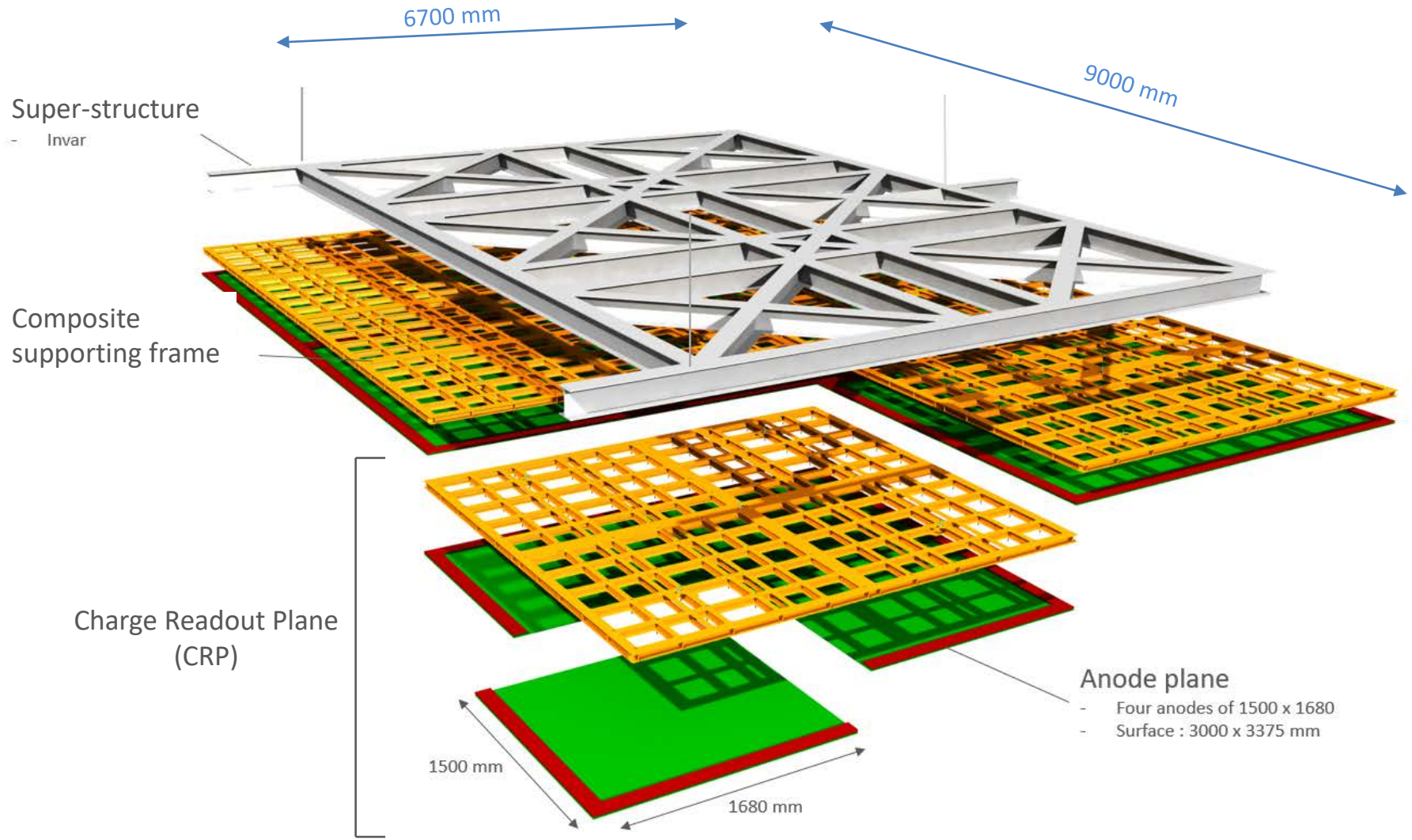


Anode & Composite frame material studies

- *DUNE Vertical Drift* -



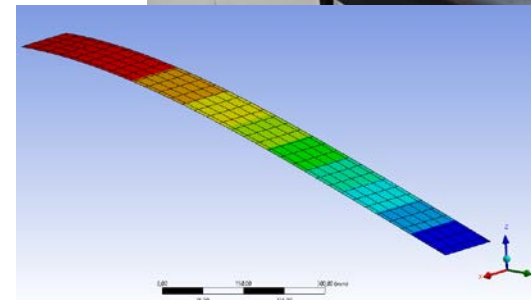
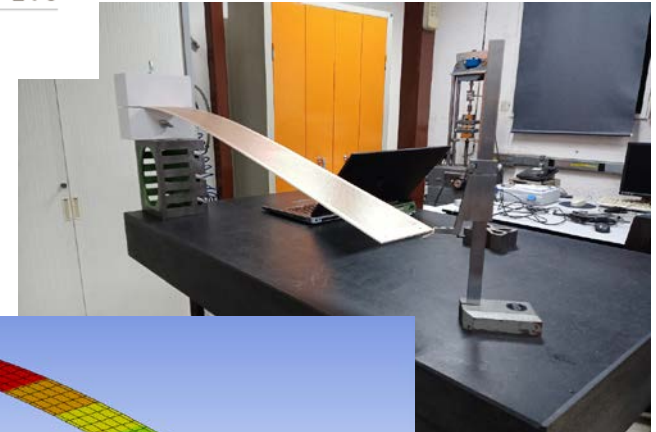
