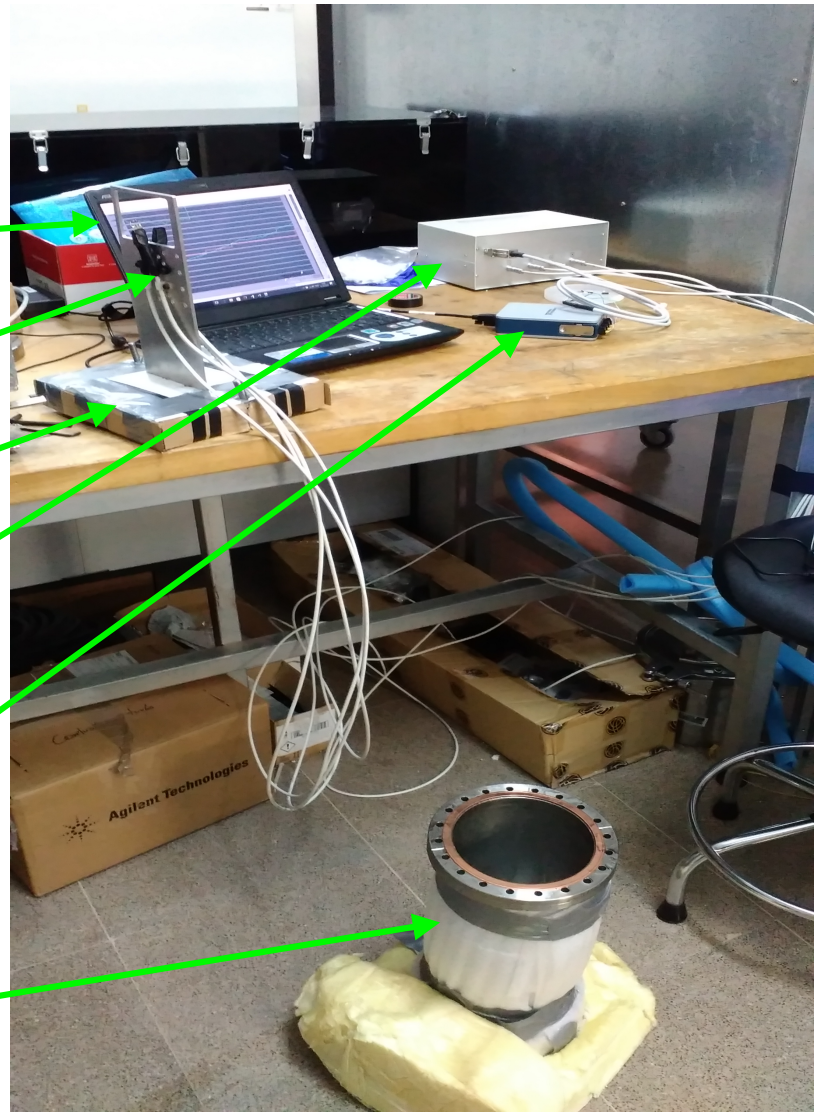
Temperature sensors calibration for protoDUNESP

Pablo (IFIC)

Introduction

Goal: calibrate LakeShore temperature sensors (PT-102) to be installed in the T-gradient

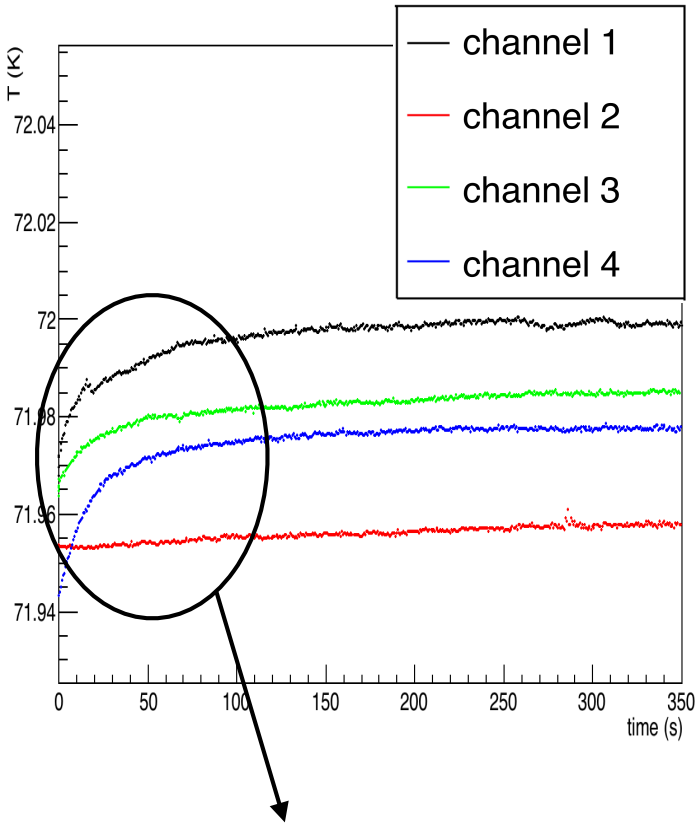
Calibration works have started at IFIC



Channel calibration with resistors

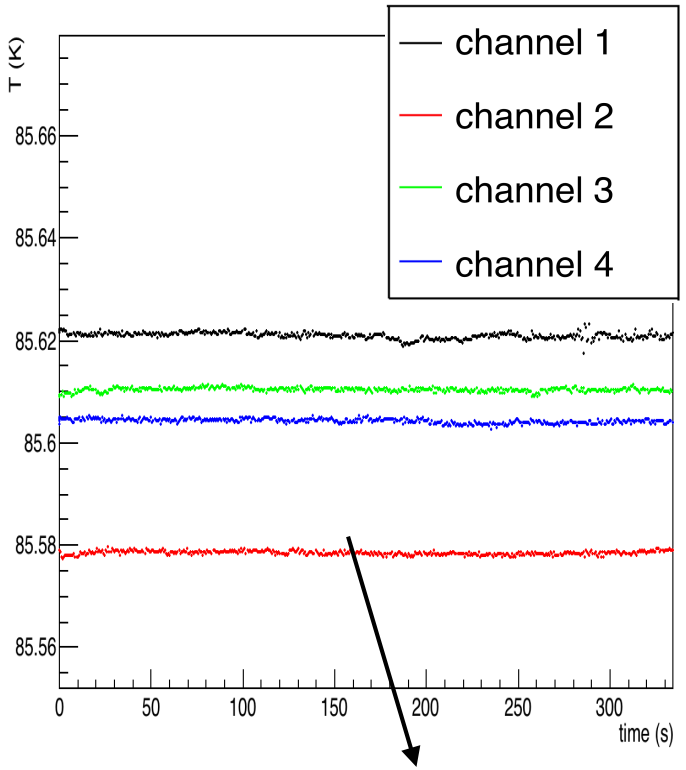
Up to now, three resistors are measured to check the stability and offset of each of the four channels

