

ECAL Barrel :

Cooling Tests

- Reminder and present status
- Next steps :
 - Test on module 0 : full module with 400 crystals dedicated to cooling tests, equipped with a fake front end electronic (heater).
 - Test on smaller scale : 1 VFE block (group 2 front end electronic cards = 10 channels in total).

Reminder

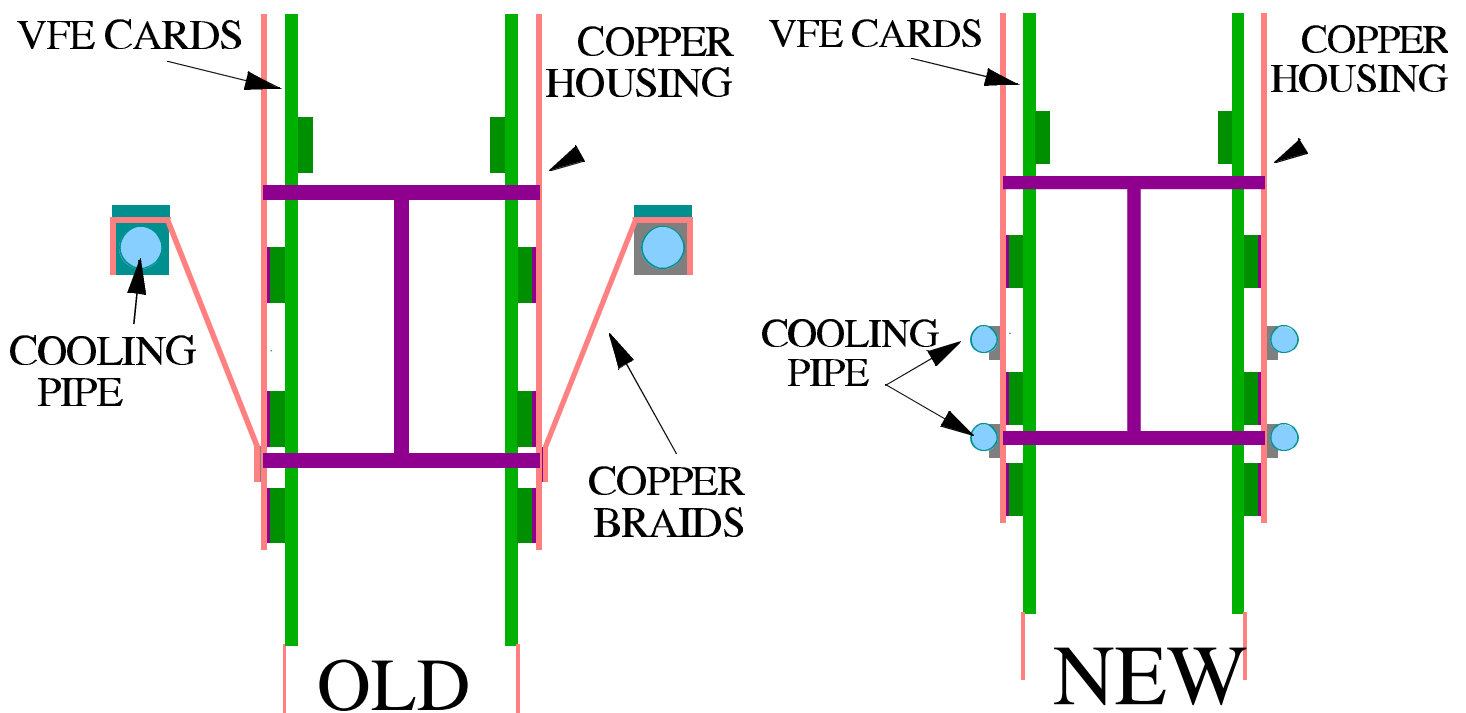
- ECAL Barrel \approx 60 000 crystals
 - **VFE Board** consumption is increasing : now **2.5 W/channel** (cooling system was originally designed for 1.2 W/ch)
- amount to 150 KW (VFE only)**

2 cooling circuits :

- **Power circuit** should absorb 90 % of the heat dissipated by the VFE.
- **Regulating circuit** absorbs the remaining heat and keeps the crystal at a stable temperature ($\pm 0.05^{\circ}\text{C}$).

