ProtoDUNE + DUNE CISC meeting
07/11/19

DUNE T-system

Sensors distribution

Miguel A. García-Peris (IFIC-Valencia)
Anselmo Cervera (IFIC-Valencia)

Temperature sensors in DUNE

Temperature sensors are considered to be placed at APAs (see last Anselmo's talk).

Sensors distribution is not trivial since

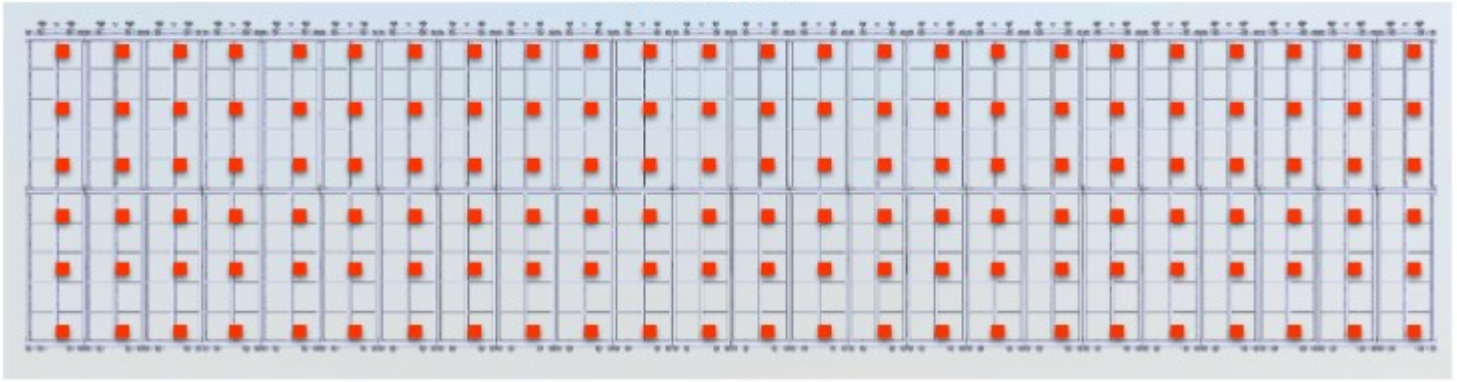
- APAs installation can not be conditioned.
- Maximum density of 10 sensors/array.
- We can not place infinite sensors.
- DUNE active volume is huge.

Some suggestions were showed last week varying sensors/array and sensors positions.

We are trying to study which distribution is providing more information for our main purpose: understanding T-map along all DUNE active volume.

