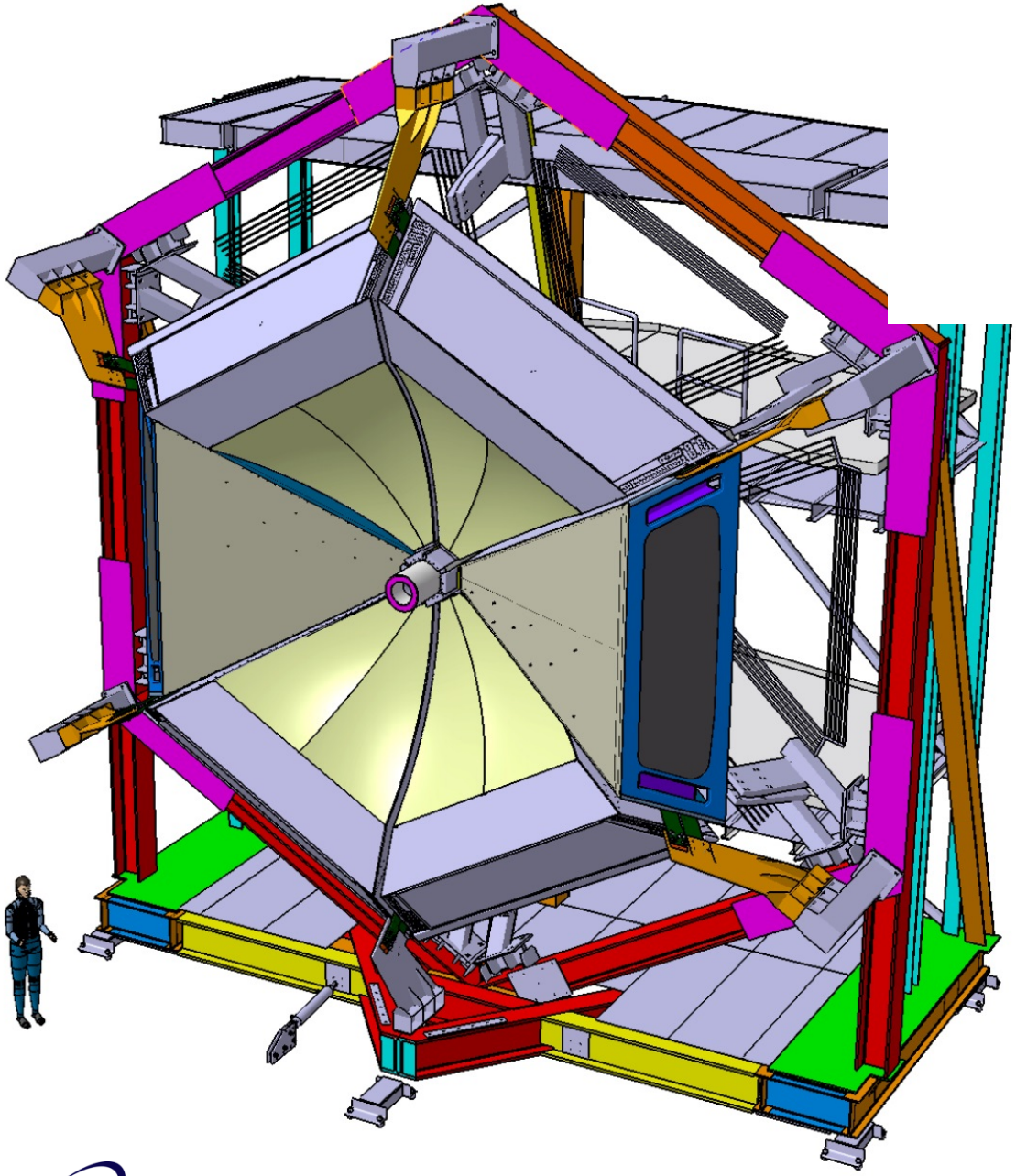


CLAS12-RICH Answers to the review committee

RICH Meeting

November 12th 2014

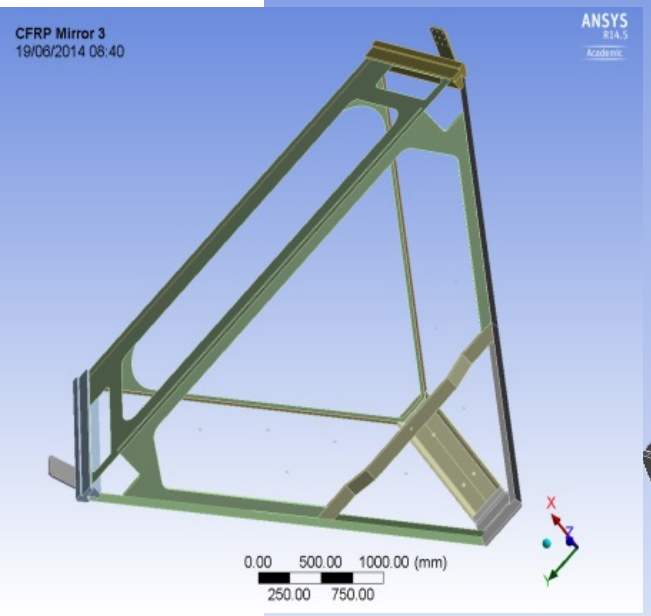
D. Orecchini, S. Tomassini

INFN Istituto Nazionale di Fisica Nucleare

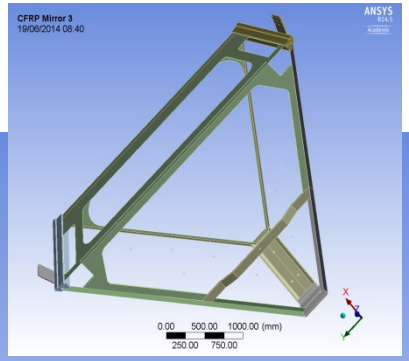
Outline

1. **Venting over-pressure effects on the panels**
2. **Hall B entrance door and Rich Transportation**
3. **Pmts electronic panel cooling issue**
4. **Conclusions.**