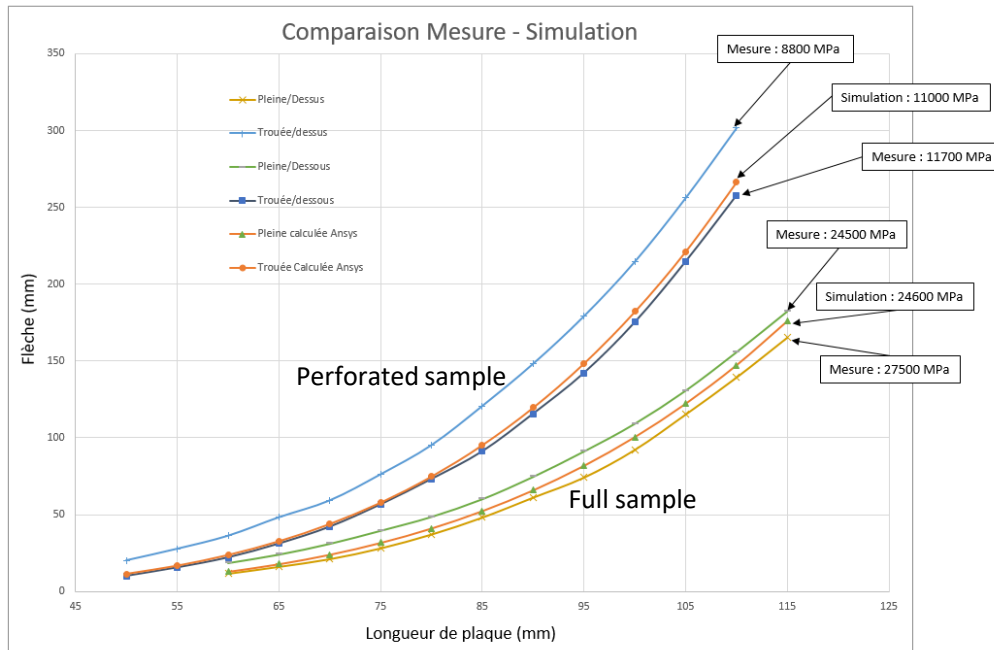
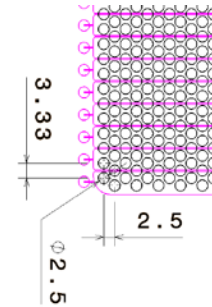
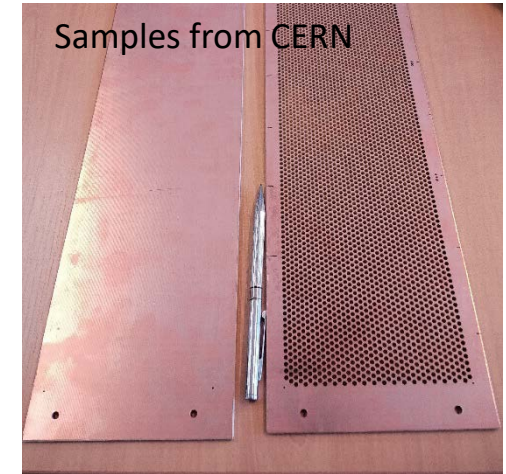
Full and drilled PCB : copper plated glass fiber - 3,2mm/2x35µm