Status

- ✓ Regulating circuit optimized according to previous tests performed on a sub-module scale : **final design is ready.**
- ✓ Power circuit new concept proposed and partially tested; **more test will be undertaken.**



New Power Cooling Design



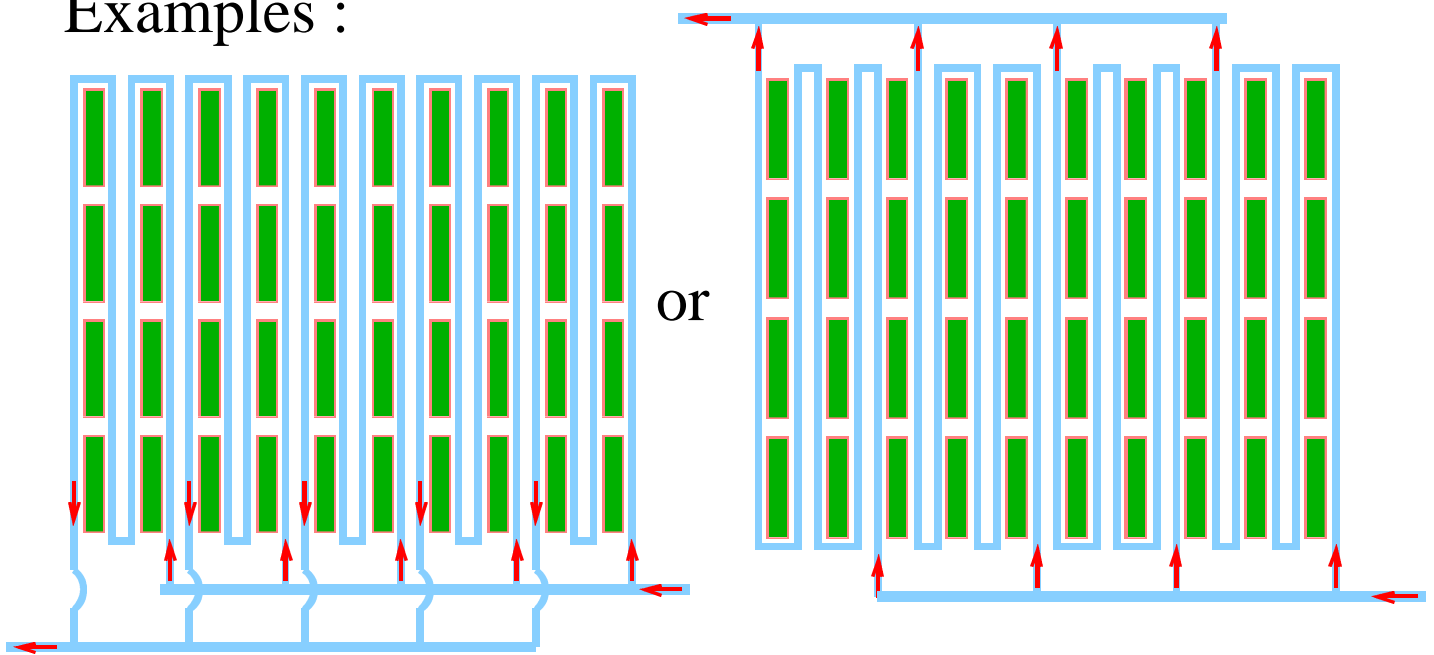
- Cooling tube directly brazed on the housing → good thermal contact
- Keep maximum flexibility to minimize the mechanical constraint on the box :
 - Stainless steel tube with small diameter ($\Phi = 4/3$ mm)
 - Partial brazing on the housing

Still to be done on this design

Arrangement of the serpentines
-VS-

Pressure drop and water flow

Examples :



⇒ Next test to be done on module 0

Will allow to quantify the needs for the power circuit flow and pressure (used to be 5 l/s for EB with 1.2 W/channel, probably need to go to **10 l/s**)

Next step :

Study the heat transfer between the **VFE block** and the **copper housing** :

- Choice of the **thermally conductive** foam (to insure a good thermal contact)
- Choice of the **fixation** between the housing and the card (to insure a good contact and an easy assembly)
- Choice of the **shape of the serpentine** (to be optimized to ease the assembly)
- **Stamped** housing (to compensate for the different heights of the the electronic chips)
- **Double** housing (IPN Lyon's proposal for safe manipulation of the VFE)

⇒ **Tests will be performed on a sub-module scale with “real” VFE block**

Conclusion

- Confident that the new concept of power cooling will be satisfactory for :
 - cooling (heat exchange between pipe and copper box)
 - mechanic (flexibility)
- Design still need to be finalized, in particular for :
 - mechanical assembly
 - heat exchange between copper housing and VFE card
- Will need to be tested in more realistic conditions (module 0')
- Planning issue : see Oliver Teller's talk (coming next)