18 Ω Resistor



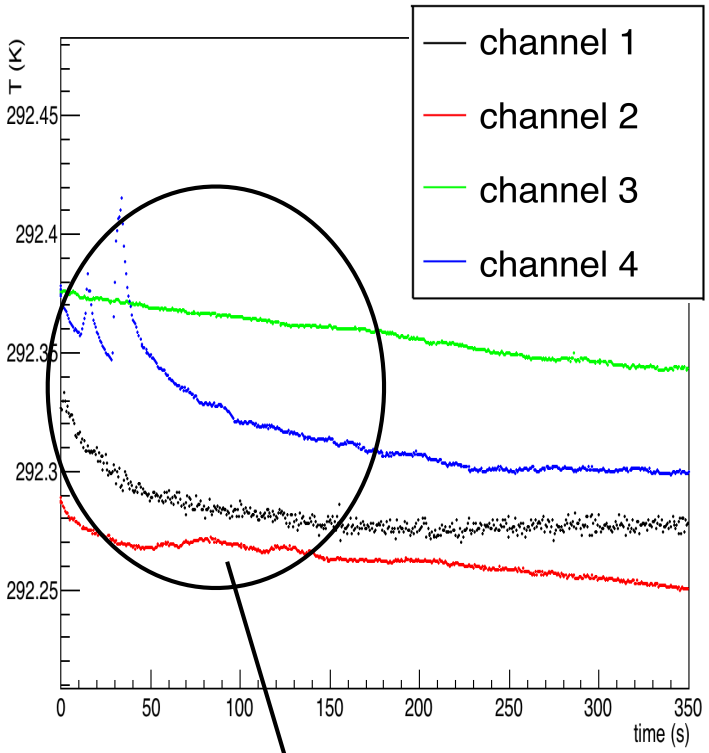
takes about 2 min to stabilise

22 Ω Resistor



very stable from the beginning

100 Ω Resistor

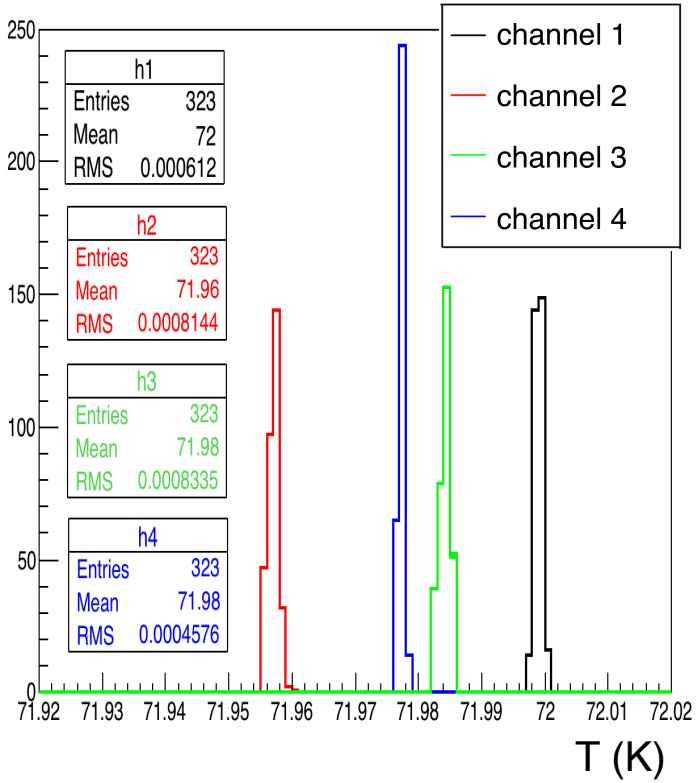


takes about 4 min to stabilise

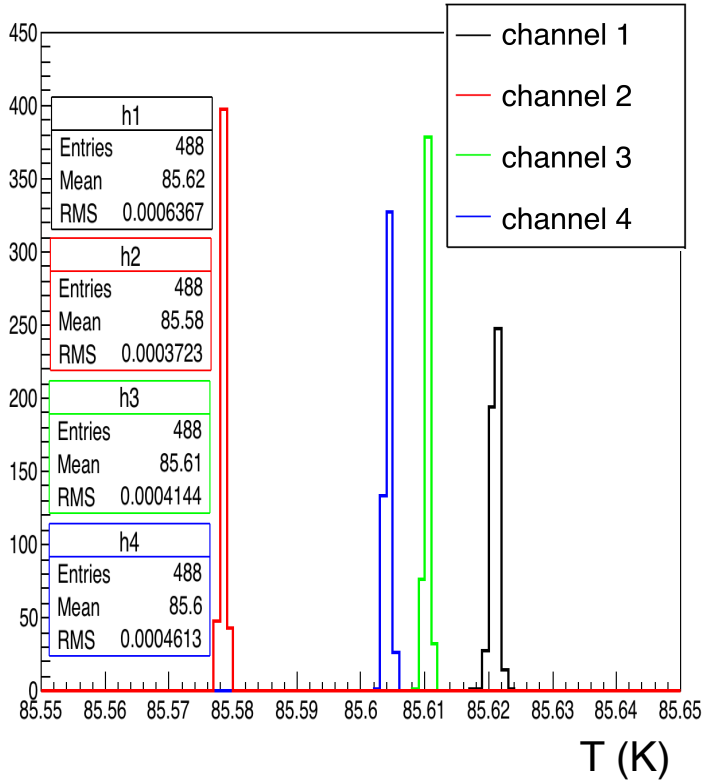
Channel calibration with resistors

Projection of measured values once they are stabilized

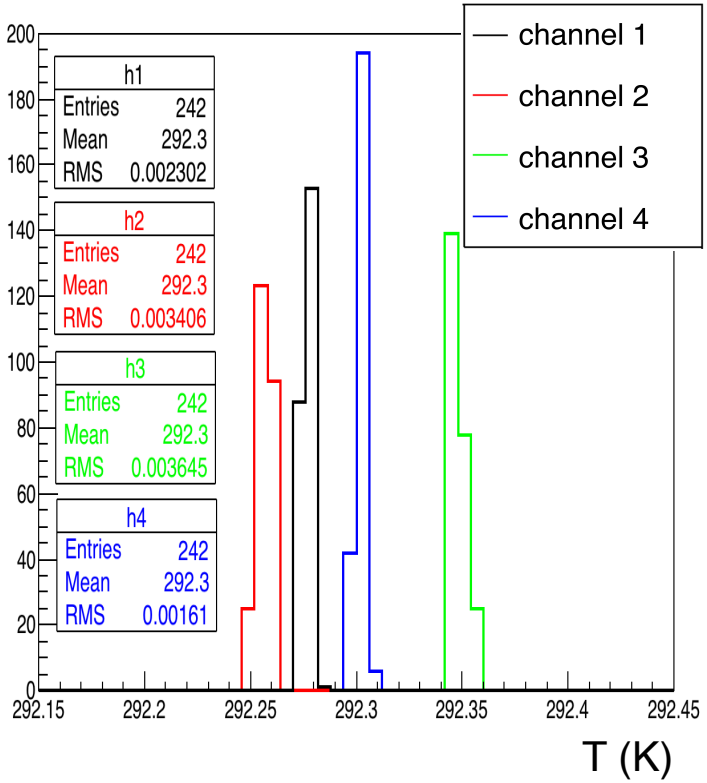
18 Ω Resistor



20 Ω Resistor



100 Ω Resistor



Another three resistors will be measured as well with values of 16 Ω, 22 Ω and 27 Ω

—> This will allow us to obtain the variation of the channel offset with the measured temperature

Measurements with liquid nitrogen

Several sensor configurations are studied in order to find the best setup, that is, all sensors are in the same conditions

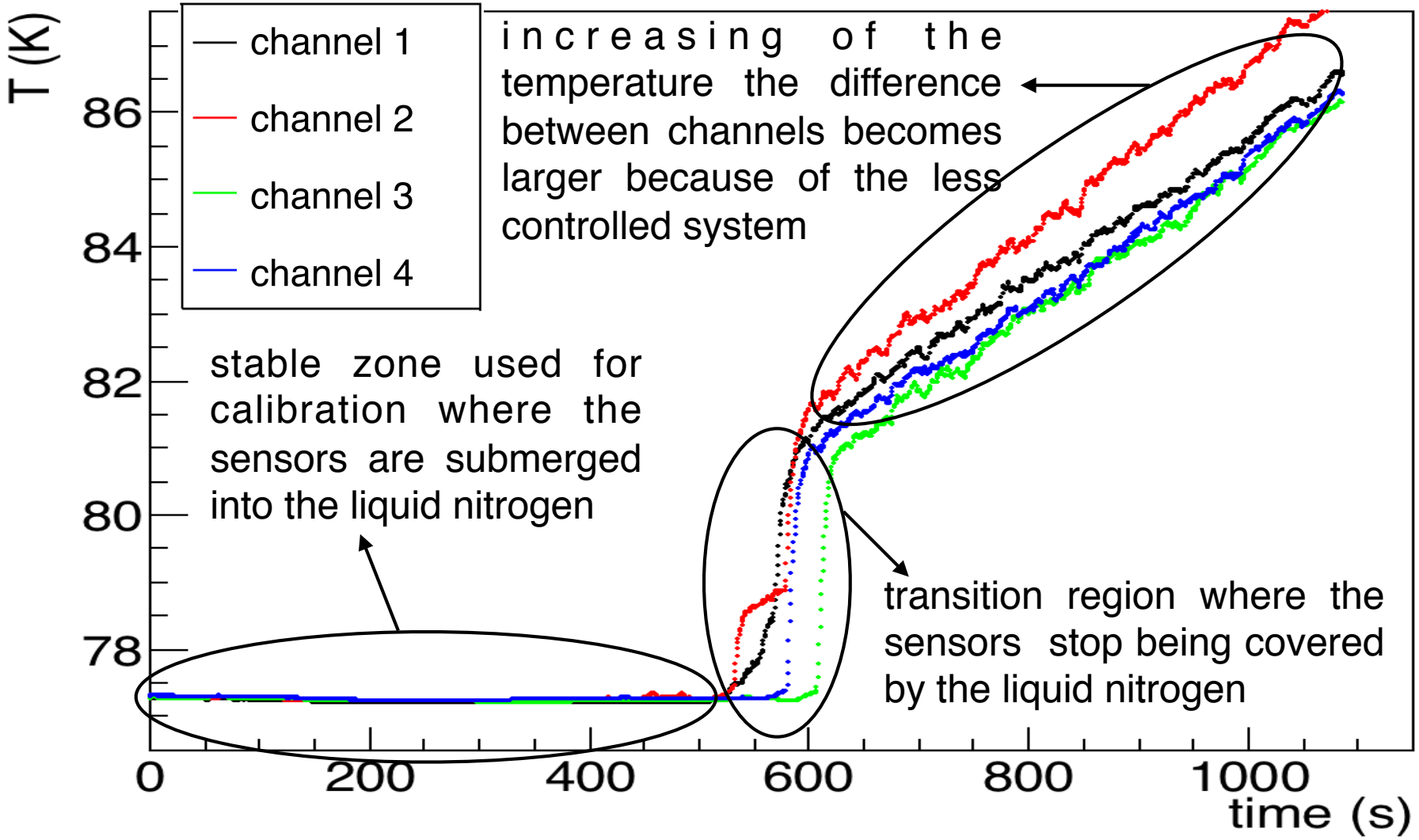
While waiting for a dedicated flange, a polystyrene cover to make as stable as possible the inner dewar

In addition, the dewar was wrapped with more polystyrene to further isolate the interior and extend the duration of the liquid nitrogen

In what follows, a given sensor will always be in the same channel

Measurements with liquid nitrogen

Different zones of the measurement



Furthermore, as the vessel is refilled it gets cooler, improving the stability and increasing the life of the liquid nitrogen inside the vessel