Length variation / Deflection measurement

From measurements : Reference equivalent Young modulus for simulations :

Full Plate : 24600 MPa (24500-27500 MPa)

Drilled Plate : 10000 MPa (8800-11700 MPa)



Density Measurement / Calculation includes :
 mass and external dimensions measurements
 copper plating mass/thickness

Reference equivalent density for simulations:

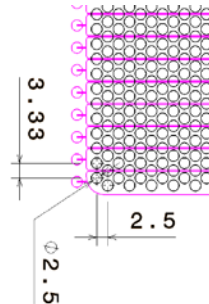
Full Plate : 1845,5 kg/m³

Drilled Plate : 804 kg/m³

For information :

1 layer of 1,5 x 1,68m drilled/plated PCB : 6,5 kg

2 layers of 3 x 3,4m drilled/plated PCB : 52 kg



Masse mesurée de la plaque pleine	1,019 kg
Masse volumique PCB plein (calculée)	1688 kg/m ³
Masse volumique Cuivre	8900 kg/m ³
Longueur	1450 mm
Largeur	119 mm
Epaisseur PCB	3,13 mm
Longueur partie trouée	1400 mm
Largeur partie trouée	98 mm
Epaisseur de cuivre	0,035 mm
Diamètre des trous	2,5 mm
Espacement en largeur	5,00 mm
Espacement en longueur	1,666665 mm
Volume PCB d'une plaque pleine	0,000540082 m ³
Masse PCB d'une plaque pleine	0,91 kg
Volume cuivre d'une plaque pleine	1,20785E-05 m ³
Masse cuivre d'une plaque pleine	0,11 kg
Masse totale d'une plaque pleine	1,0190 kg
Densité corrigée d'une plaque pleine plaquée cuivre	1845,479571 kg/m³
Nombre de trous dans la partie trouée	15624 trous
Volume de trous PCB	0,000240053 m ³
Masse de trous PCB	0,41 kg
Volume de trous Cuivre	0,00000536859 m ³
Masse de trous Cuivre	0,0478 kg
Masse calculée de la plaque trouée échantillon	0,566 kg
Masse mesurée plaque trouée	0,574 kg
Ecart masse	-0,01 kg
Ecart pourcentage	-1,40 %
Nombre de trous dans la partie trouée	19836,02 trous
Volume de trous PCB	0,00 m ³
Masse de trous PCB	0,51 kg
Volume de trous Cuivre	0,00 m ³
Masse de trous Cuivre	0,0607 kg
Masse calculée d'une plaque taille échantillon, trouée intégralement :	0,4440 kg
Densité corrigée d'une plaque trouée plaquée cuivre	804 kg/m³
Masse d'une anode de 1,5*1,68 (une seule épaisseur trouée)	6,48 kg
Masse du plan d'anode de 3*3,4 trois vues (deux épaisseurs trouées)	51,87 kg

Sample building for determination of the thermal shrinkage coefficients (CTE)

