FIRST LOOK AT THE AGL MEASUREMENTS

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CIEMAT

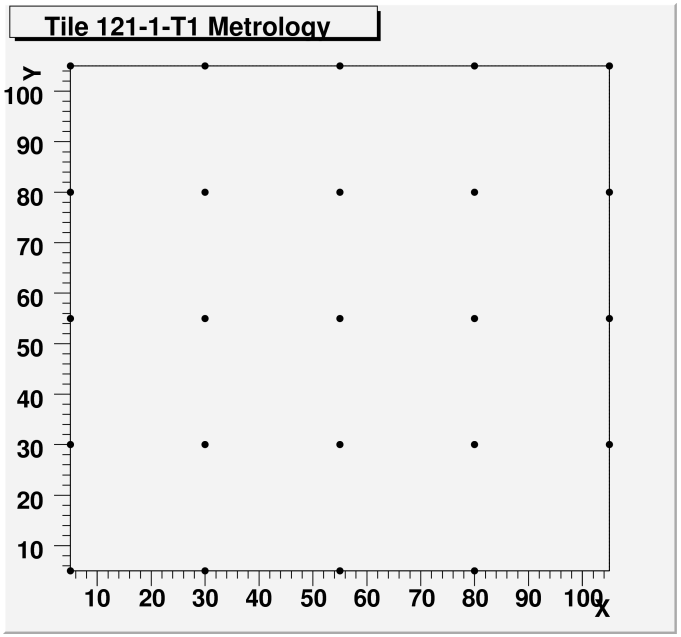
Goal

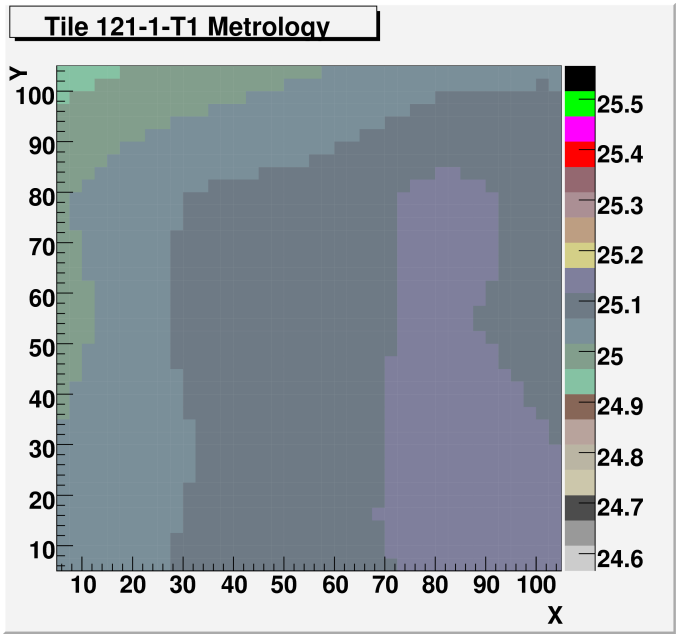
- Analyse the metrology and optical measurements performed at LPSC to conclude either
  - ✔ The need of dedicated real detector package (simulation & reconstruction)
  - ✔ An estimate of the safety margin wrt the “ideal” detector settings
- Assert the completeness of the measurements and their correct translation into the RICH Sim/Rec software

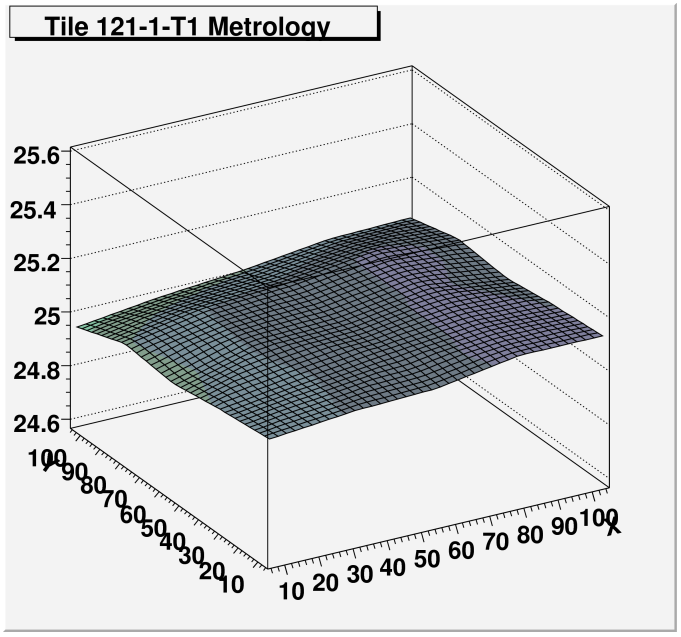
Sample

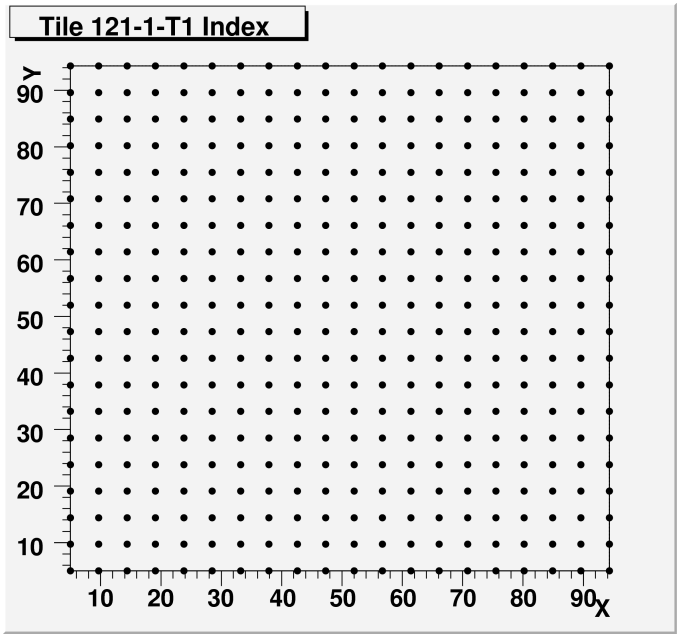
- Consisting in the measurements provided by Mariane on 51 tiles corresponding to the first batches received at Grenoble
- 2 types of measurements:
  - ✔ Metrology Scan (Thickness) (~25 meas. 25 mm pitch)
  - ✔ Optical Scan (Refractive Index) (~400 meas. 4.7 mm pitch)
- 44 tiles selected with “good” Metrology & Optical measurements
  - ✔ 32 (T1) + 4 (T2) + 4 (T3) + 4 (T5)