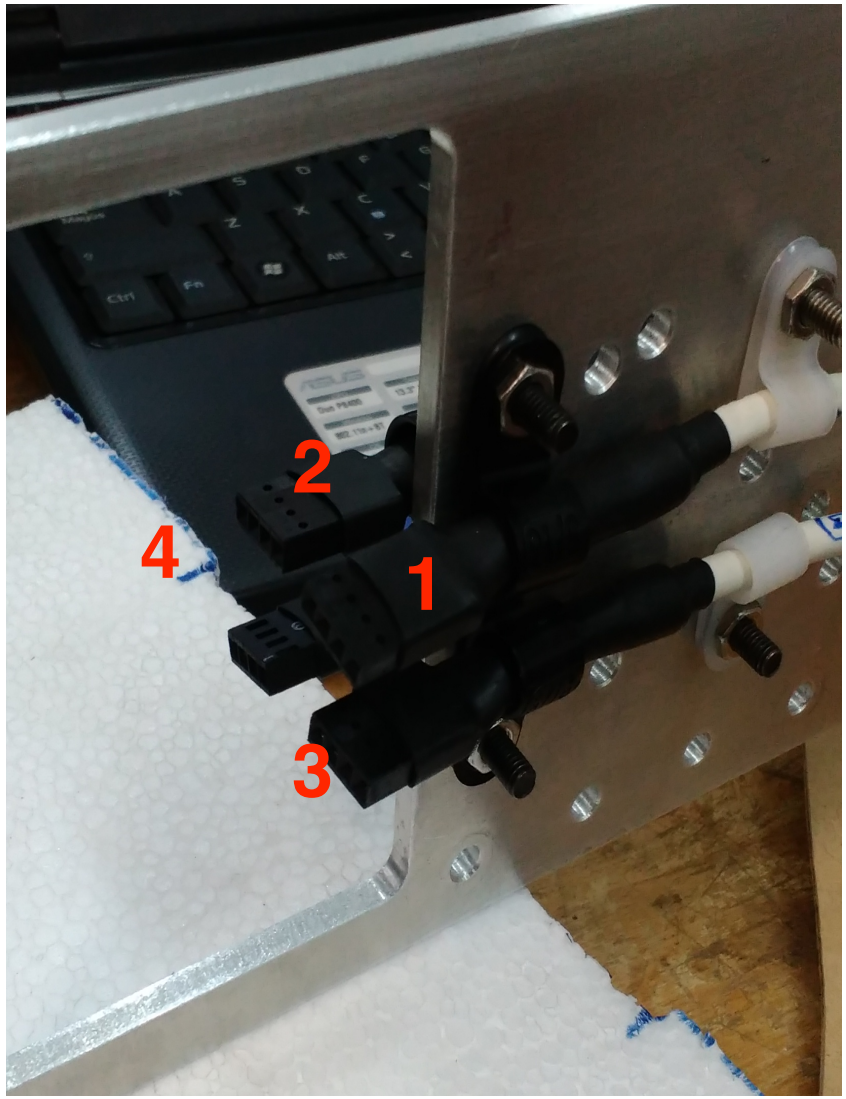
Measurements with liquid nitrogen

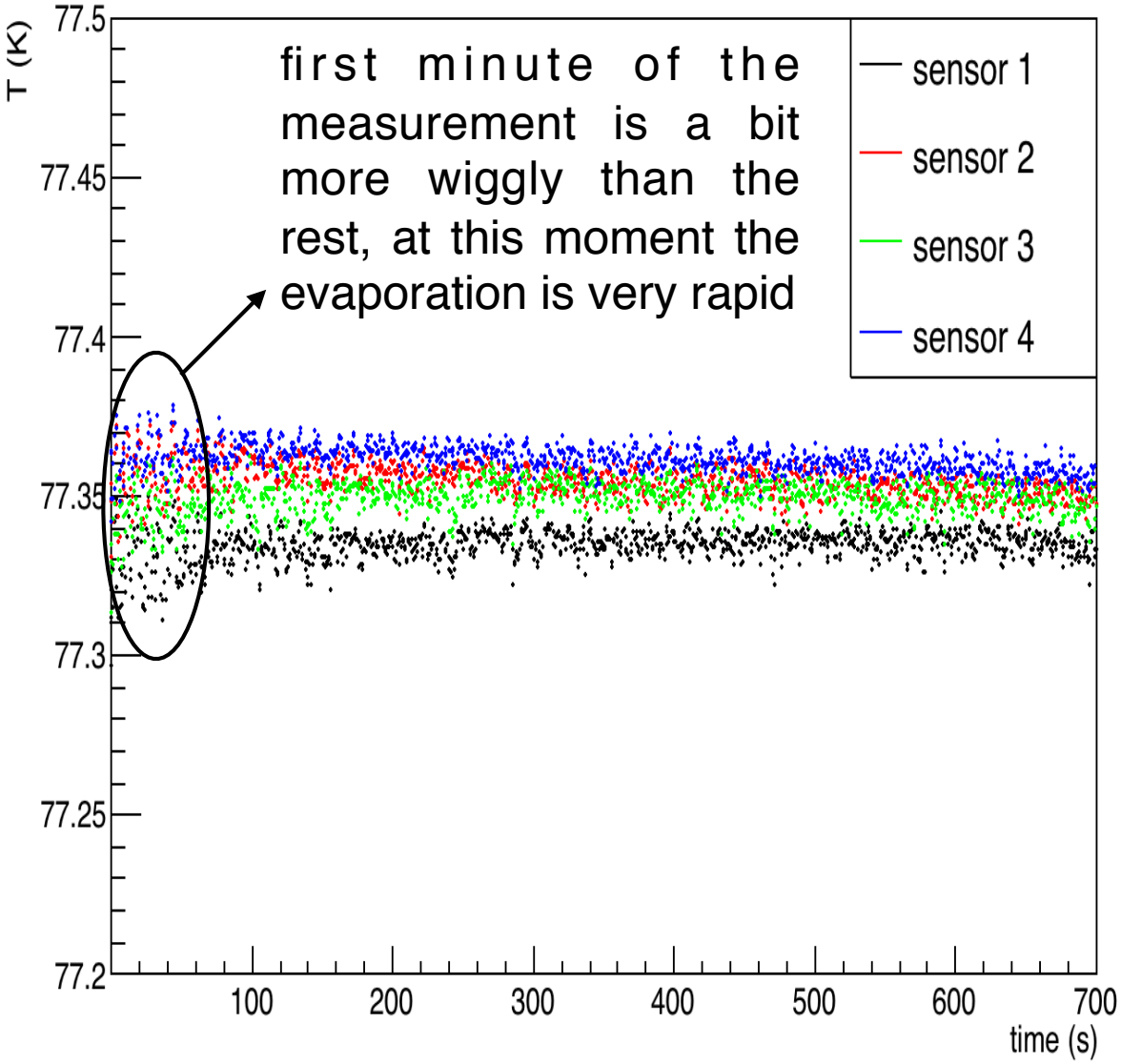
After several measurements for the understanding of the overall system, three different sensor arrangements were tested pursuing the most similar conditions for all sensors

The more similar the conditions are, the easier is to obtain the resolution of the sensors

Measurements with liquid nitrogen

Default sensor positions:





Measurements with liquid nitrogen

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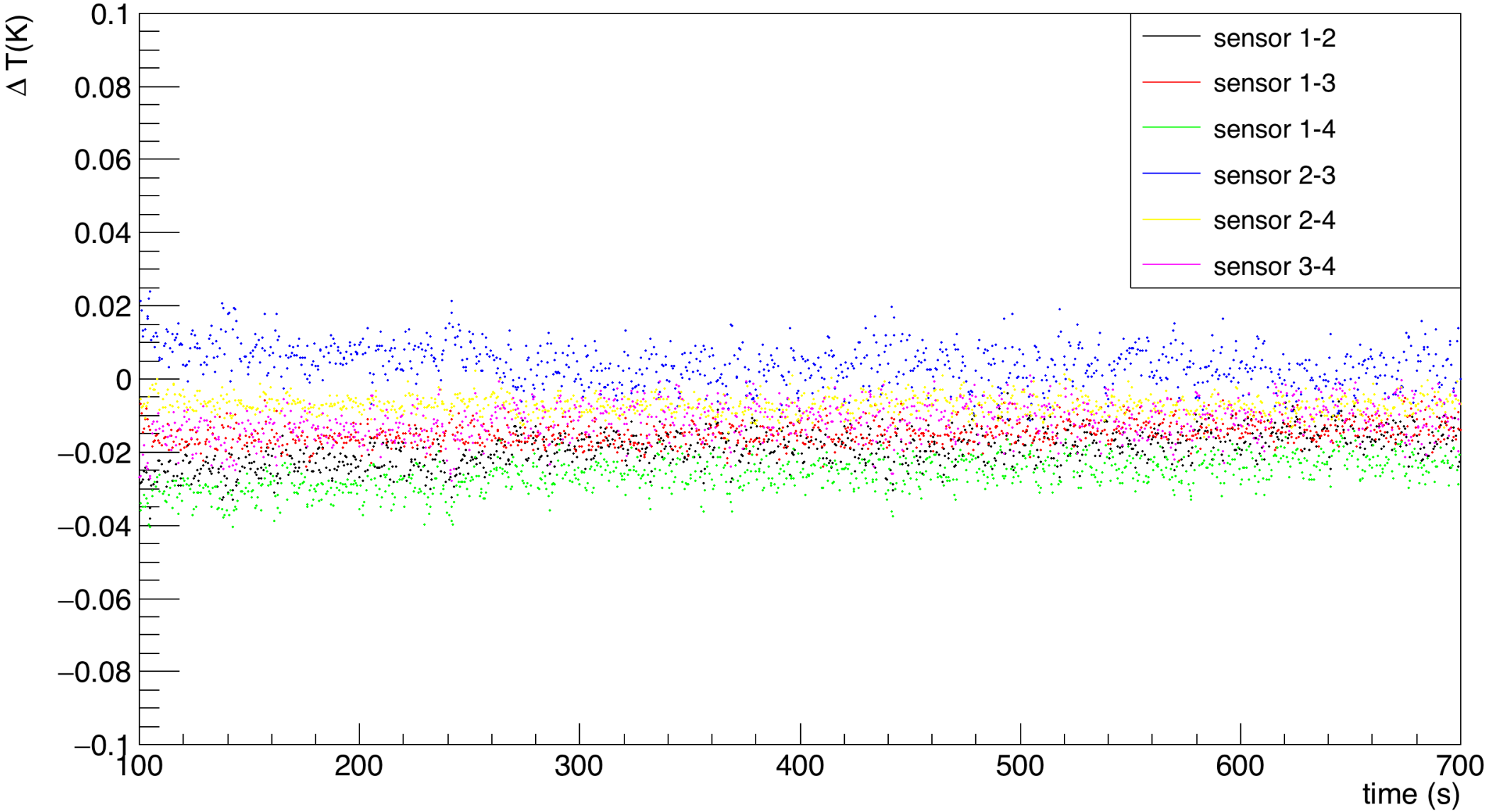

