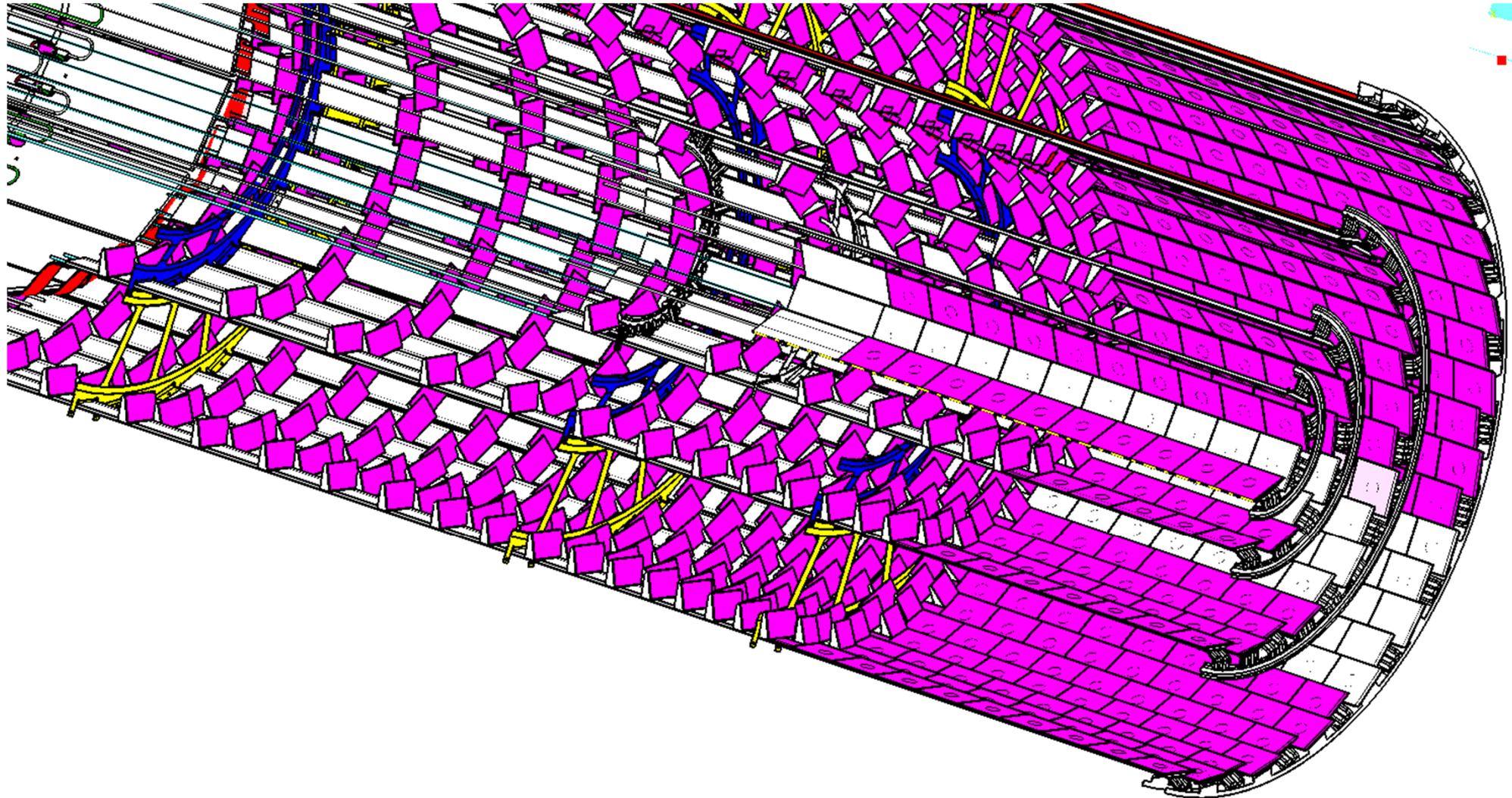


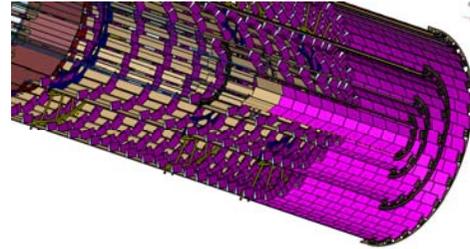


## Optimisation Thermique Du Detecteur Refroidi Au Co2 Diphasique

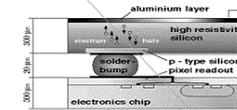




ATLAS pixel alpin



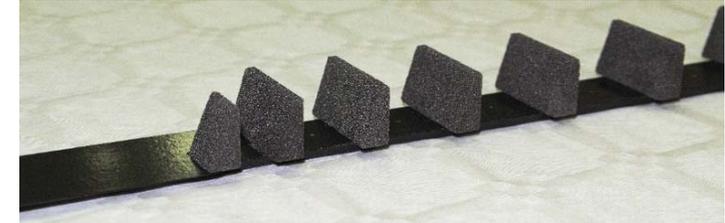
Chip



Sensor



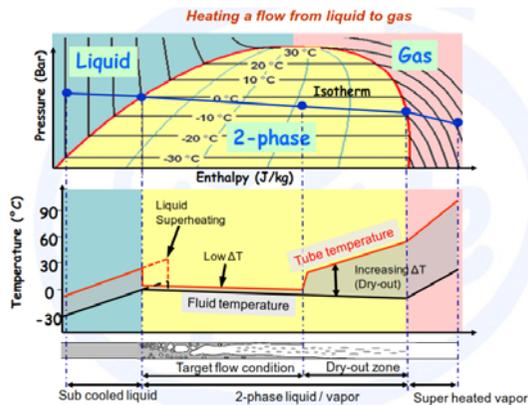
Jouer avec le feu



Montagnes

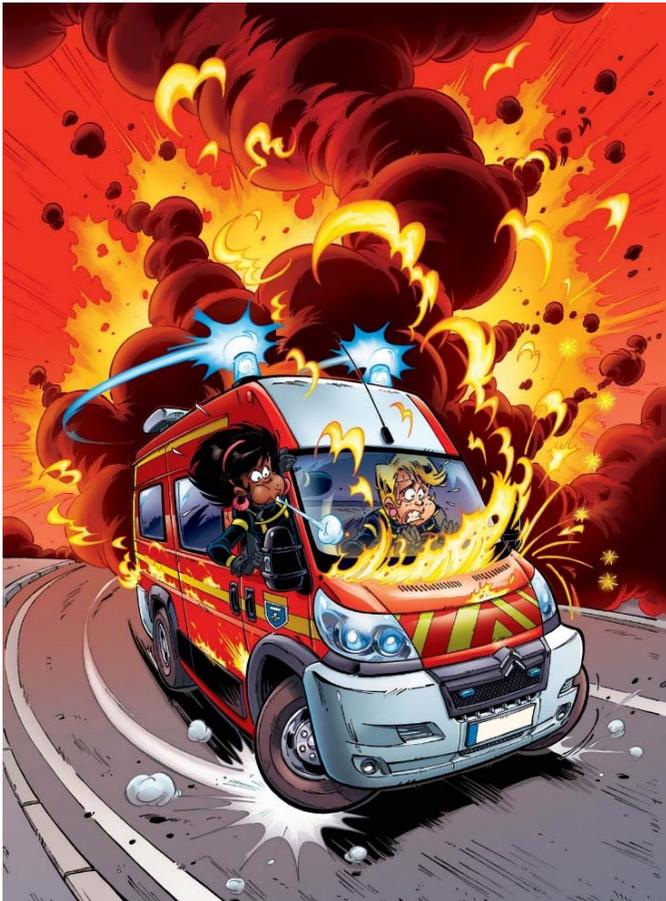


CO2 cooling



Thermique et matériaux

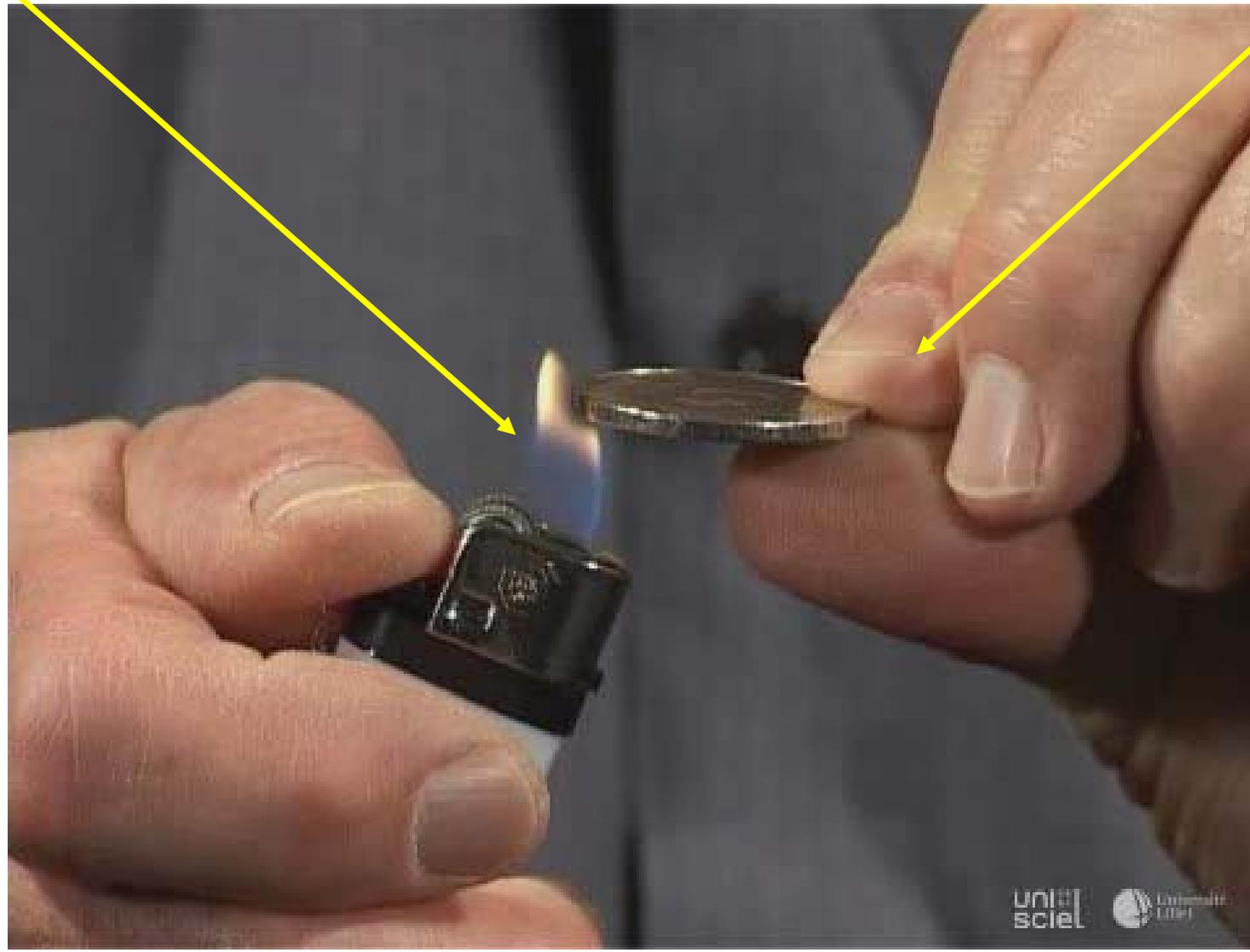