FEA Model for Stress-Strain Analysis

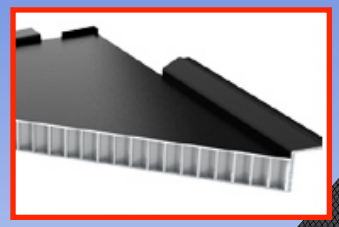


Front & Rear Mesh View and Materials



Mesh
17/06/2014 09:04

ANSYS
R14.5
Academic



Stiffening Ribs
Thick Al

CFRP

Sandwich Panel with
aluminum honeycomb core

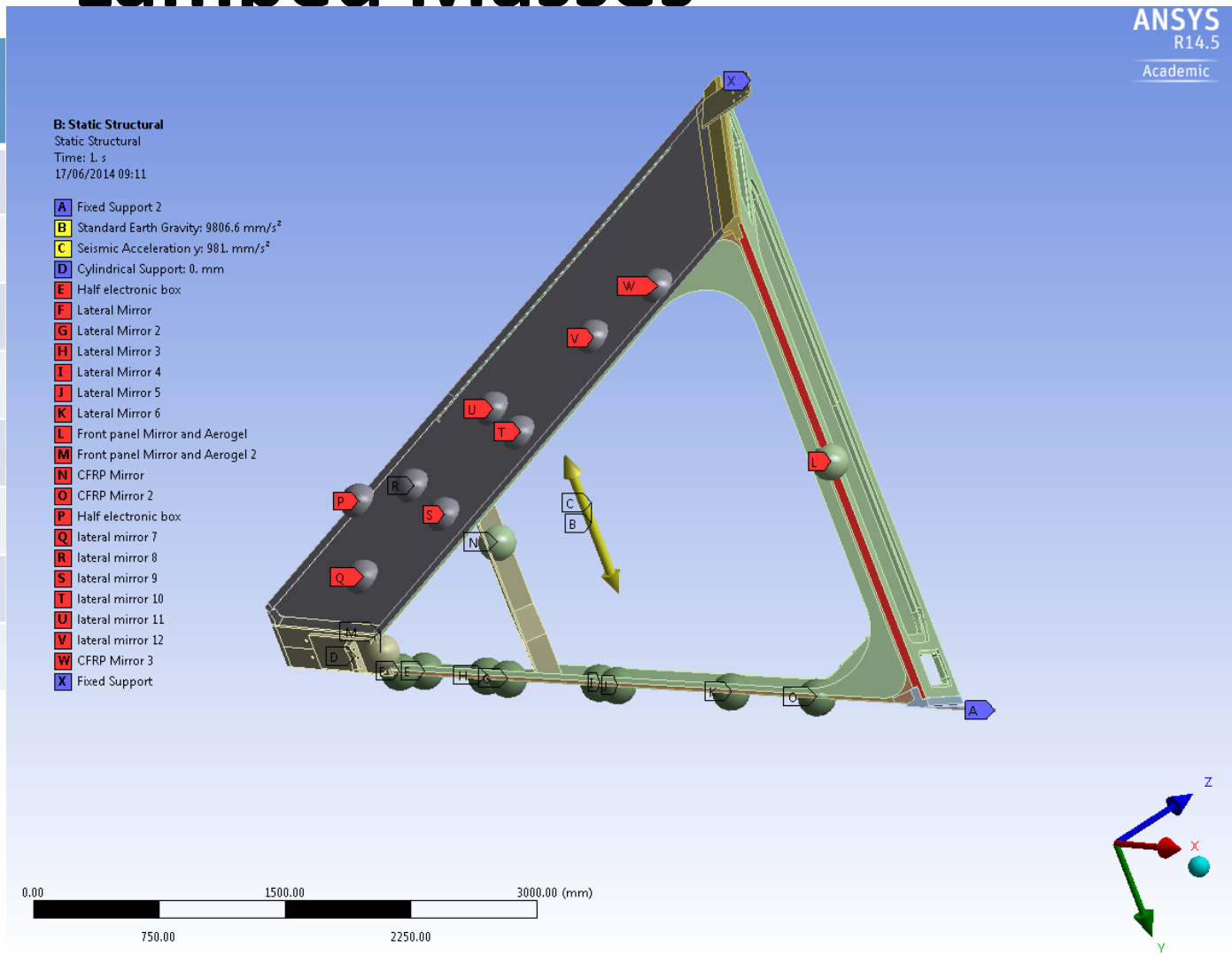
Z

1000.00 2000.00 (mm)
0 1500.00

Layer	Material	Thickness (mm)	Angle (°)
(+Z)			
3	Aluminum Alloy	0.7	0
2	5/32-5052-0.002	23.6	0
1	Aluminum Alloy	0.7	0
(-Z)			

Inner Components Simulated as Lamped Masses

Lamped Mass Name	Weight (kg)
E,P	35
F,G,H,I,J,K	2.34 each
L	30
M	30
N	50
O	20
W	20
Q,R,S,T,U,V	2.34 each



Purge Nitrogen Over-pressure

One finding from the review Committee was related to the purge dry-nitrogen overpressure inside the Rich vessel.

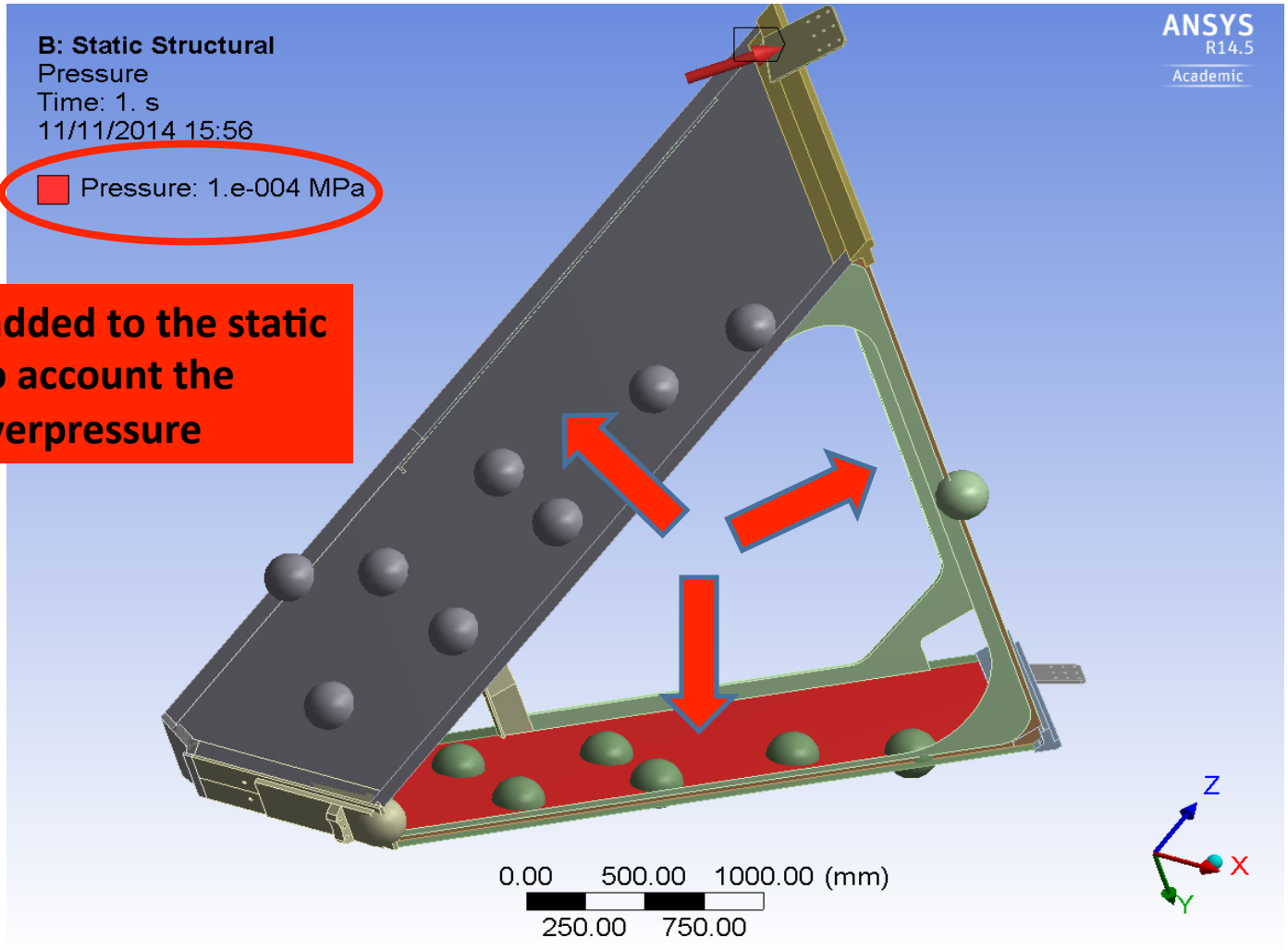
At the beginning it was assumed that this overpressure should have been 30-40 mbars.