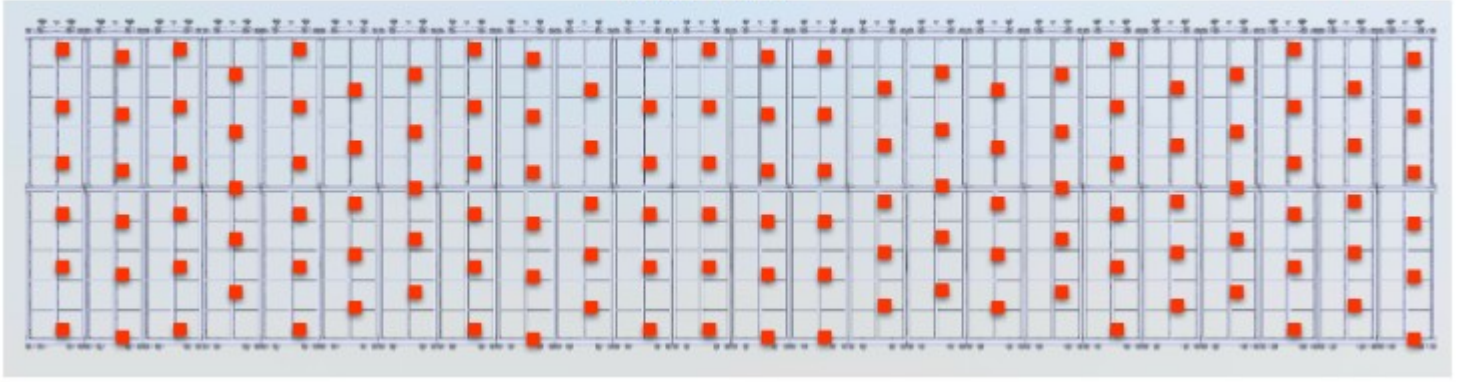
side view

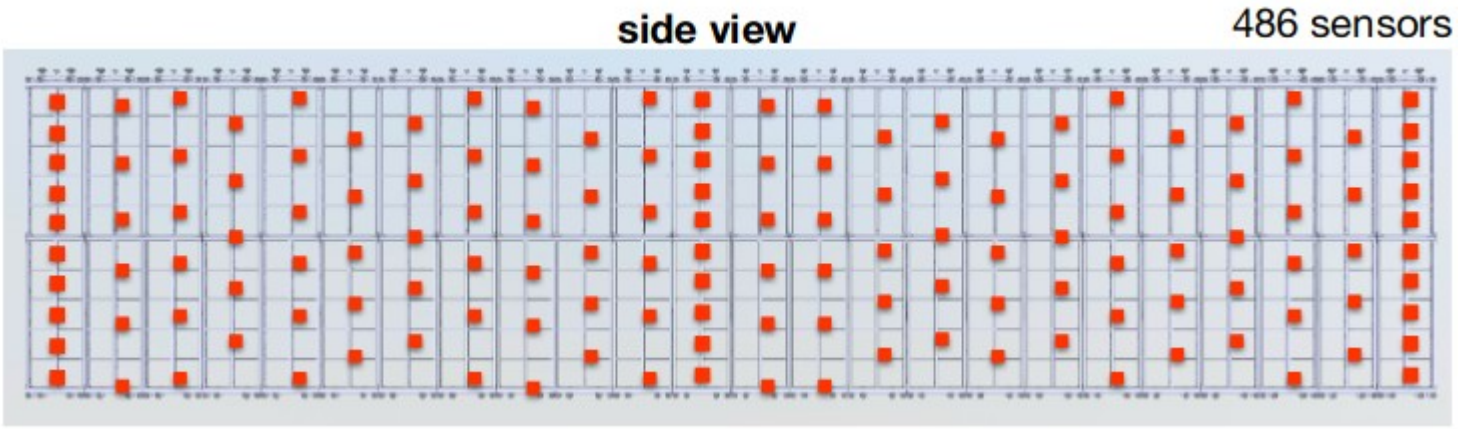
450 sensors

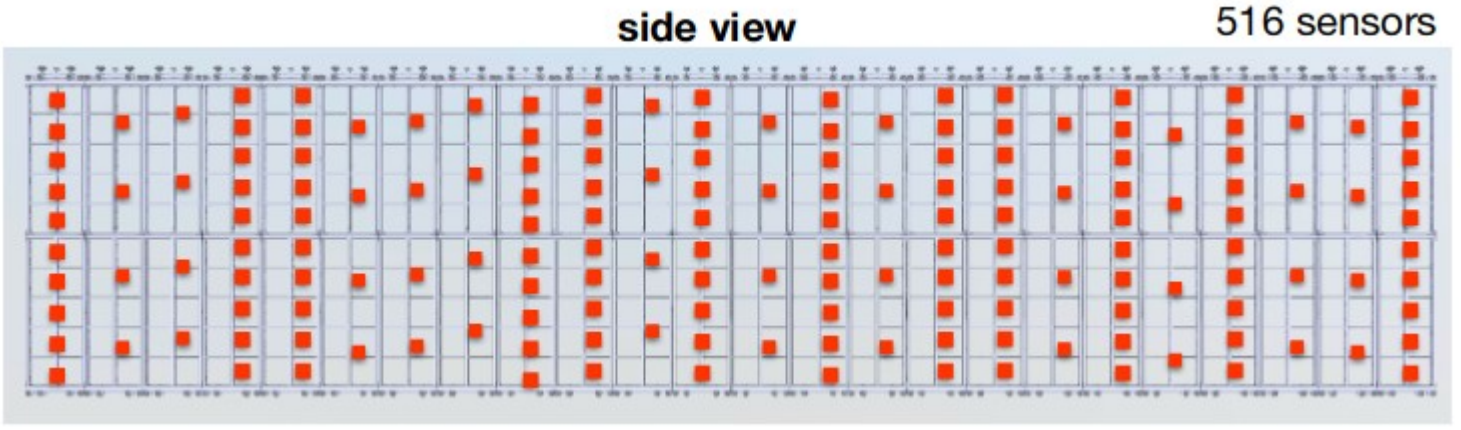


side view

400 sensors




side view
486 sensors


side view
516 sensors

Procedure

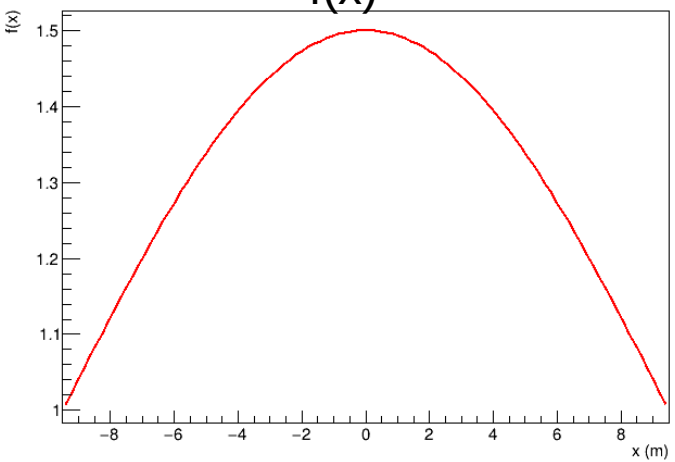
Generate a T-map of the form Tr(x,y,z) = f(x)g(y)h(z).

