Temperature analysis

Nuetrino Oscillations group’s meeting
04/10/2018

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ProtoDUNE-SP Status

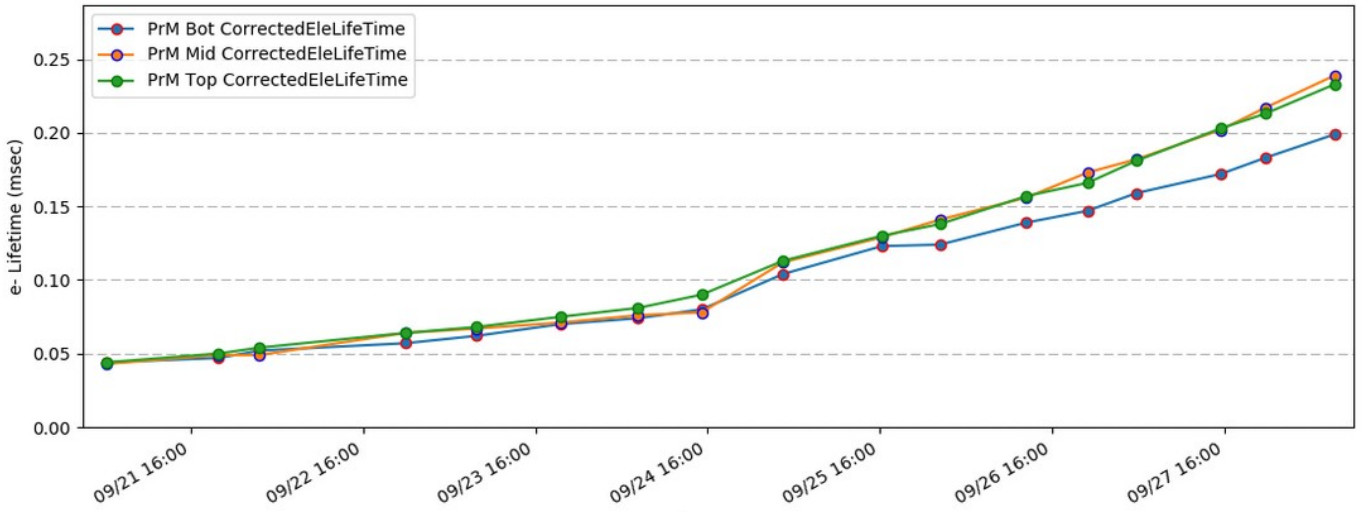
Cryostat filling process finished on September 13.

Preassure test on September 17.

LAr recirculation started on September 18

180 kV reached on September 21.

Taking data 24/7 since then.

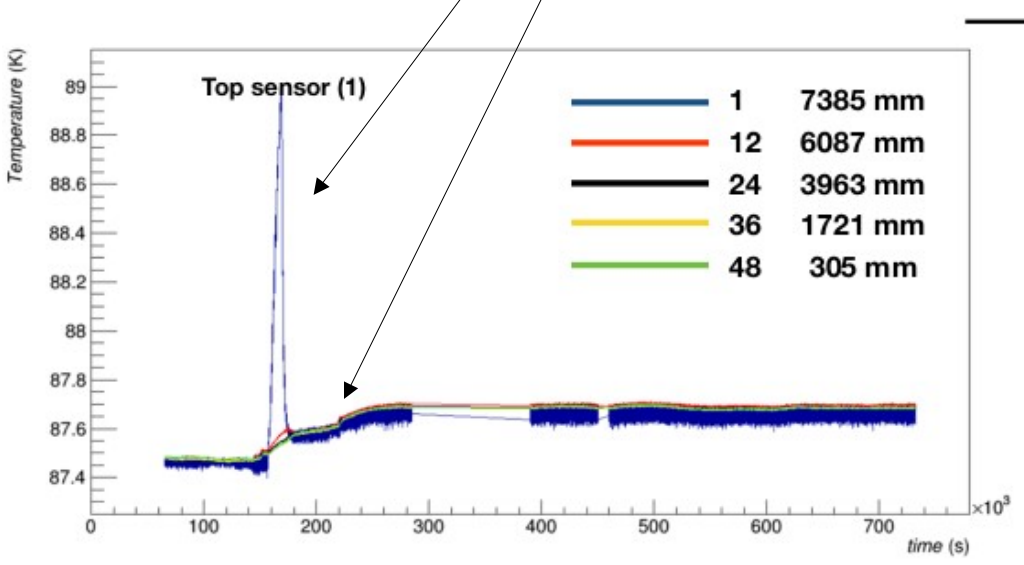


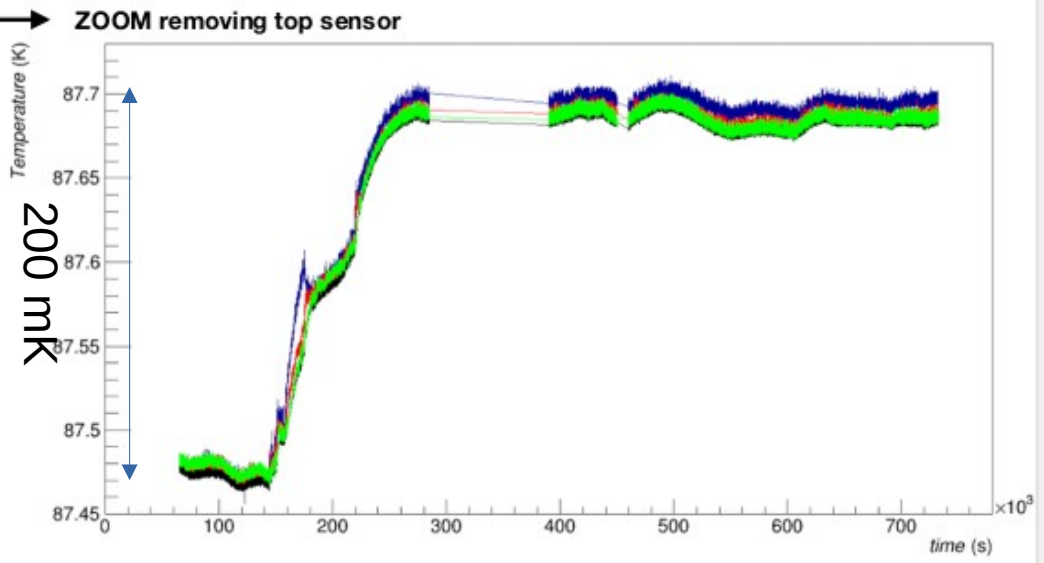
However, purity is still too low. Last measurement gave 0.6 ms.