Because of the large volume of the RICH, that pressure is too much and there is no reason to take a such kind of overpressure to prevent the outside air entering into the vessel.

An overpressure of 1 mbar or less is enough to make the venting system working properly and take the stress and strain in the mechanical structure acceptable.

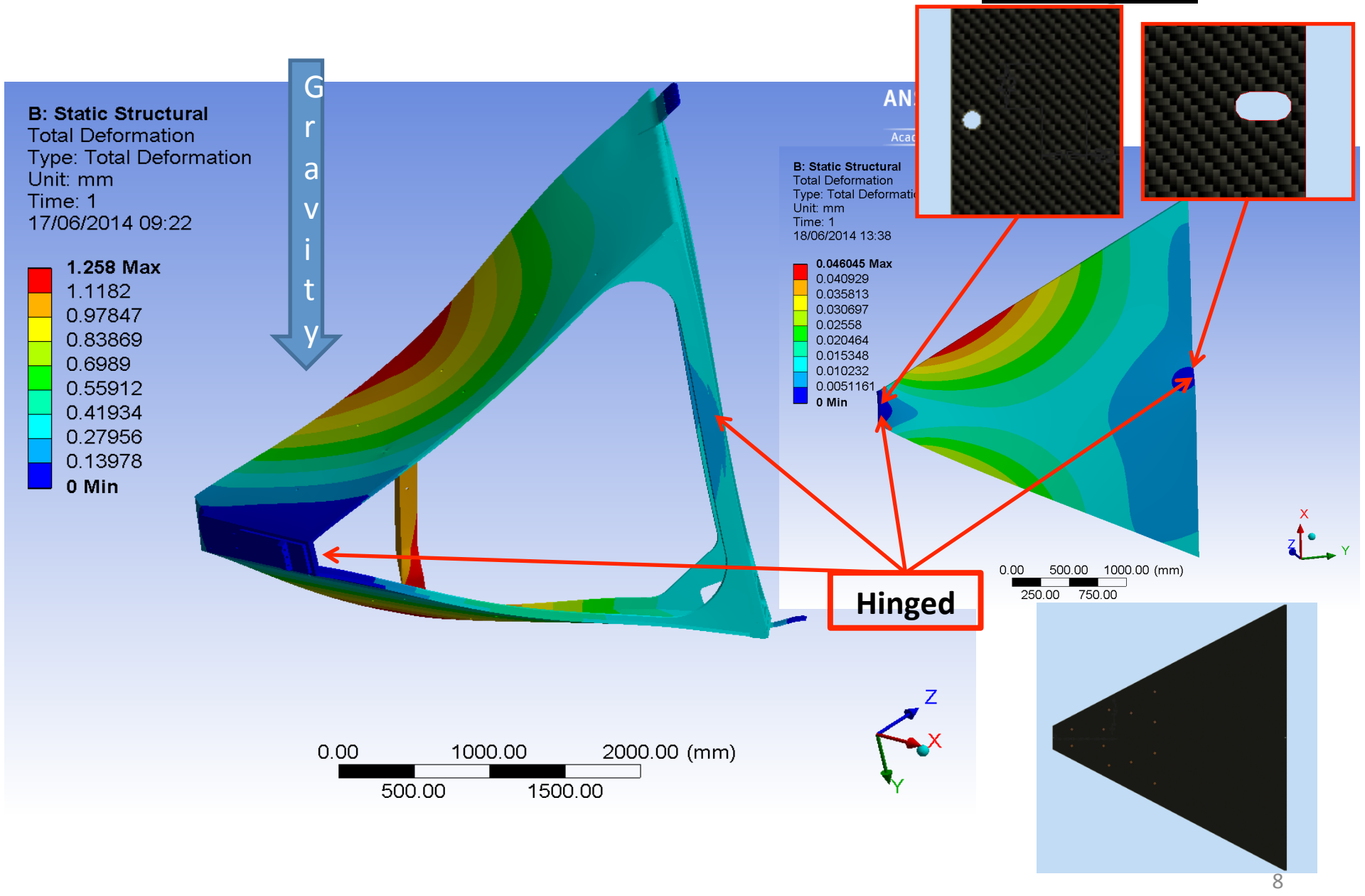
The dry N2 outlet can be made with a glycerin bubbler to prevent air entering the system and create the required counter-pressure. 8 mm of glycerin give 1 mbar of counter-pressure