Measurements with liquid nitrogen

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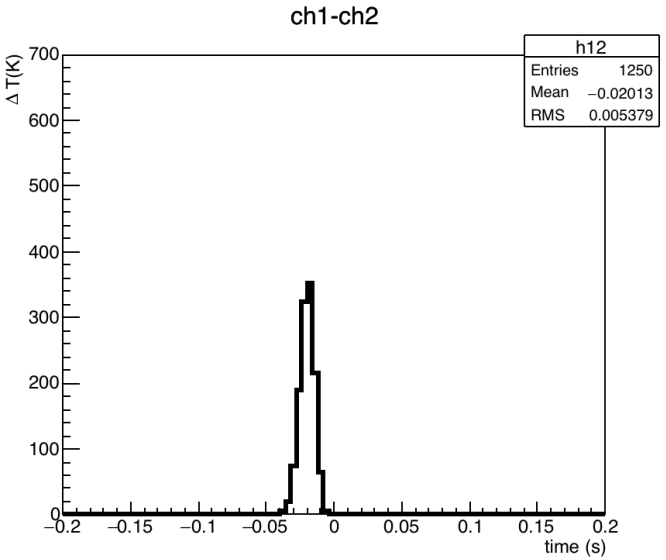
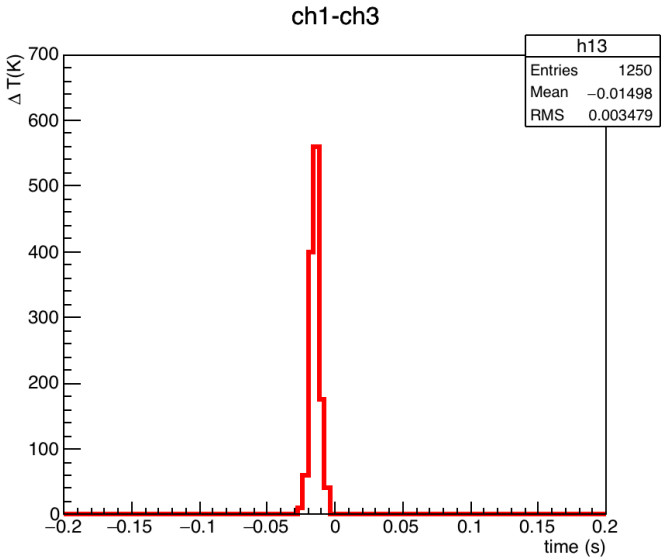
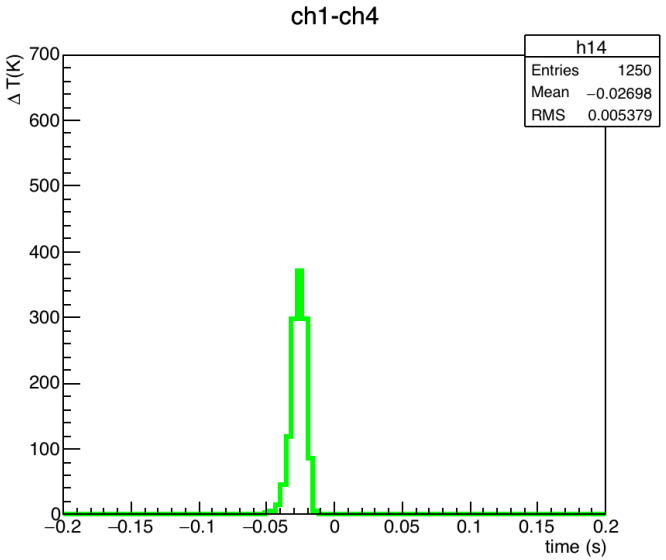
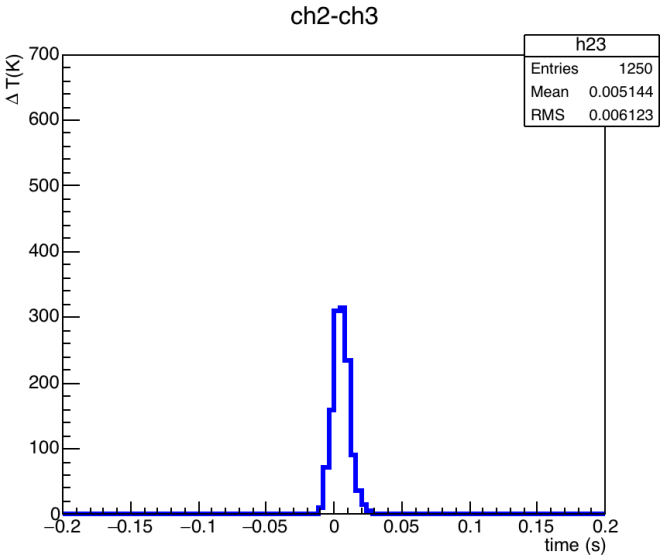
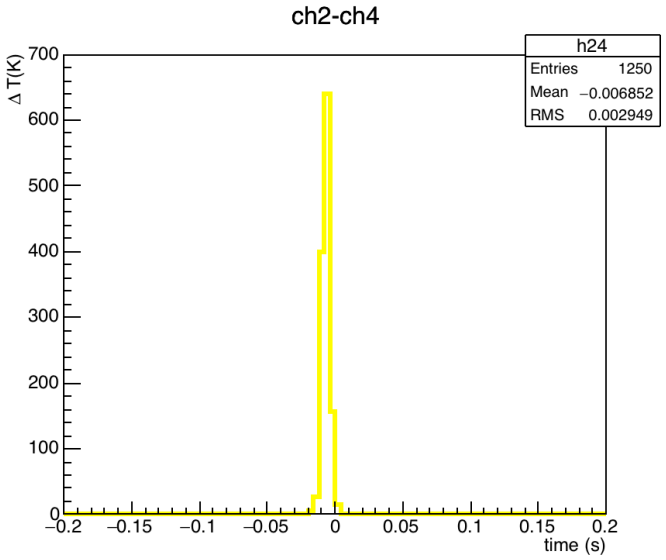
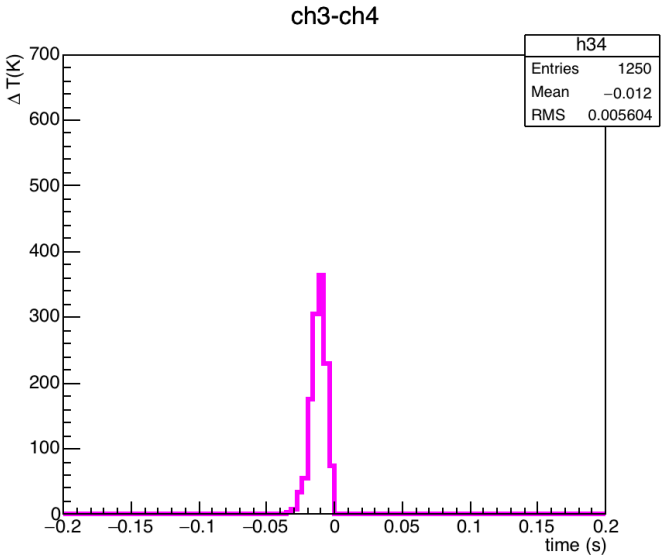






