Small Scintillator Tiles & Inter-tile Crosstalk Revisited

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CALICE meeting

Hamburg

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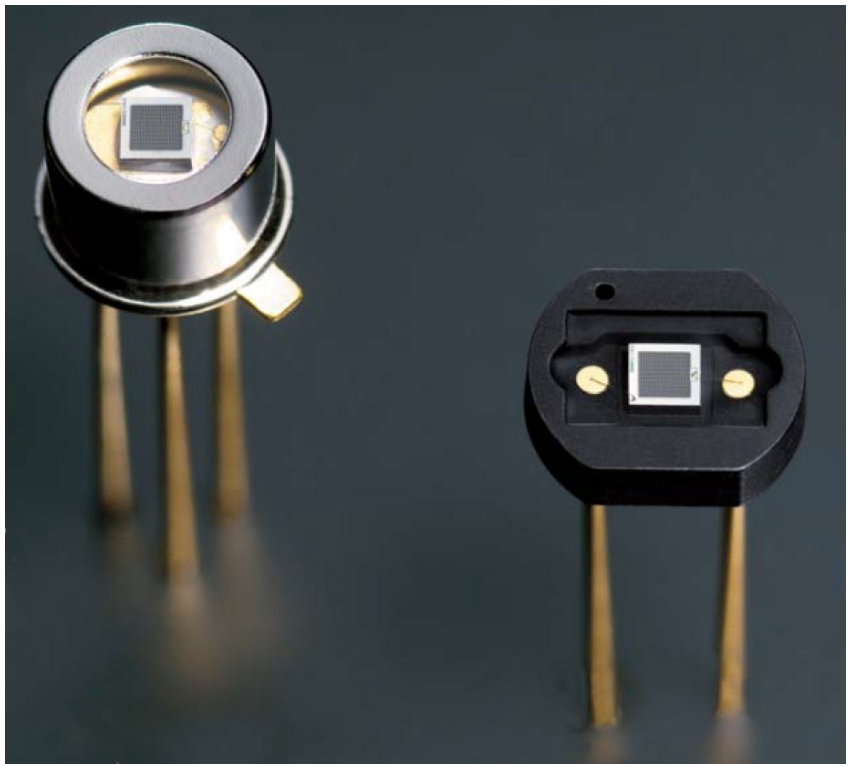
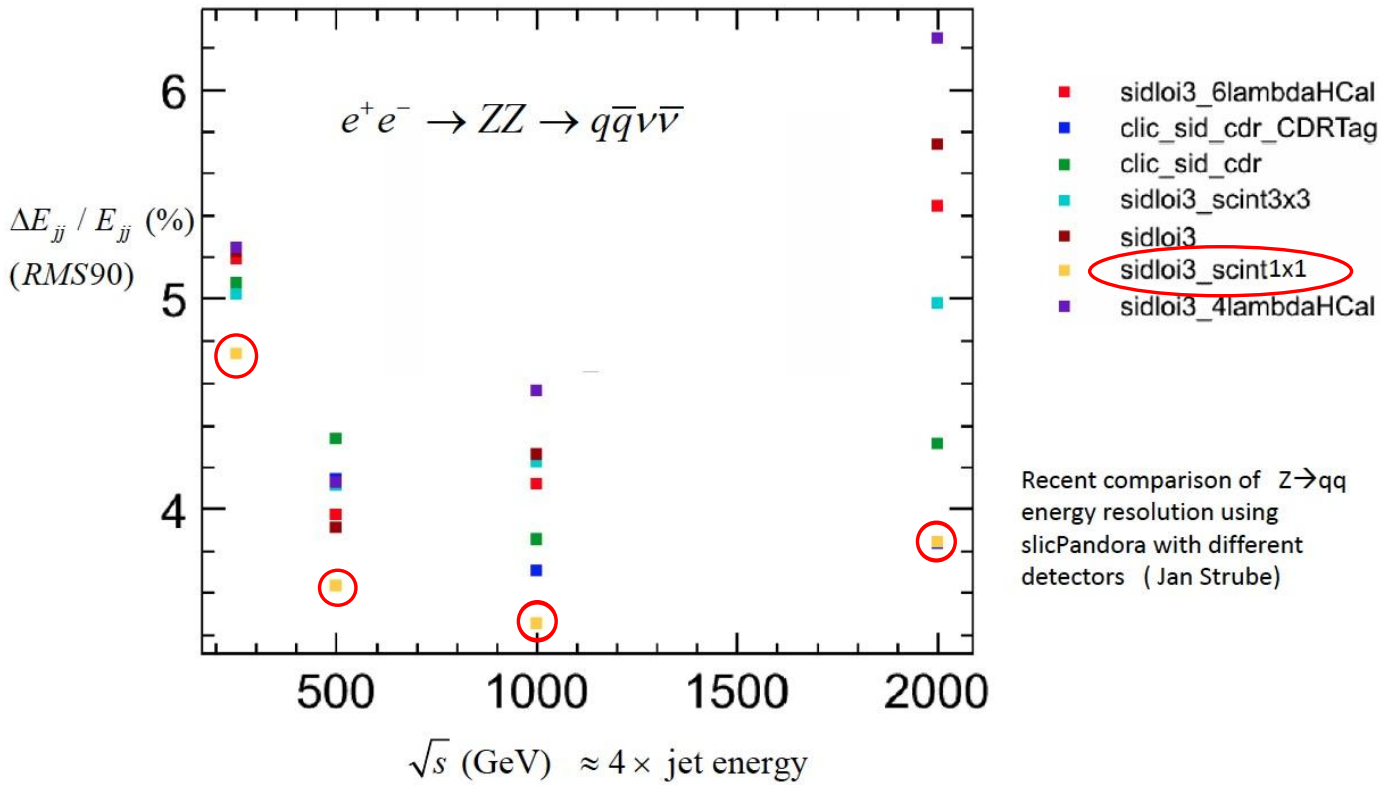
Outline:



Motivation:

- SiD HCAL simulation → smaller radius, higher B-field than ILD
- Results favour smaller tiles
- Test for application in HCAL and ECAL

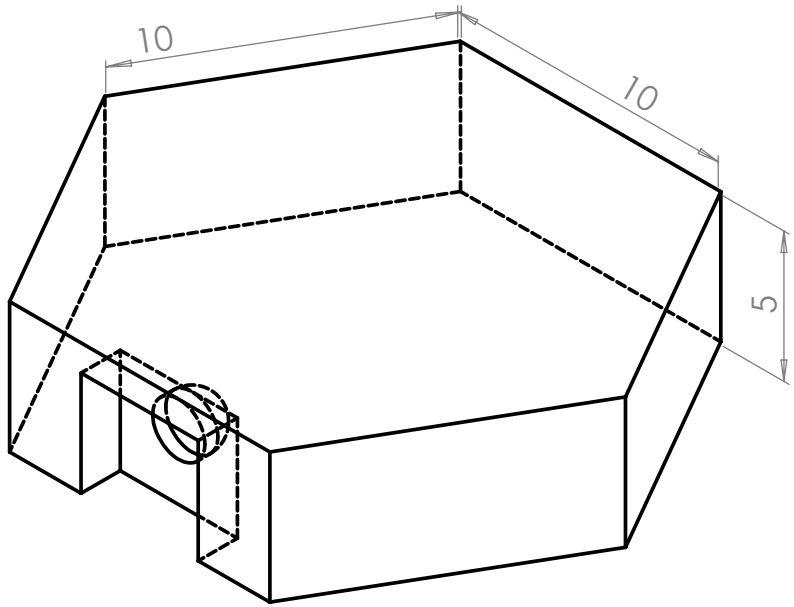


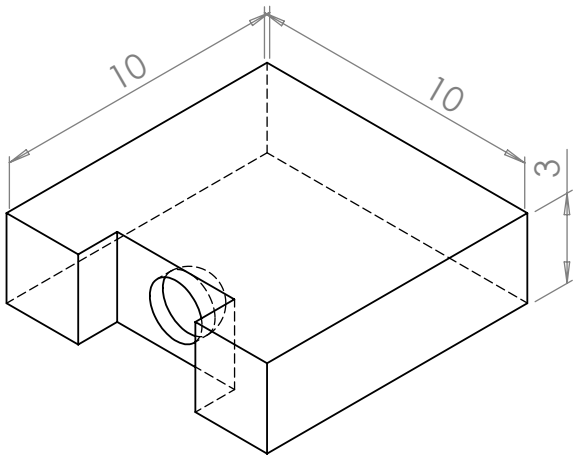
Recent comparison of Z→qq energy resolution using slicPandora with different detectors (Jan Strube)