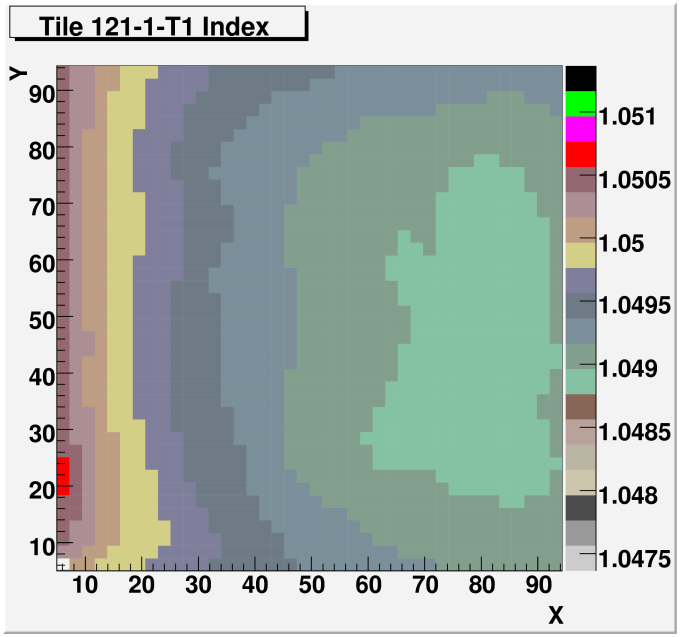
121-1-T1

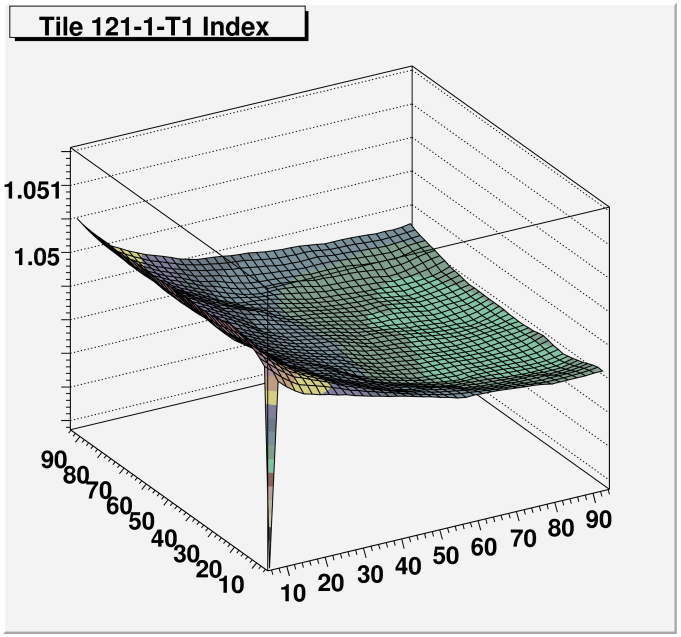

Tile 121-1-T1 Metrology
Y
X


Tile 121-1-T1 Metrology
Y
X
25.5
25.4
25.3
25.2
25.1
25
24.9
24.8
24.7
24.6

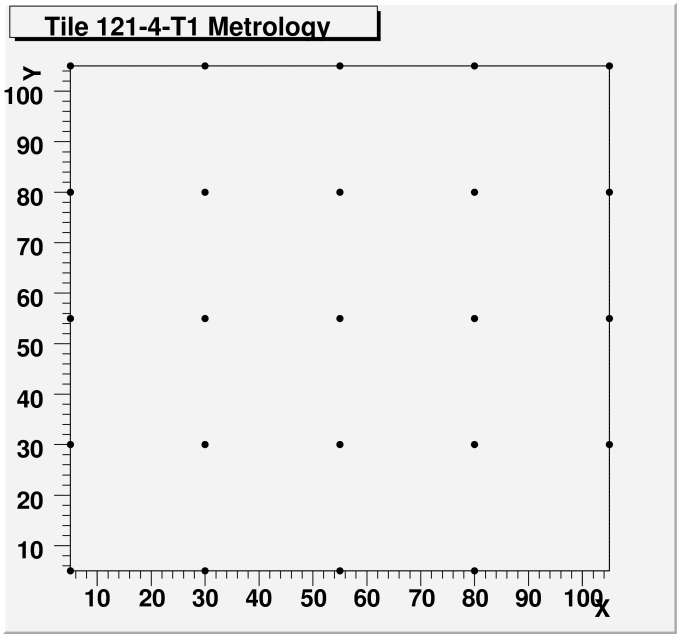

Tile 121-1-T1 Metrology
25.6
25.4
25.2
25
24.8
24.6
Y
X

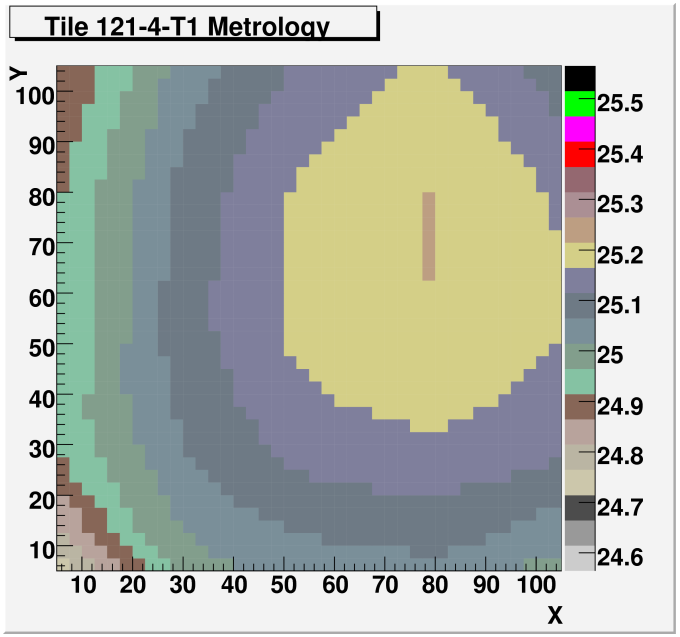

Tile 121-1-T1 Index
Y
X

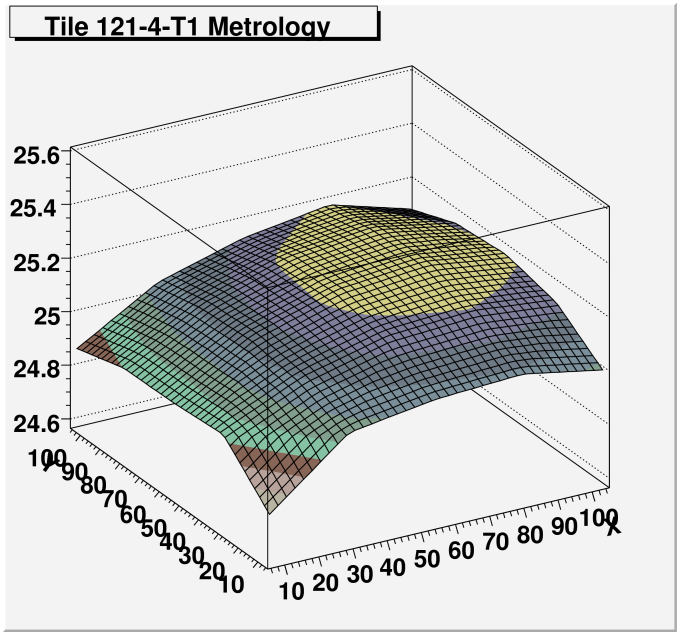

Tile 121-1-T1 Index
Y
X
1.051
1.0505
1.05
1.0495
1.049
1.0485
1.048
1.0475

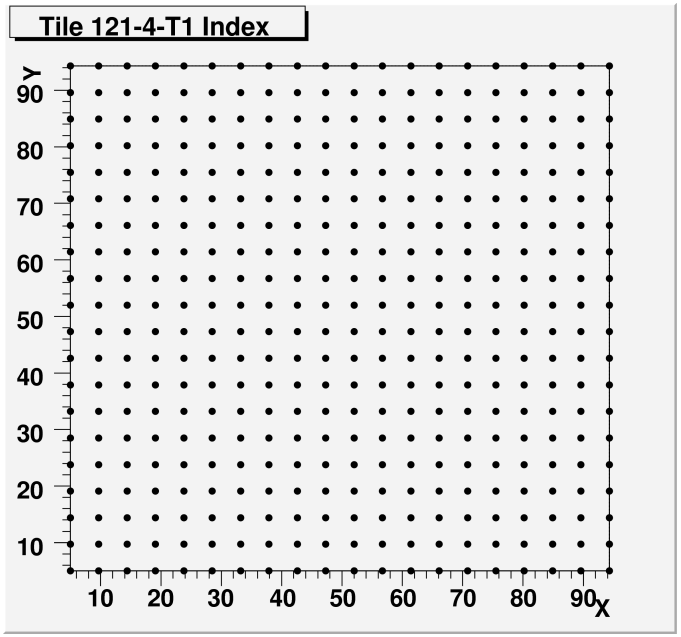

Tile 121-1-T1 Index
1.051
1.05

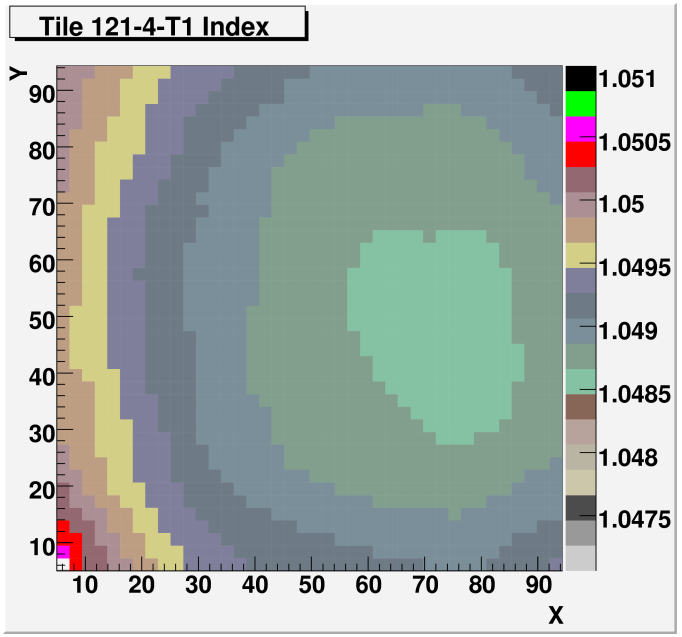
121-4-T1

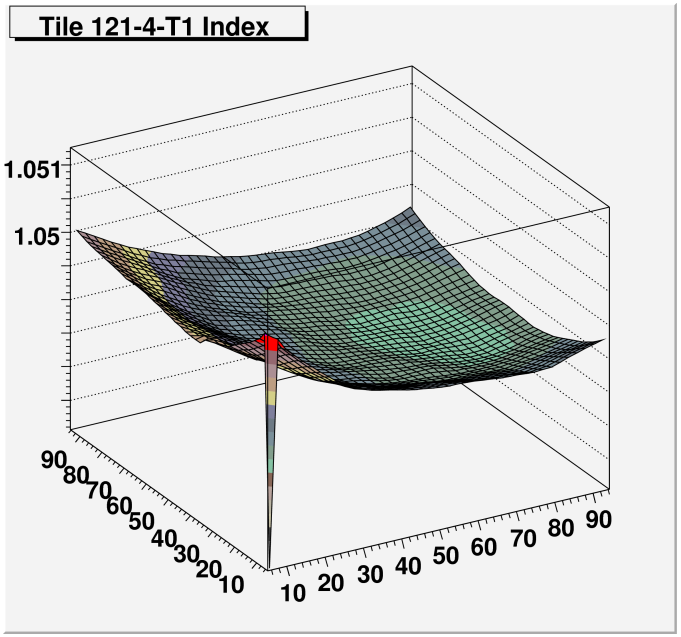

Tile 121-4-T1 Metrology
Y
X