Assume a sensor distribution.

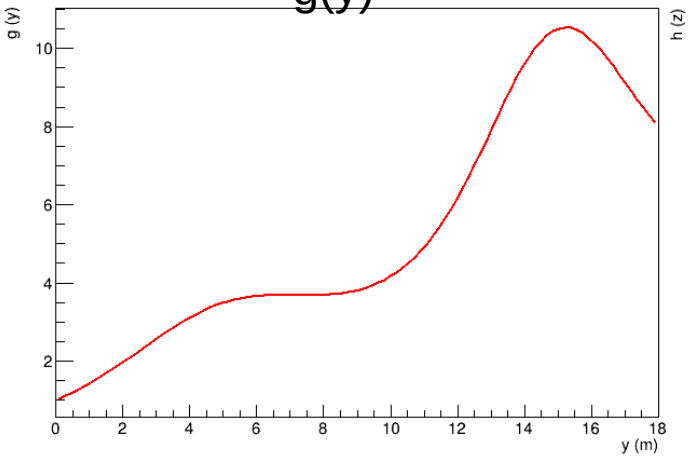
Generate a T measurement for each sensor with a ‘calibration’ bias.

Use measurements to infer Tr(x,y,z).

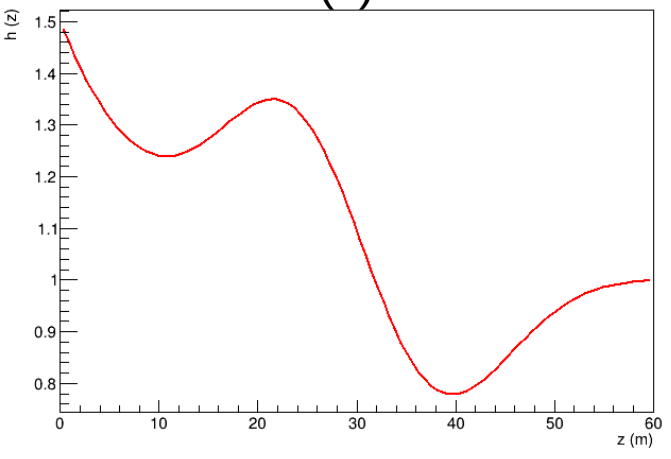
f(x)



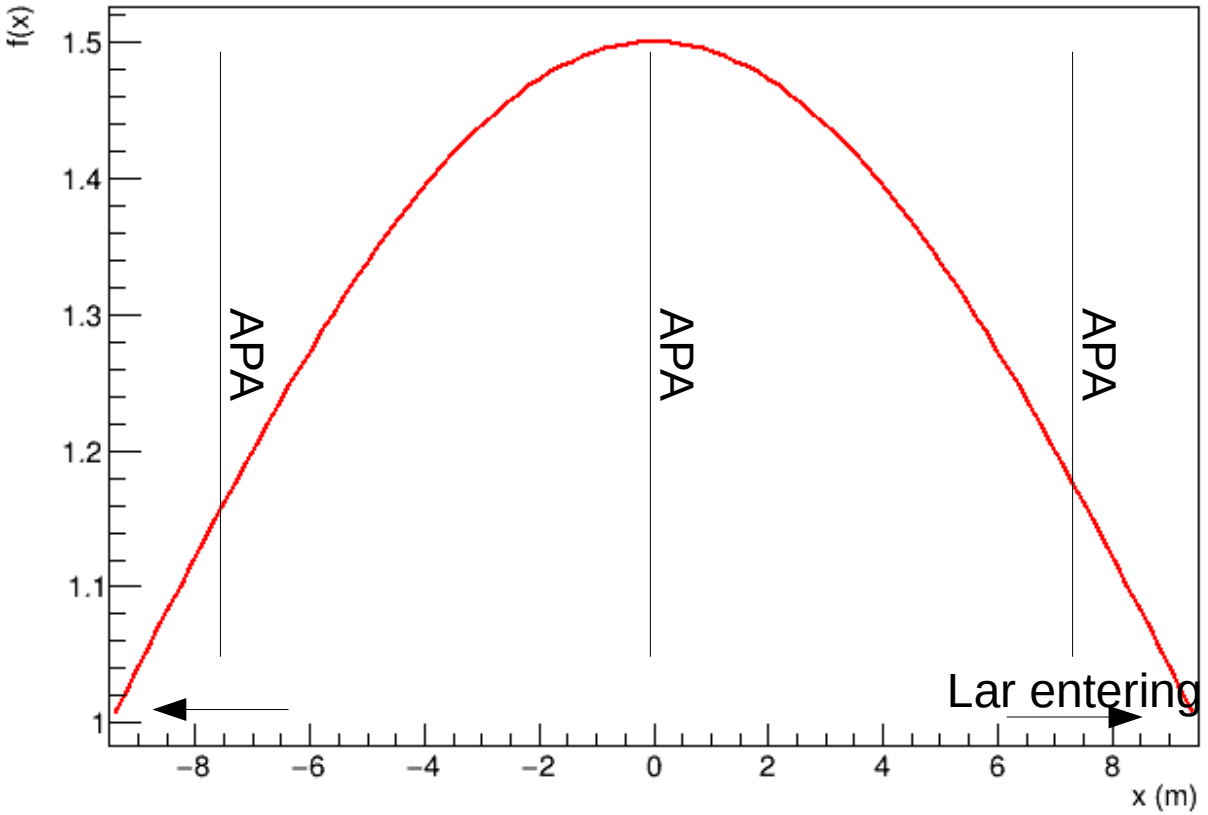
g(y)