Source de chaleur

Refroidissement



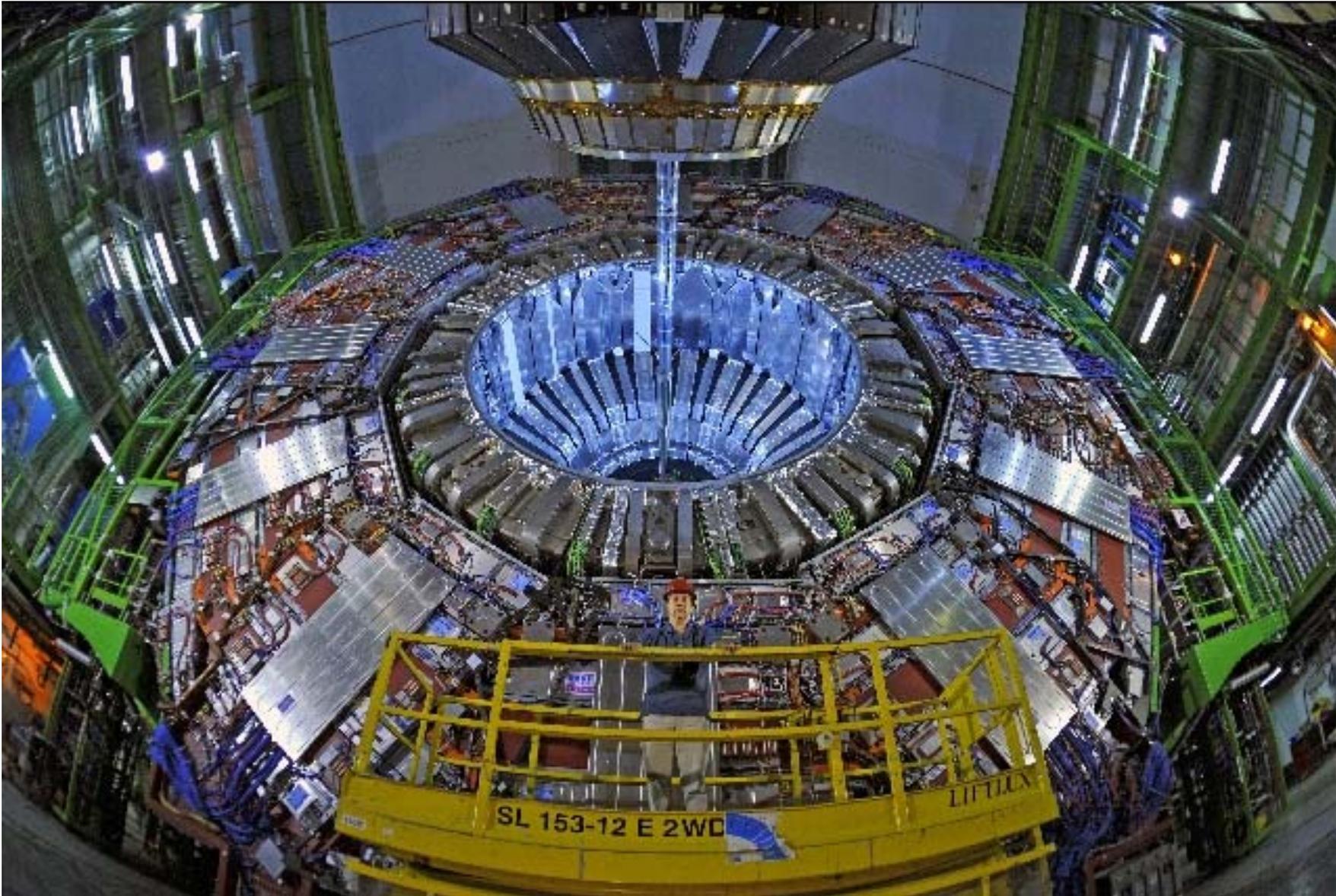


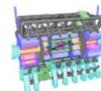
# Contexte



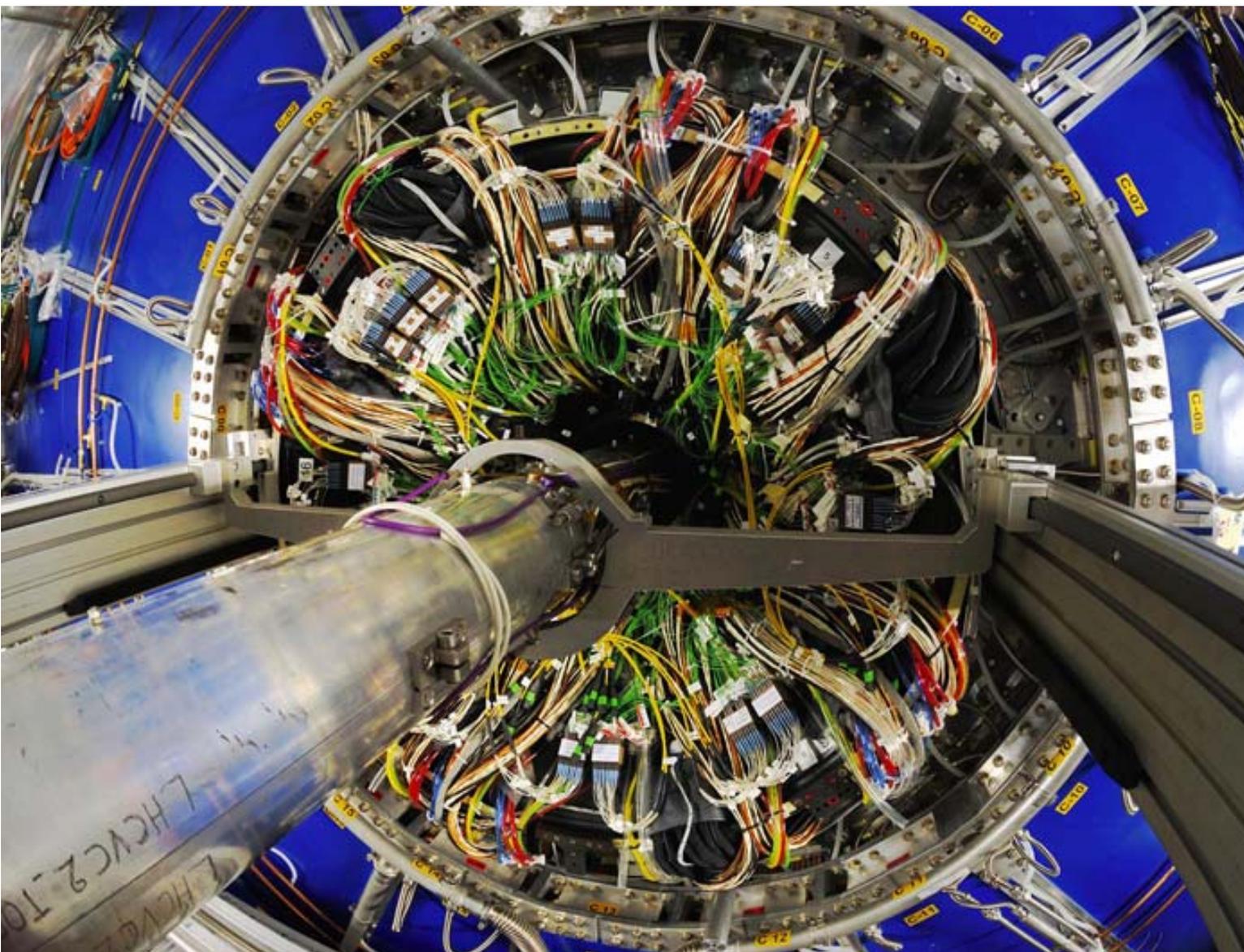


## Tracker silicium (CMS)





## Tracker silicium ALICE



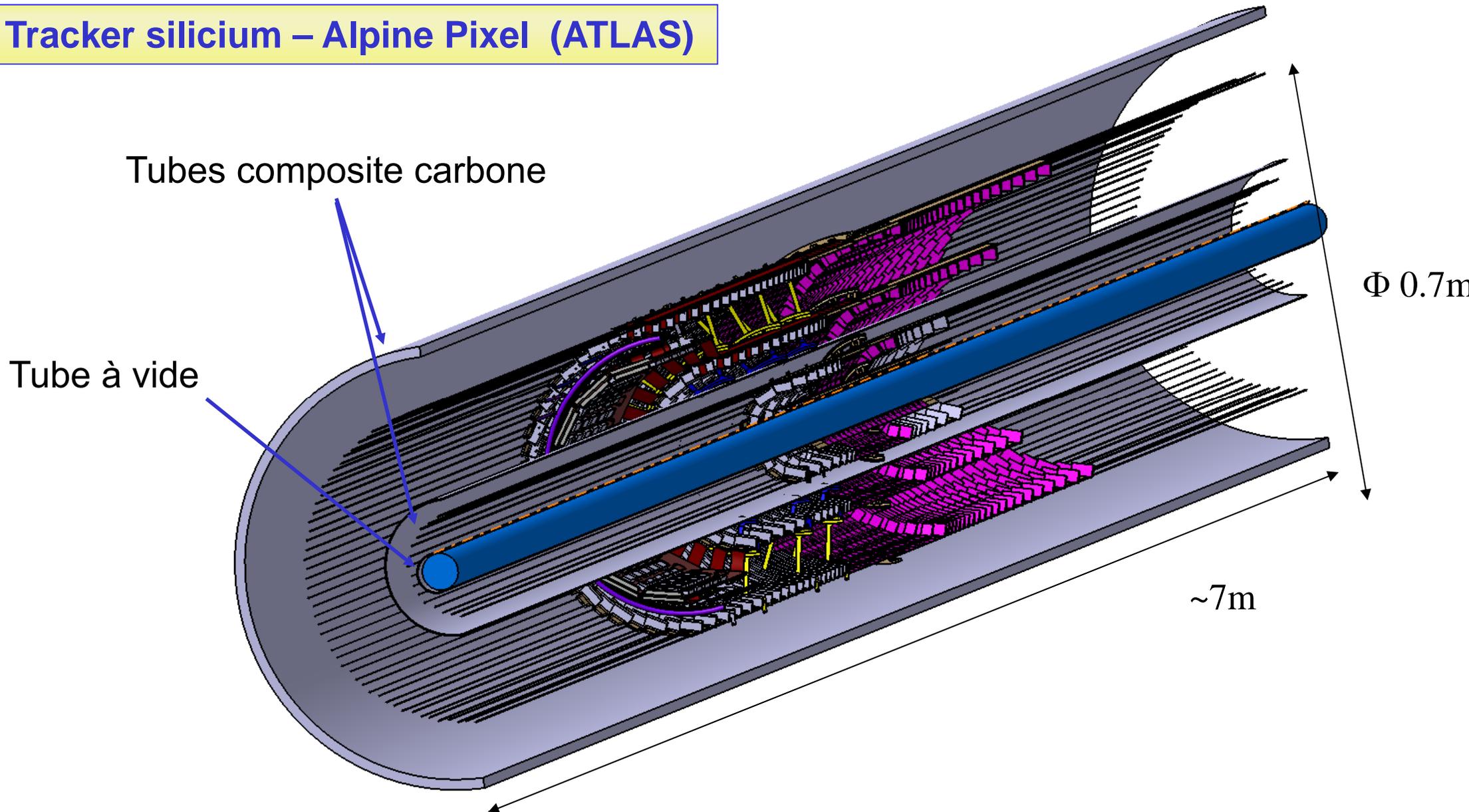


## Tracker silicium (ATLAS)





## Tracker silicium – Alpine Pixel (ATLAS)

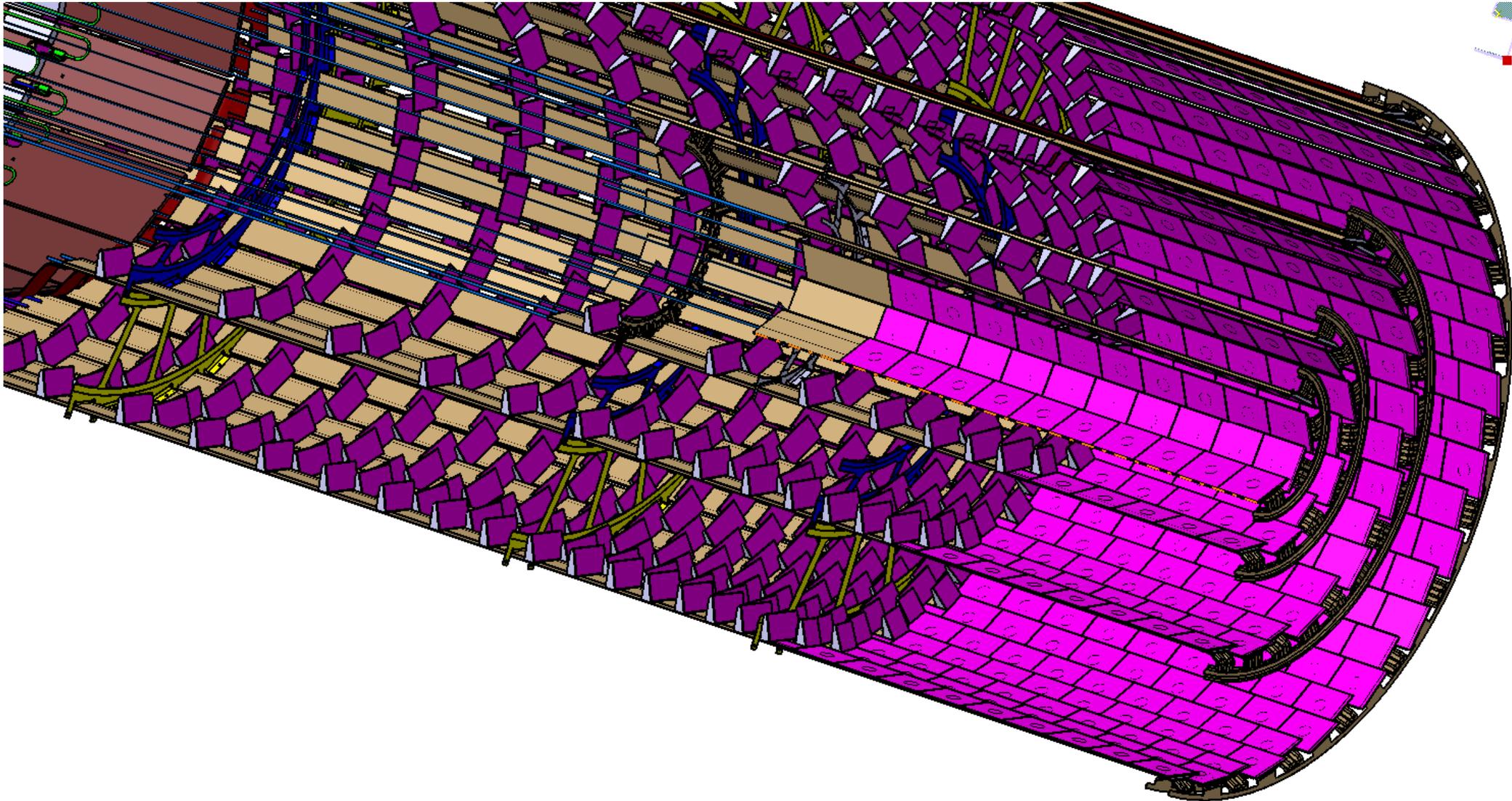


Nouveau pixel à partir de 2023 / durée de vie 15 ans / augmentation luminosité.