Answer to the Review Committee

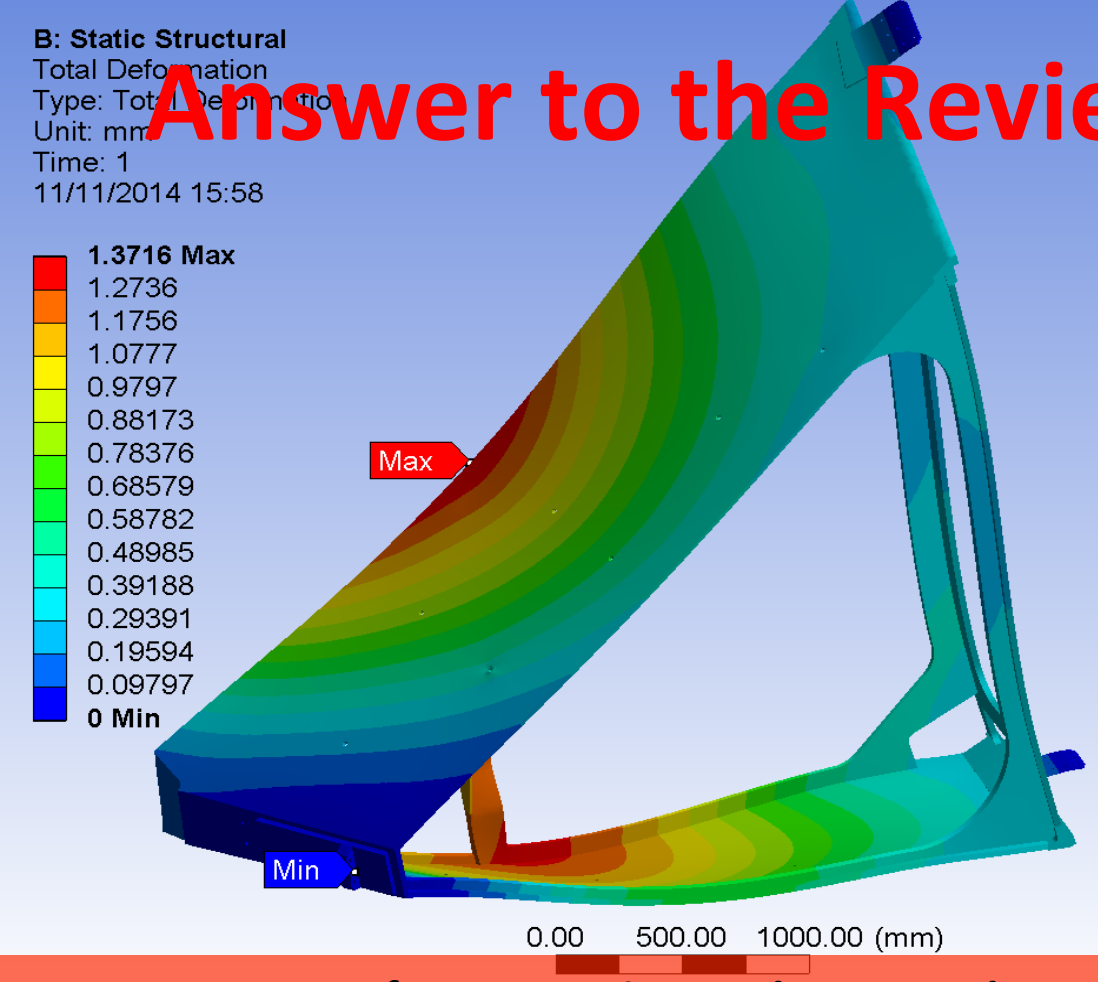


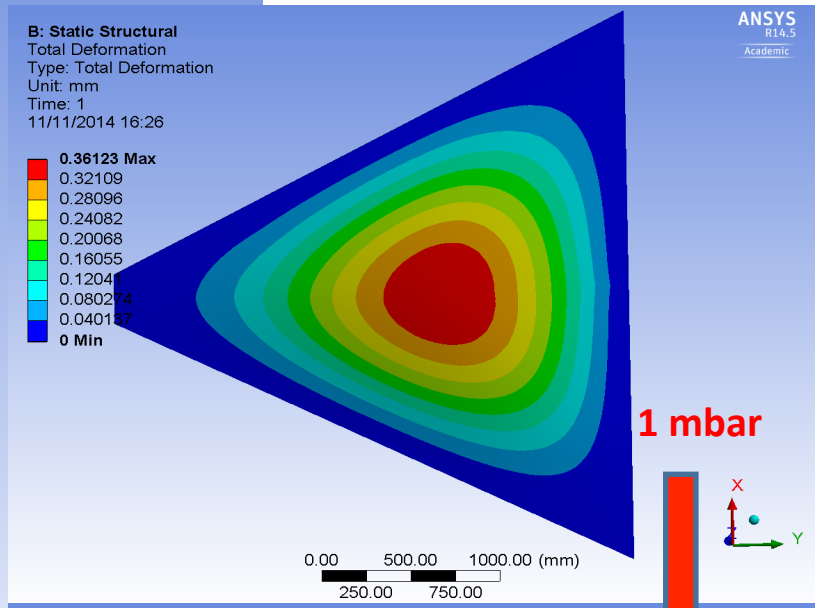
Pressure added to the static analysis to account the venting overpressure