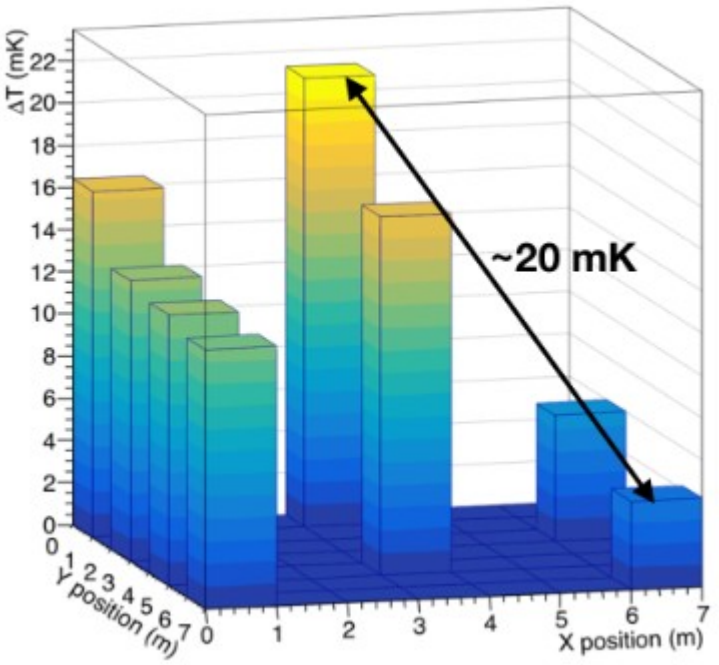
h(z)



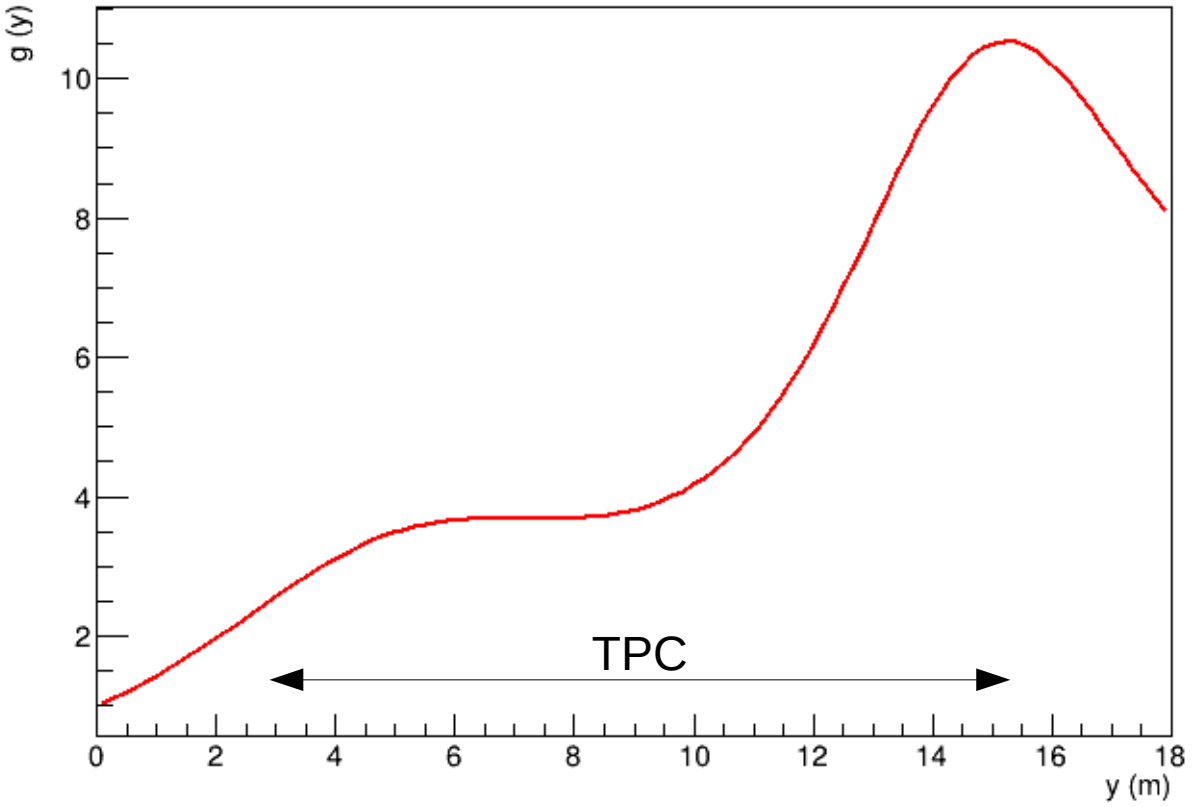
f(x)