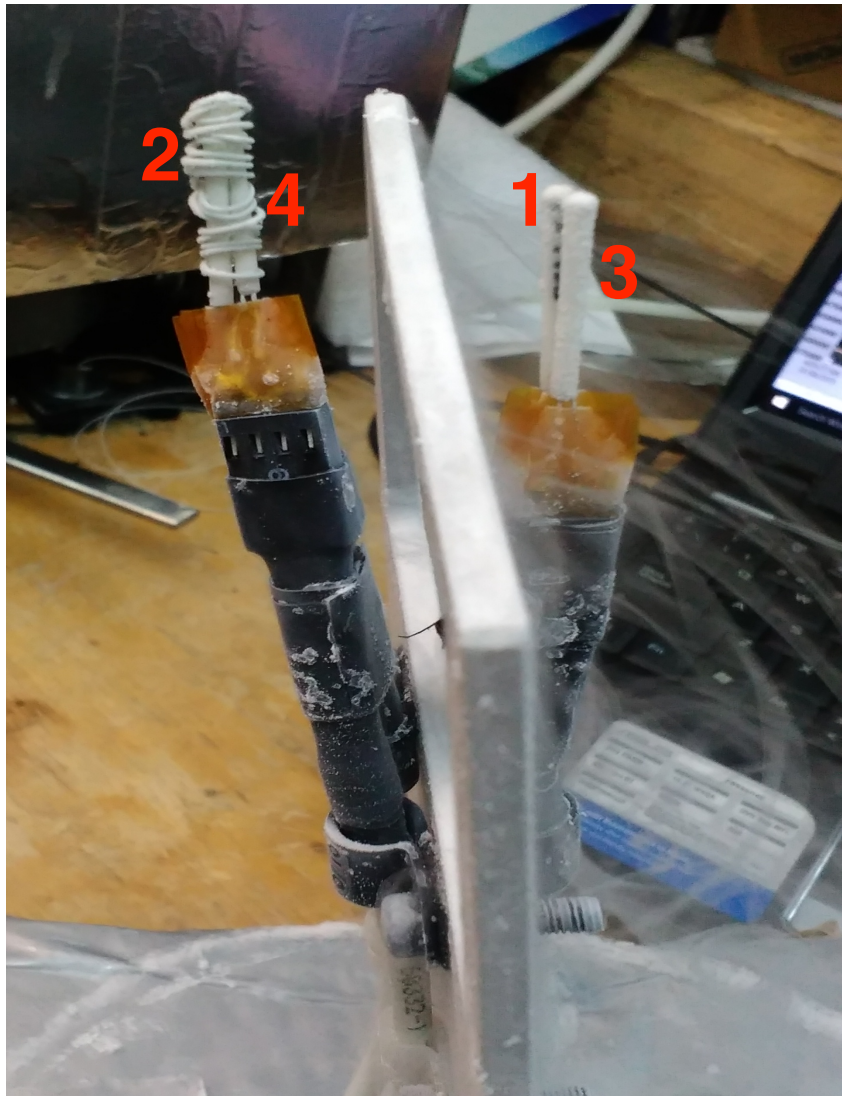


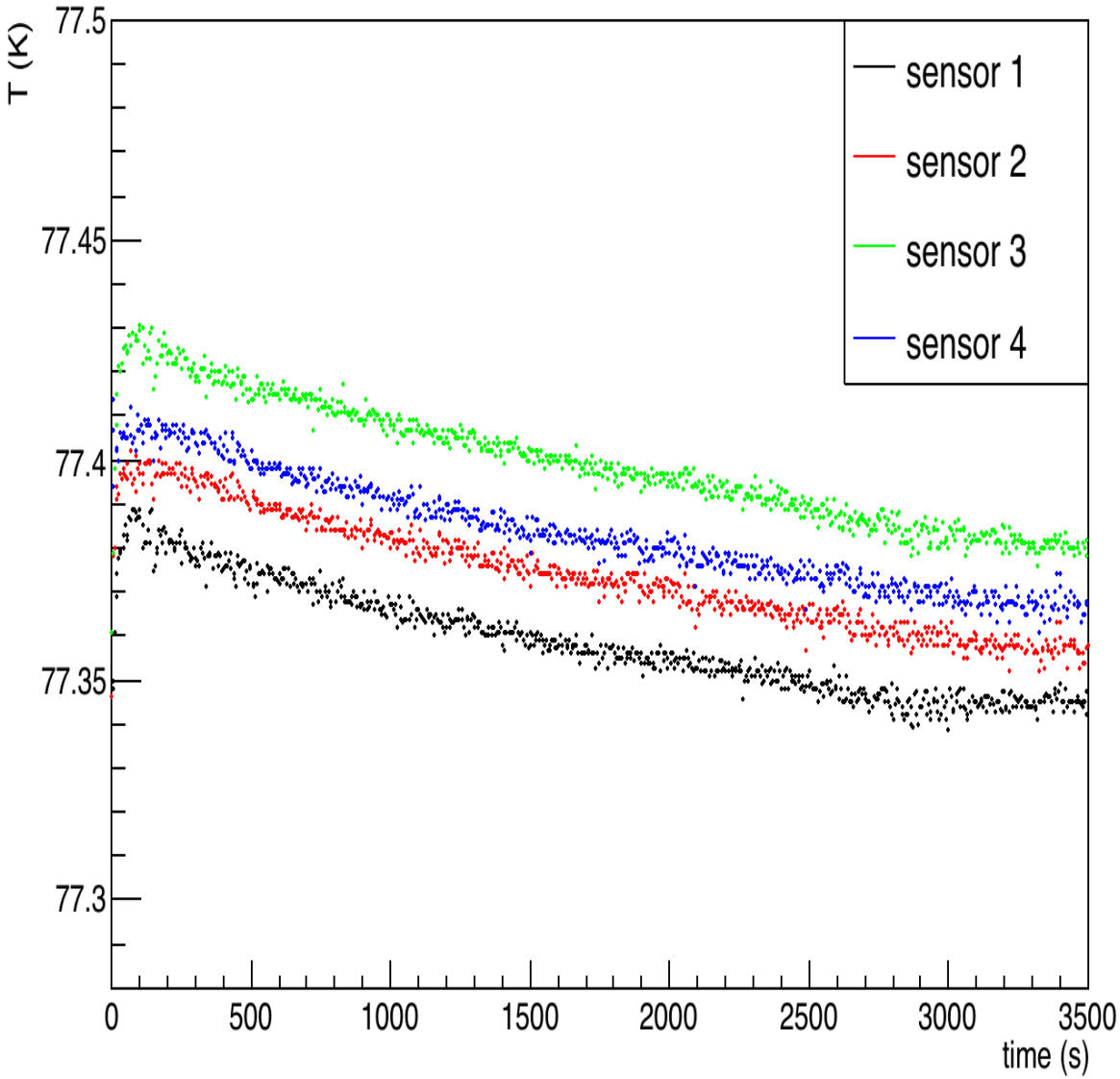




Measurements with liquid nitrogen

2 tied and 2 very close sensors:





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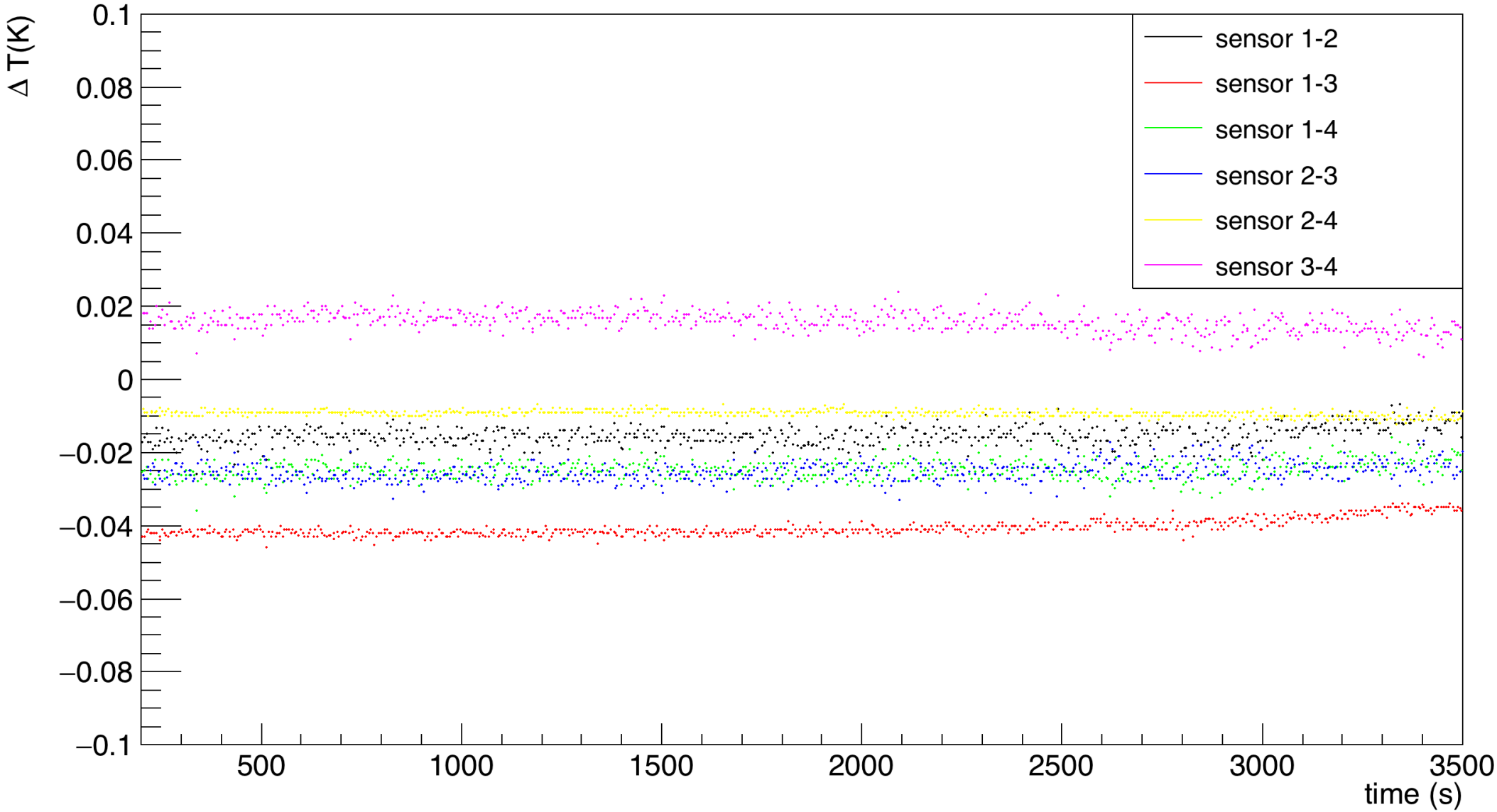