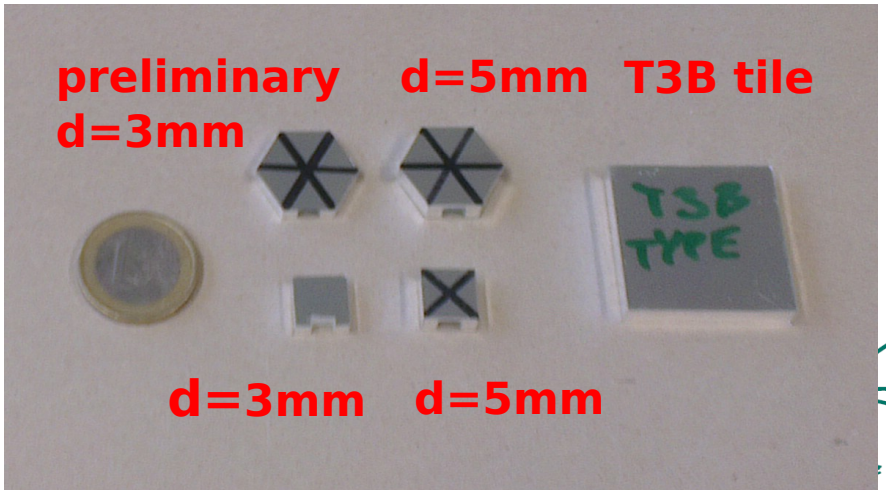
energy resolution for different detector types

New tile geometries:

- Small square and hexagonal tiles with simple dimple geometry
- 3mm and 5mm layer thickness each
- Covered in highly reflective foil

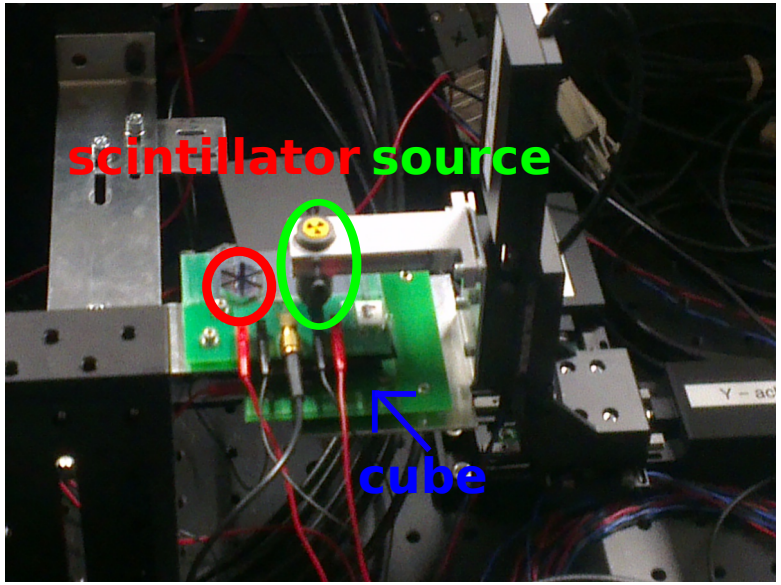


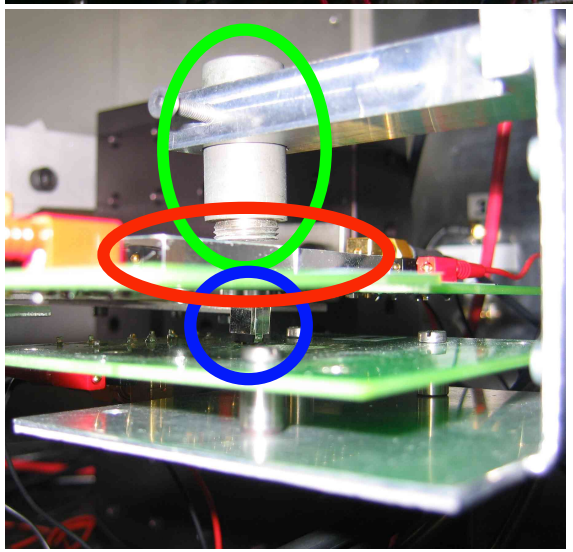




Test setup:

- ^{90}Sr source mounted on xy stage
- β-particle traverses through examined tile
- Second small scintilltor(cube) functions as a trigger
- Trigger: energy deposited exceeds threshold