Tile 121-4-T1 Metrology
Y
X
25.5
25.4
25.3
25.2
25.1
25
24.9
24.8
24.7
24.6

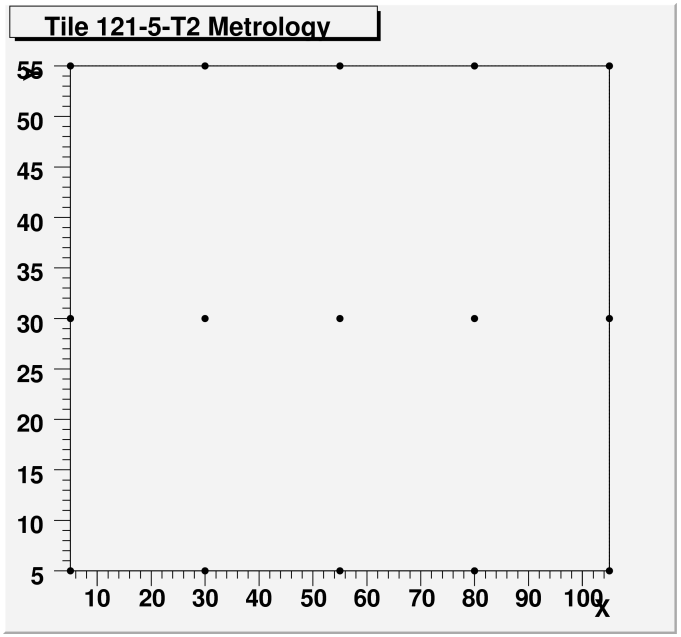

Tile 121-4-T1 Metrology
25.6
25.4
25.2
25
24.8
24.6
X

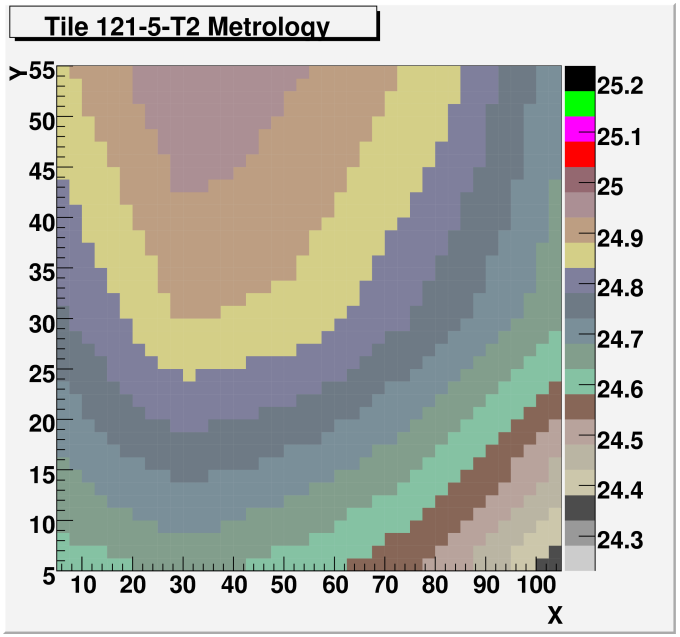

Tile 121-4-T1 Index
Y
X

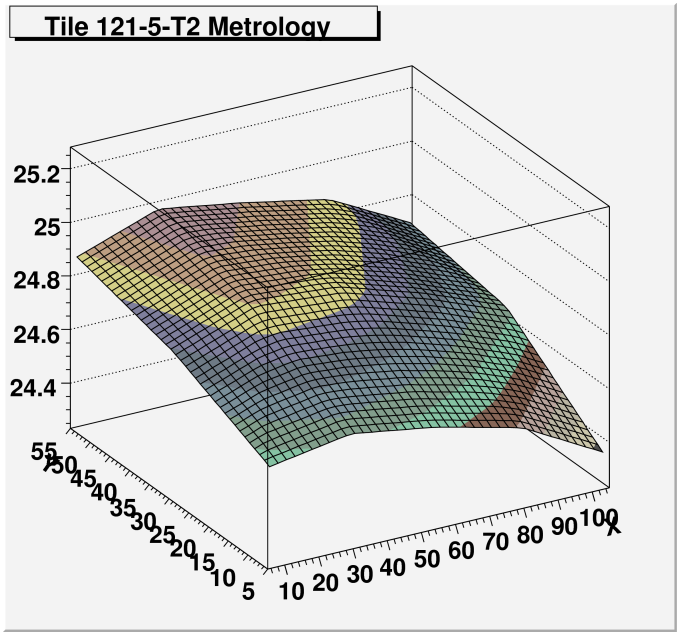

Tile 121-4-T1 Index
Y
X
1.051
1.0505
1.05
1.0495
1.049
1.0485
1.048
1.0475

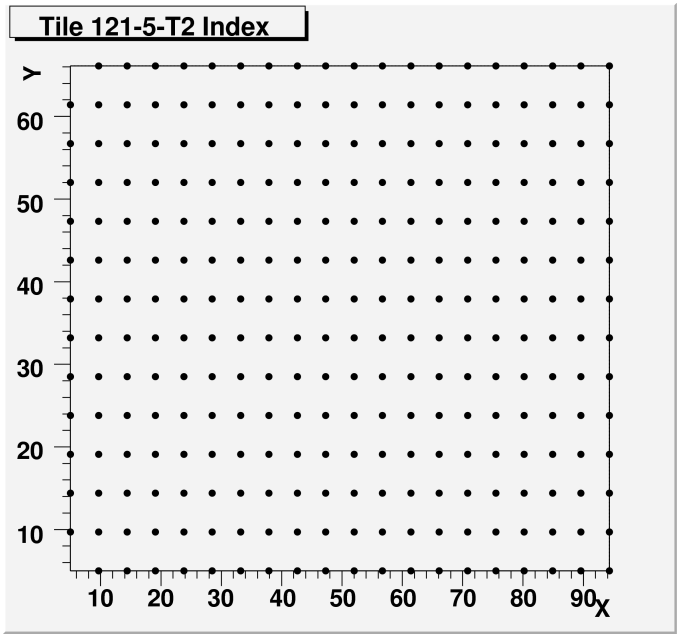

Tile 121-4-T1 Index
1.051
1.05

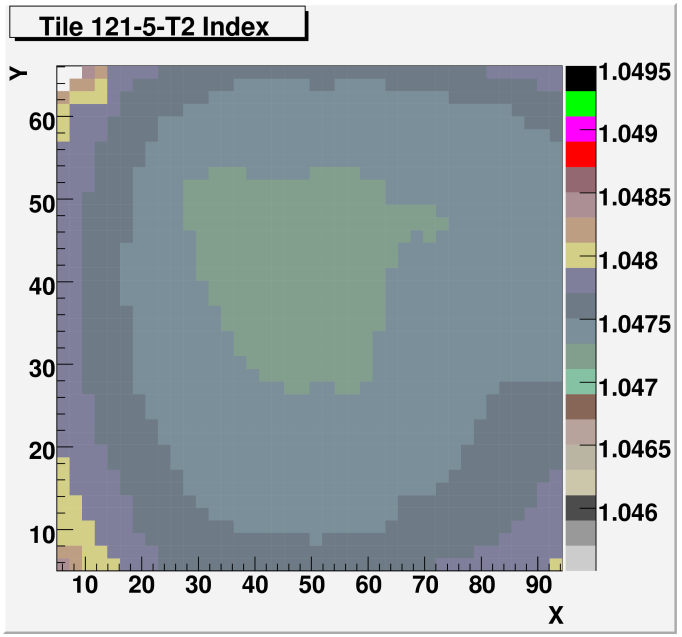
121-5-T2

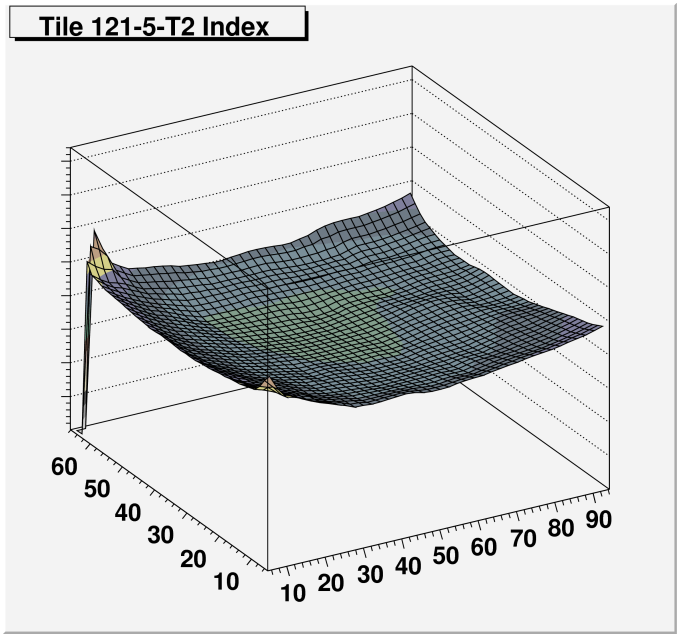

Tile 121-5-T2 Metrology
Y
X


Tile 121-5-T2 Metrology
Y
X
25.2
25.1
25
24.9
24.8
24.7
24.6
24.5
24.4
24.3

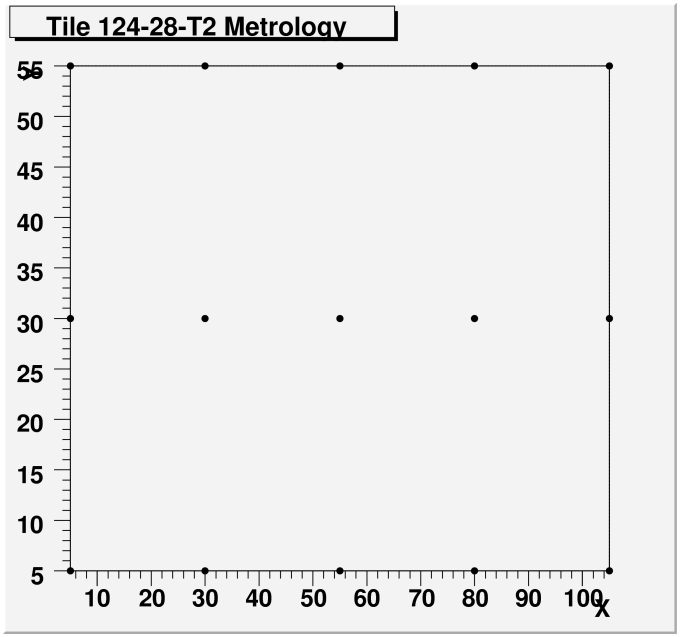