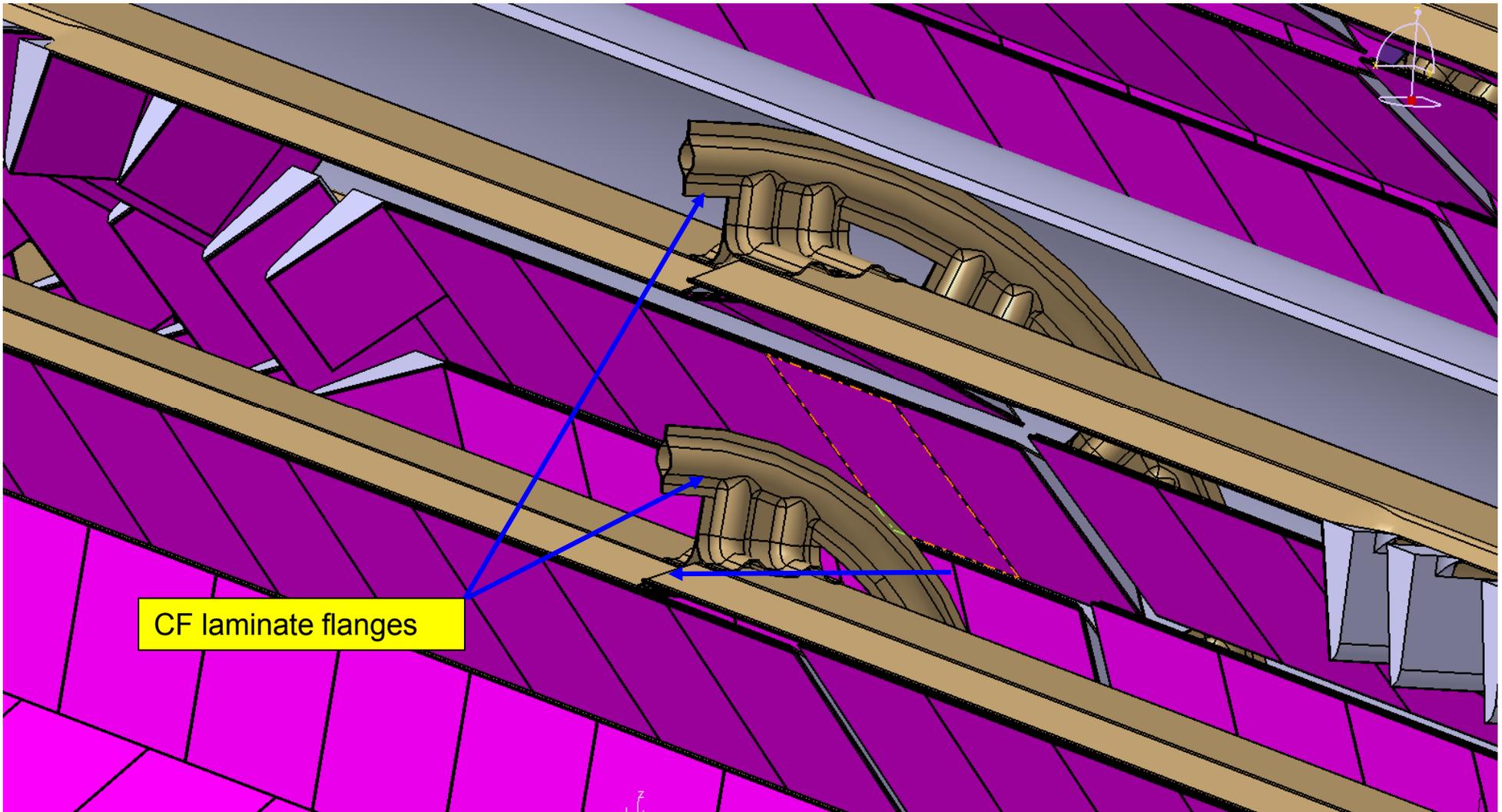


## Tracker silicium – Alpine Pixel (ATLAS)





## Tracker silicium – Alpine Pixel (ATLAS)

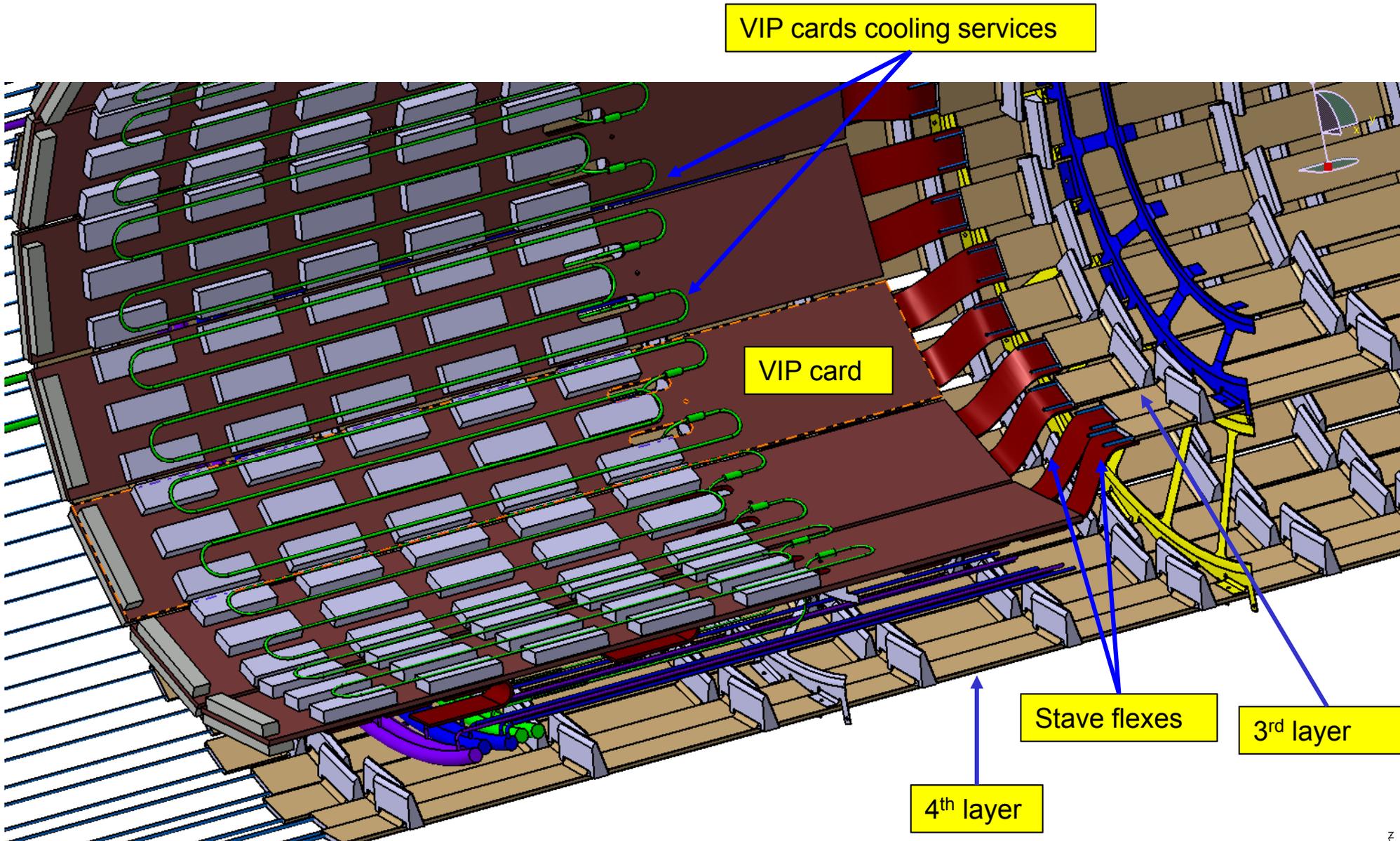


A and C side staves are not exactly at the same radius to manage the overlap





## Tracker silicium – Alpine Pixel (ATLAS)





# Pourquoi refroidir ?

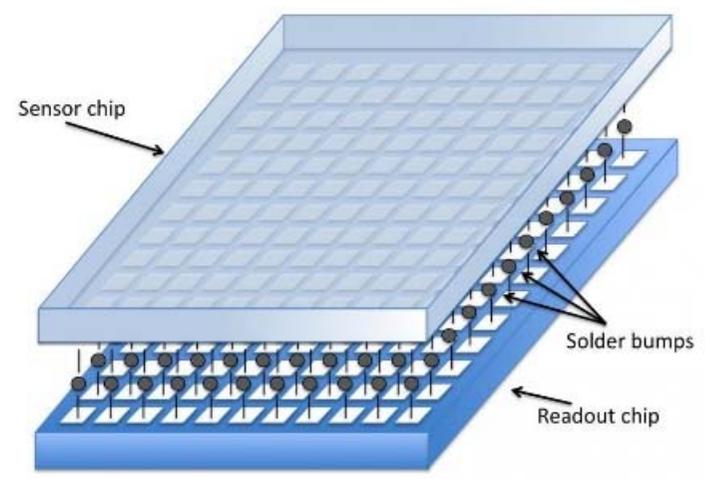
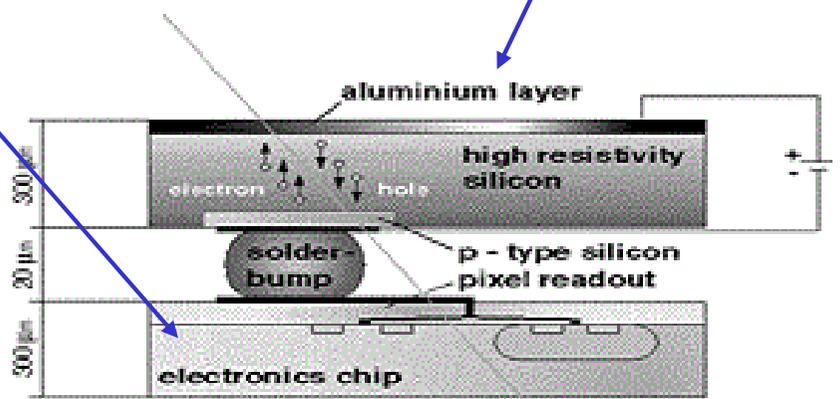
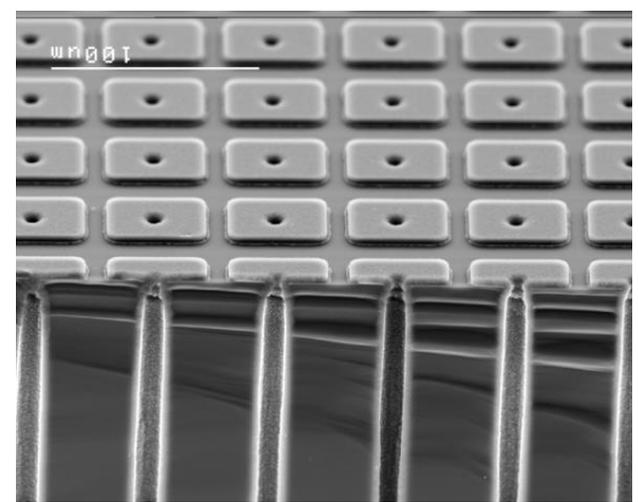
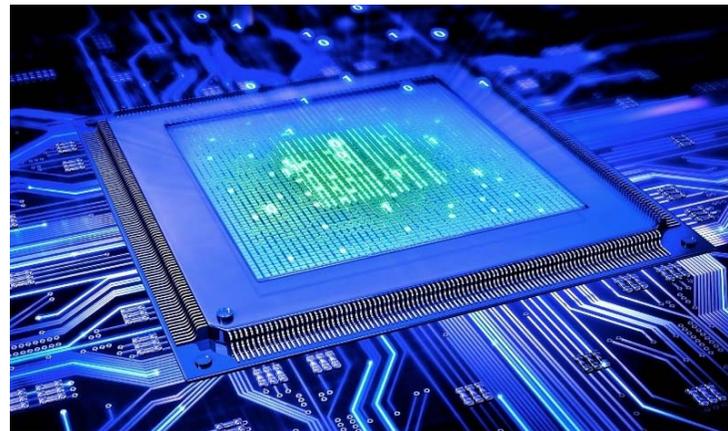