ProtoDUNE-SP Status

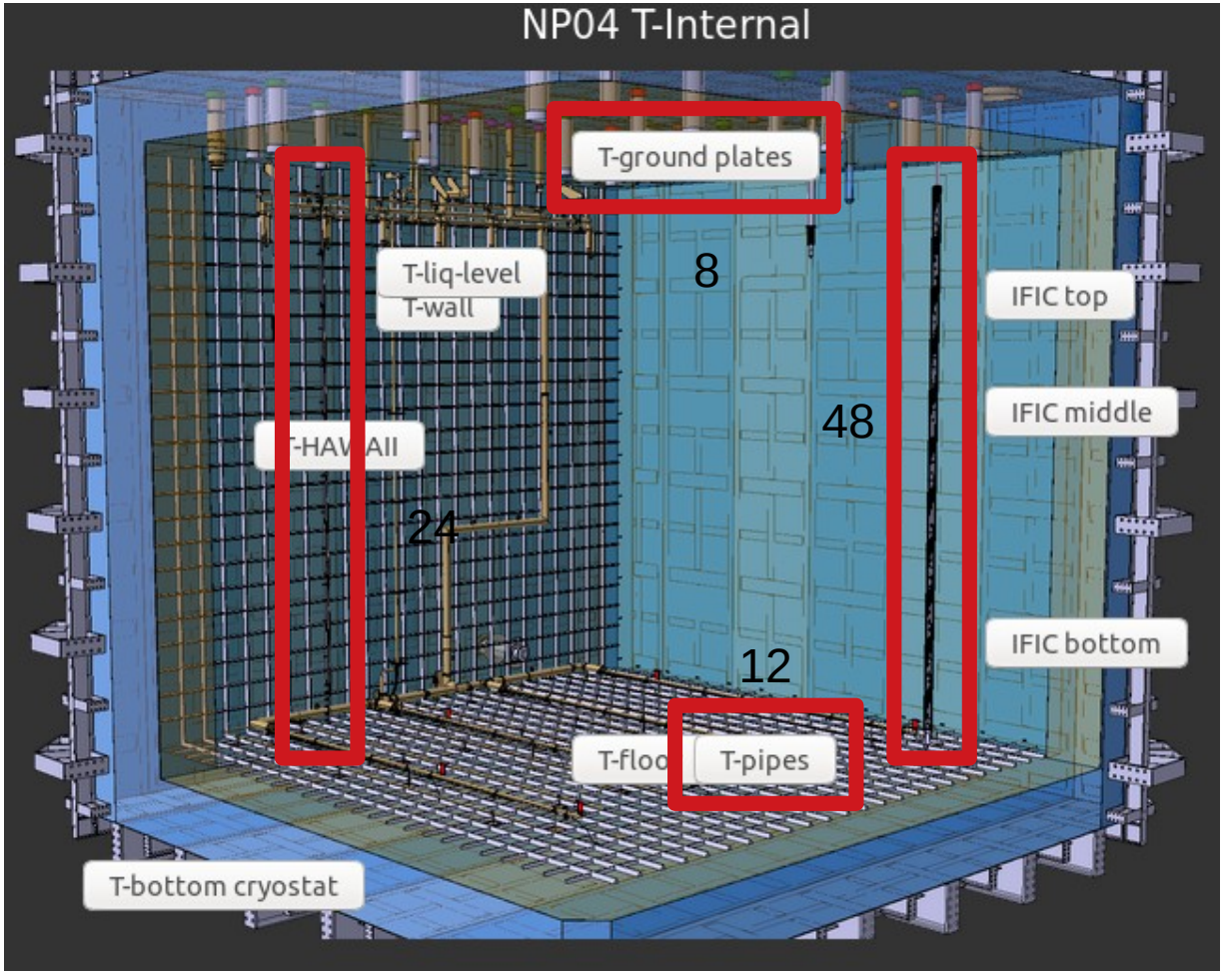
Pressure test
Recirculation's start

Since then temperature has been quite stable





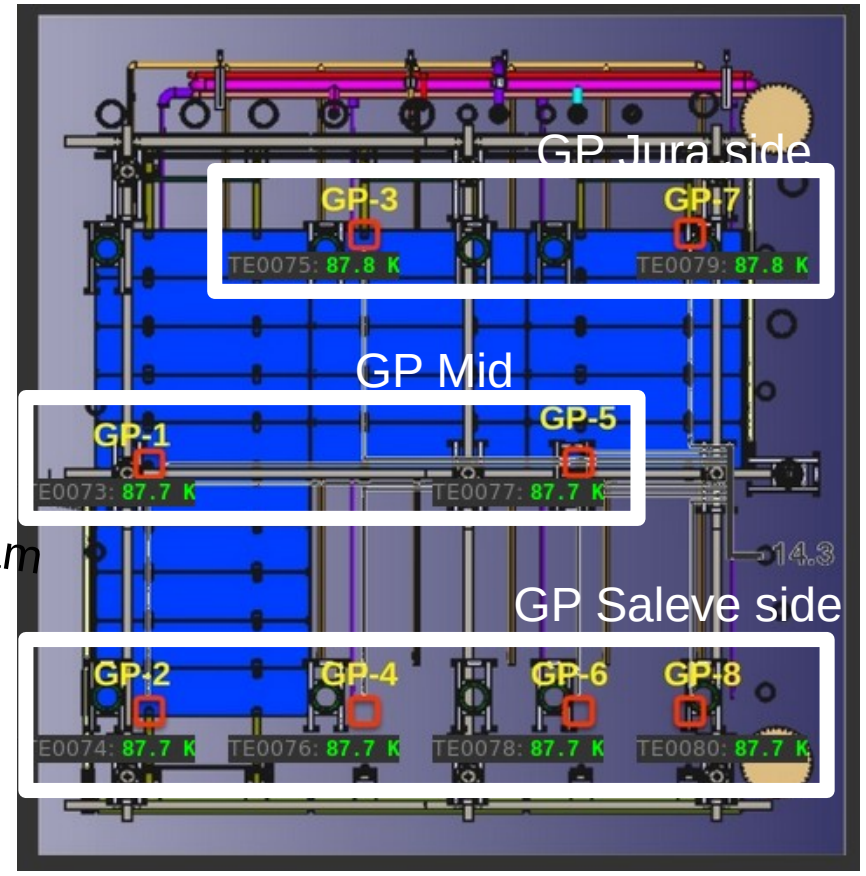
Temperature sensors

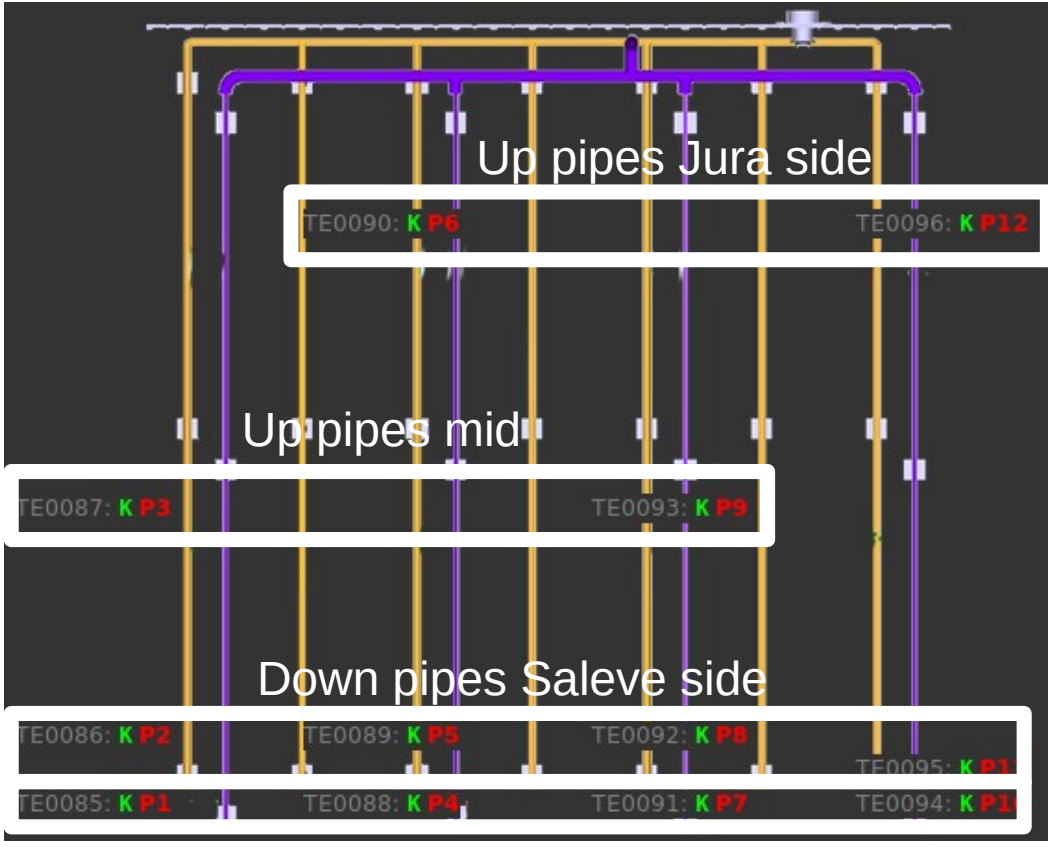


92 high precission sensors:

- 8 on GP
- 12 on pipes
- 24 on Hawaii profile
- 48 on Valencia profile

Temperature sensors



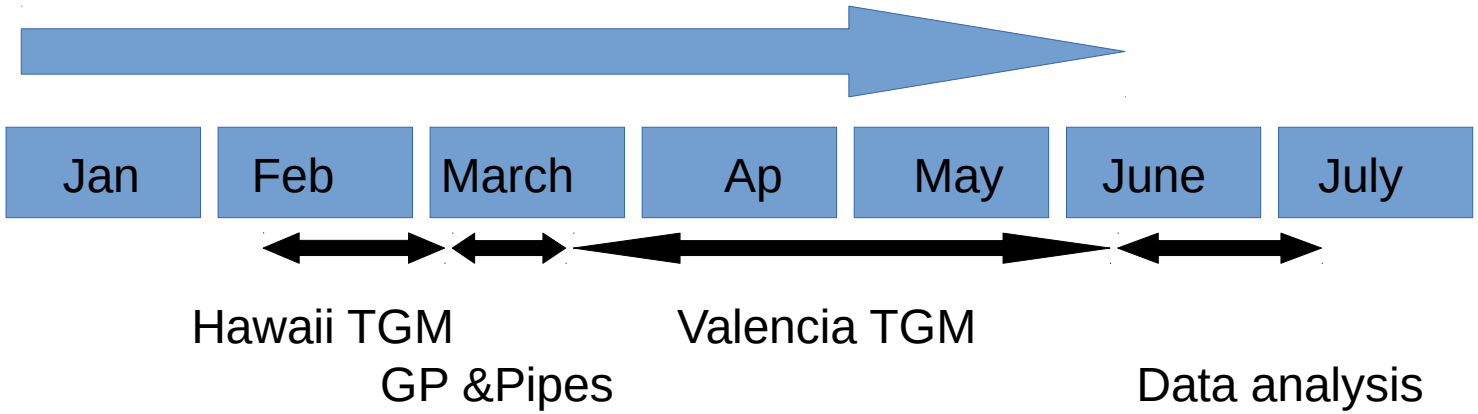


Up pipes Saleve side

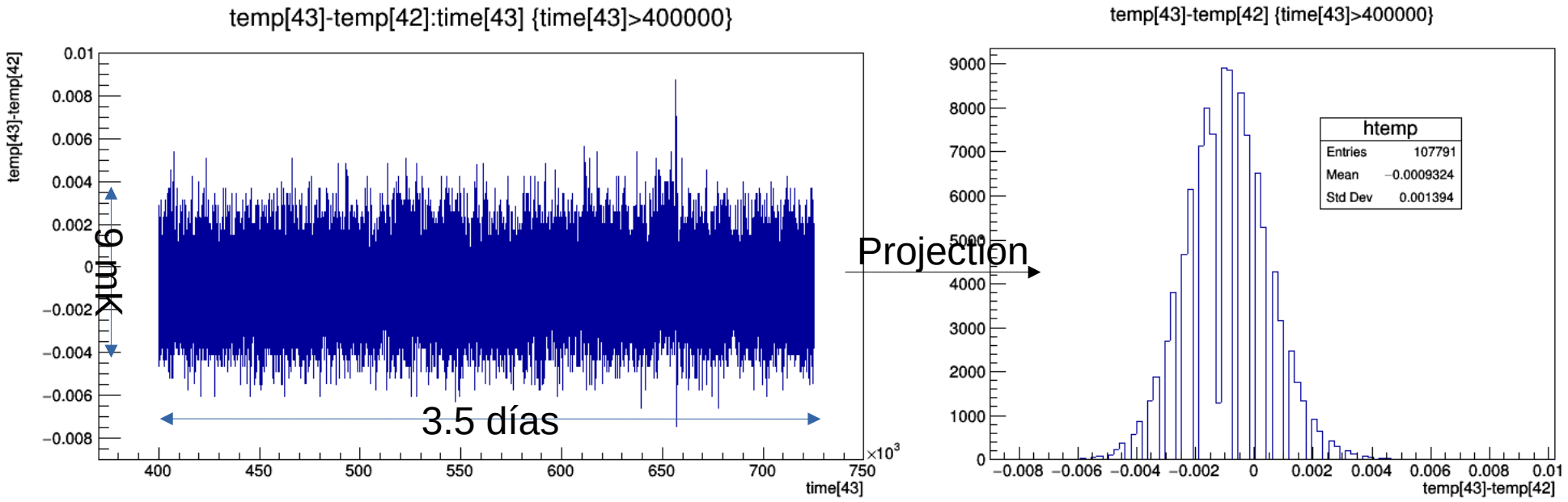
Temperature sensors

All sensors were calibrated at IFIC.

Hawaii profile should be recalibrated again in-situ, but it will be done after beam run → for the moment we only have IFIC calibration.



Temperature sensors: general aspects



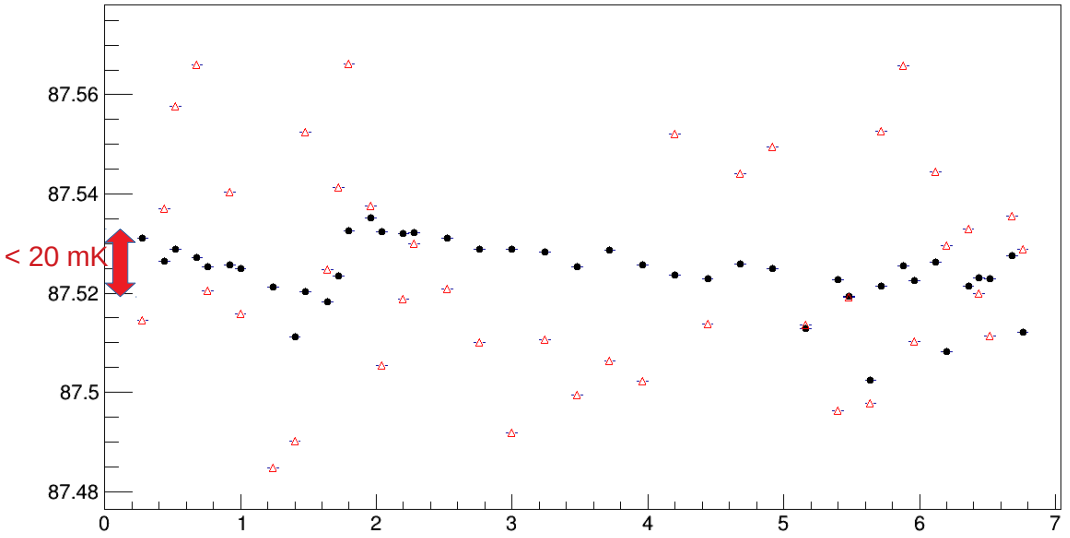
Sensors show a nice behavior.

Difference between sensors is very stable in time → really low RMS.

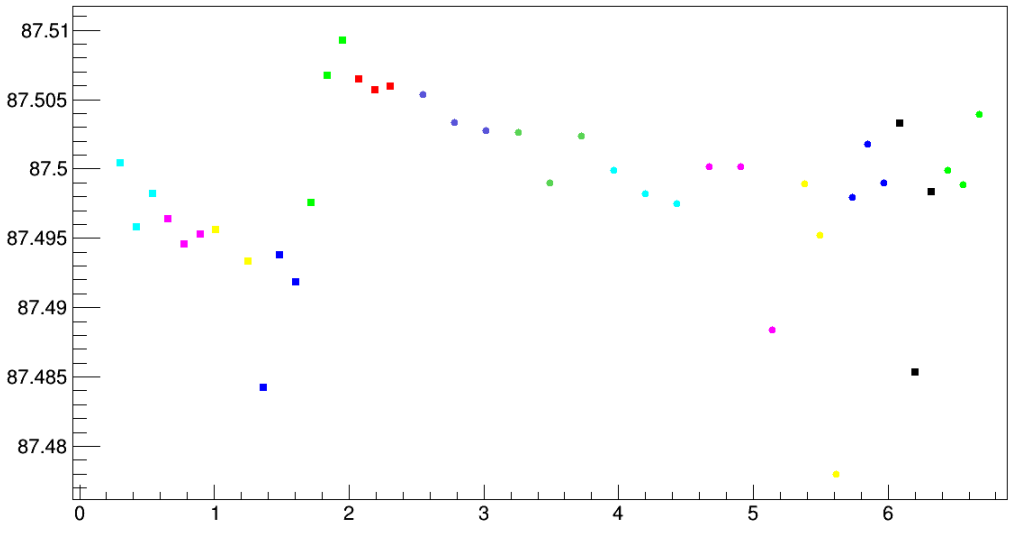
No ‘reproducibility’ problem has appeared.

Only four sensors of the TGM shows an strange behavior (see later)

The last thing you saw



Uncalibrated Calibrated



Each color is a set. ref 39606

ref 39656

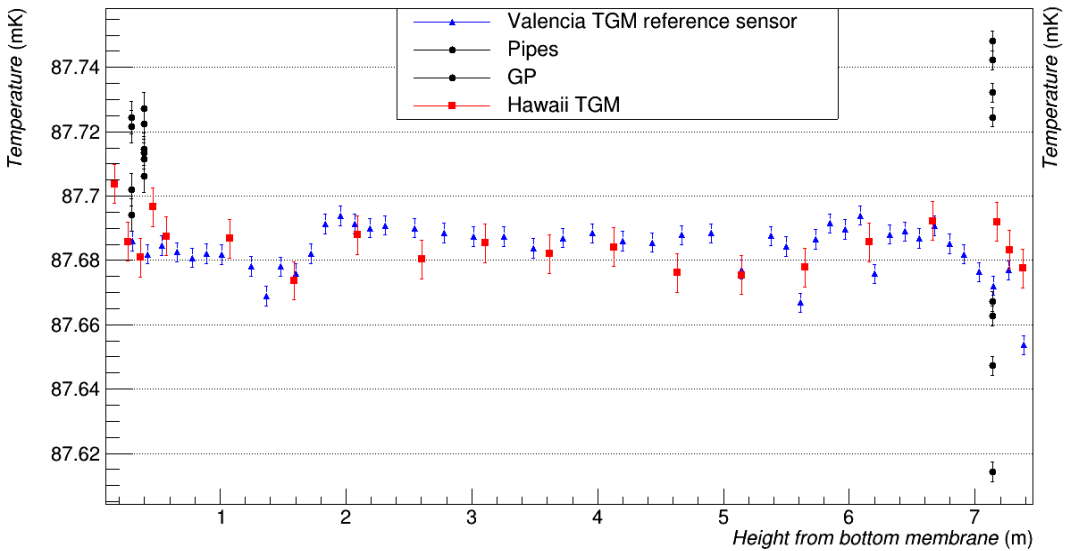
It was show that Valencia calibration was quite consistent but an strange discontinuity appears on 1.8 m.