Tile 121-5-T2 Metrology
25.2
25
24.8
24.6
24.4
X

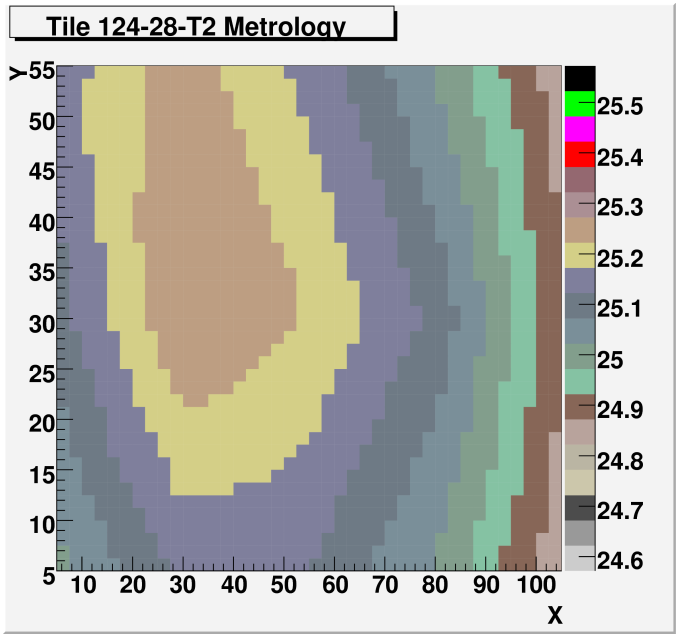

Tile 121-5-T2 Index
Y
X

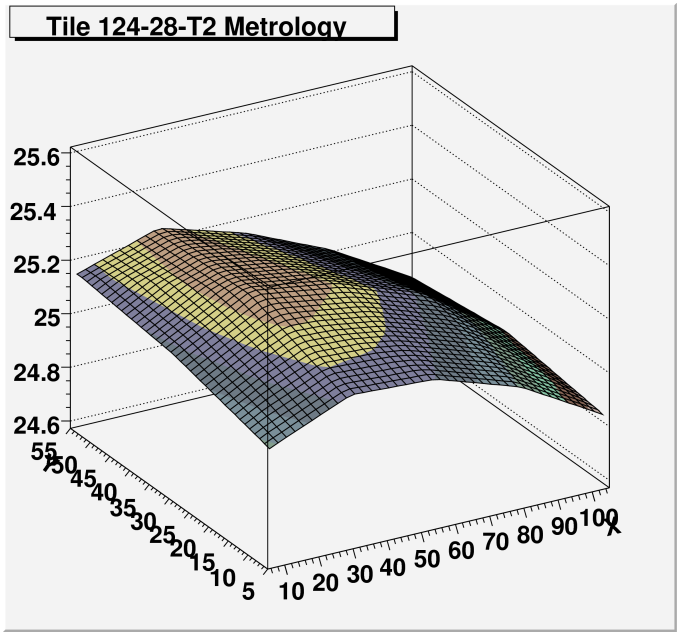

Tile 121-5-T2 Index
Y
X
1.0495
1.049
1.0485
1.048
1.0475
1.047
1.0465
1.046

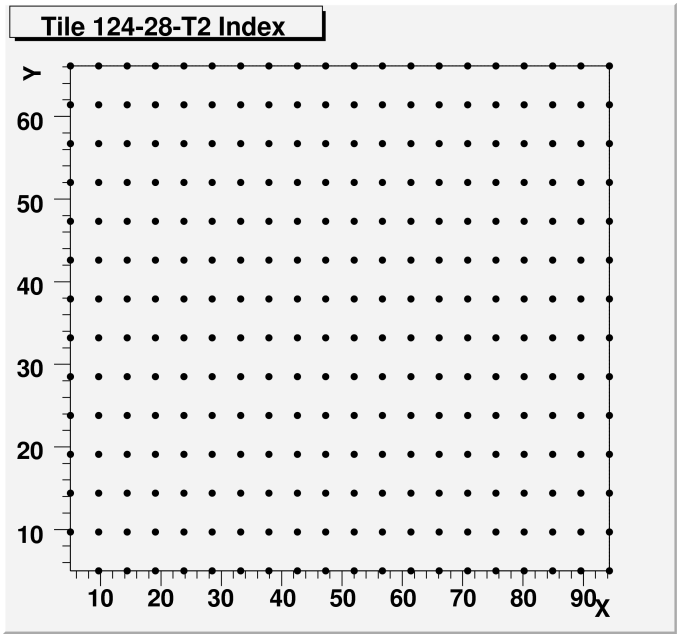

Tile 121-5-T2 Index

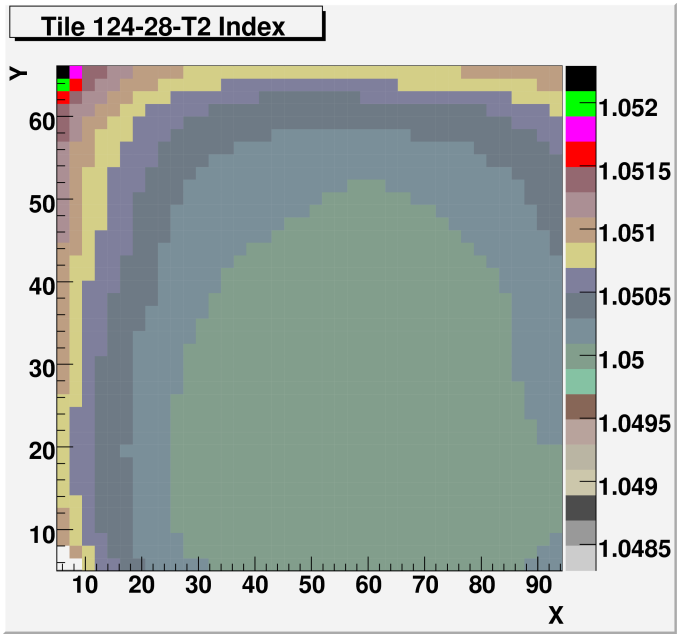
124-28-T2

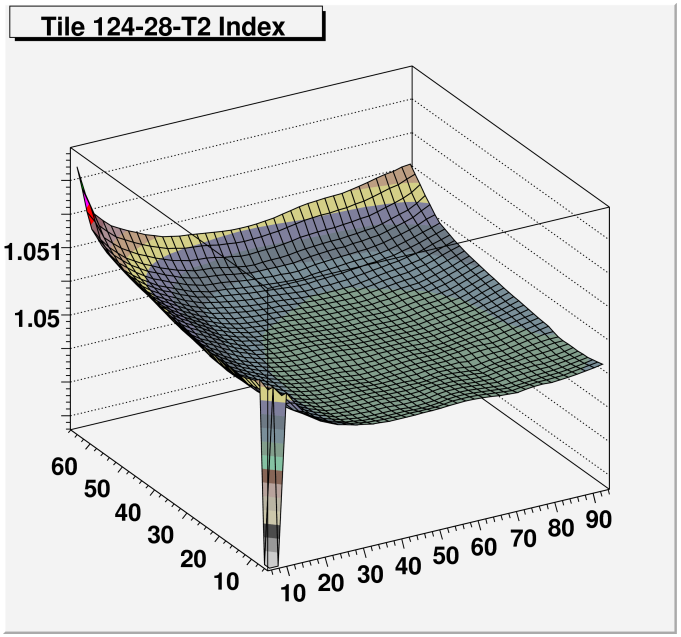

Tile 124-28-T2 Metrology
X


Tile 124-28-T2 Metrology
X
25.5
25.4
25.3
25.2
25.1
25
24.9
24.8
24.7
24.6


Tile 124-28-T2 Metrology
X


Tile 124-28-T2 Index
Y
X


Tile 124-28-T2 Index
Y
X
1.052
1.0515
1.051
1.0505
1.05
1.0495
1.049
1.0485


Tile 124-28-T2 Index

Thickness & Index Mapping

STRATEGY :