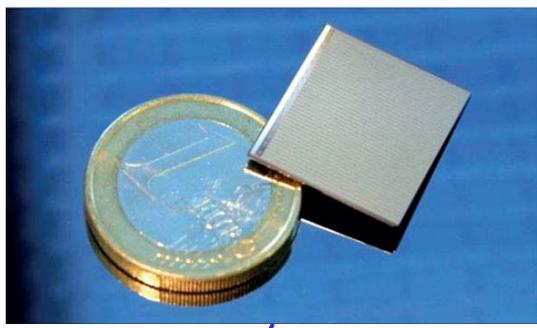
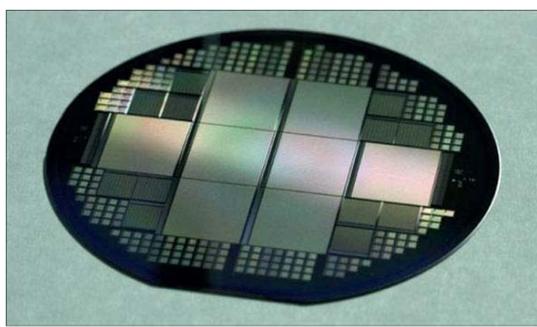


# 3 – Pourquoi refroidir ?



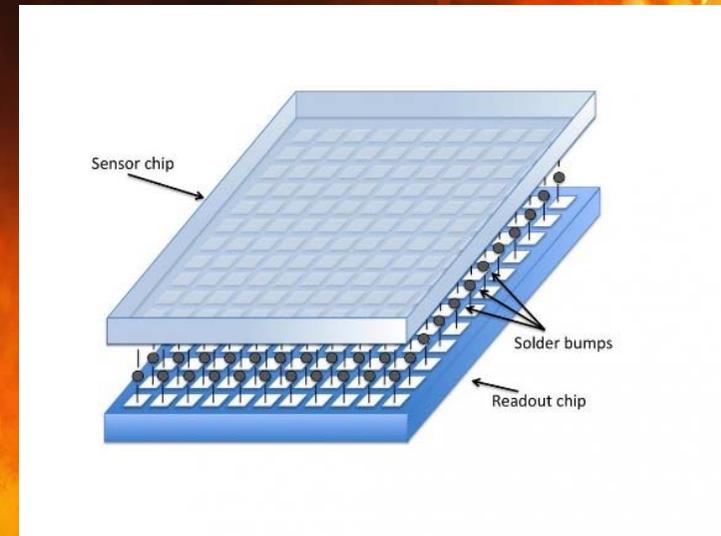
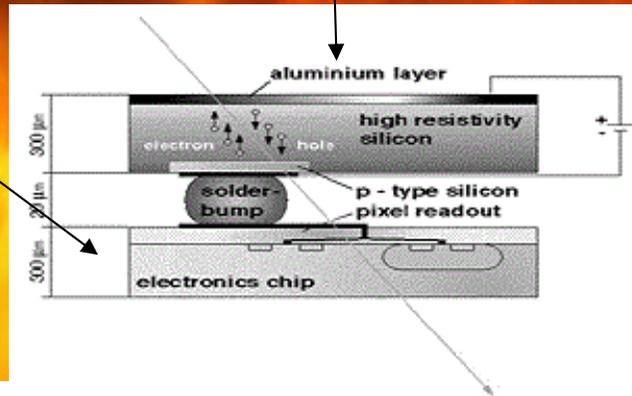
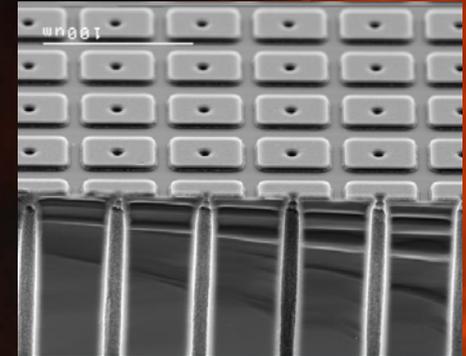
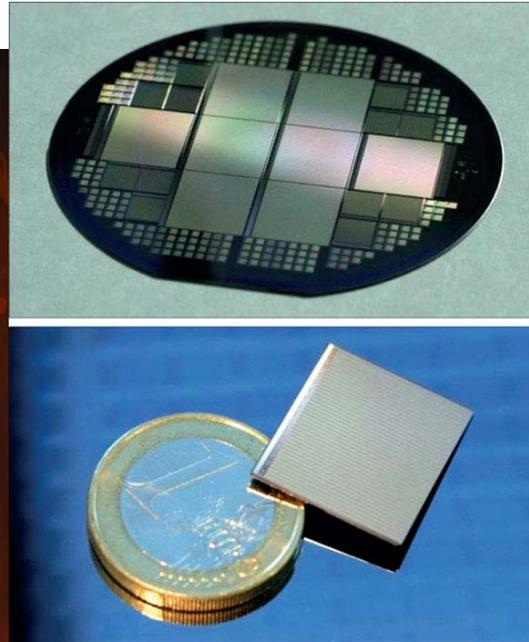
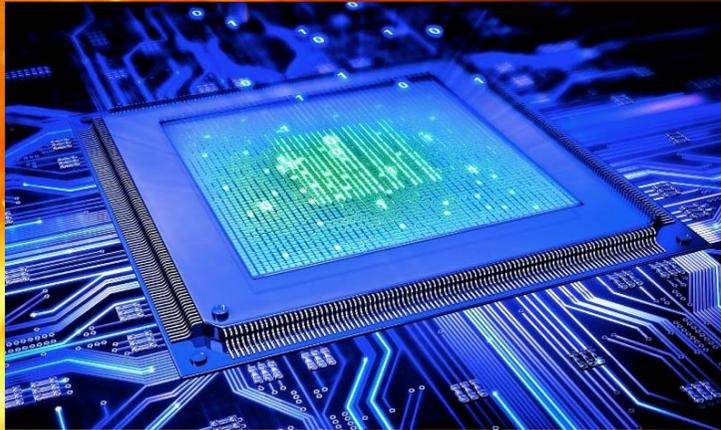
## Les modules pixel)

5 m<sup>2</sup> silicium





## Les modules pixel)





**Le thermal runaway**

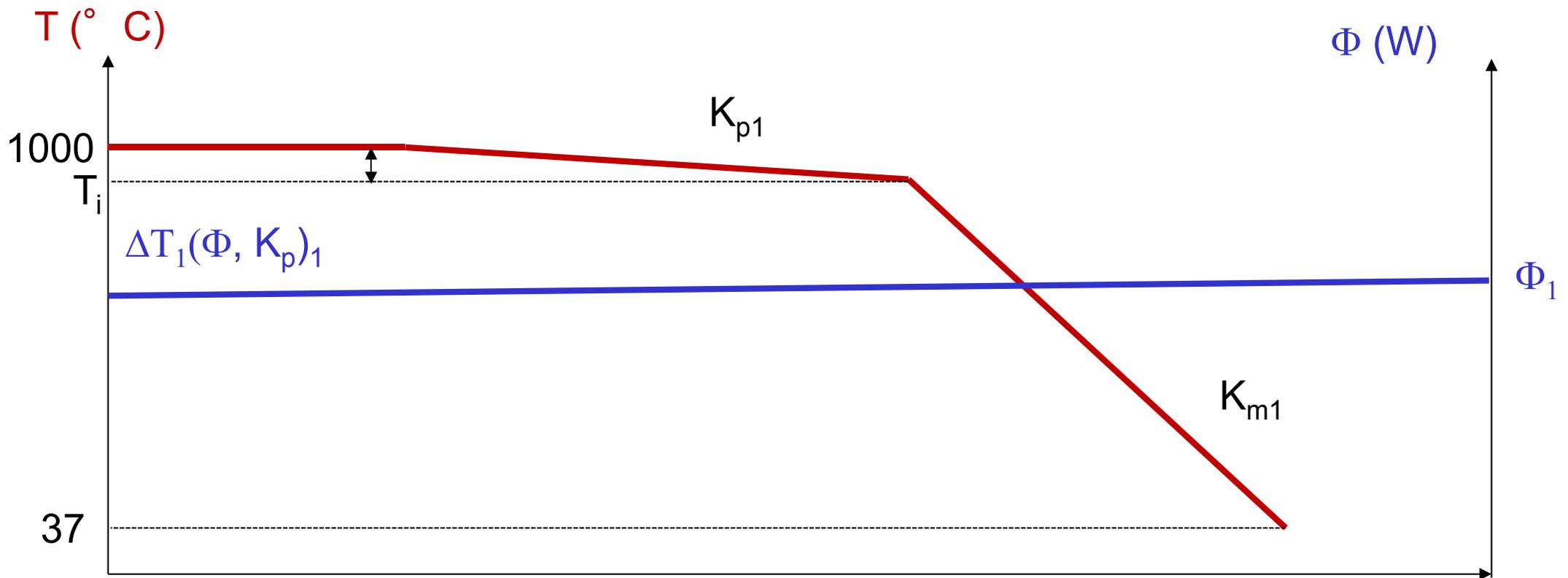
Typical temperature = -20° C)