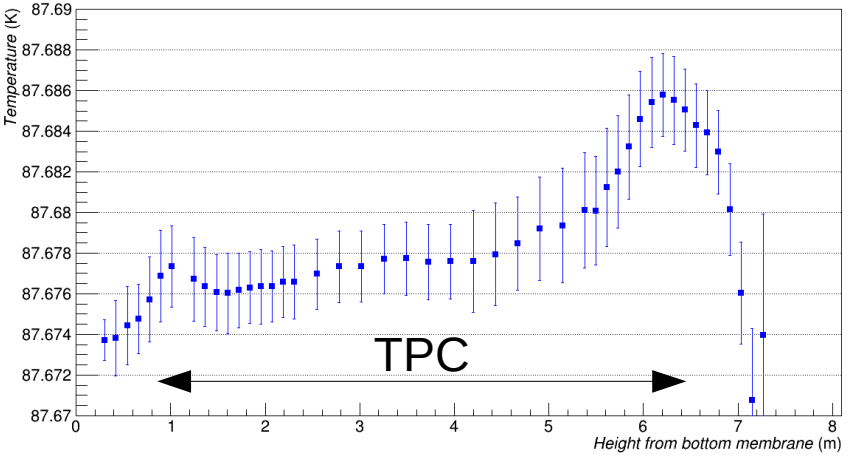
ProtoDUNE pipes temperature



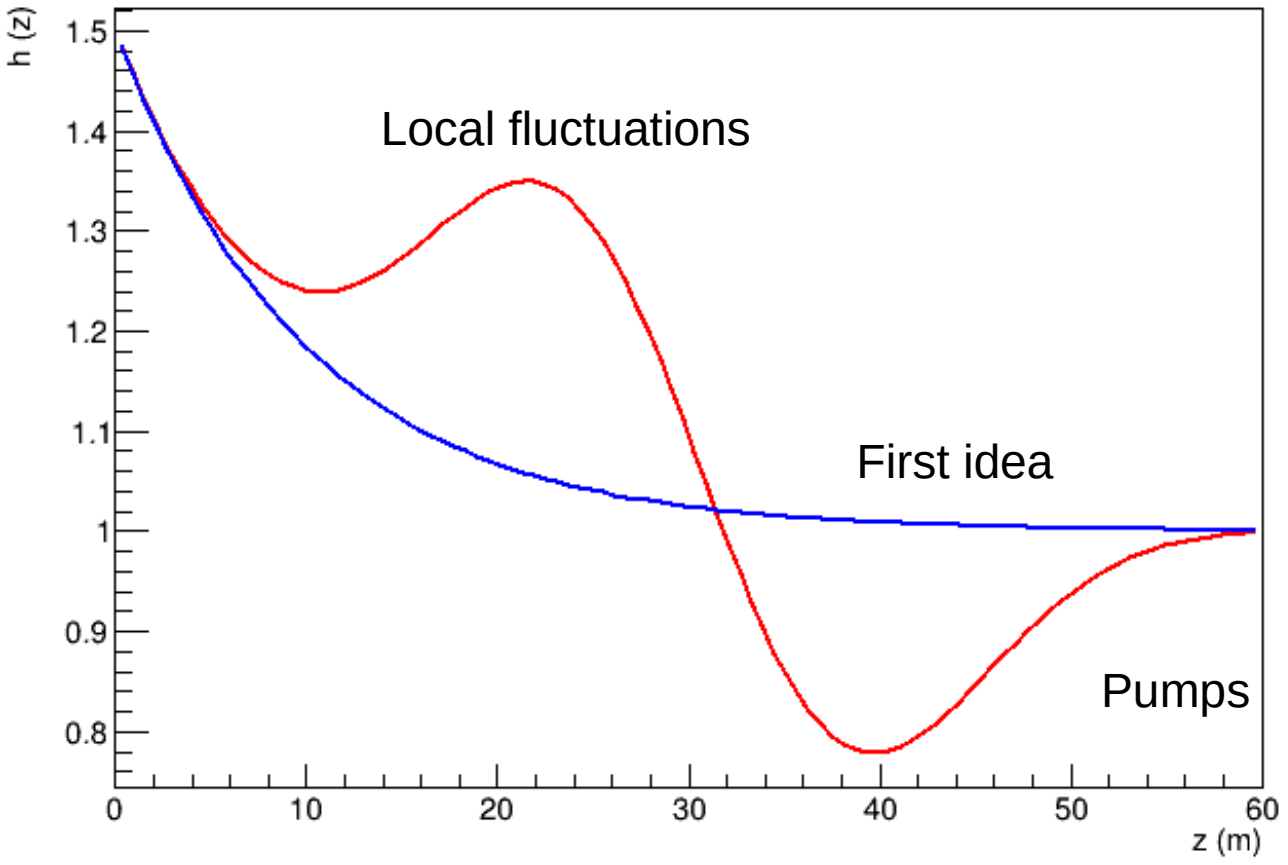
g(y)