Total deformation due to weight

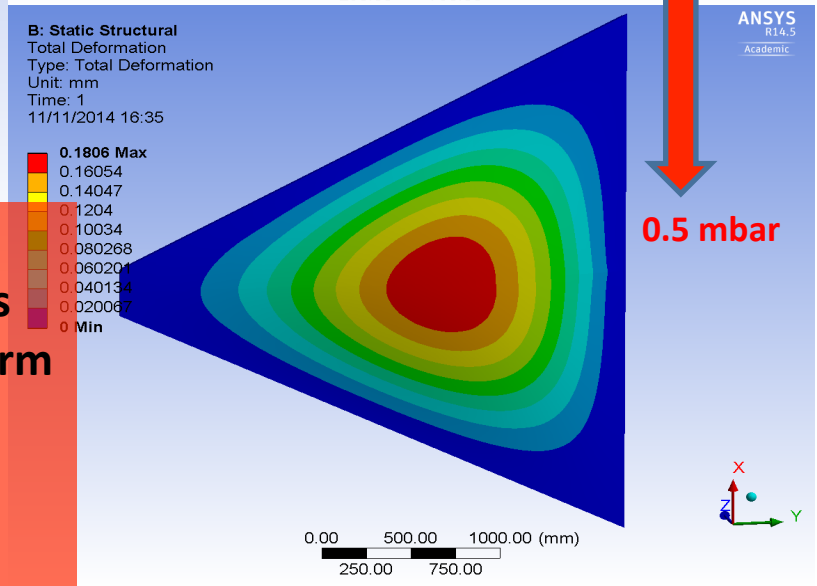


Answer to the Review Committee





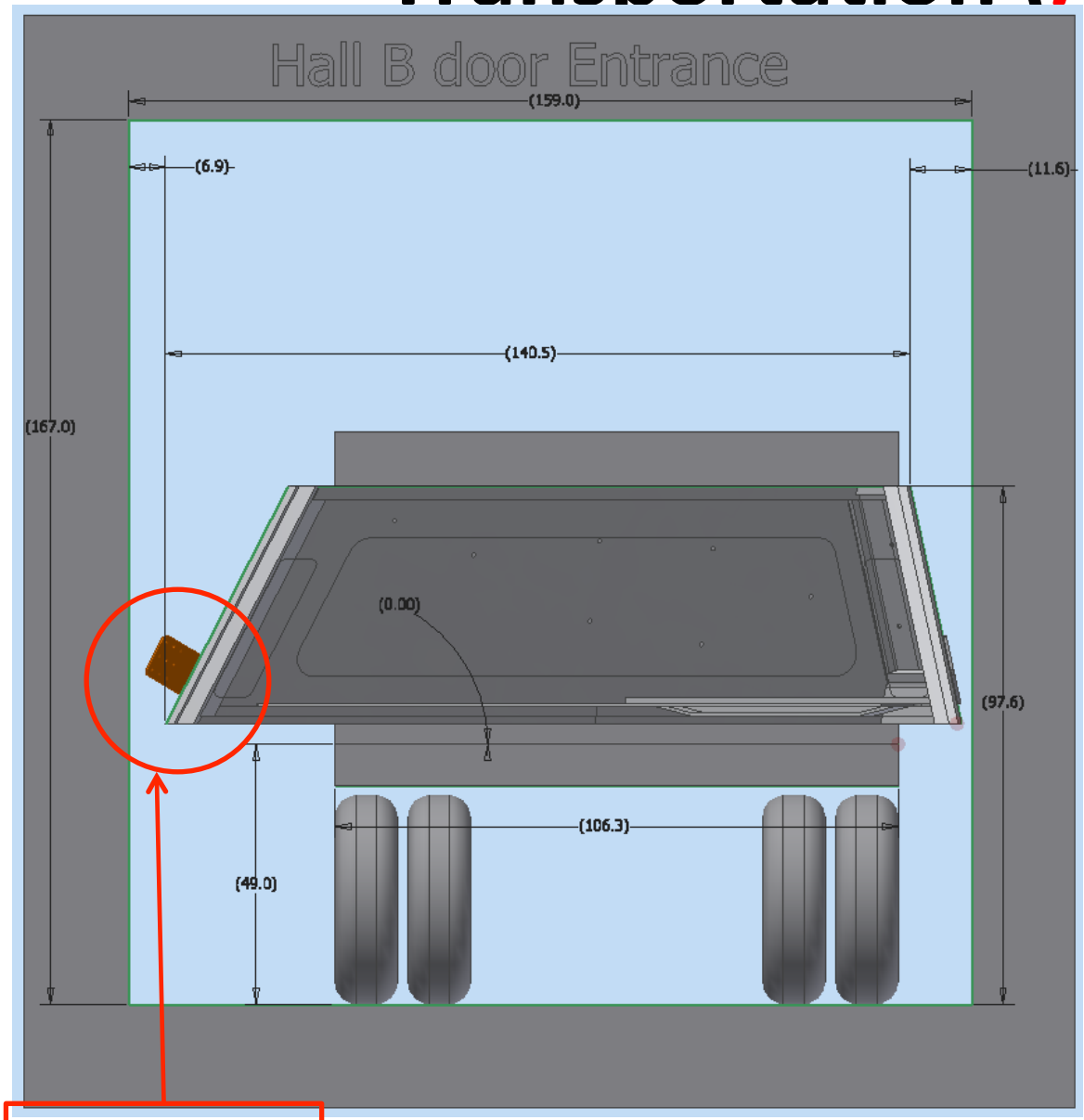
1 mbar



0.5 mbar

An overpressure of 1 mBar acting on the external surfaces, was added to the FEA analysis and the results show that the effect on the structure is negligible in term of stress and strain. The entrance panel (with a very large area (5 m^2)) is more sensitive to the overpressure. An overpressure of 1 mbar gives a displacement of few tens of mm.

Transportation (Answer)



Stirrup to be removed

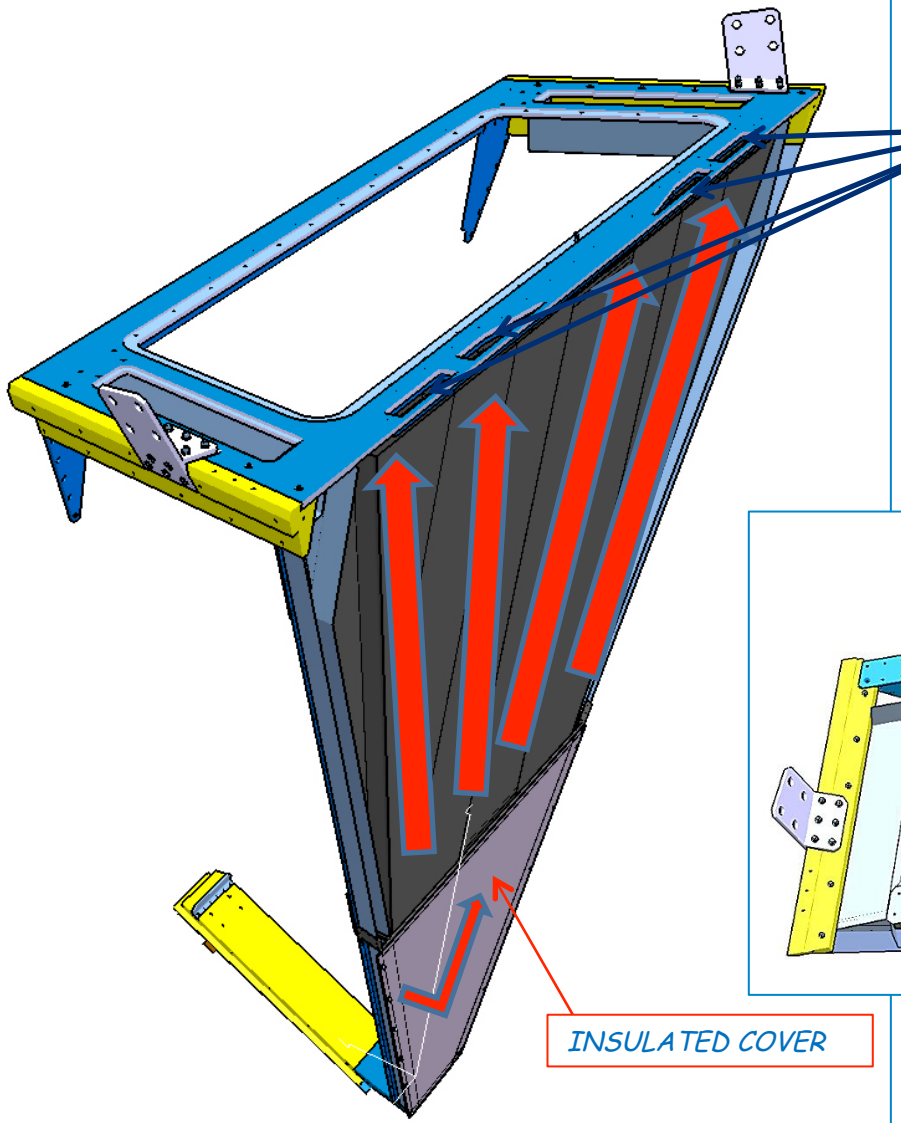
All the dimensions are in inches

The height of the truck (49”) is the real one of the Jlab truck just measured on March this year.