Performed by Cryolab (CERN) by beginning of March 2021

Following standard procedure

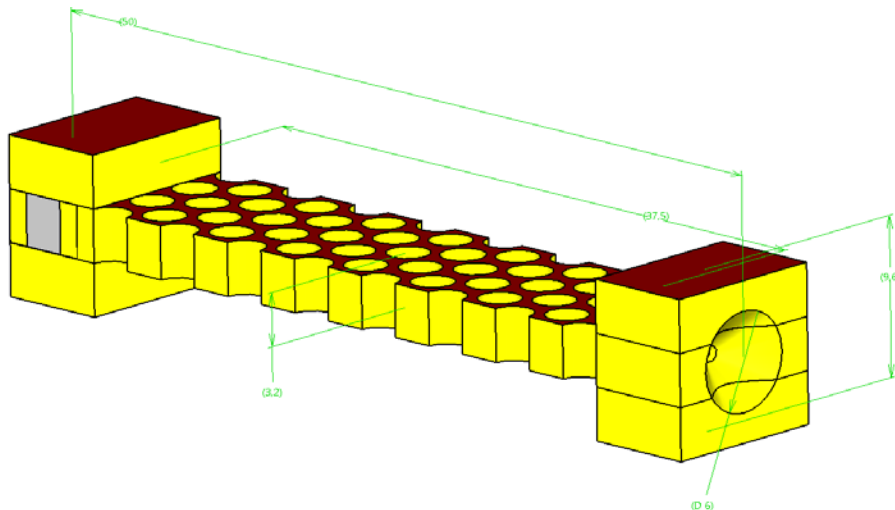
In two plane directions

In liquid Argon

Same setup used for the dual phase CRP G10 frame

Measurement deviation : around $5e-5$ mm/mm between 293K and 77K

Inputs are essential to optimize the design (planarity)

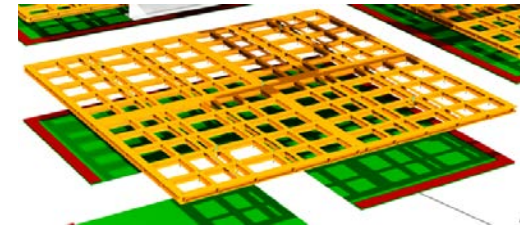


Initial design is made with assembled PCB plates (Glass-fiber)

An alternative design under study : Honeycomb/Glass-Fiber pannels that could be an efficient way to produce industrially the composite frames

First general behaviour tests in liquid argon will be performed at CERN next week (~15/02)

If conclusive (no cell colapsing, no glueing damage...) further photogrametric tests will be carried out to measure the CTE characteristics.

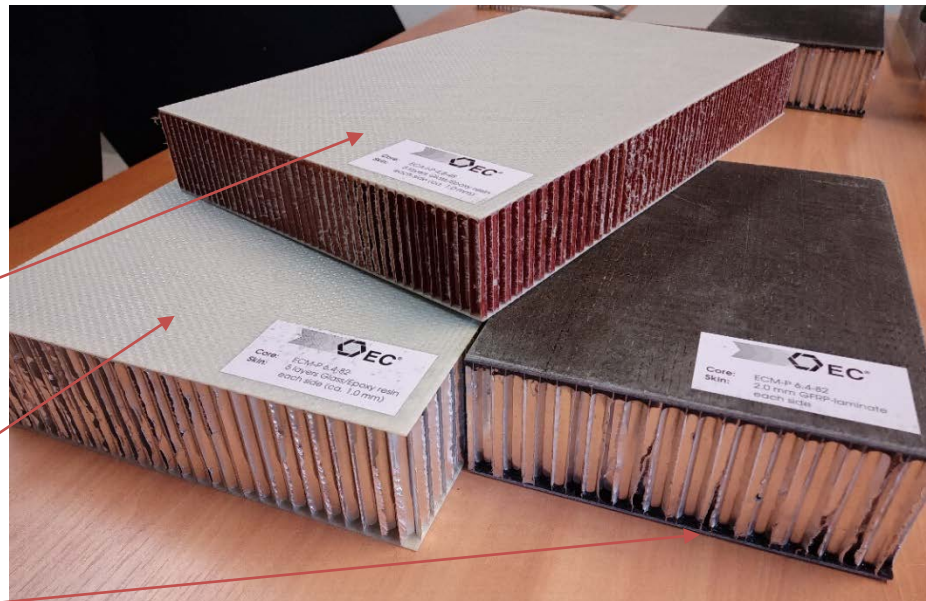


Open cells types

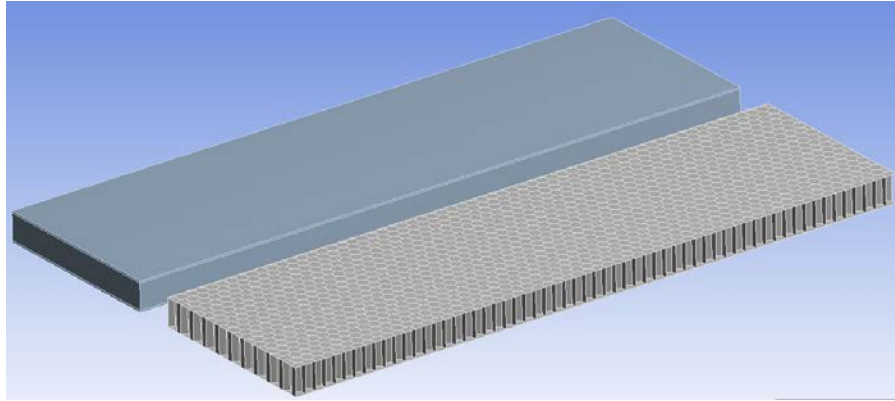
Glass-Fiber skins
Nomex core
(best candidate)