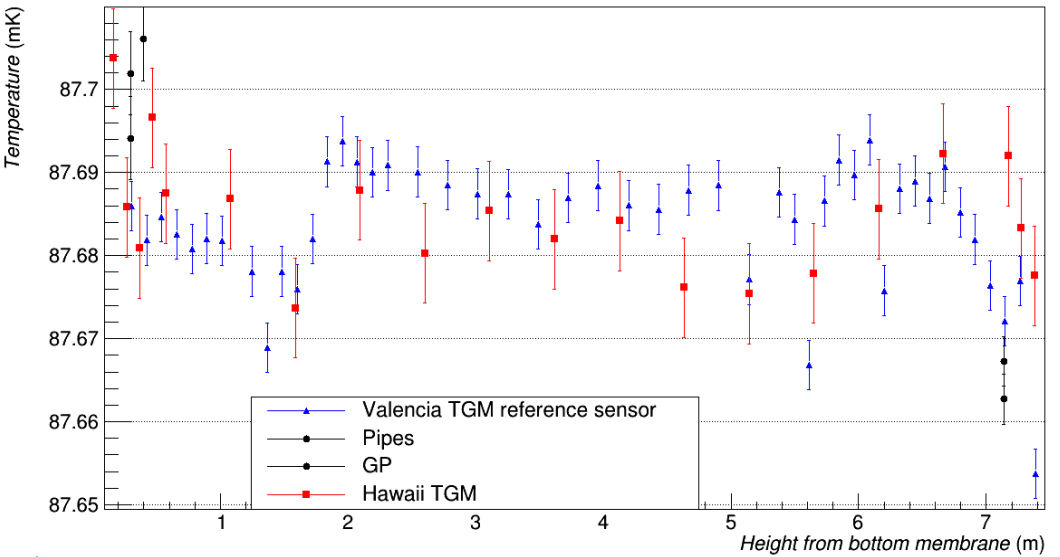
Current status

Pipes sensors are expected to be warmer than the rest

GP behave in a very strange way. Under investigation.

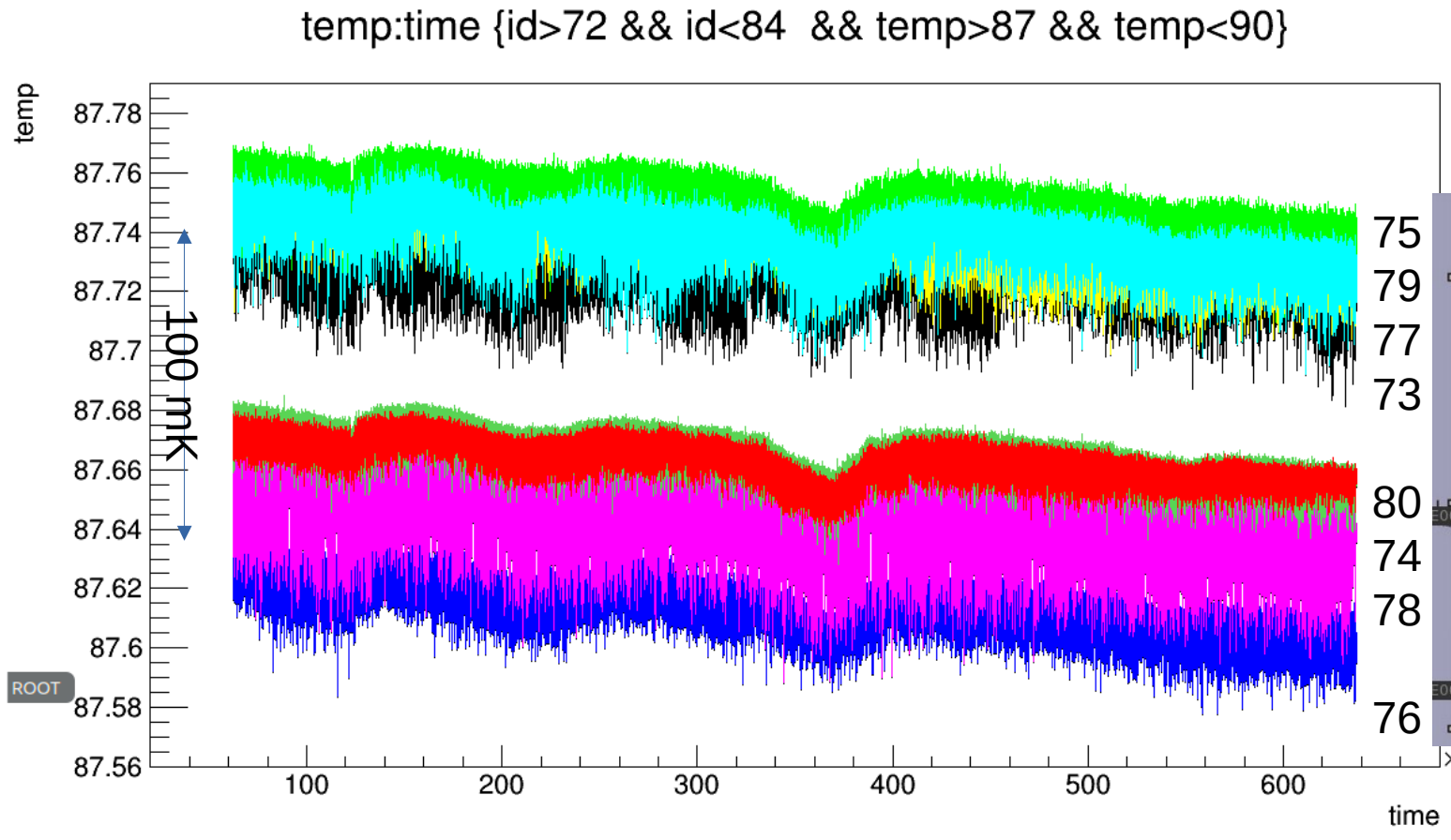
Valencia and Hawaii profiles behave quite similar, but 1.8 m jump is still here and keeps under investigation.

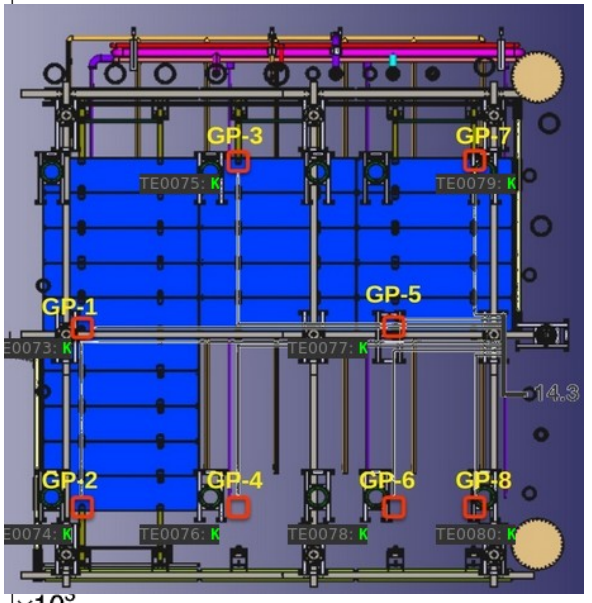




zoom

GP sensors

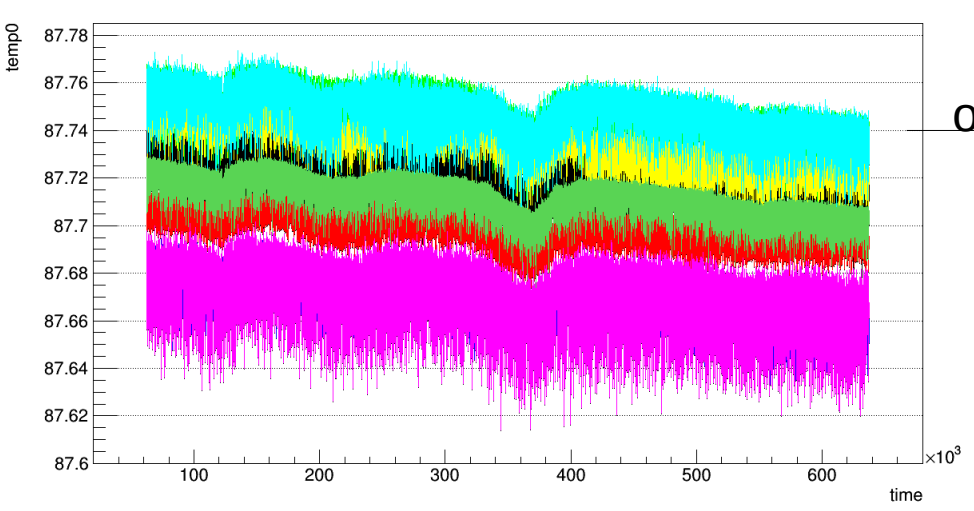

temp:time {id>72 && id<84 && temp>87 && temp<90}
temp
87.78
87.76
87.74
87.72
87.7
87.68
87.66
87.64
87.62
87.6
87.58
87.56
100 mK
75
79
77
73
80
74
78
76
100
200
300
400
500
600
time
ROOT


GP-3
GP-7
GP-1
GP-5
GP-2
GP-4
GP-6
GP-8

GP sensors

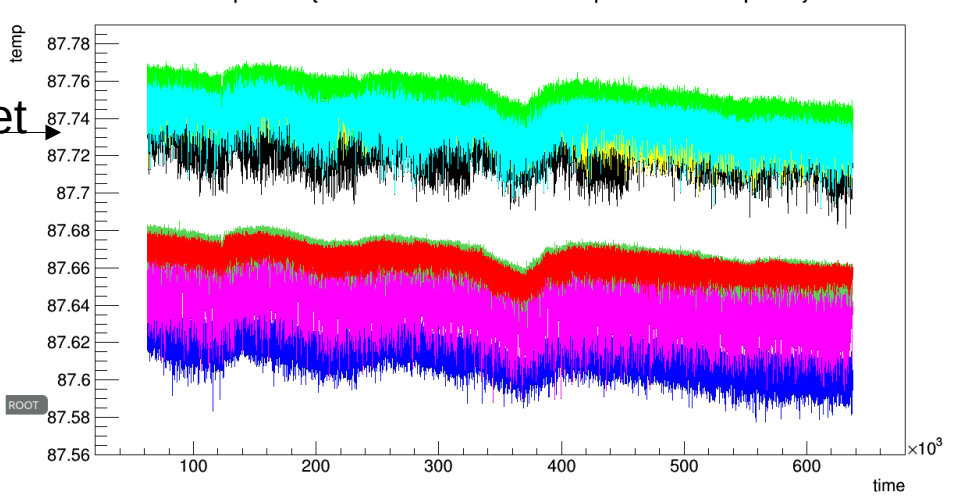
Everything related with calibration or data reading has been reviewed but nothing explain this separation.
Anyway, no calibration error could explain 100 mK separation.
Electronic and readout must be checked. Further investigation is going on.