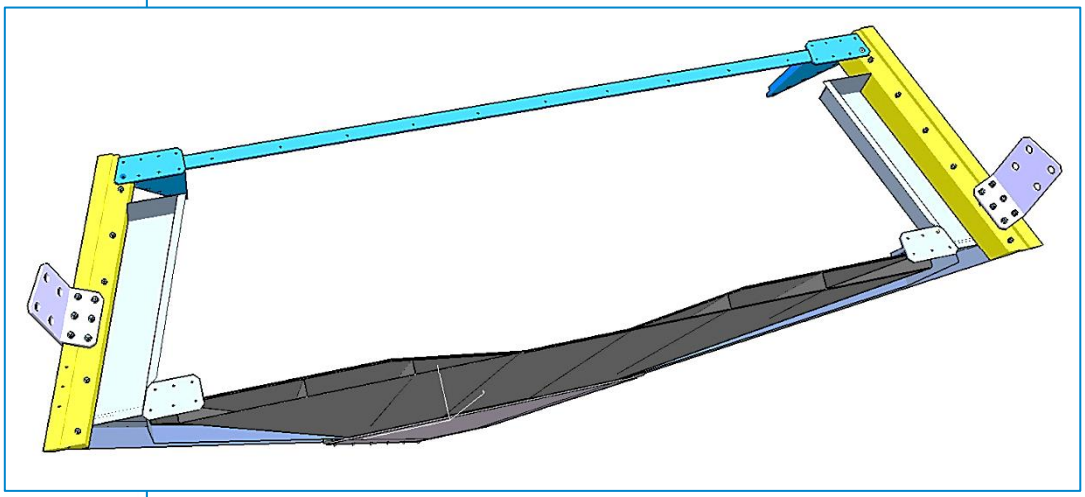
The module must be transported without the entrance panel because of the aerogel fragility

The front panel with the aerogel tiles and glass mirrors will be transported separately taking in mind the extremely fragile nature of the aerogel.

Electronic Panel cooling



Slots to be connected to the exhaust or to bring the hot air away…

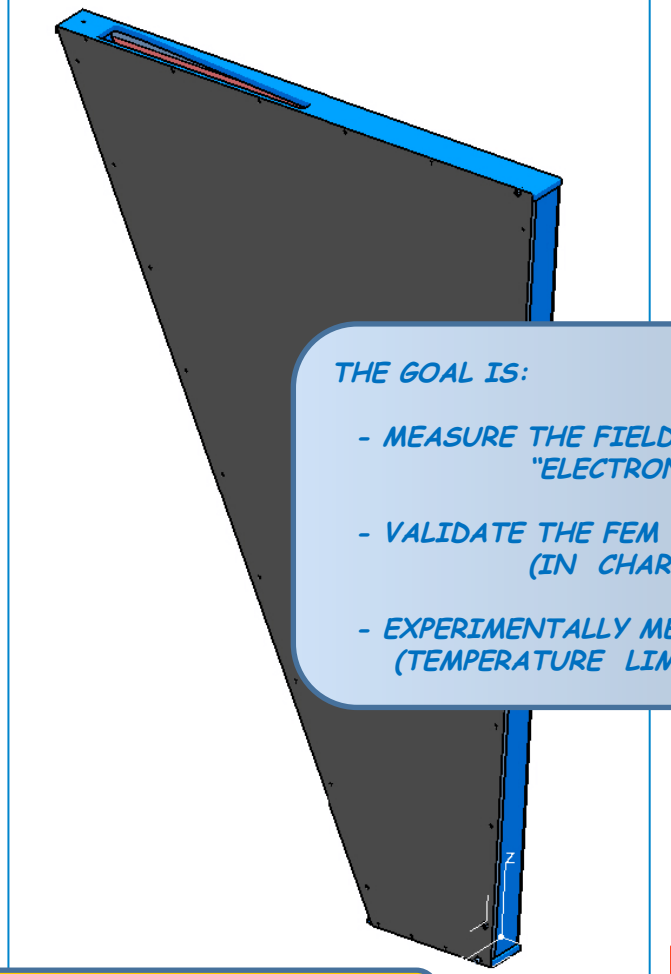


ELECTRONIC PANEL: THERMAL PROTOTYPE - MANIFACTURING IS ONGOING AT LNF WORKSHOP

METAL EXTRUSION
WITH HOLES FOR FRESH AIR INLET

SLOT FOR
EXAUST HOT AIR

EXPLODED VIEW"



THE GOAL IS:

- MEASURE THE FIELD TEMPERATURE INSIDE THE "ELECTRONIC PANEL;
- VALIDATE THE FEM SIMULATION (IN CHARGE OF R. PERRINO' INFN)
- EXPERIMENTALLY MEASURE THE COVER TEMPERATURE (TEMPERATURE LIMIT AT STEADY STATE 30*)

PMTs SUPPORT PANEL

ELECTRIC RESISTANCES

INSULATION COVER

FPGA LAYER
(400 W DISTRIBUTED)

ASIC LAYER
(100 W DISTRIBUITED)

FULL SCALE HALF
"ELECTRONIC PANEL BOX"