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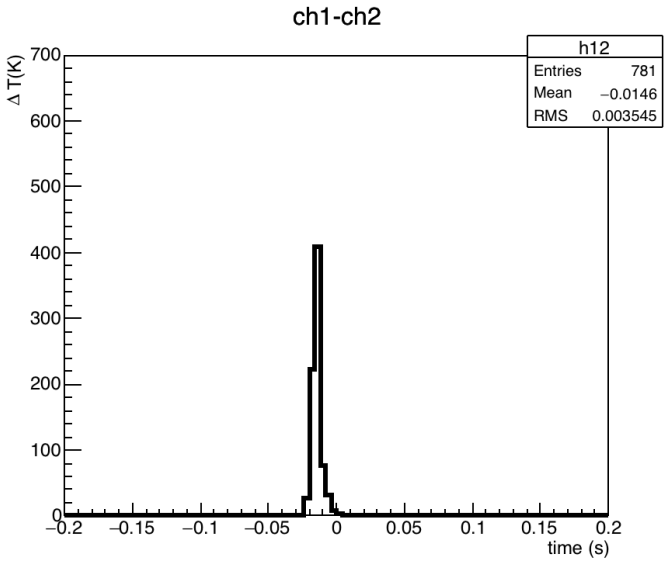
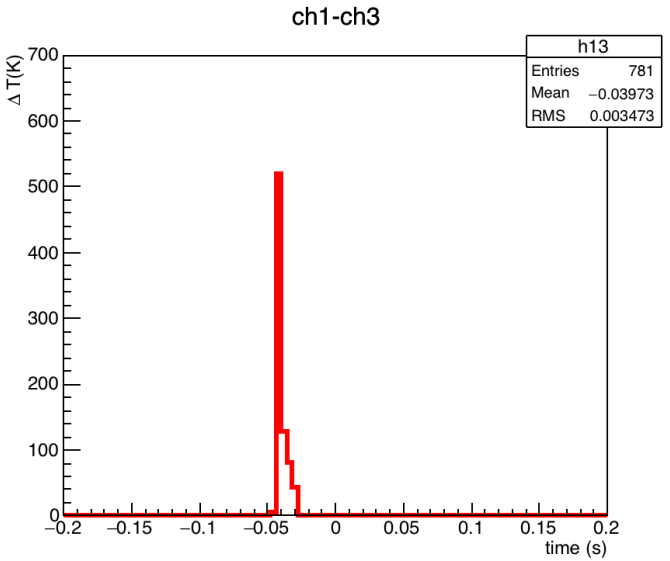
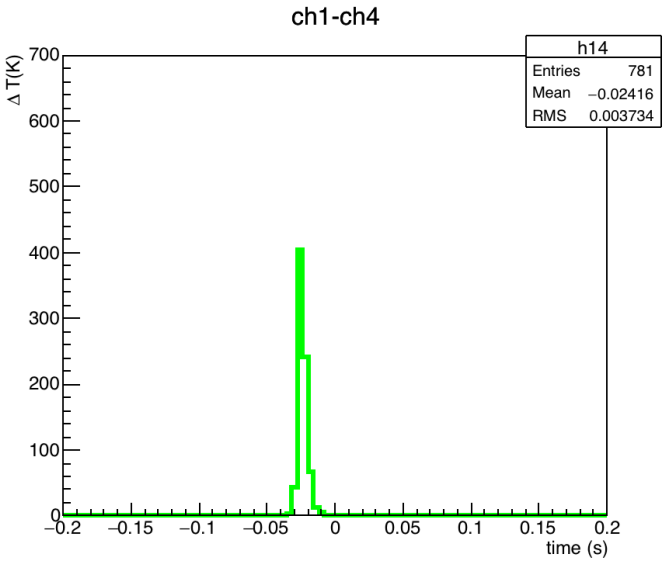
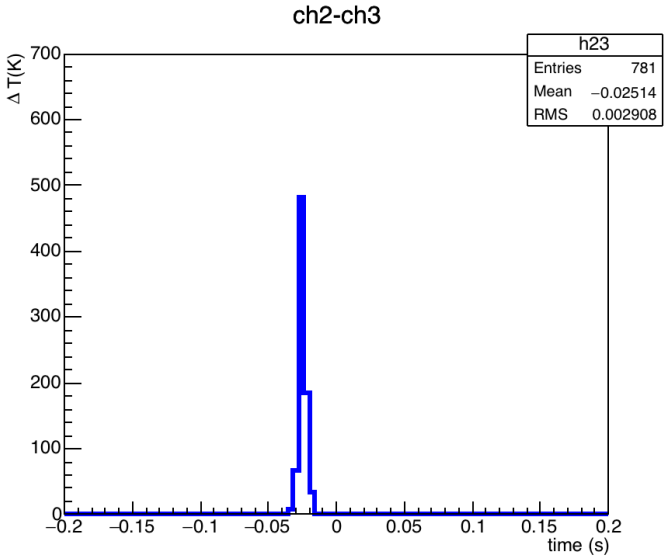
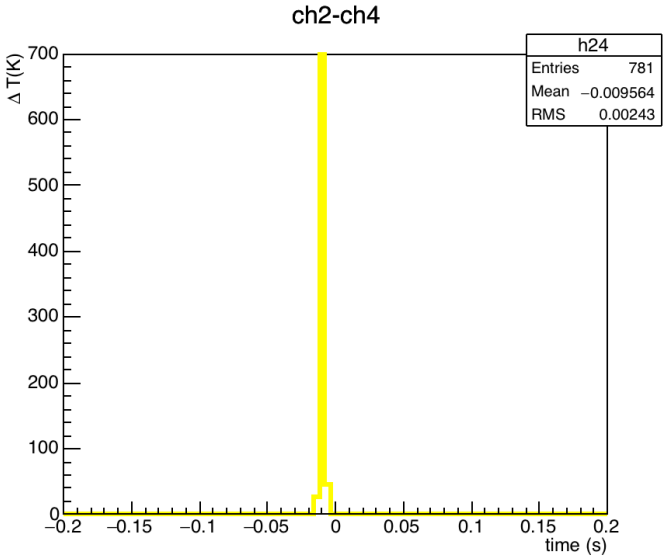
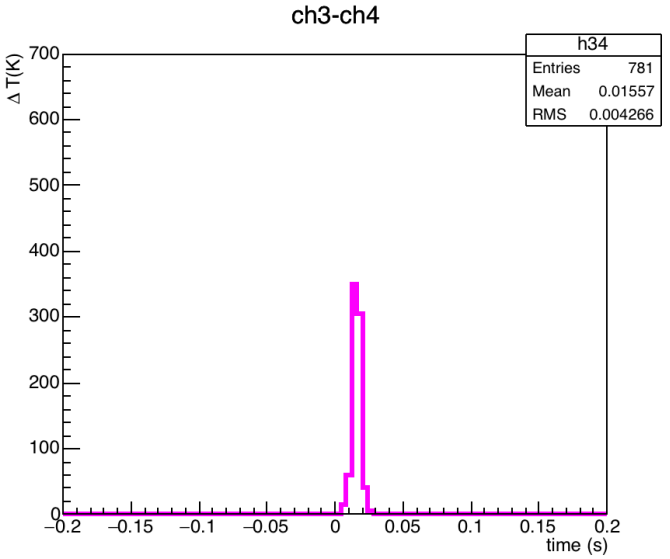






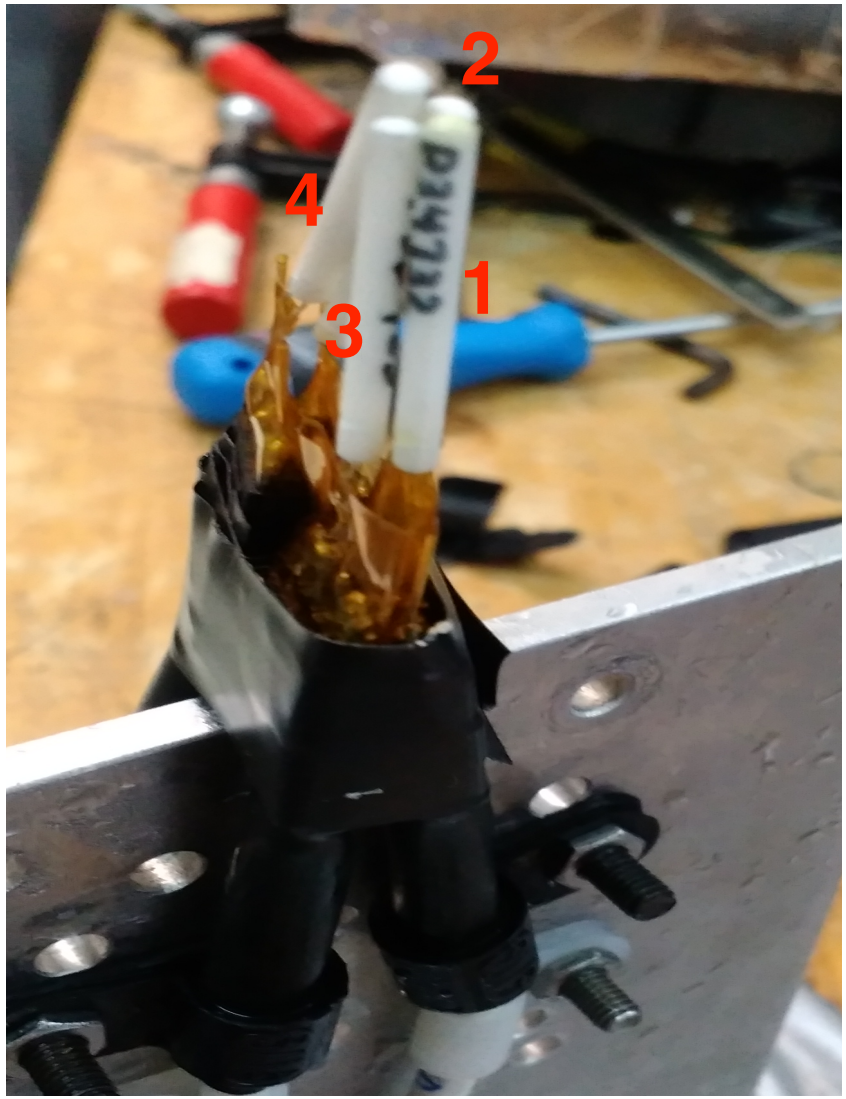


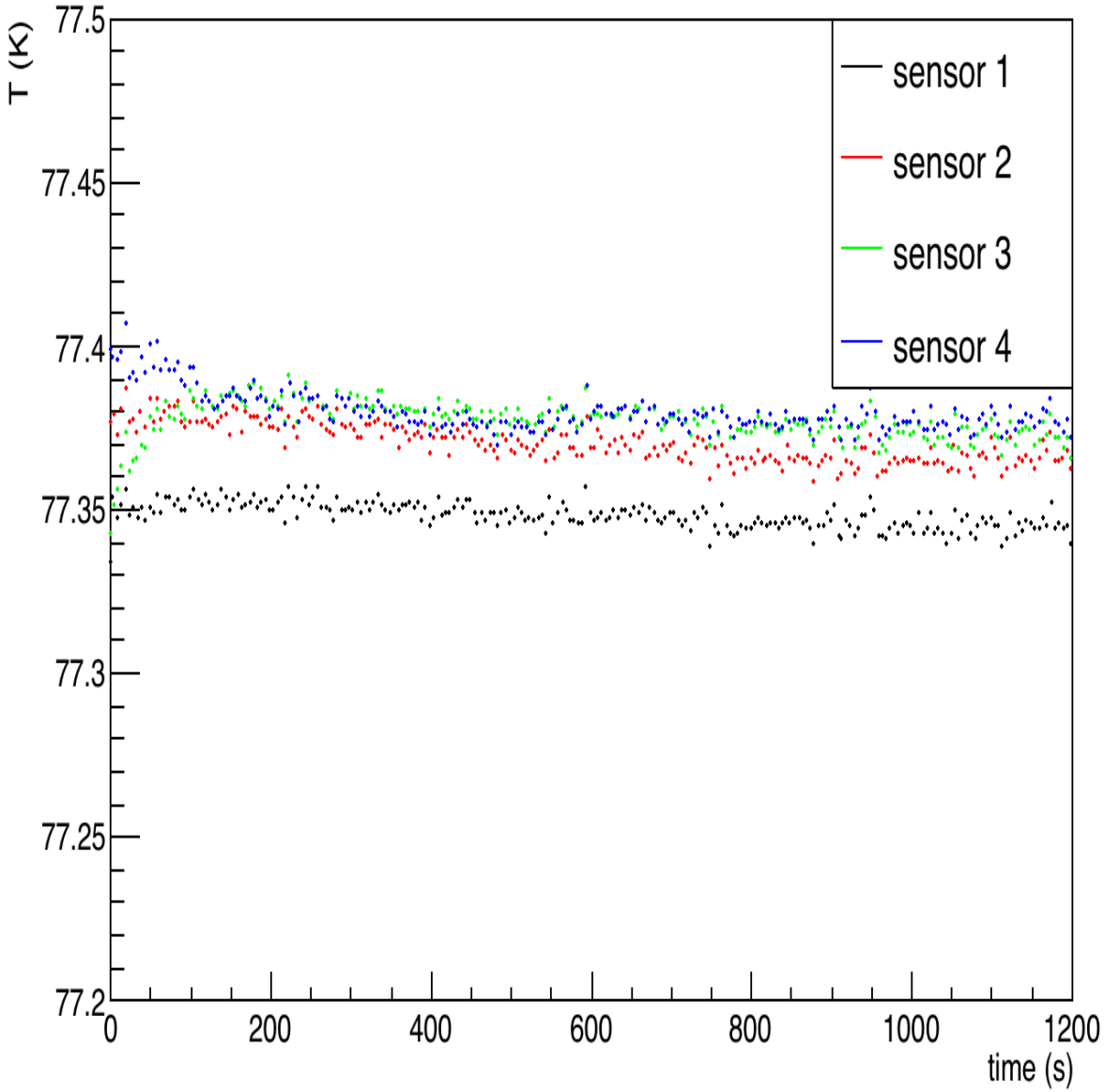




Measurements with liquid nitrogen

All sensors very close:





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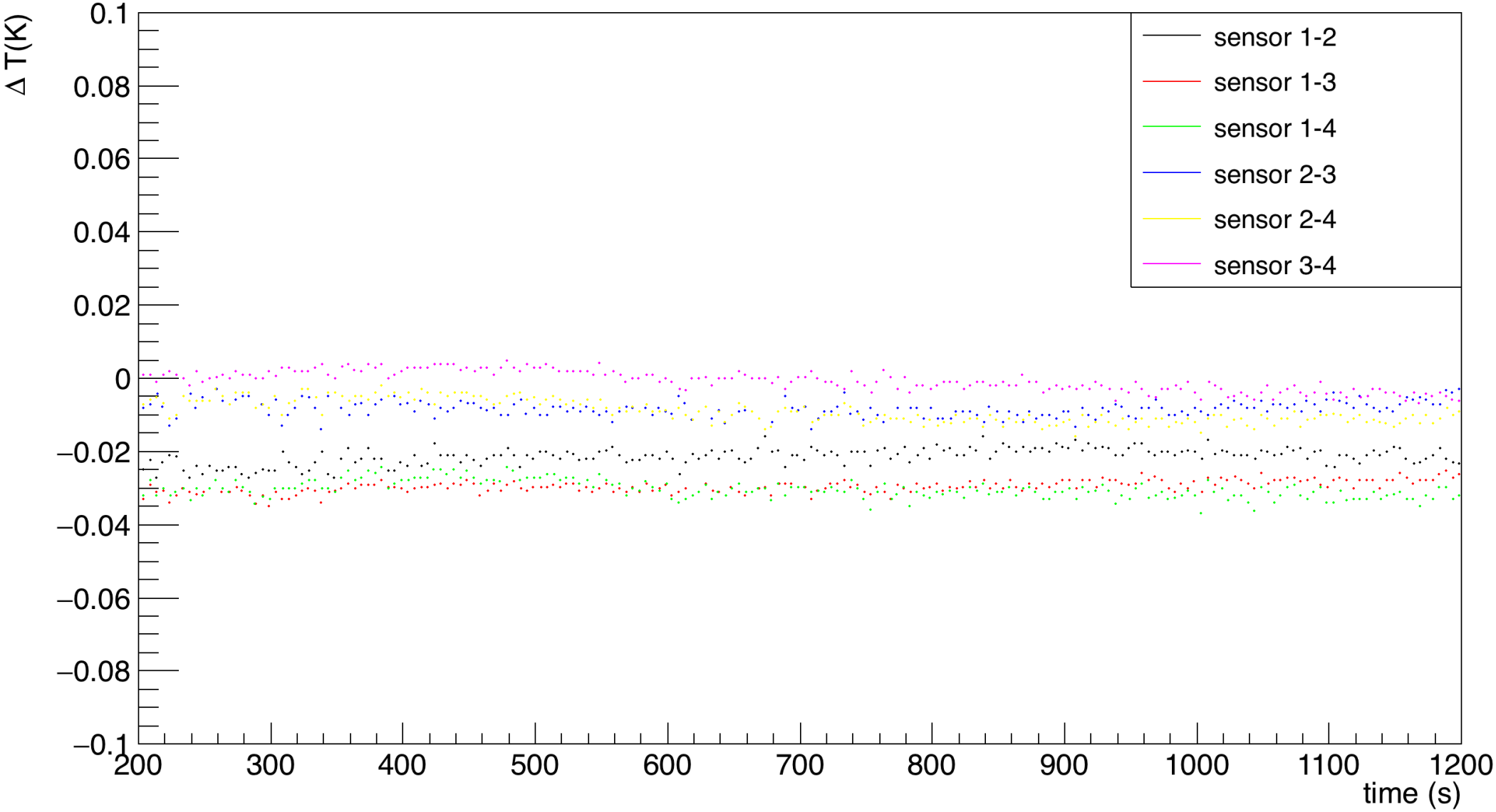

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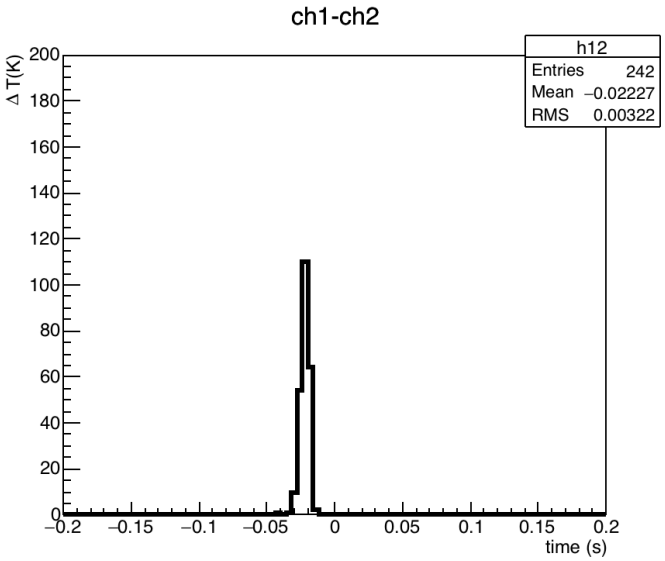
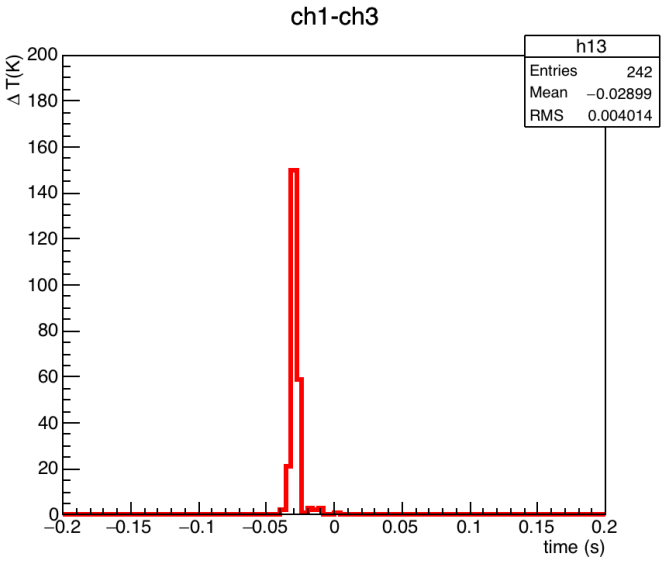
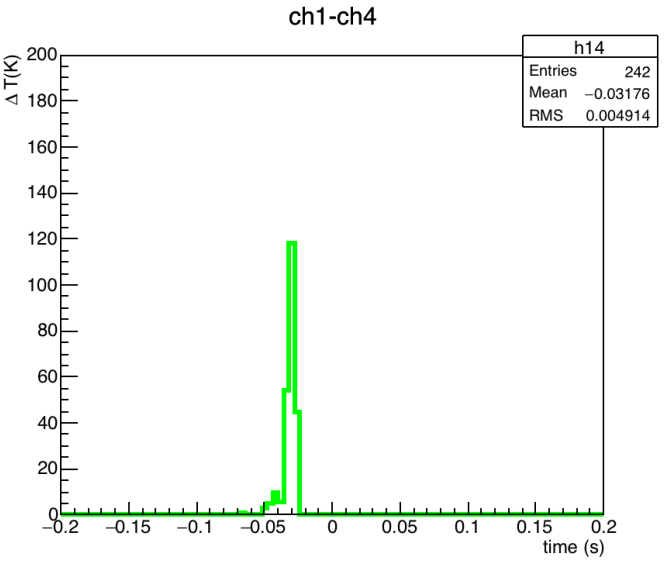
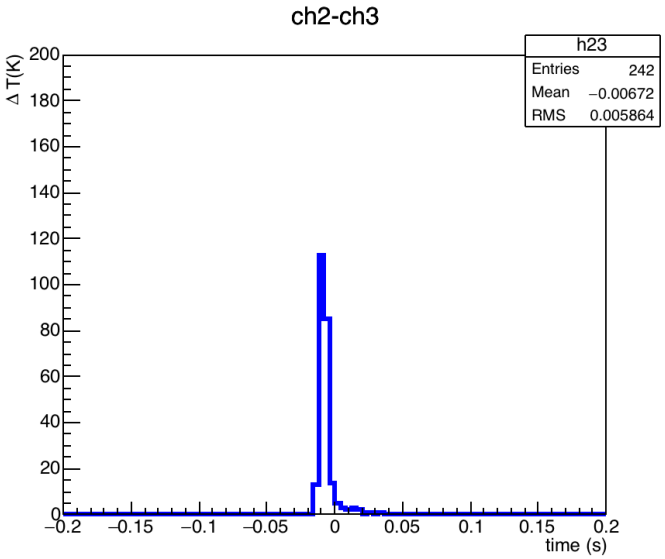
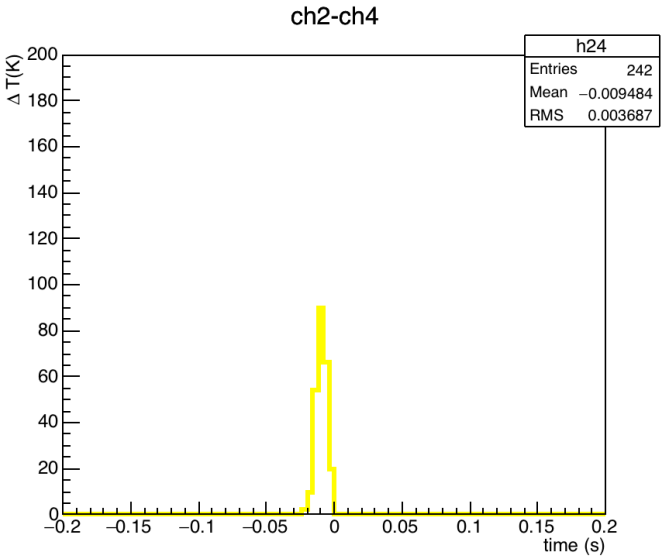
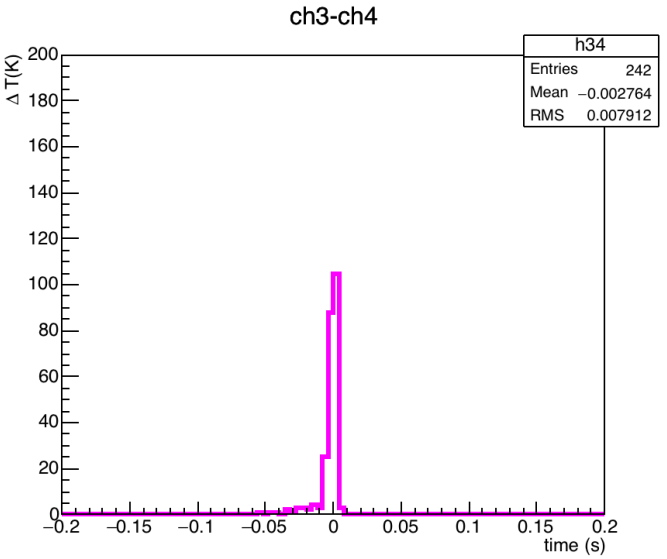