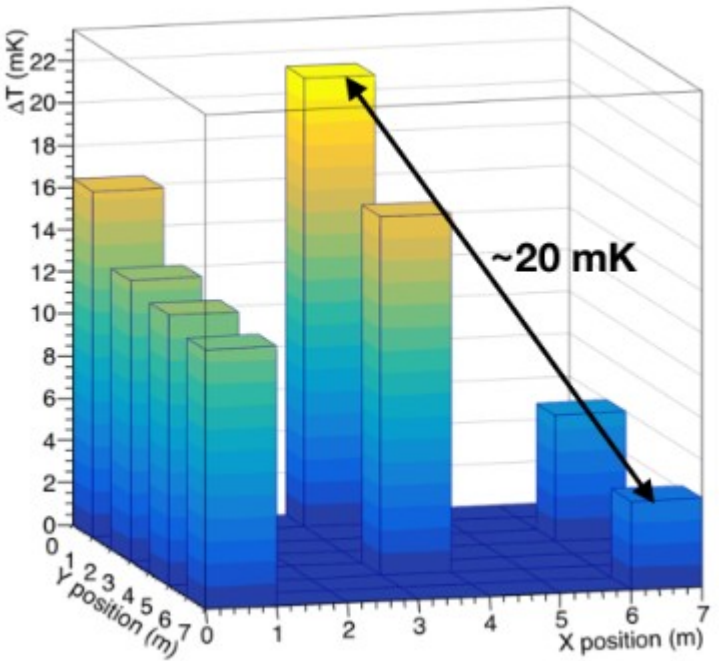
ProtoDUNE vertical profile



h(z)



ProtoDUNE pipes temperature



How to ‘infer Tr(x,y,z)’?

Infer Tr(x,y,z) → Predict in the active volume with enough precision.

Difference between prediction and real value is a good metric for benchmarking each distribution.

This allows to set requirements → maximum deviation of 3 mK (to be reviewed).

How do we predict? Using all data to perform a fit.

Global fit

Once fake measurements are performed, use all data to perform a global fit.

It is assumed that Tr(x,y,z) is unkown.

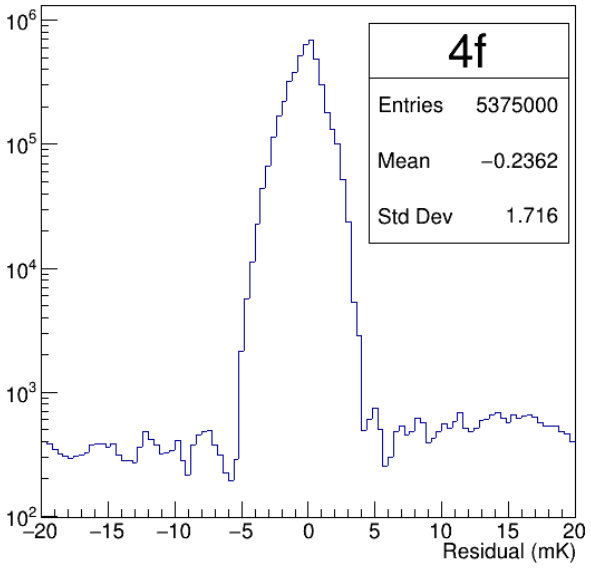
Data if fitted to polynomial → Fit(x,y,z) = Pol2(x)Pol9(y)Pol9(z).

Study Fit(x,y,z)-Tr(x,y,z) in the active volume sampling a grid of points:

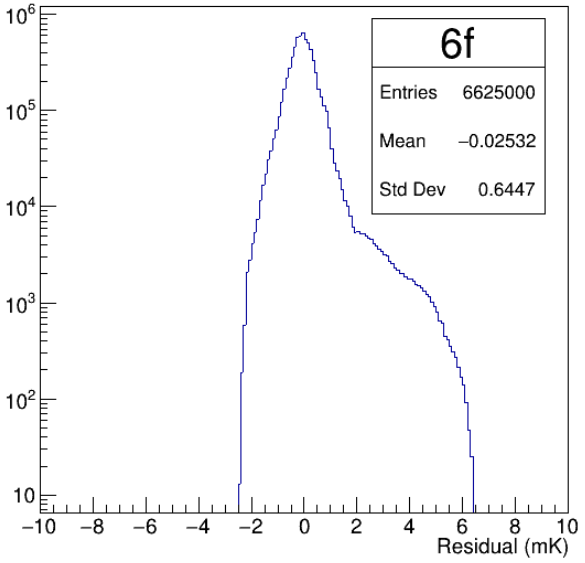
- x → 50 points from -7.5 m to 7.5 m
- y → 50 points from 10 m to 15 m (complicated region)
- z → 50 points from 15 m to 45 m (complicated region)