Raw data



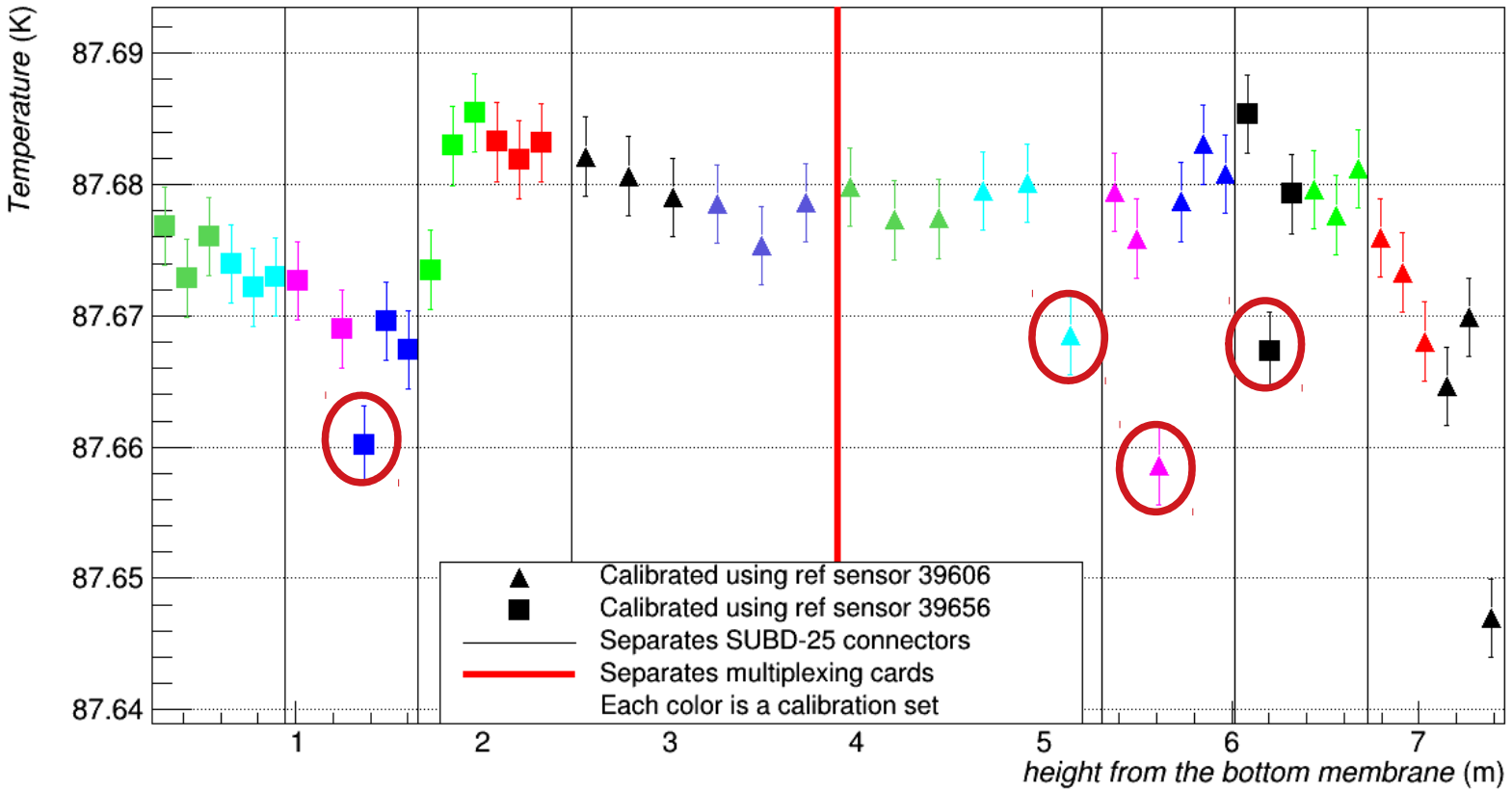
offset

Calibrated data



Profiles

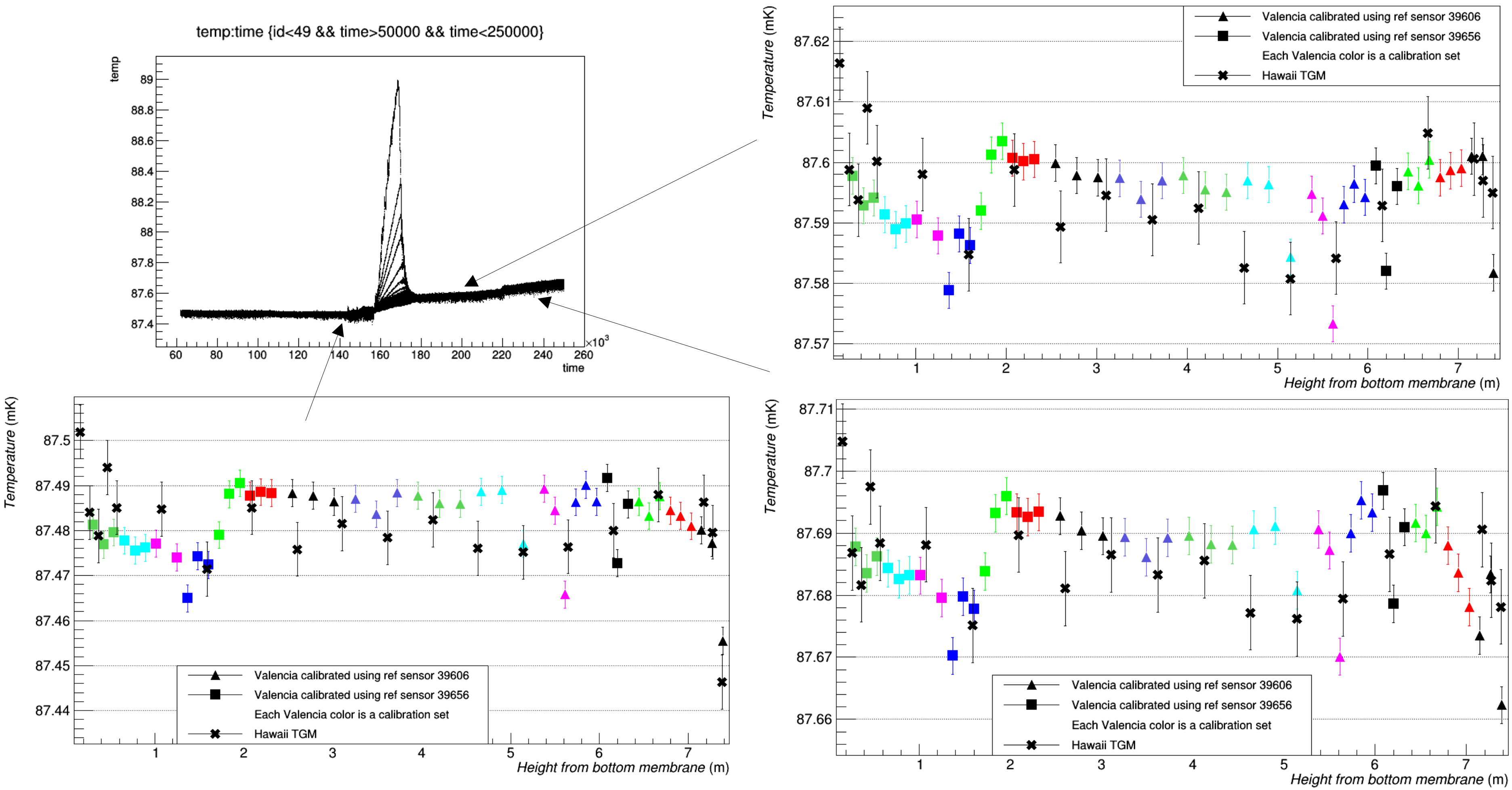
Apart of the jump, only four sensors away from normal behavior → 43 useful sensors.
I've been lately focused on studying the strange jump.