Conclusions

Make curves for channel offset variation with temperature with various resistors

Rather good stability of first measurements with liquid nitrogen, achieving RSM ~ 3 mK for all channels

New and improved calibration system to be ready by June 12th

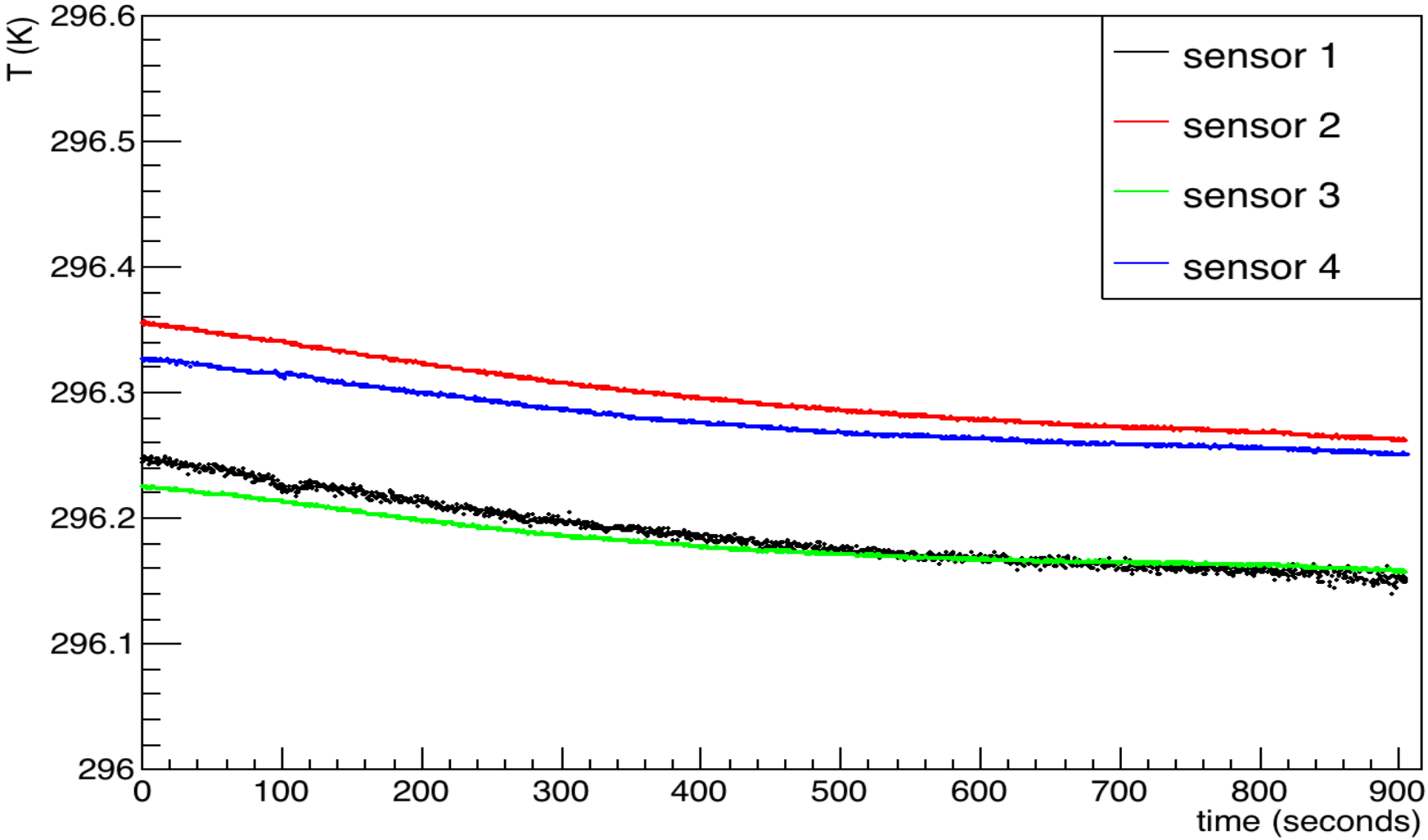
- vessel with liquid Argon inside a bucket with liquid nitrogen
- new structure for the sensors
- a lid for the vessel with pressure gauge
- the connectors will be installed in a long pipe attached to the lid and away from the vessel to avoid condensation

With the new calibration setup we expect to achieve calibration up to RMS ~ 1 mK at temperatures from ~82 K to ~93 K

back up

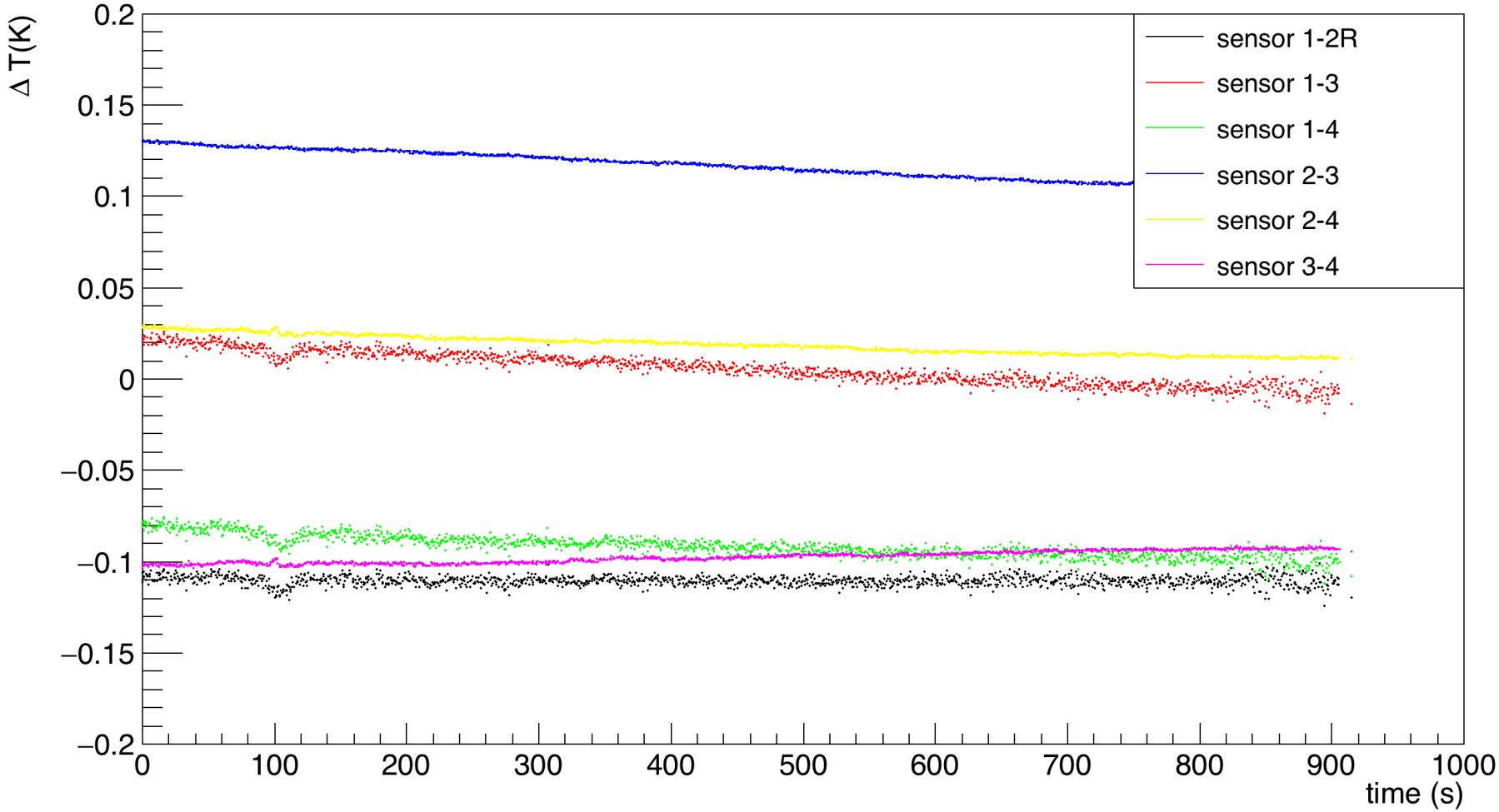
Measurements at room temperature

The setup was exactly the same as in the default sensor configuration and with the same sensor-channel relationship



These measurements show a more stable behaviour than the liquid nitrogen ones, most probably due to the bubbles from its evaporation

Measurements at room temperature



Sensor differences are larger than for liquid nitrogen measurements

Measurements at room temperature