Global fit: basic results

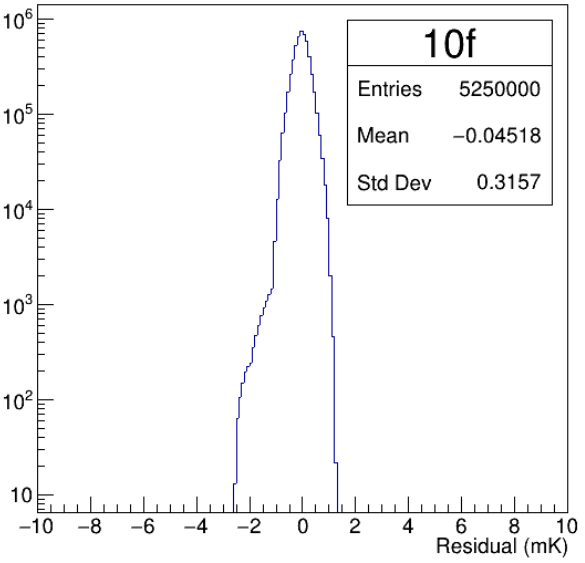
Arrays of 4 fixed sensors



Arrays of 6 fixed sensors



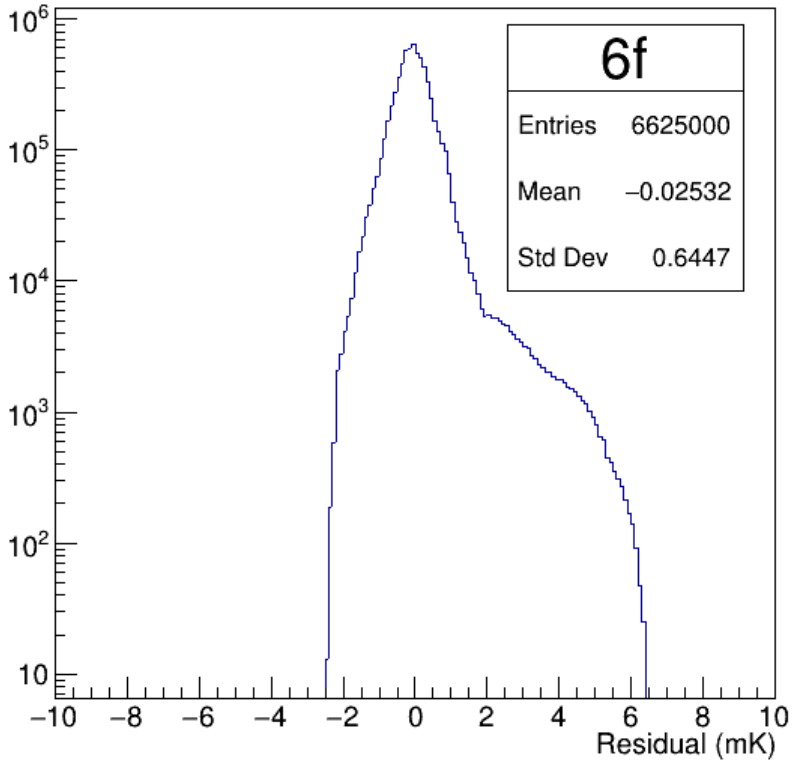
Arrays of 10 fixed sensors



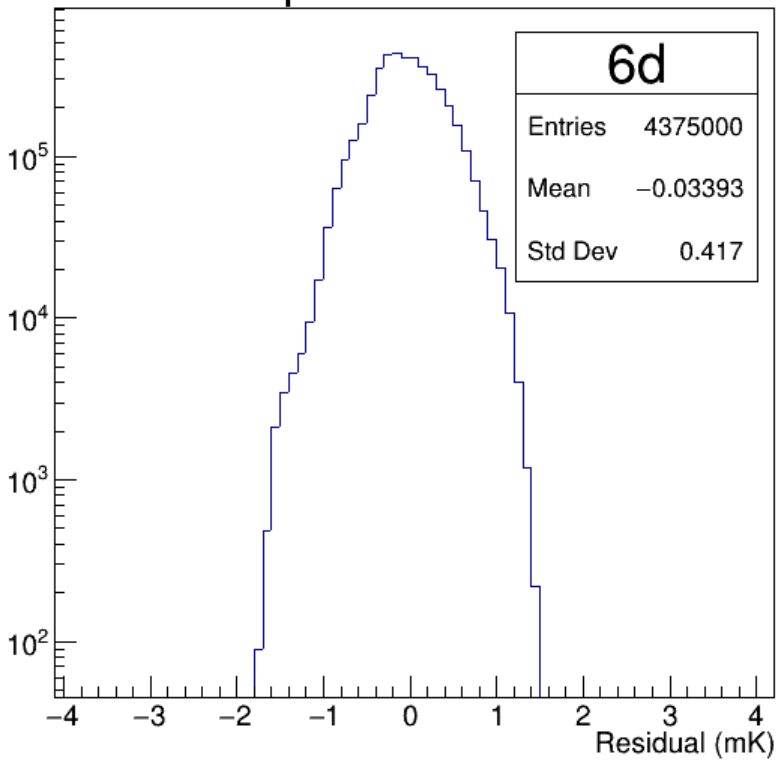
Residuals are lower for more sensors, which points method is working properly