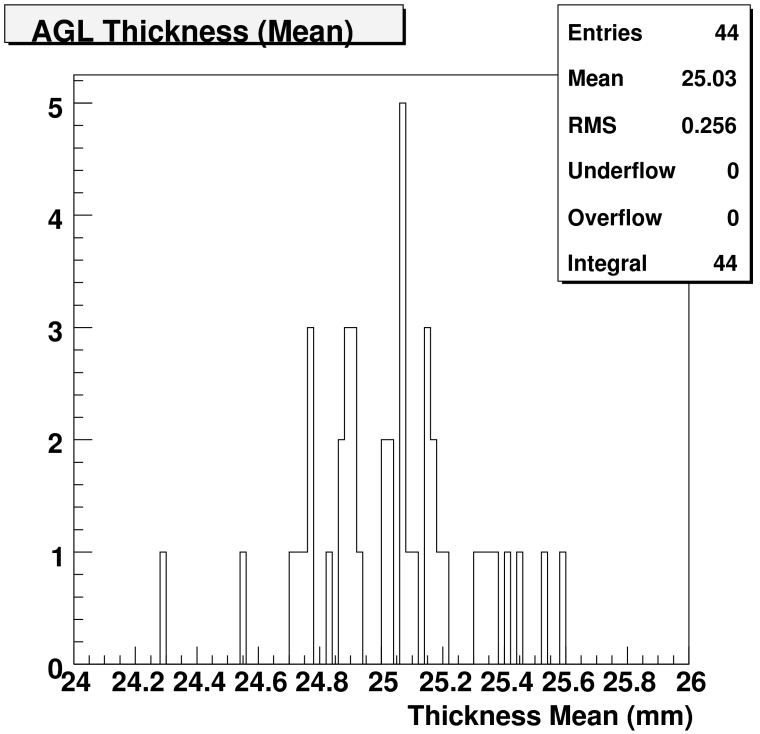
- Sample points uniform distributed in the tile surface
- Use ROOT embeded interpolation (based on Delaunay Triangles) to map the AGL thickness/index
- Compute relevant quatities on interpolated data (Mean/RMS/gradients/...)

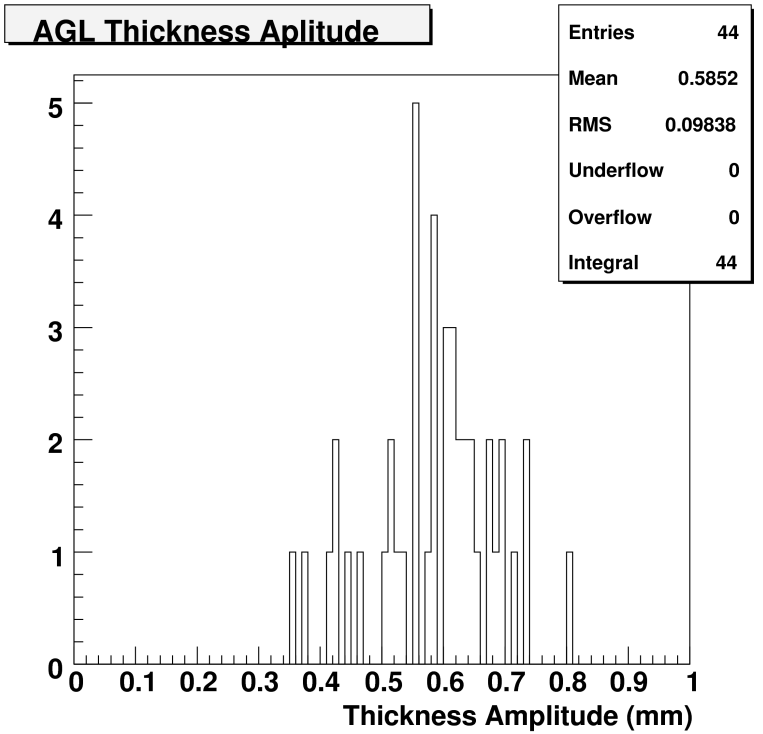
CAVEAT EMPTOR :

- Coarse pitch – 25(4.7) mm - can limit the validity of the interpolation
- No extrapolation assumed: Tile edges not properly mapped

Thickness Mapping

- The average mean-thickness of the AGL tiles is 25.0 mm with an RMS of 1% (for a total amplitude of ±3%)
- The average thickness-amplitude (ThickMax-ThickMin) is 0.6 mm with a maximum below 0.8 mm