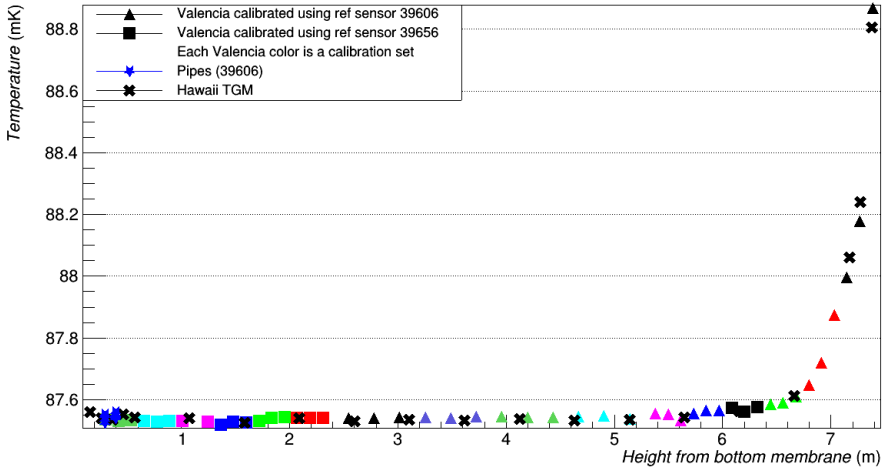
Options:

- Real effect
- Calibration error
- Electronic error

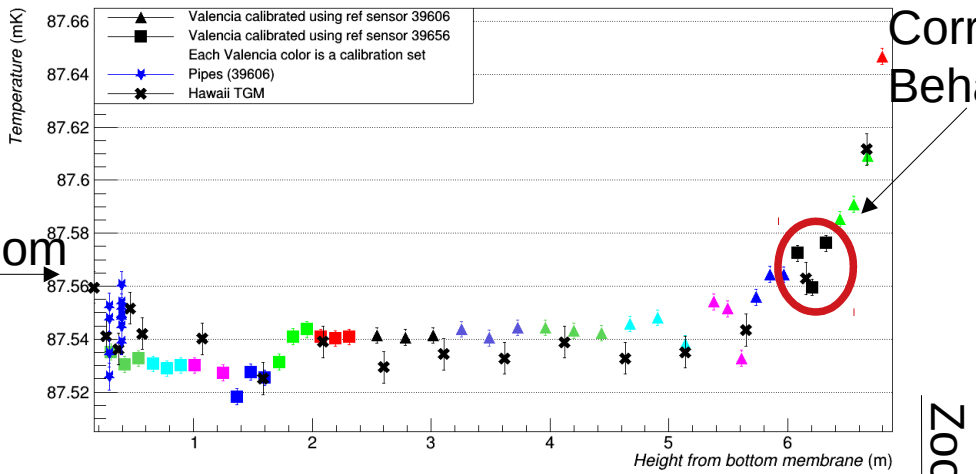
Profiles ¿real effect?



Profiles ¿real effect?

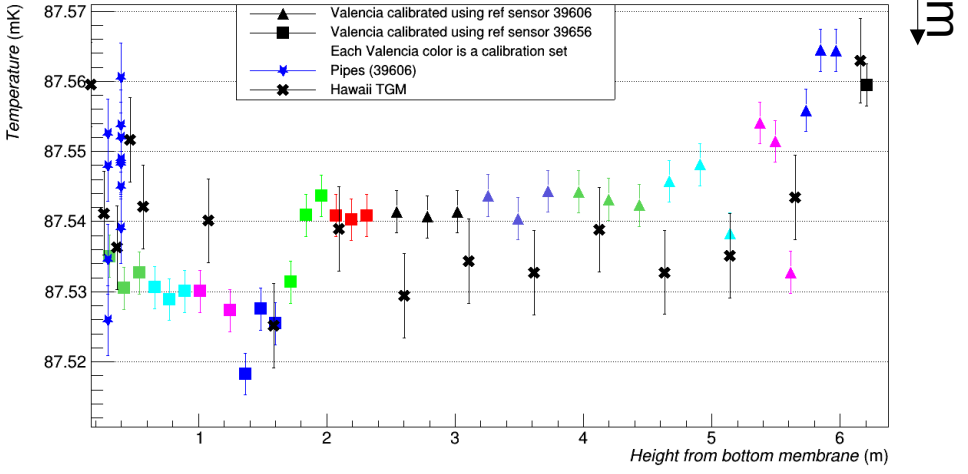


Zoom



Correctly Behaved

Zoom

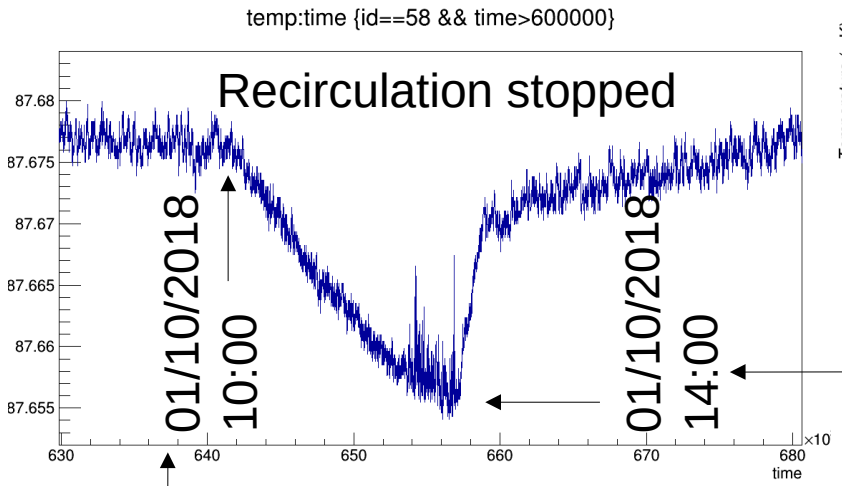


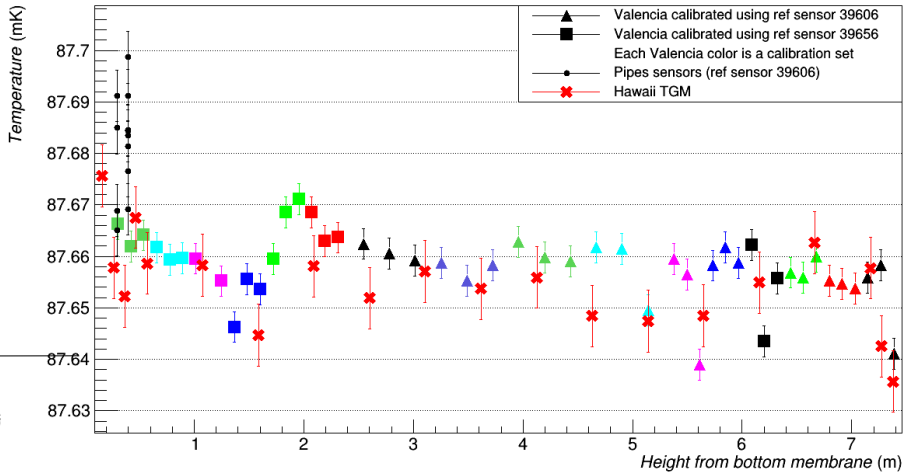
Profiles during preassure test.

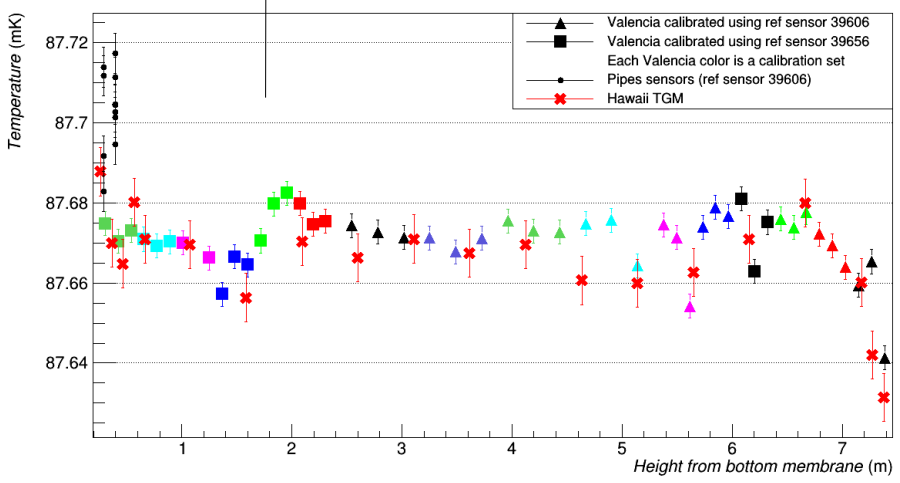
Hawaii and Vlc behave quite similar above 2m.

No matter what, jump is always there.