Global fit: fixed vs displaced arrays

6 fixed sensors



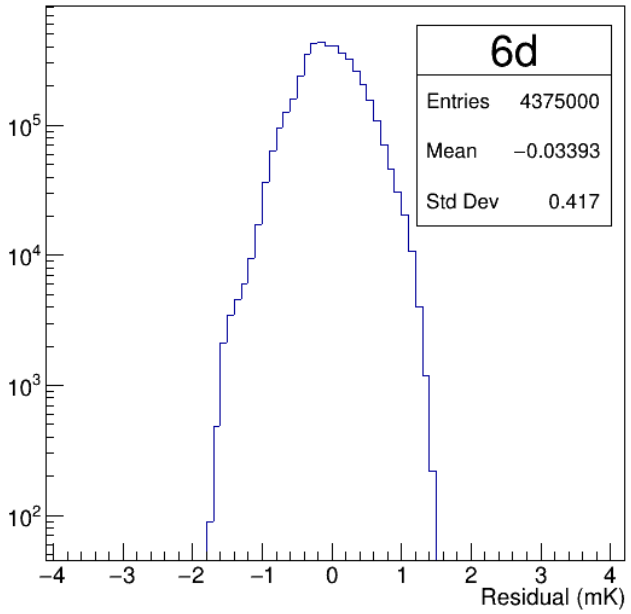
6 displaced sensors



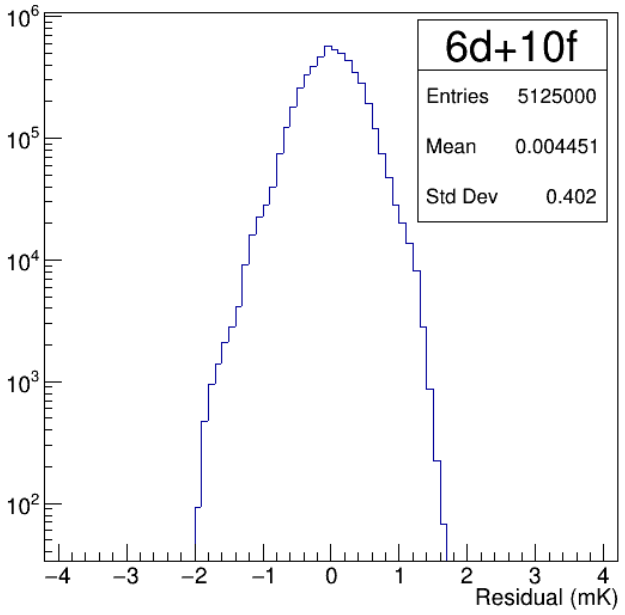
Apparently when more heights are sampled fit quality improves

Global fit: different configurations

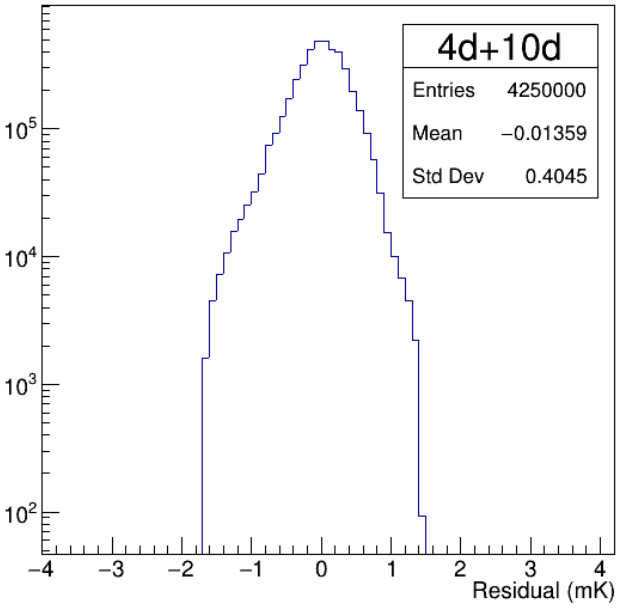
Arrays of 6 displaced sensors



Added arrays of
Ten fixed sensors



Arrays of 4 and 10
Displaced sensors



Model is not difficult enough to discern which of these configurations is better, more work in progress!!

Conclusions

First studies to figure out which sensor distribution is better for DUNE are being carried on.

As it was expected configurations that samples more heights are preferred over fixed ones.

It is needed to increase model difficulty (add ‘local’ fluctuations) to discern between higher level configurations.