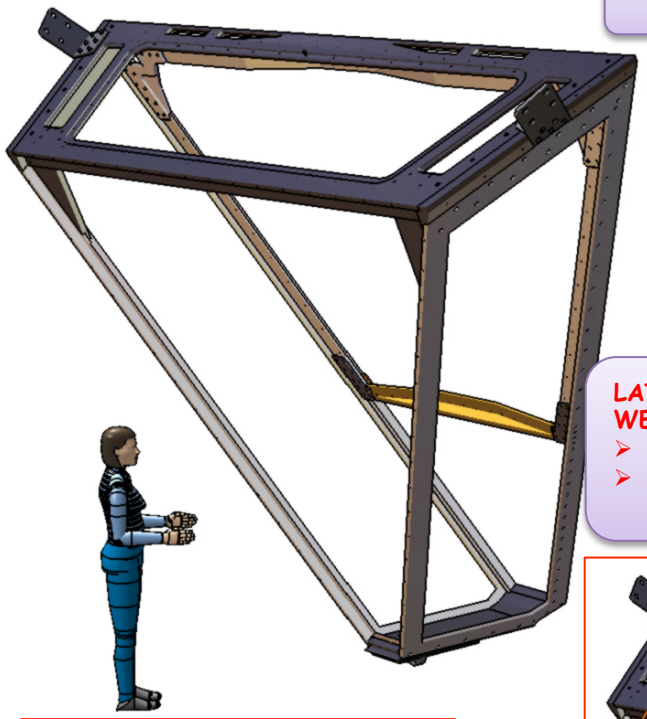
CONCLUSIONS

- **The FEA results show that the maximum displacement on the lateral skins is of the order of 1.3 mm (1.3/4000= 0.03%) and the max equivalent stress on the support constraint is less than 75 Mpa. Including 1 mbar overpressure inside the rich vessel, the stress and strain on the mechanical structure increase of about 10% but still acceptable.**
- **For the purge N_2 an overpressure of 1 mbar or less is feasible and can be obtained using a glycerin bubbler at the outlet. 8 mm of glycerin is equivalent to a counter-pressure of 1 mbar**
- **The entrance panel (aerogel and flat mirror holder) has a large mechanical stiffness but is assembled to the rich vessel after the mechanical installation of the rich frame to the forward carriage. In this way the flat mirror misalignment is prevented as well as the contribution to the stiffness budget.**
- **A study of the transportation and Hall B entrance issue have been performed and the rich can enter the hall b door horizontally just removing the fixture brackets.**
- **The electronic Box cooling study is ongoing. FEA calculation and experimental setup to validate the FEA analysis are on the way. Insulating material can be put on the back side of the box in order to create an adiabatic wall.**

Spare Slides

THE RICH Module: *Mechanical Shell Overview.*

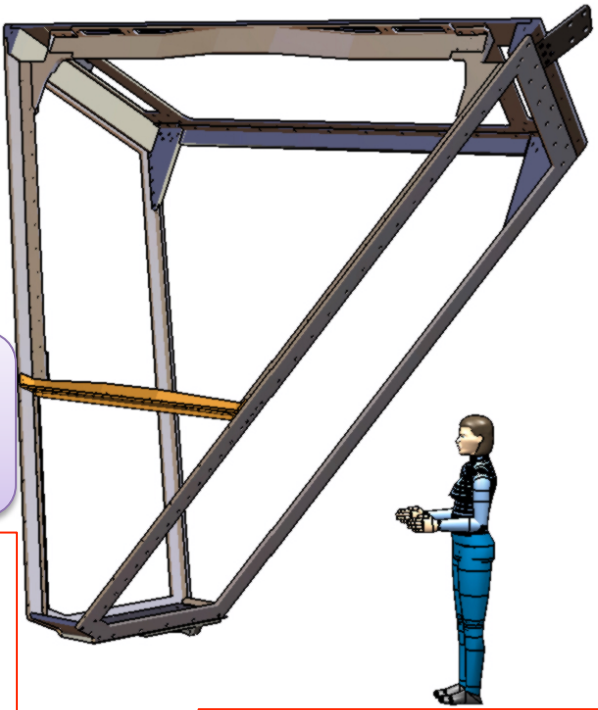
STRUCTURAL FRAME WITHOUT SANDWICH PANELS



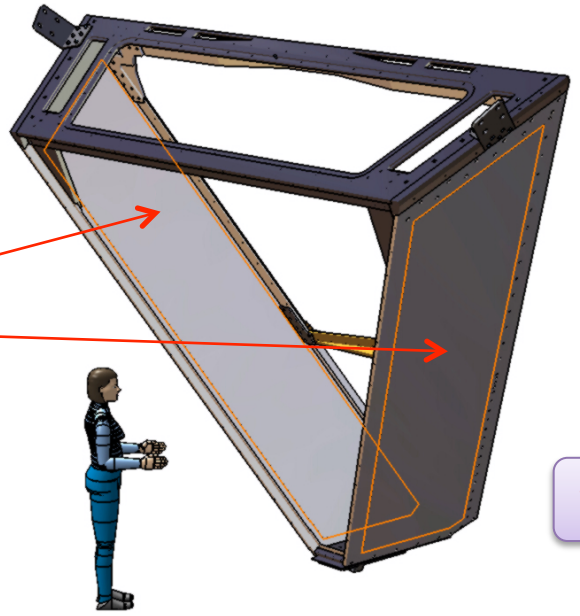
RICH MODULE BACKWARD VIEW

LATERAL PLATES MATERIAL SHYPOTESIS
WEIGHT COMPARISON:

- MONOLITIC SLABS 17mm Th.:400Kg (Both)
- SANDWICH PANELS: 25mm Th.:180Kg (Both) (220Kg LESS)