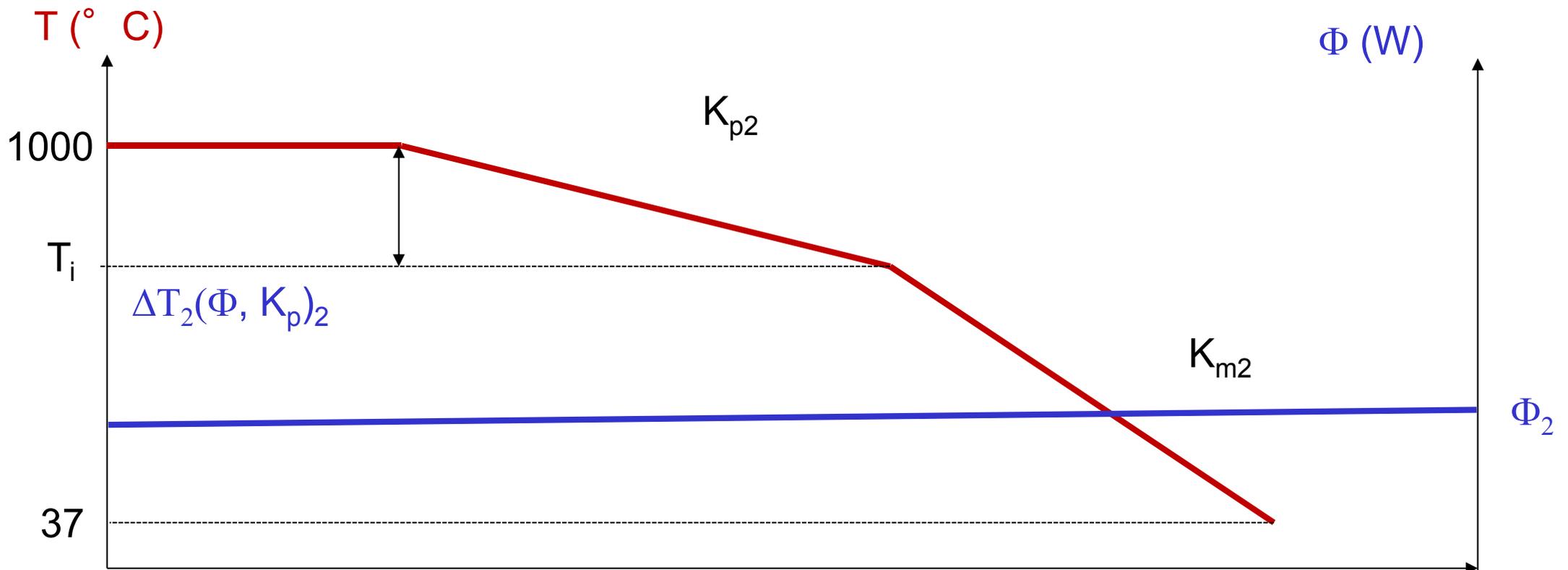


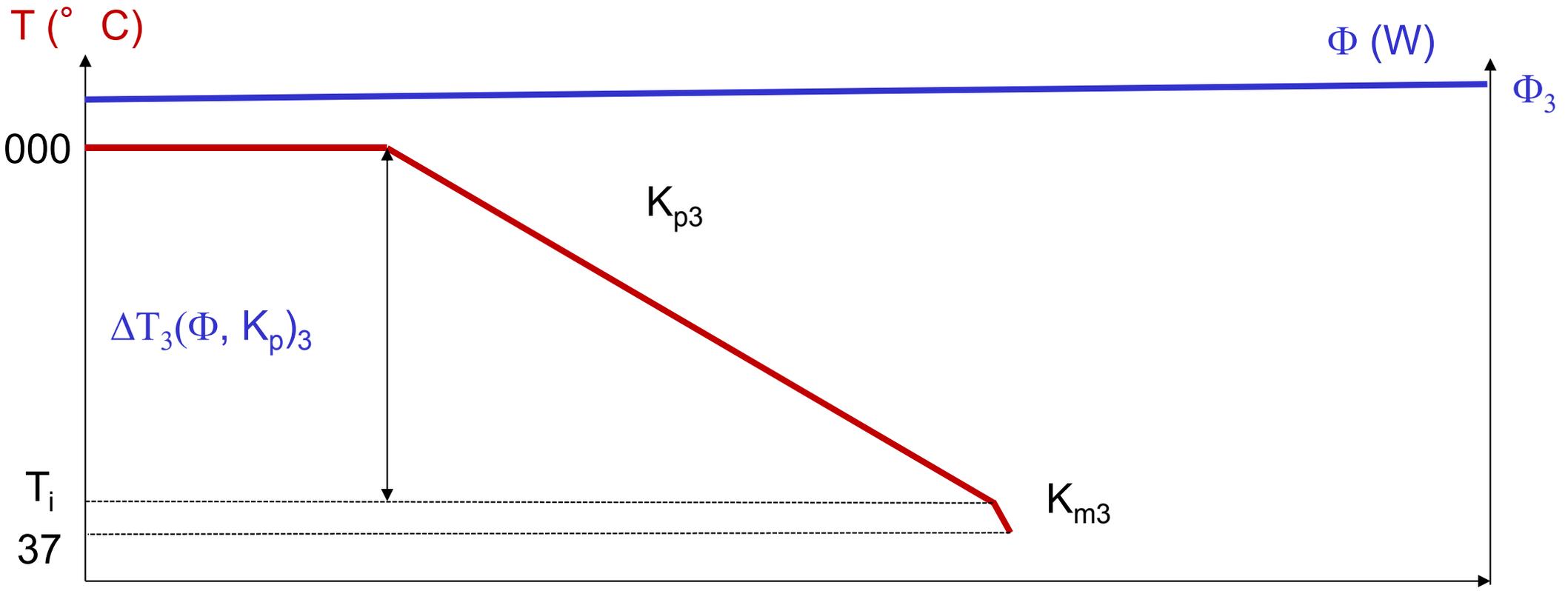
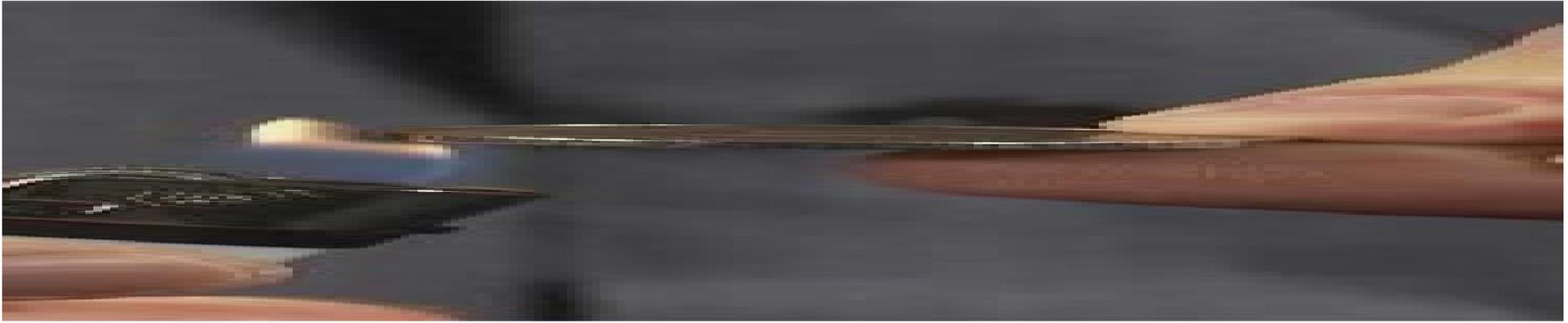


# Considérations sur le cooling





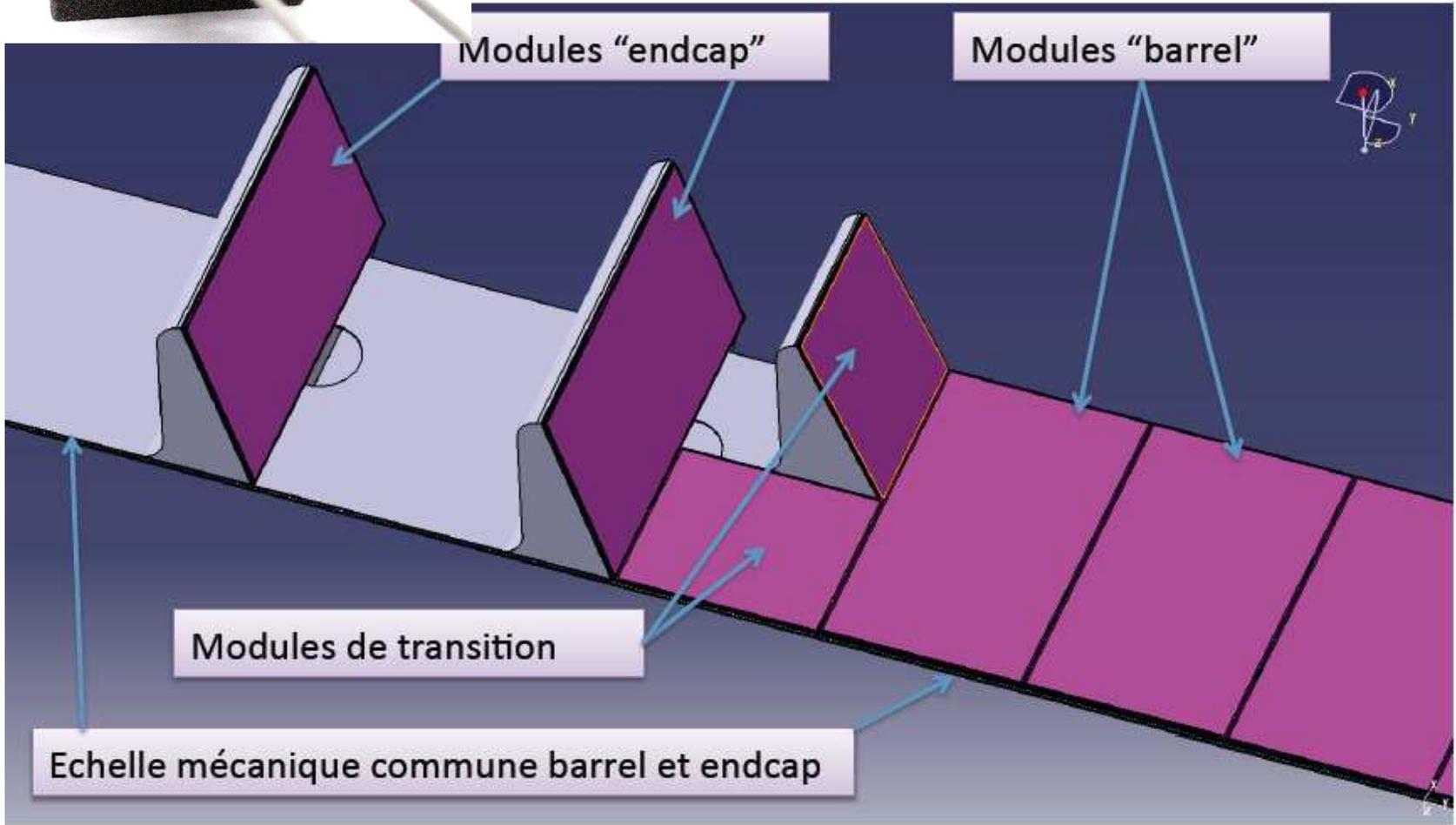
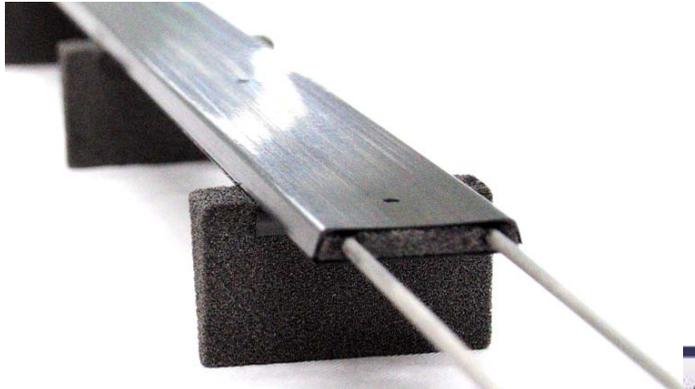






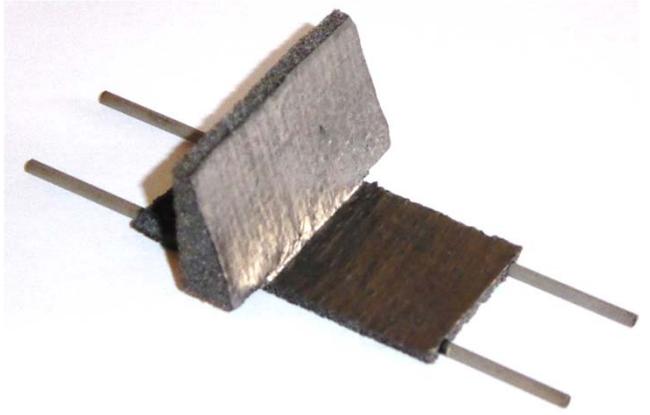
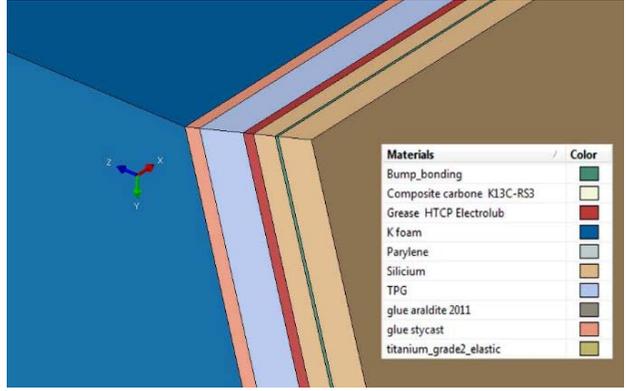
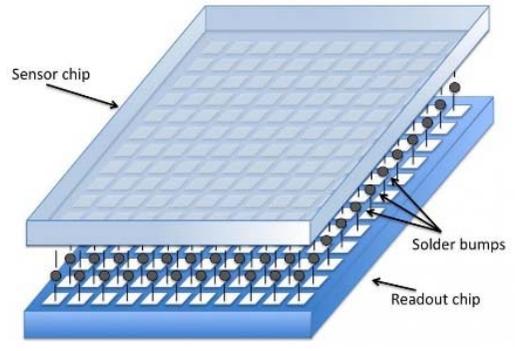
# Le cooling appliqué aux montagnes