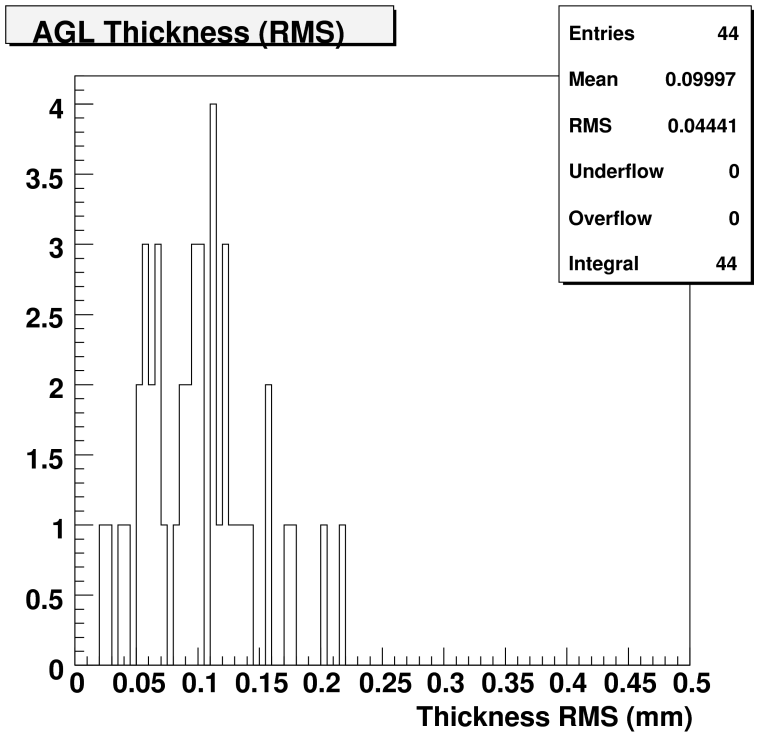


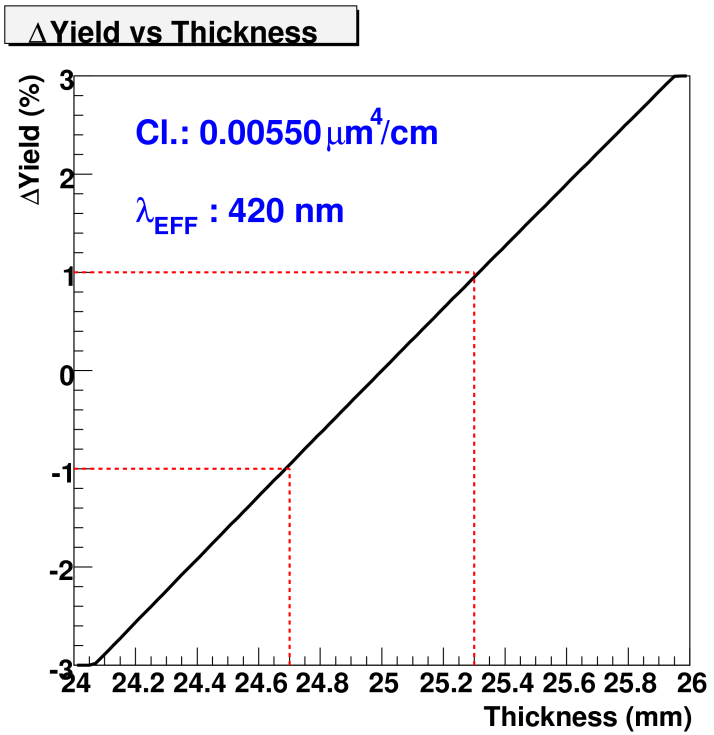


Thickness Mapping

- The average RMS-thickness of the AGL tiles is 0.1 mm with a maximum below 0.25 mm

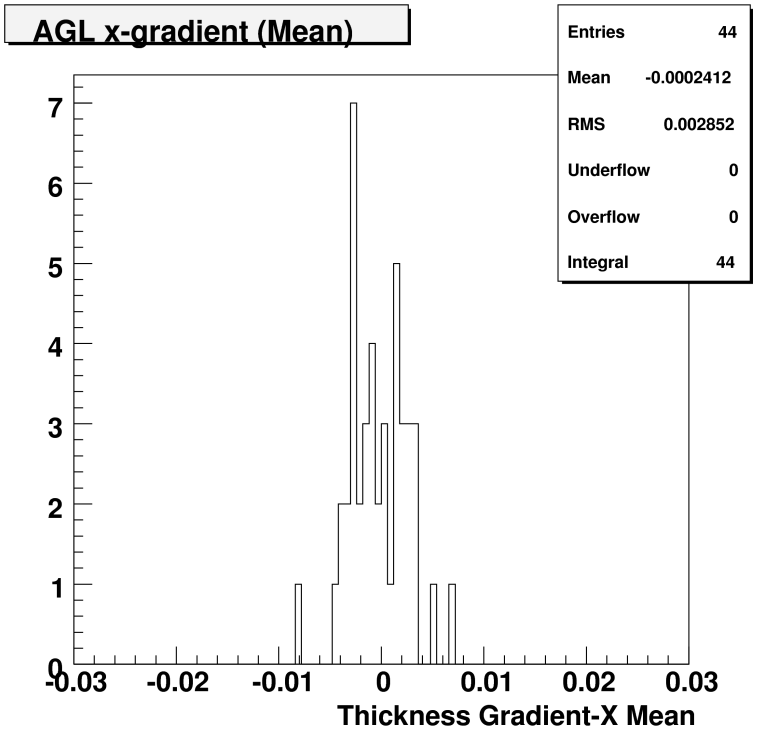
The photon yield under control (<1%) with a single parameter per tile

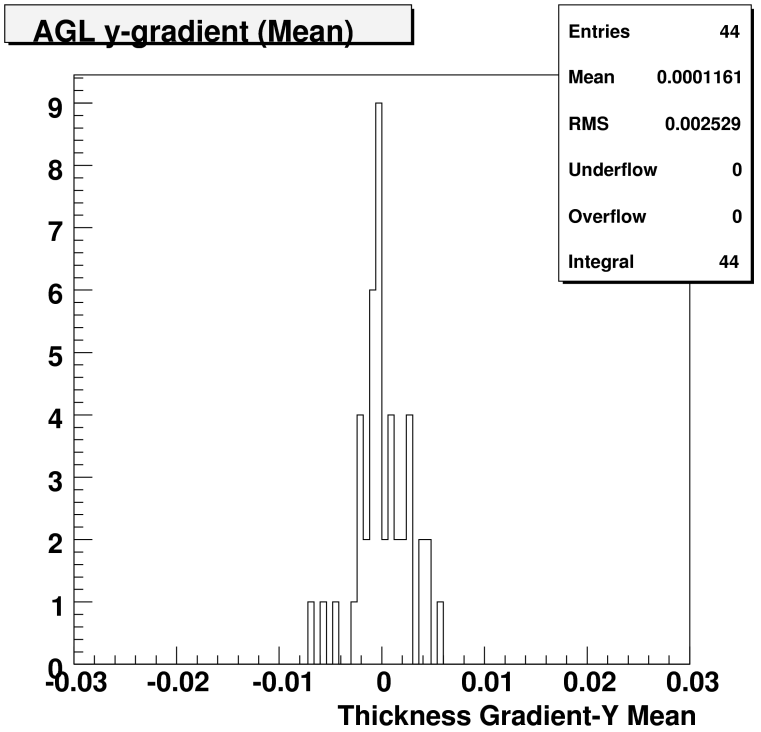




Thickness Mapping

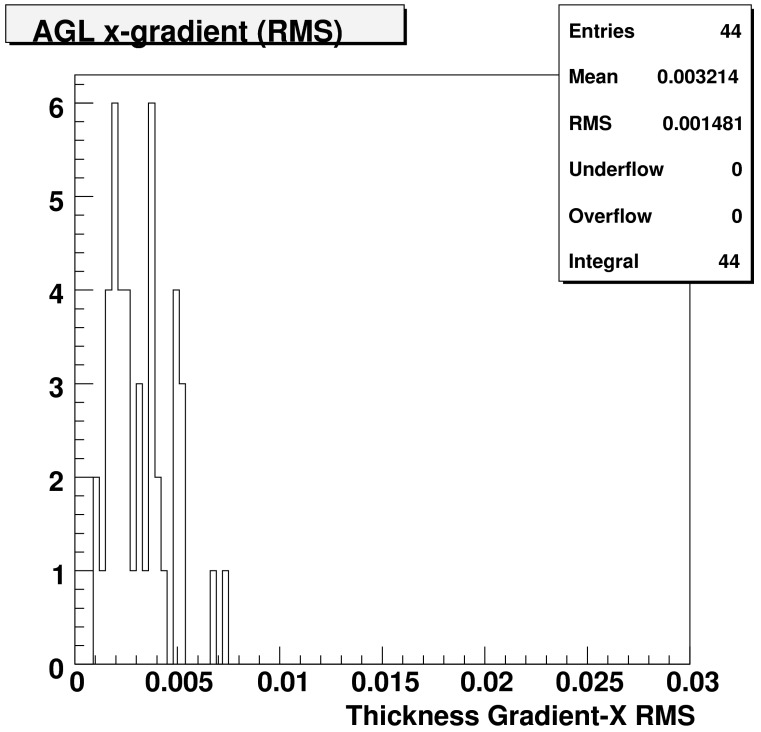
- The surface gradients (dz/dx, dz/dy) could affect the velocity reconstraction through an anomalous refraction at the radiator exit
- The mean gradients indicate an effective slope of the tile
- The effect on the reconstructed velocity small due to left/right compensations on the Cerenkov cone (to be checked with MC)