RICH MODULE FORWARD VIEW



LATERAL PANEL

ALUMINUM HONEYCOMB

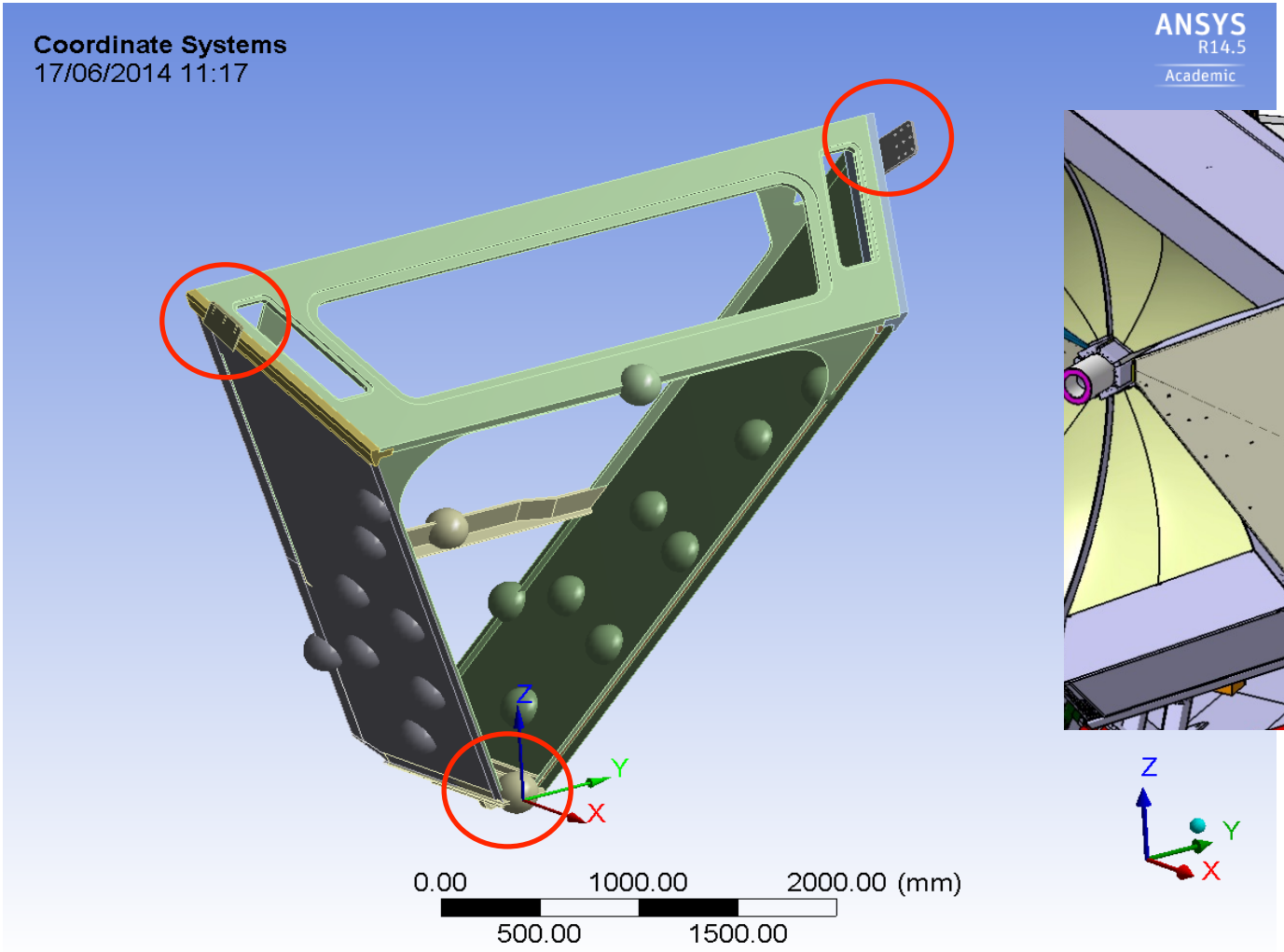
STRUCTURAL FRAME WITH HONEYCOMB PANELS

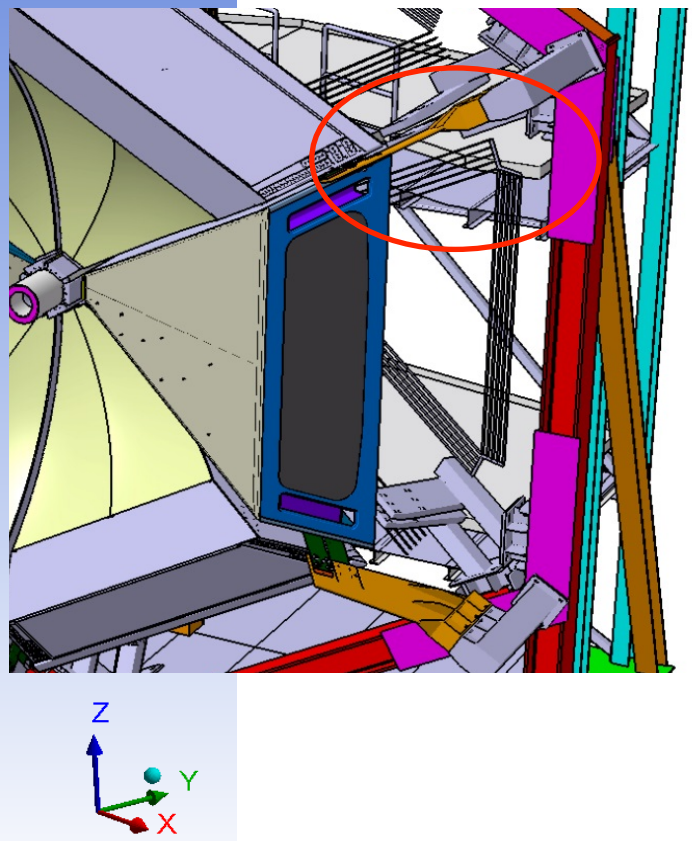
- FEM ANALYSIS RESULTS IN SANDRO TALK -

Force reaction on the constraints

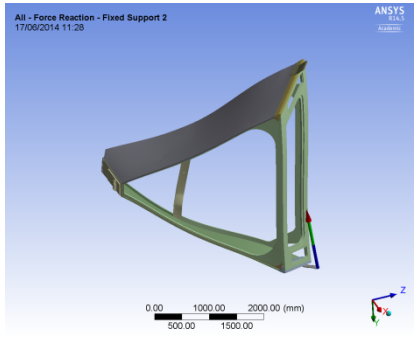
1. The additional seismic load has been taken into account
2. Jlab personnel should verify that the forward carriage constraint points (the interface between the RICH and the forward carriage) are OK to support the load from the RICH detector
3. The RICH whole weight is about 900 kg (**400 kg less than the LTCC**)

Reference System and Constraints

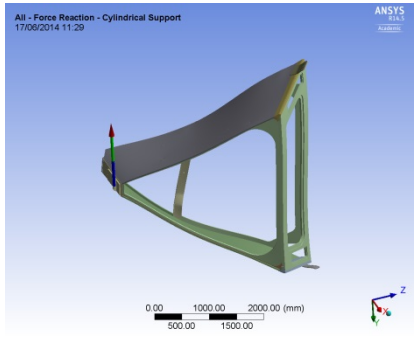




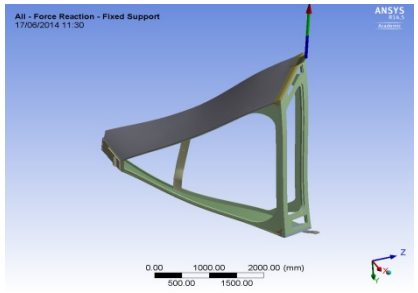
Constraint Reactions in the Worse load Case



Reaction X [N]	Reaction Y [N]	Reaction Z [N]
-71	-2860	-741



Reaction X [N]	Reaction Y [N]	Reaction Z [N]
15	-3157	16



Reaction X [N]	Reaction Y [N]	Reaction Z [N]
56	-2805	725
0	**-8822**	**0**

SUM