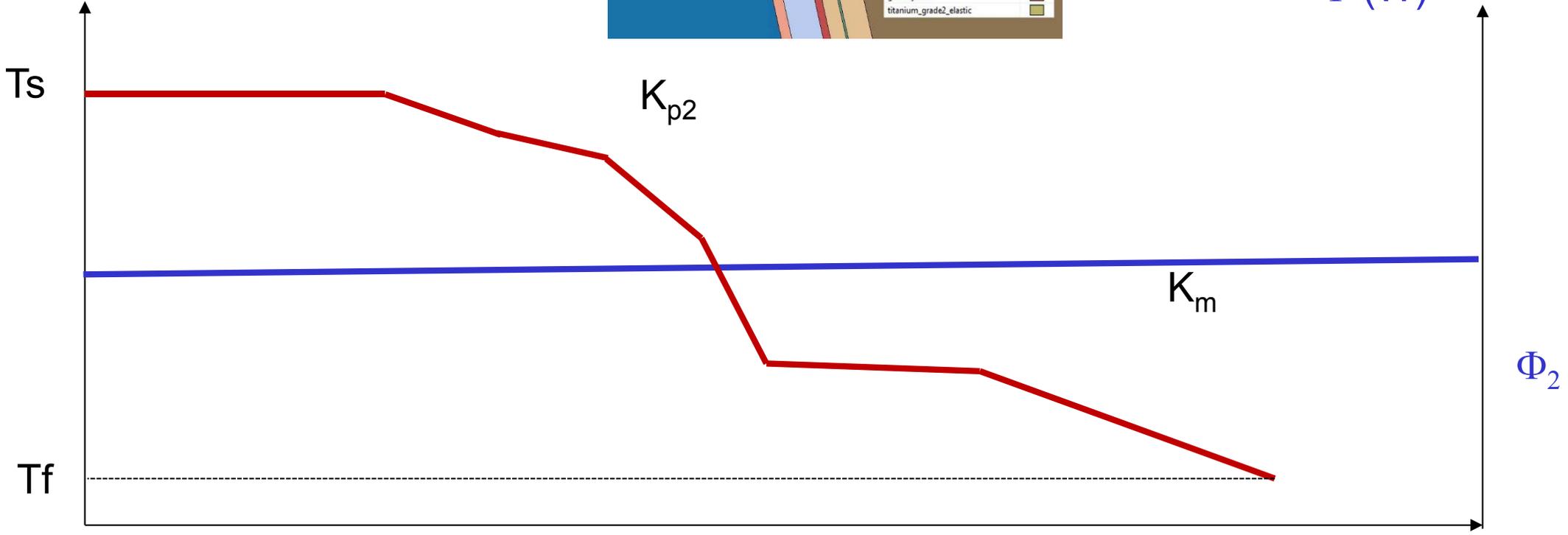




## Le gradient de température dans la structure

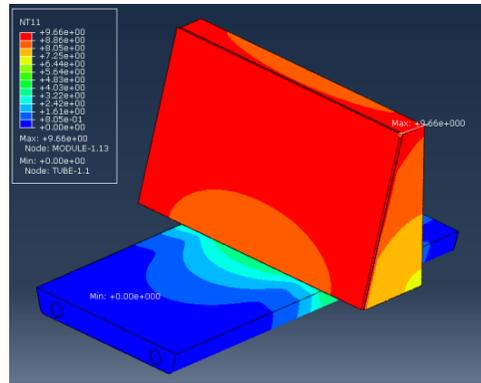
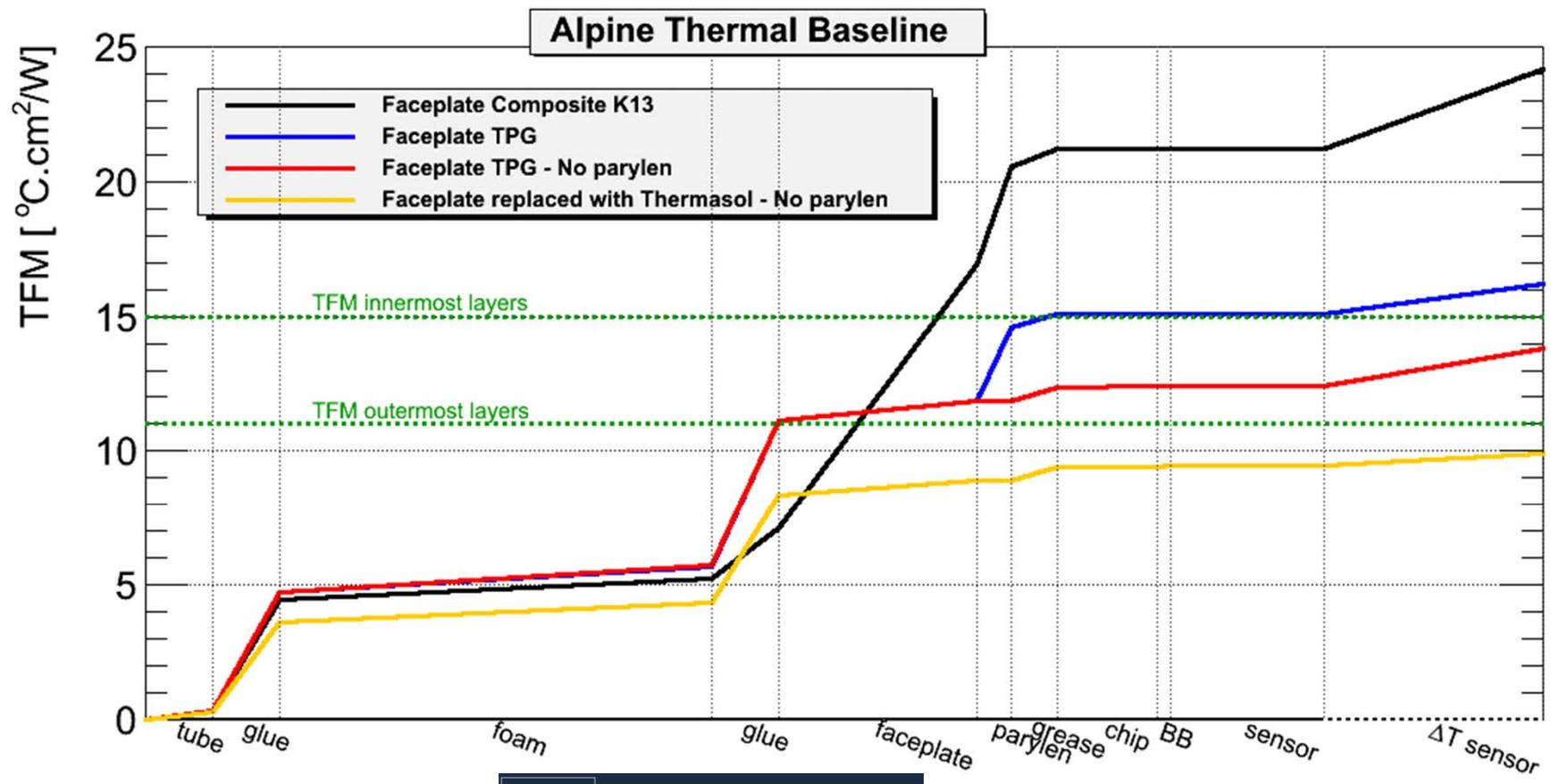
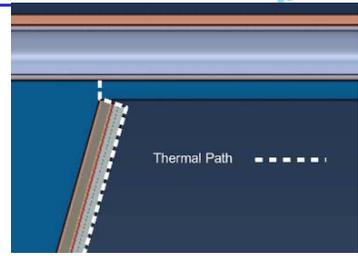


T (° C)



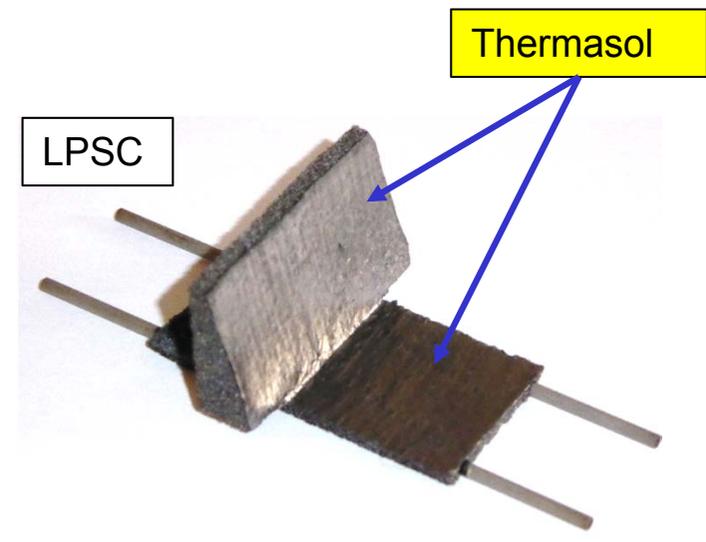
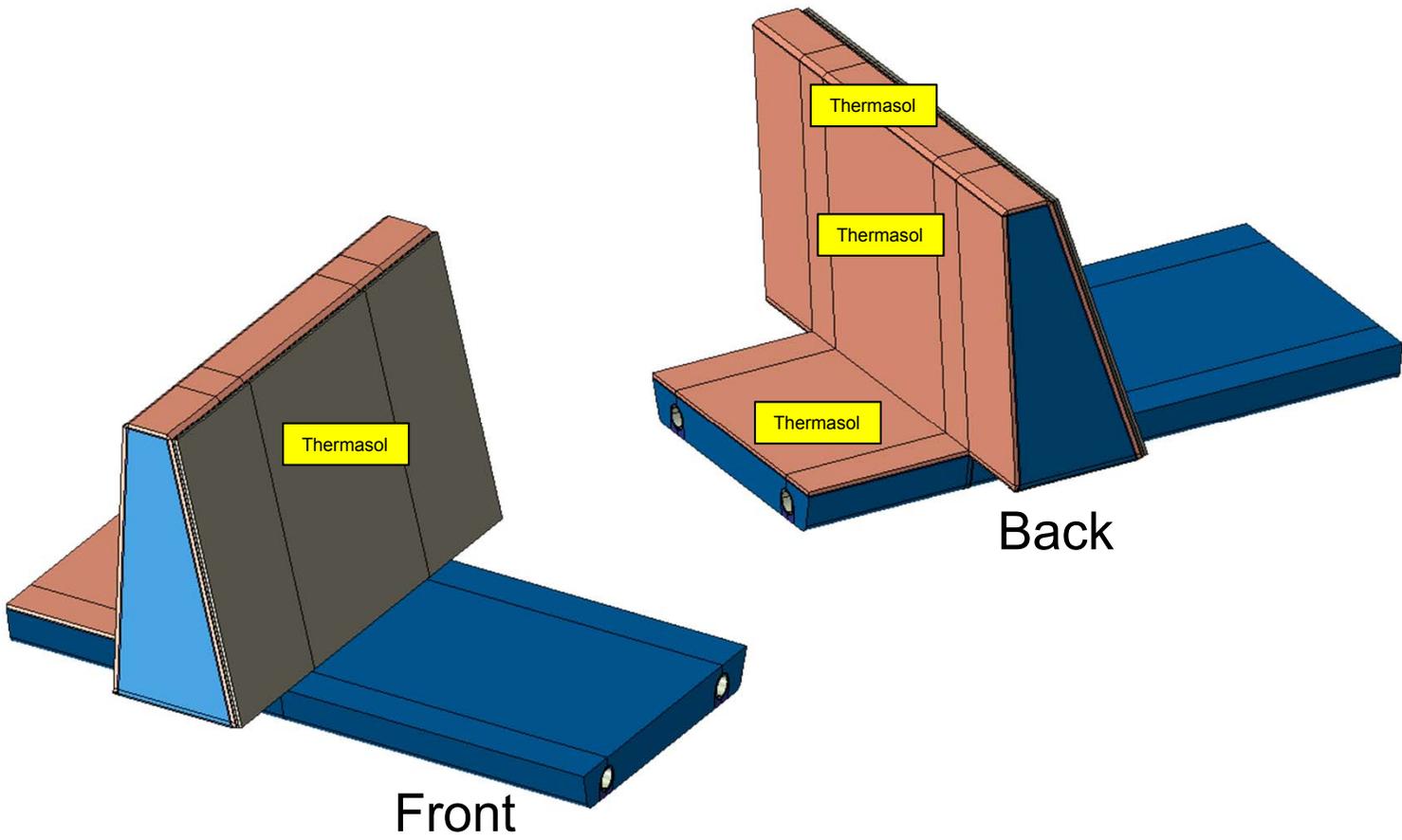