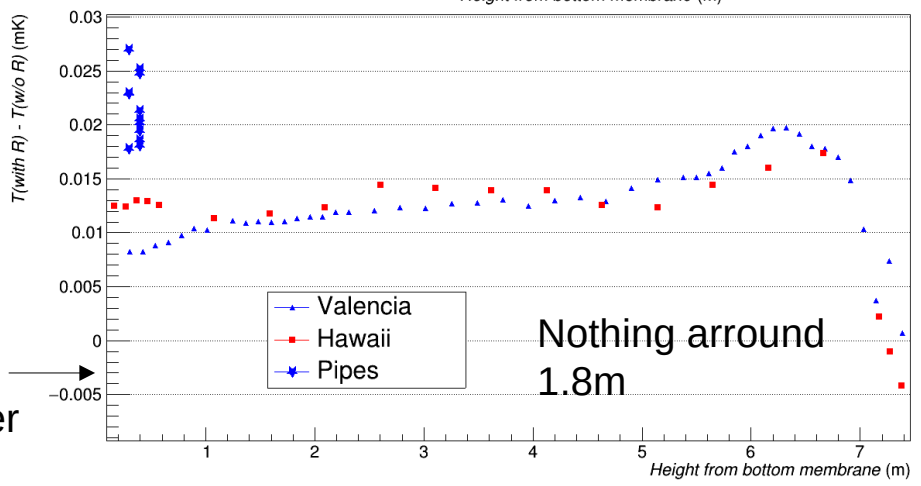
Profiles ¿real effect?





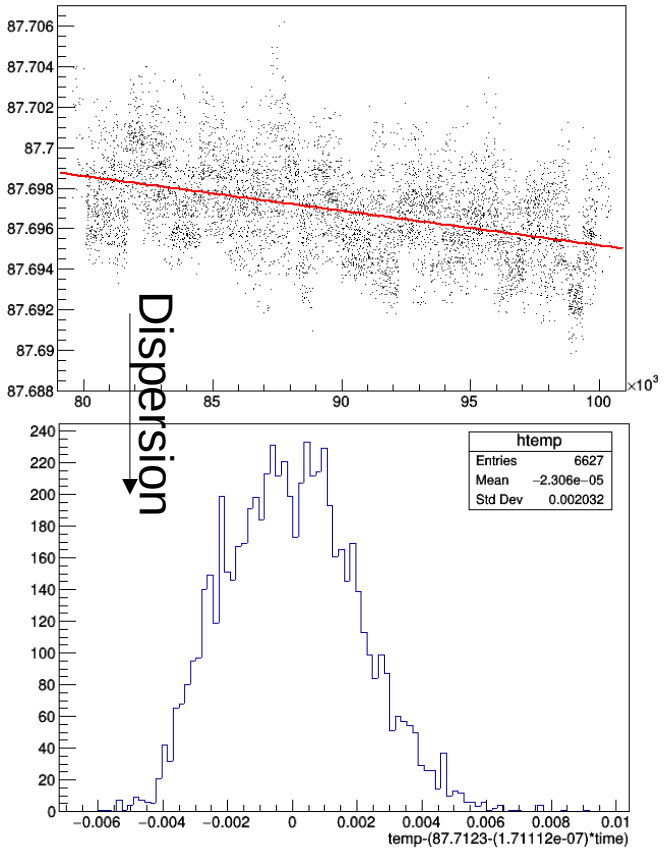


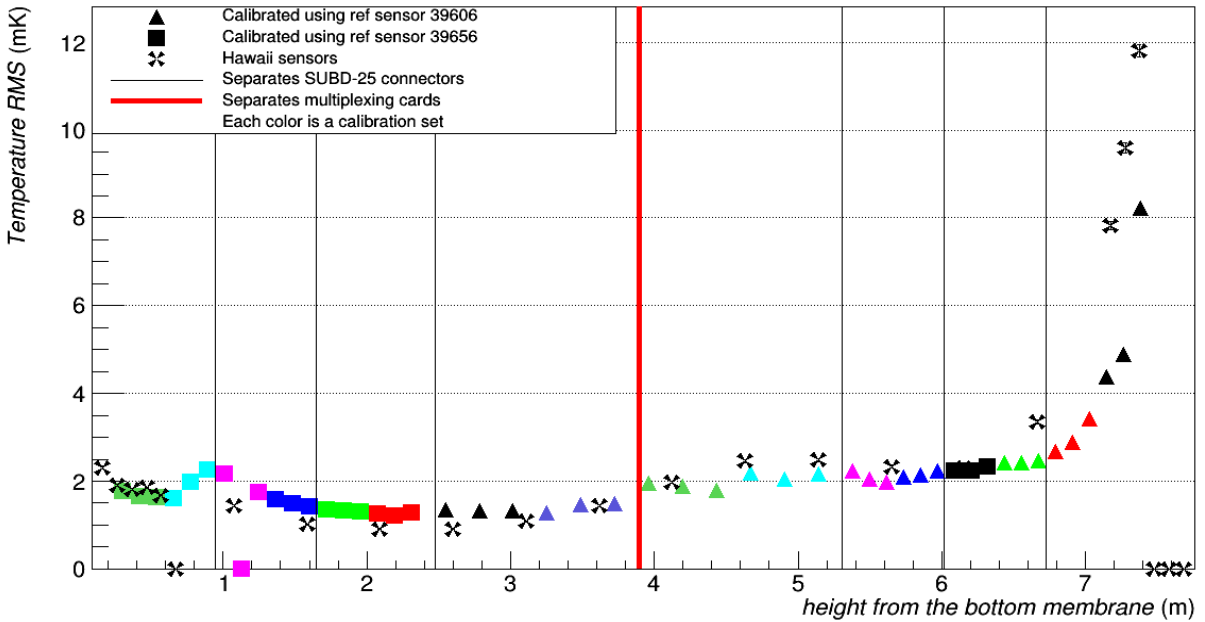
Difference before-after



Profiles ¿real effect?

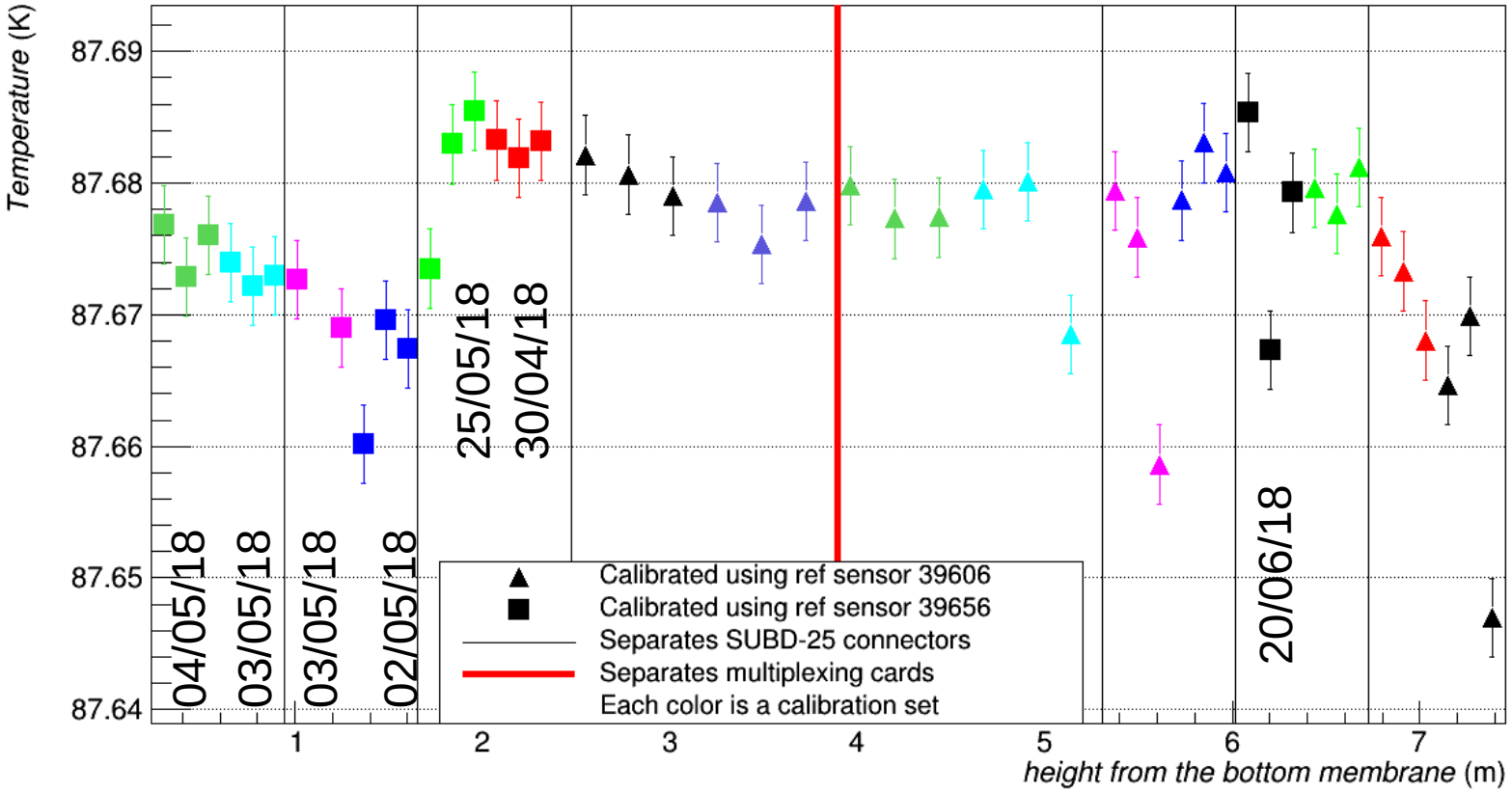
In stable temperature periods we can fit temperature to a soft line. Dispersion arround line should be low unless sensors are close to a heat source.