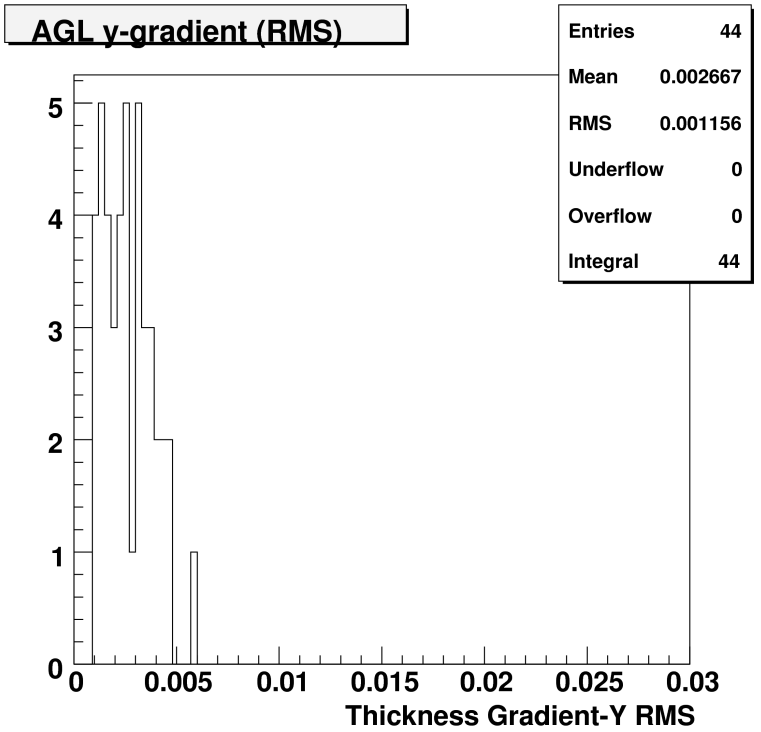




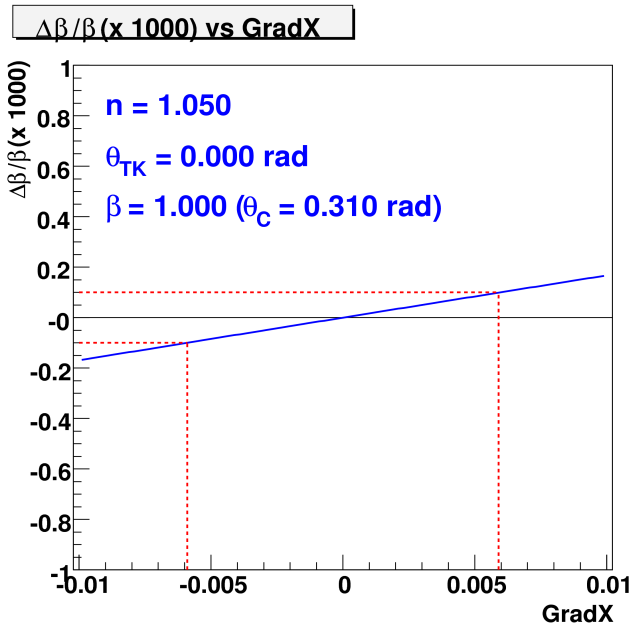
Thickness Mapping

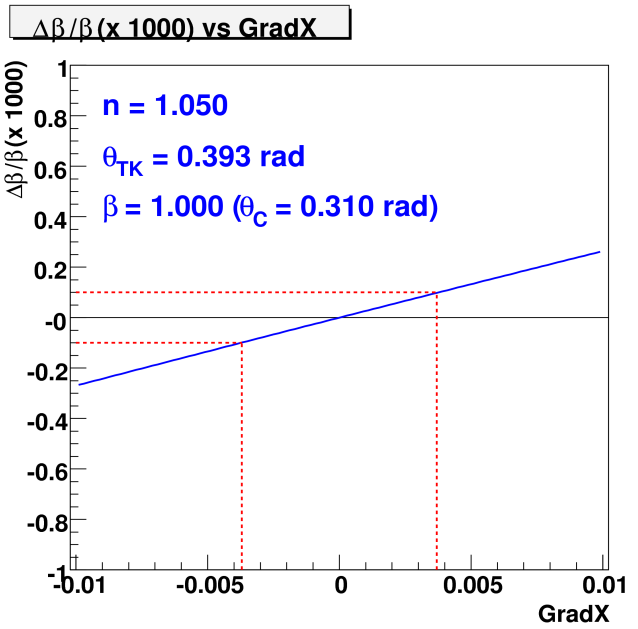
- The widths of the distributions of thickness gradients determine the size of an extra smearing of the β resolution ($\Delta\beta/\beta \sim (n-1)/n * \sigma$)
- The average RMS is 0.003 both for gradX and gradY
- We can study the maximum acceptable value for different configurations not to spoil the high-Z resolution (~0.1‰)