## FEA results 4 cases comparison



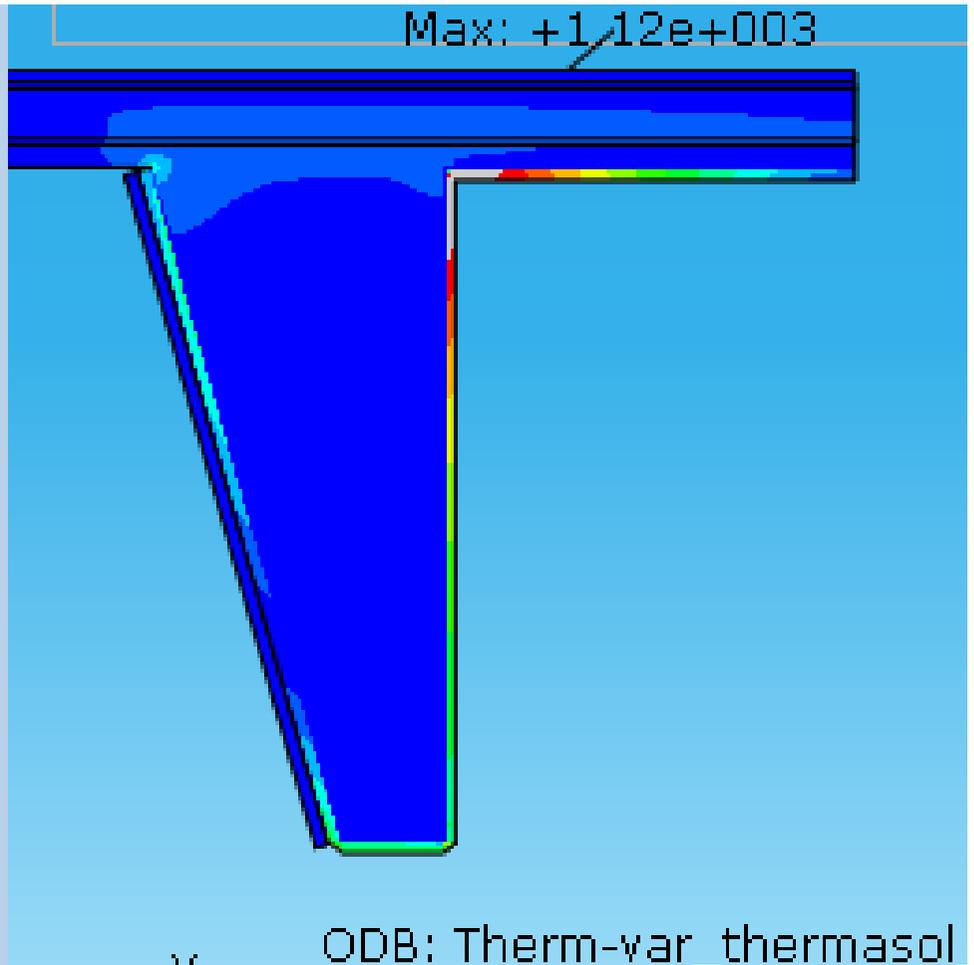
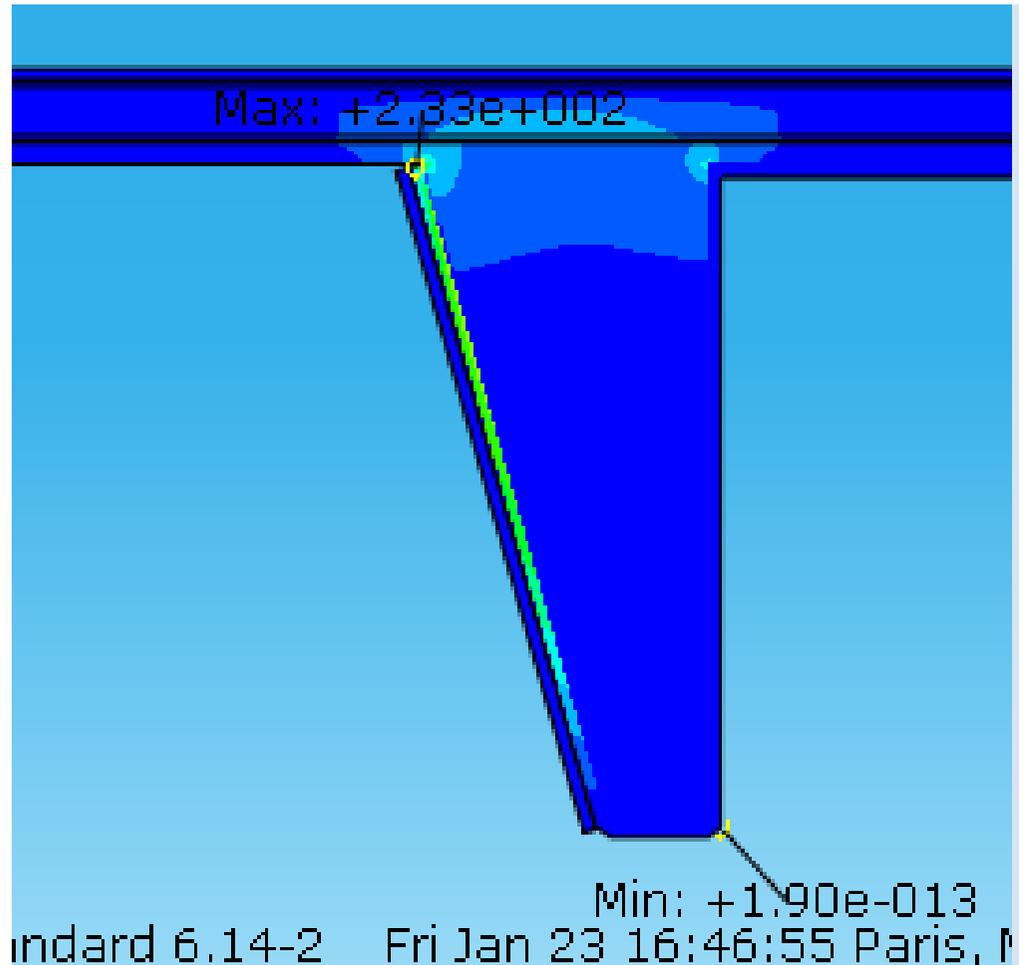
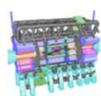


## First thermasol mountain



Thermasol (same as PGS) covers the mountain to improve the TFM and improve temperature homogeneity.