Nothing seems to point to a heat source around 1.8m

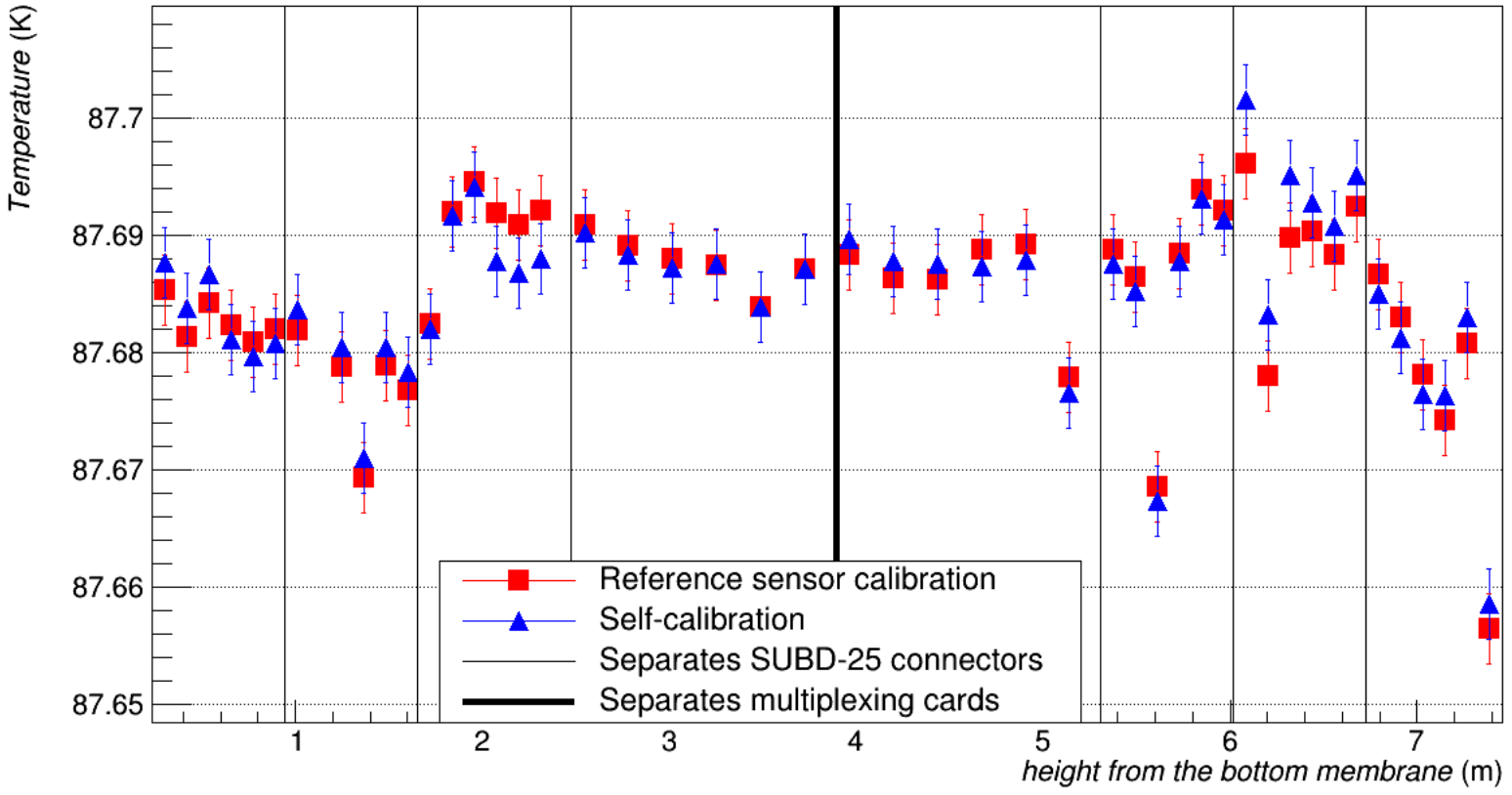
Profiles ¿calibration error?



There is no correlation between jump and:

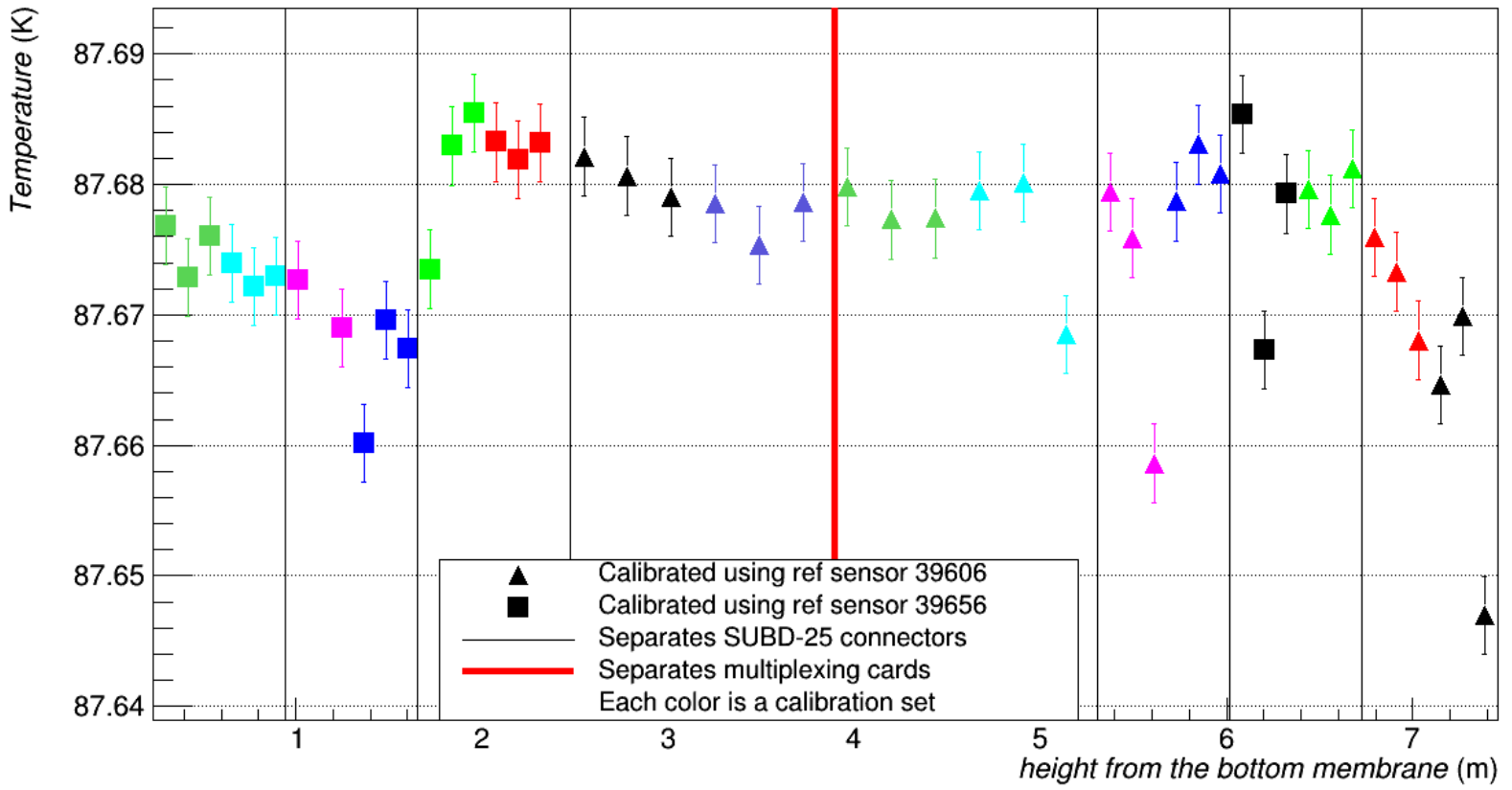
- Reference sensor
- Calibration date

Profiles ¿calibration error?



With two independent calibration methods the jump keeps appearing exactly equal.

Profiles ¿electronic error?



Only 12 of 24 sensors sharing a multiplexing card are displaced.

Each 6 of these 12s share a connector, but it would be very strange that two different connectors generate the same effect.

Basic tests will be performed to figure this out.

Conclusions

Individually sensors behave quite well and they have been really important for understanding cryostat filling and operation.

There are some things that we do not fully understand and we are investigating but

- without Hawaii calibration we can’t cross-check
- without CFD simulations results we do not know what we should expect

so it is complicated to get any definitive conclusion.

We will keep working on this.