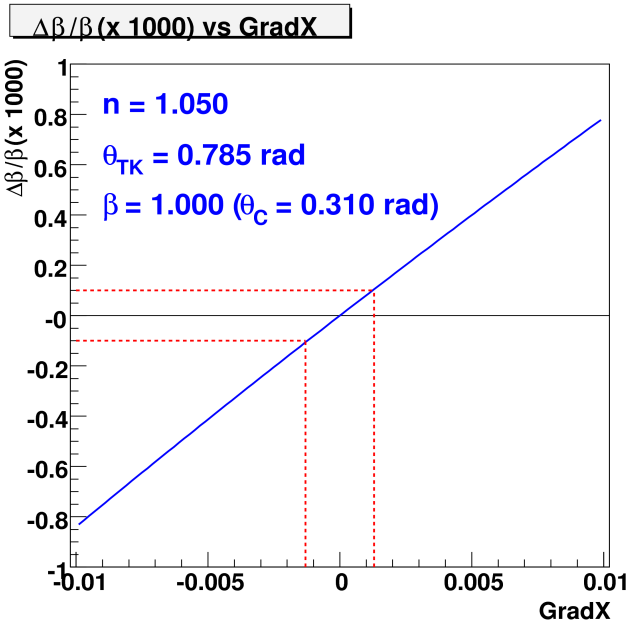


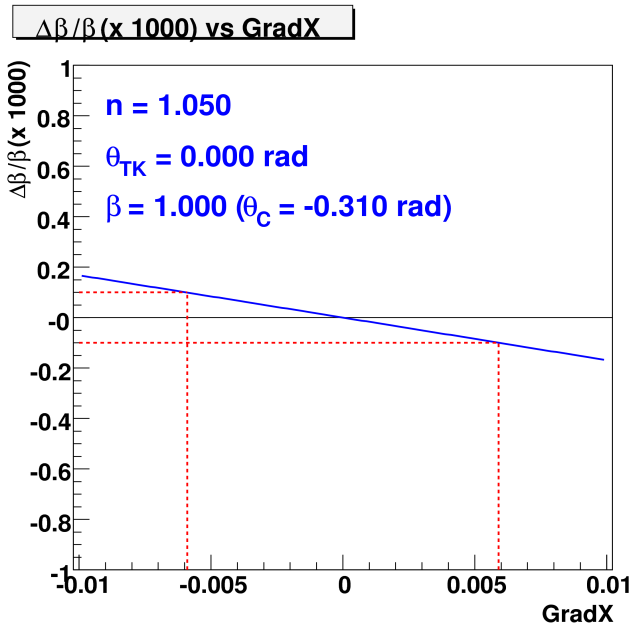


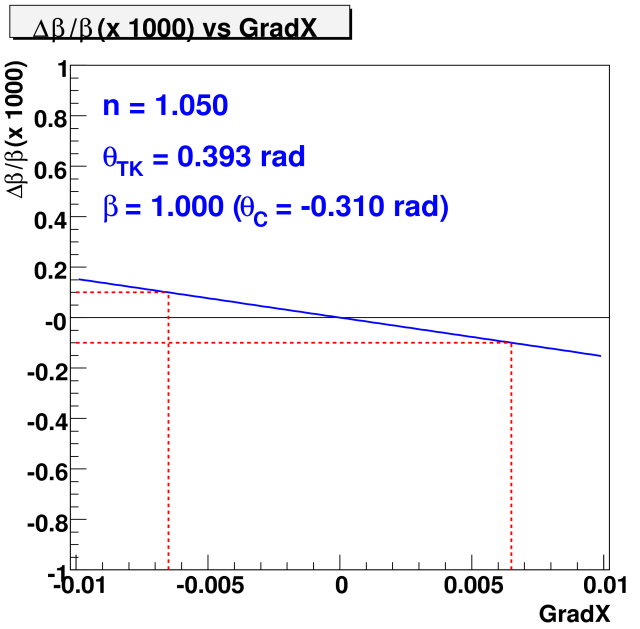
Δβ/β vs gradX

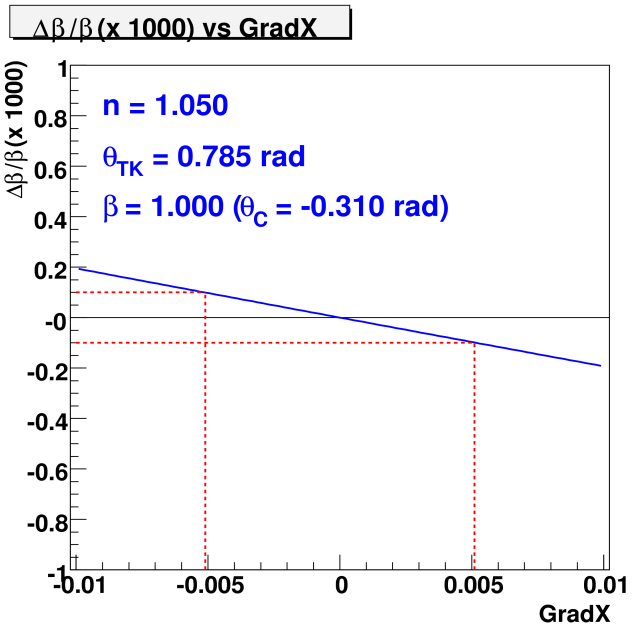

Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.000 rad
β = 1.000 (θC = 0.310 rad)
Δβ/β (x 1000)
GradX


Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.393 rad
β = 1.000 (θC = 0.310 rad)
Δβ/β (x 1000)
GradX


Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.785 rad
β = 1.000 (θC = 0.310 rad)
Δβ/β (x 1000)
GradX


Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.000 rad
β = 1.000 (θC = -0.310 rad)
Δβ/β (x 1000)
GradX


Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.393 rad
β = 1.000 (θC = -0.310 rad)
Δβ/β (x 1000)
GradX


Δβ/β (x 1000) vs GradX
n = 1.050
θTK = 0.785 rad
β = 1.000 (θC = -0.310 rad)
Δβ/β (x 1000)
GradX

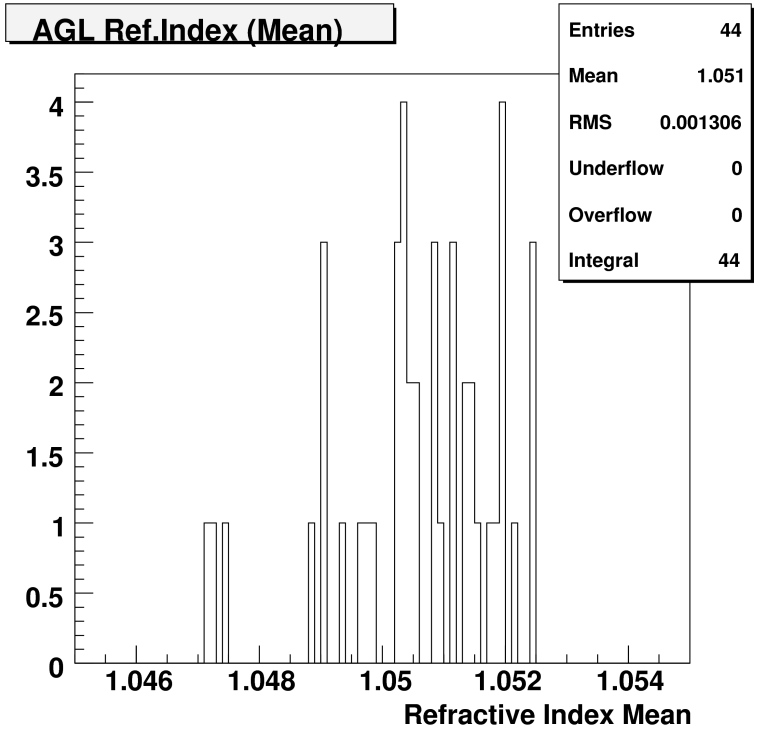
Thickness Mapping

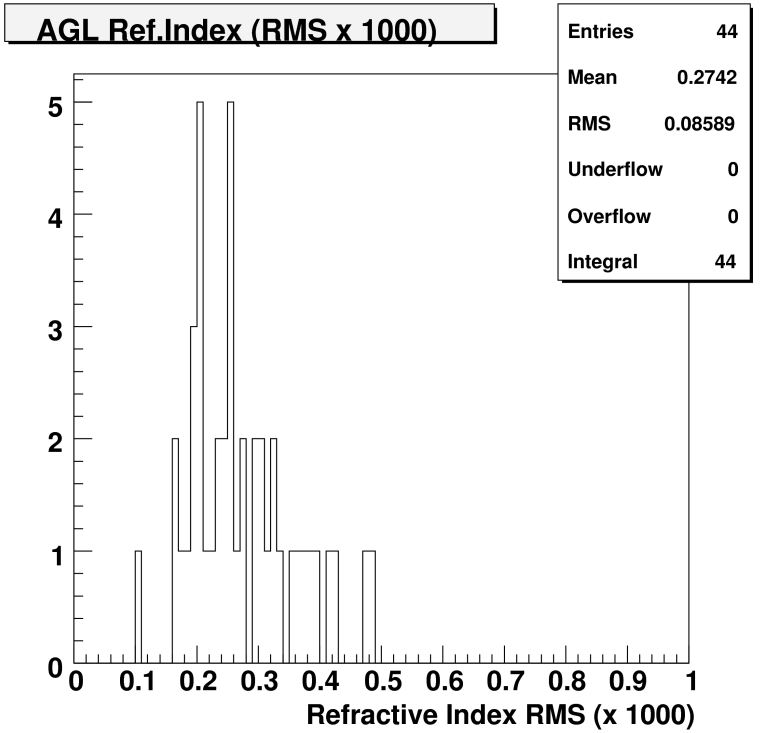
- Only extreme configurations (e.g. $\theta_{TK} = \pi/4$, $\beta=1$ & $\alpha=\theta_{TK} + \theta_C$) could compromise the high-Z resolution for the measured thickness gradients (mean RMS = 0.003)
- Though only negligible effects are expected, this should be confirmed with the simulation

Index Mapping

- The average mean-index of the AGL tiles is 1.051 with an RMS of 1.2‰ (for a total amplitude of ±3‰)
- The average index-RMS is 0.3‰

  The refractive index must be modeled to avoid the ‰ tile-to-tile variation and the intra-tile variations above the 0.1‰





Next Steps

- Use MC simulation with simple radiator geometry to confirm the open points:
  - Mean gradient (i.e. inclination) compensation
  - RMS gradient negligible
- Try simple modeling to avoid tile-to-tile and intra-tail refractive index variations
- DB/Sim/Rec updates
- Include recent measurements