Glass-Fiber skins
Aluminium core

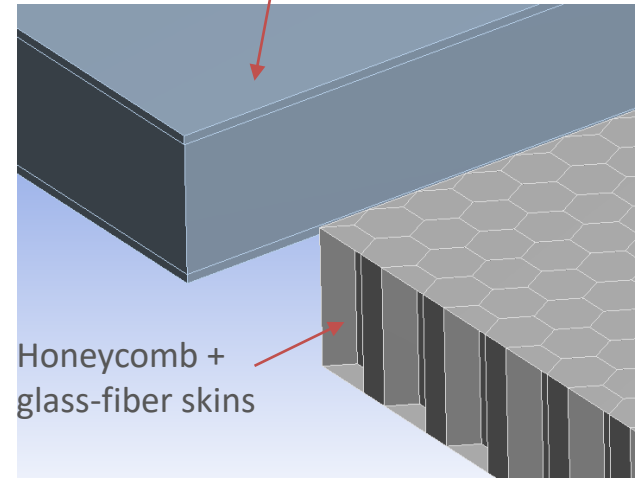
Carbon-fiber skins
Aluminium core



Available samples are microperforated.

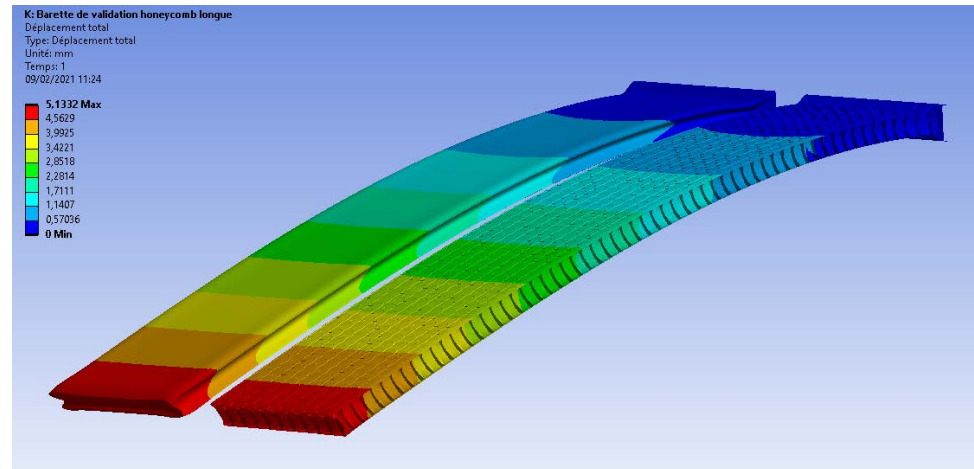


Equivalent material for simulation
+ glass-fiber skins

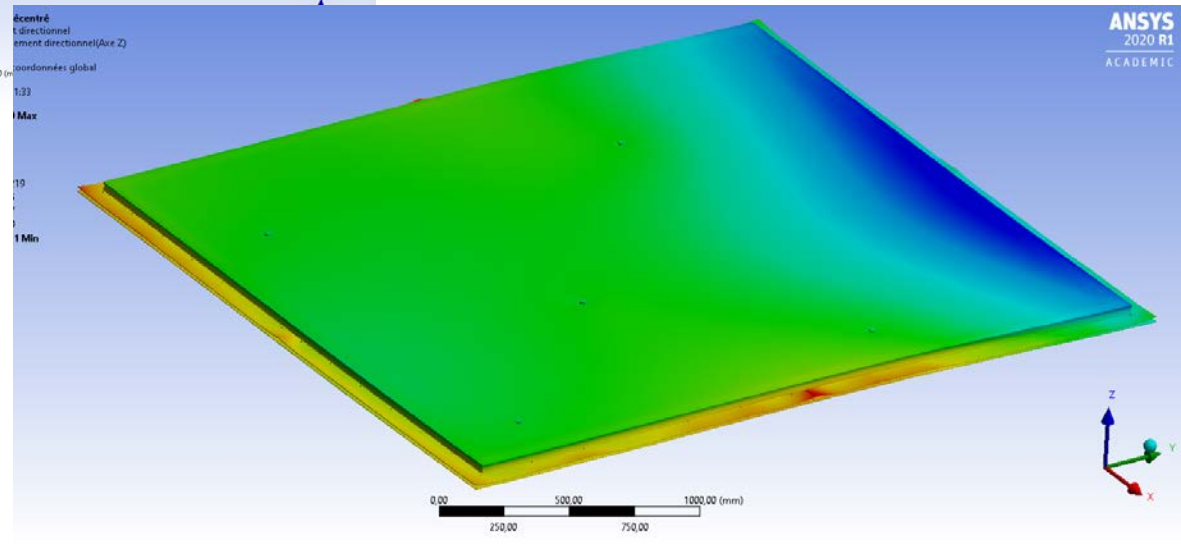
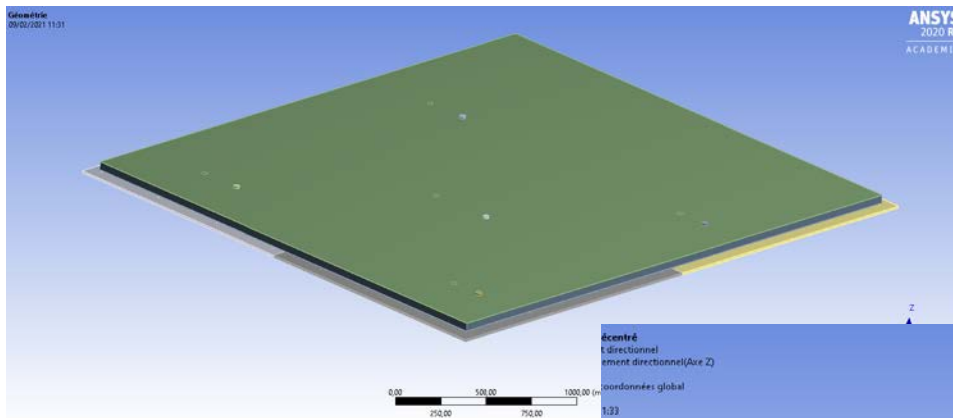
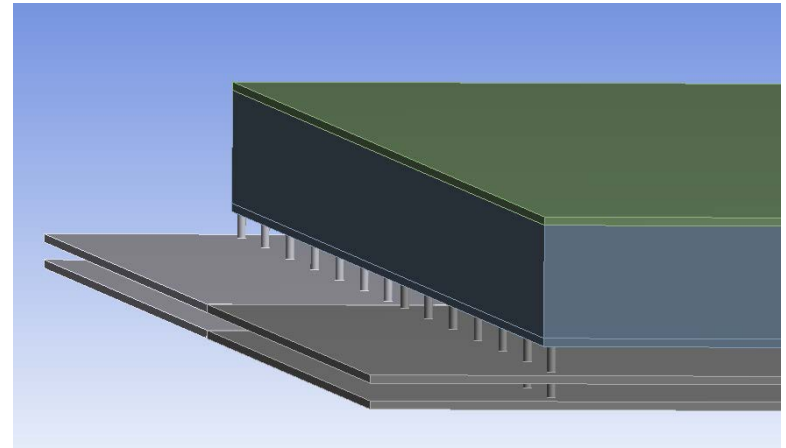


Honeycomb +
glass-fiber skins

Deflection comparison under
standard load, to validate model



First full CRP models, displacement results to come as soon as measurement results are available



- CTE studies on anodes and honeycomb material will define the composite frame design (honeycomb or assembled)
 - Results foreseen by mid-March
- Mechanical integration of the CRU and electronics will be done in details
 - Can be started now
- CRP production procedure and tooling for ColdTest will be defined in details
 - Cranes, transport box, logistics...