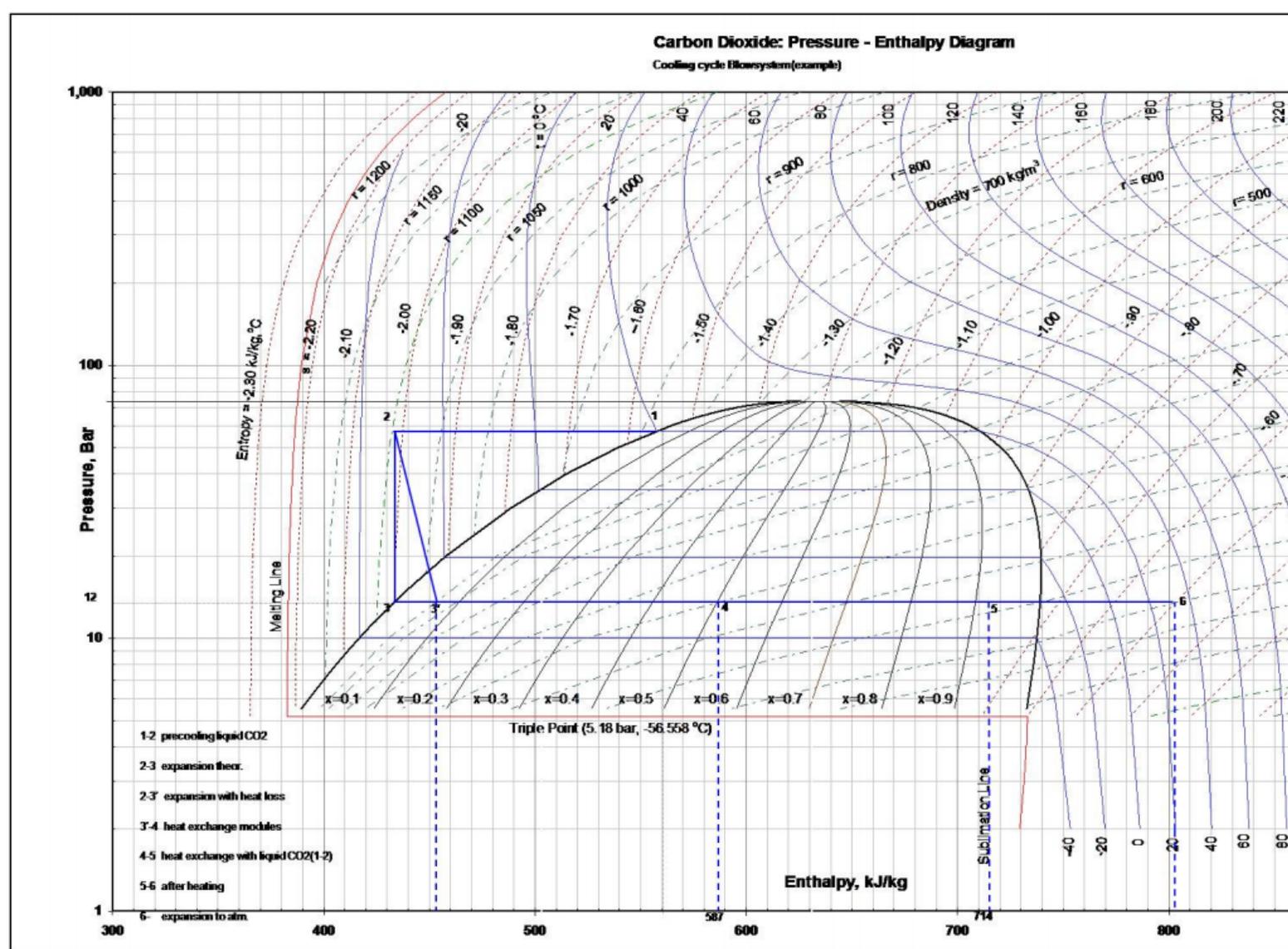


## Station cooling CO2





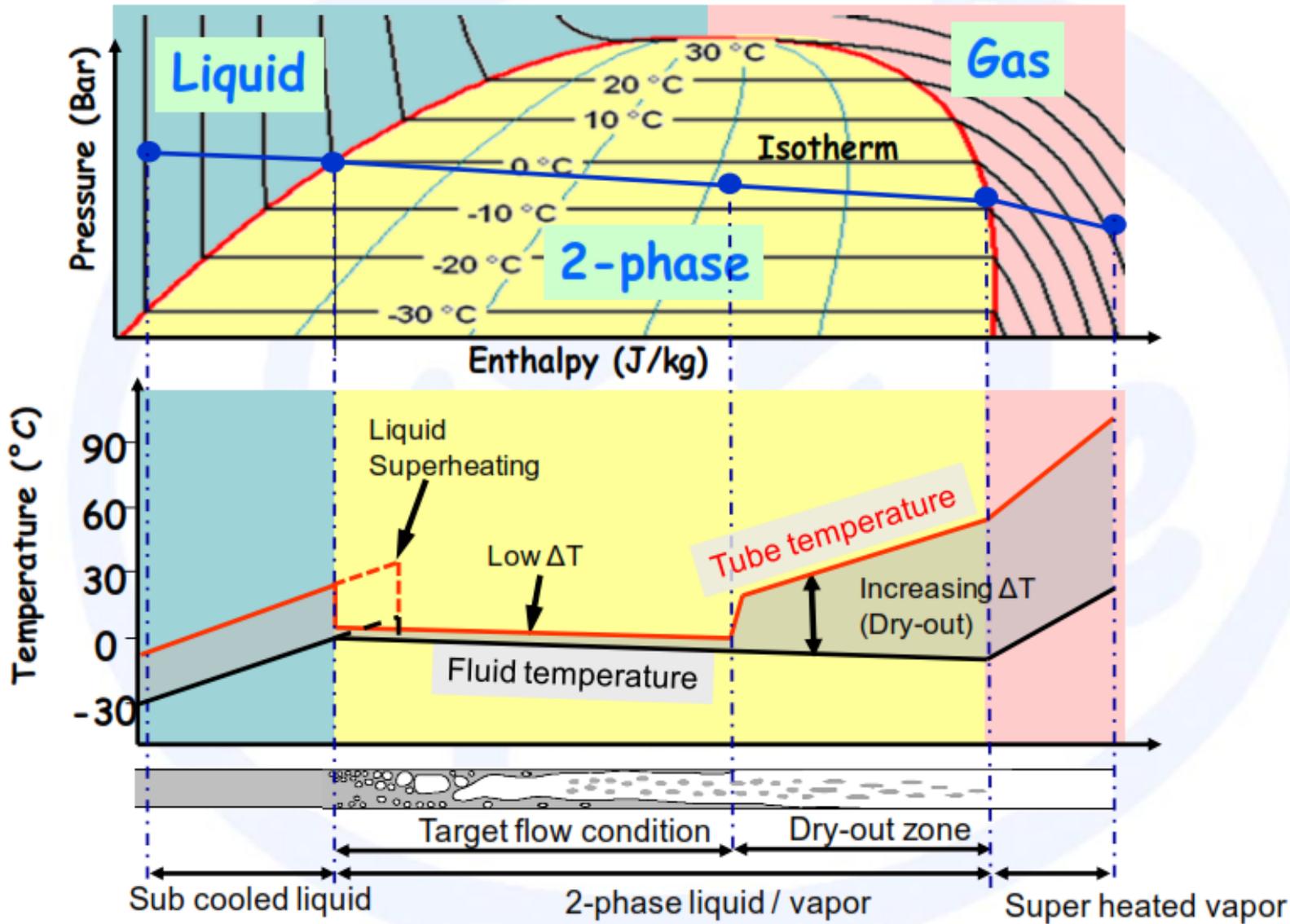
## Diagramme Pression -Enthalpie





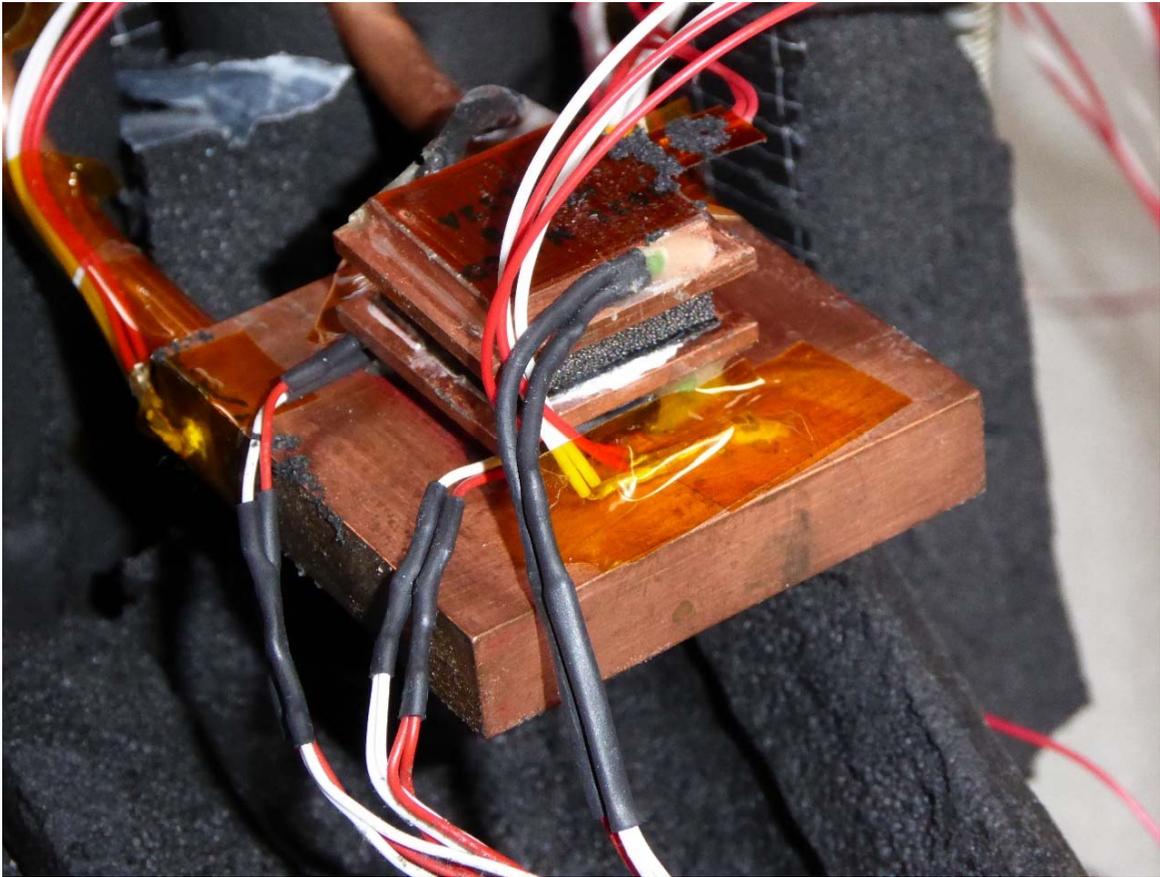
**First thermasol mountain**

*Heating a flow from liquid to gas*





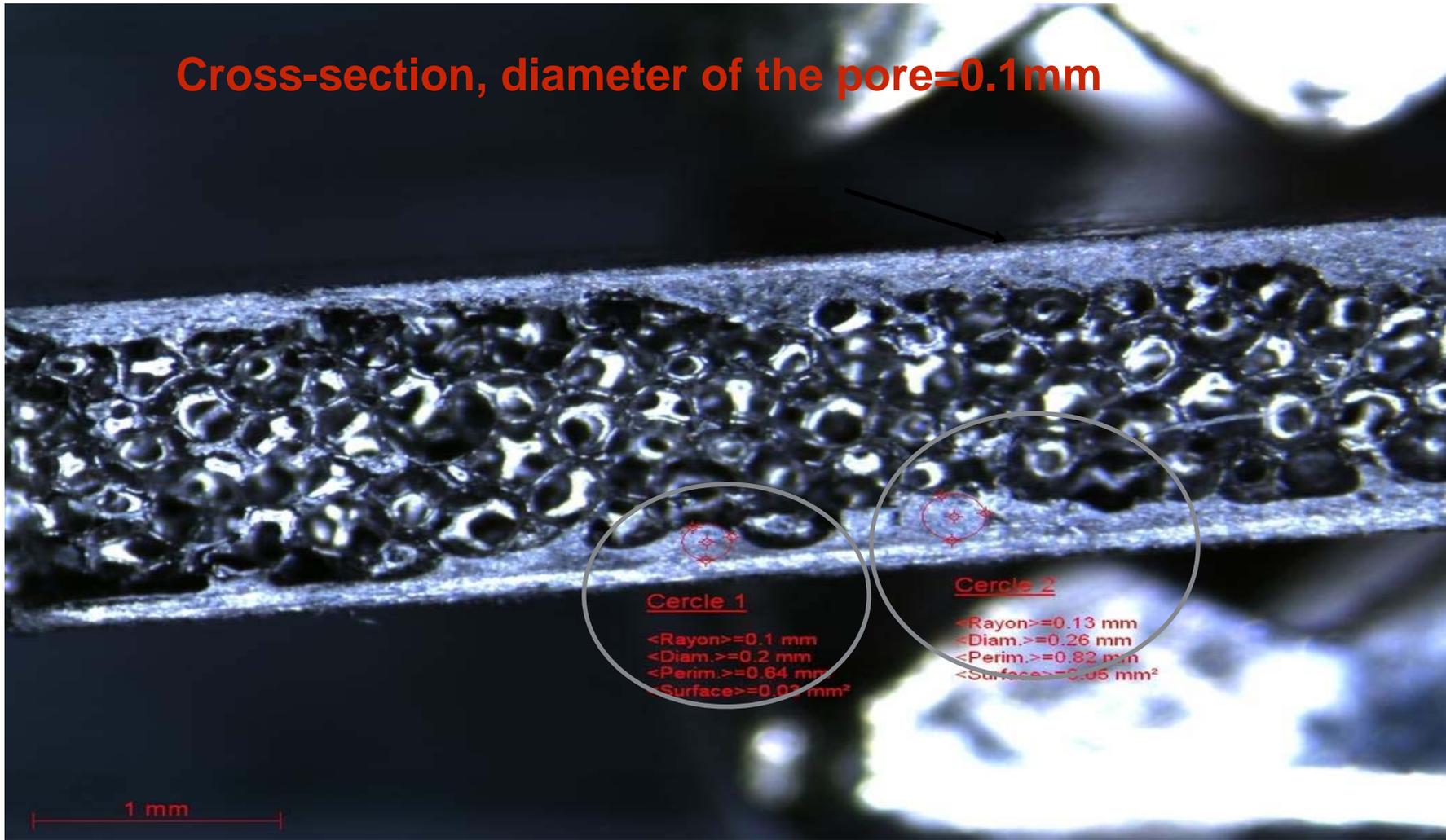
## Mesure conductivité matériaux





## Mesure conductivité matériaux

Cross-section, diameter of the pore=0.1mm

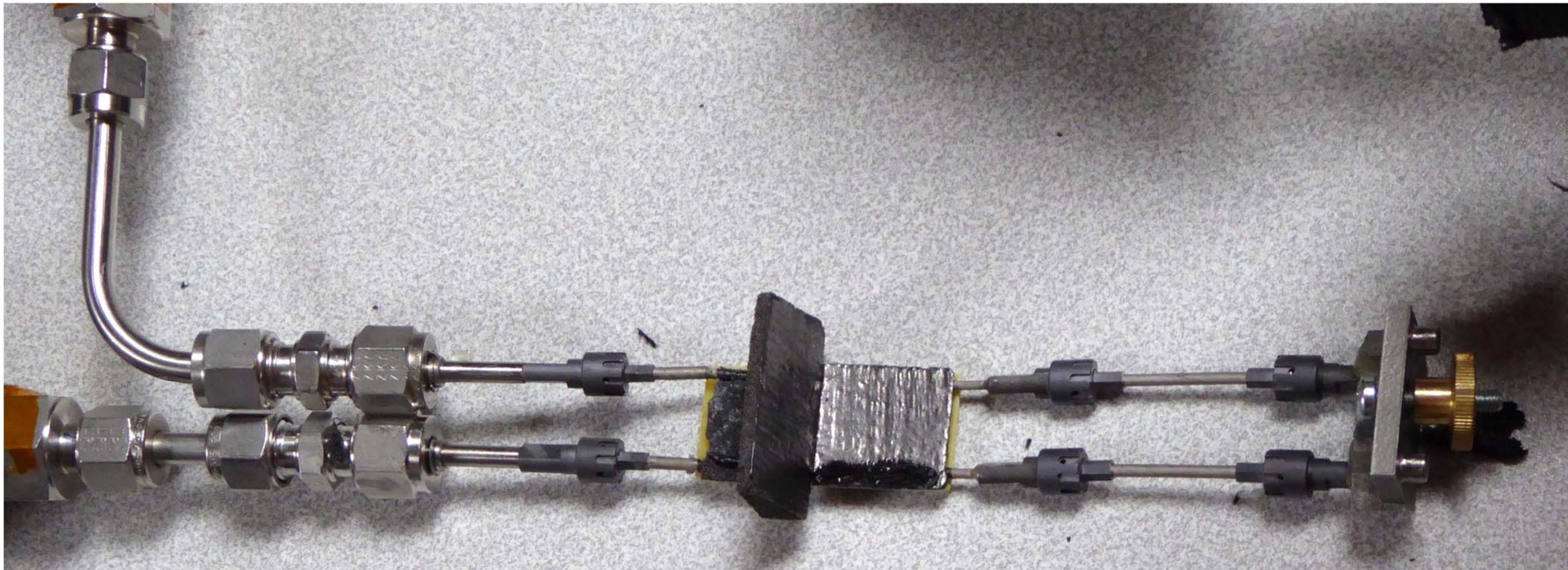


CF laminate glued on Graphite foam (Allcomp K9)





## Mesure performances thermiques montagne





## Mesure performances thermiques montagne