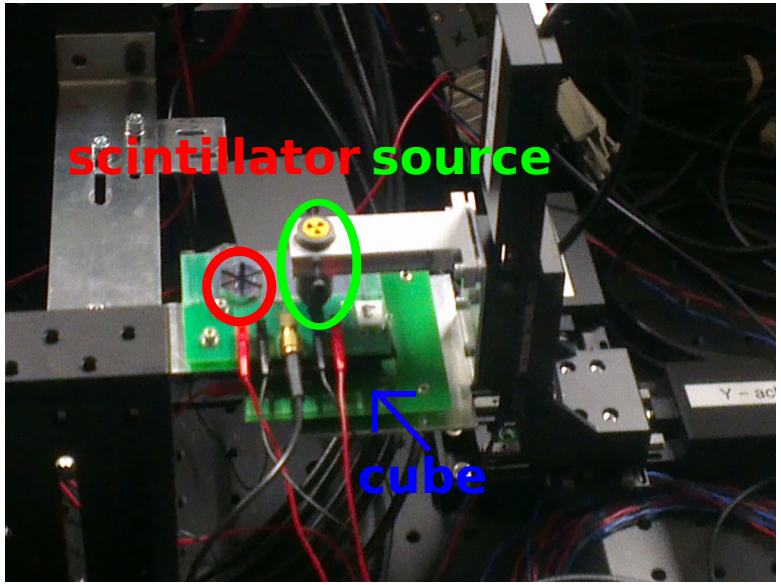


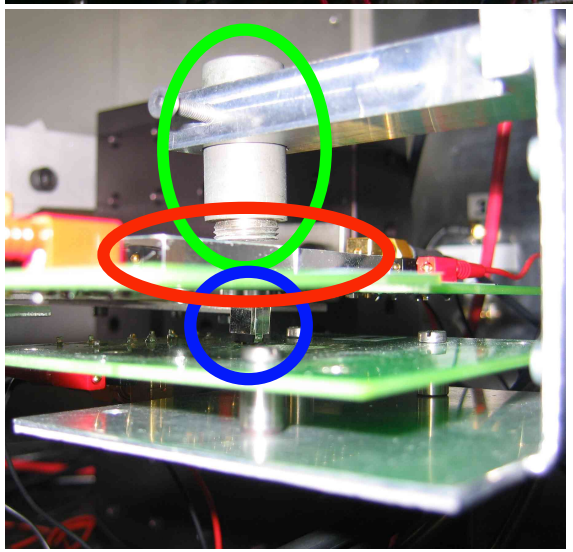


Test setup:

- ^{90}Sr source mounted on xy stage
- β-particle traverses through examined tile
- Second small scintilltor(cube) functions as a trigger
- Trigger: energy deposited exceeds threshold

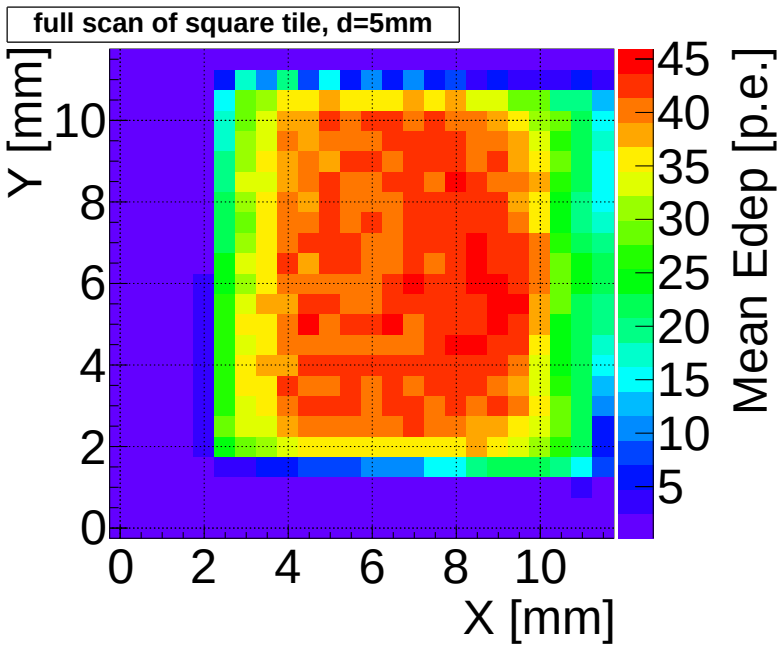
⇒ Waveform from the tile is recorded

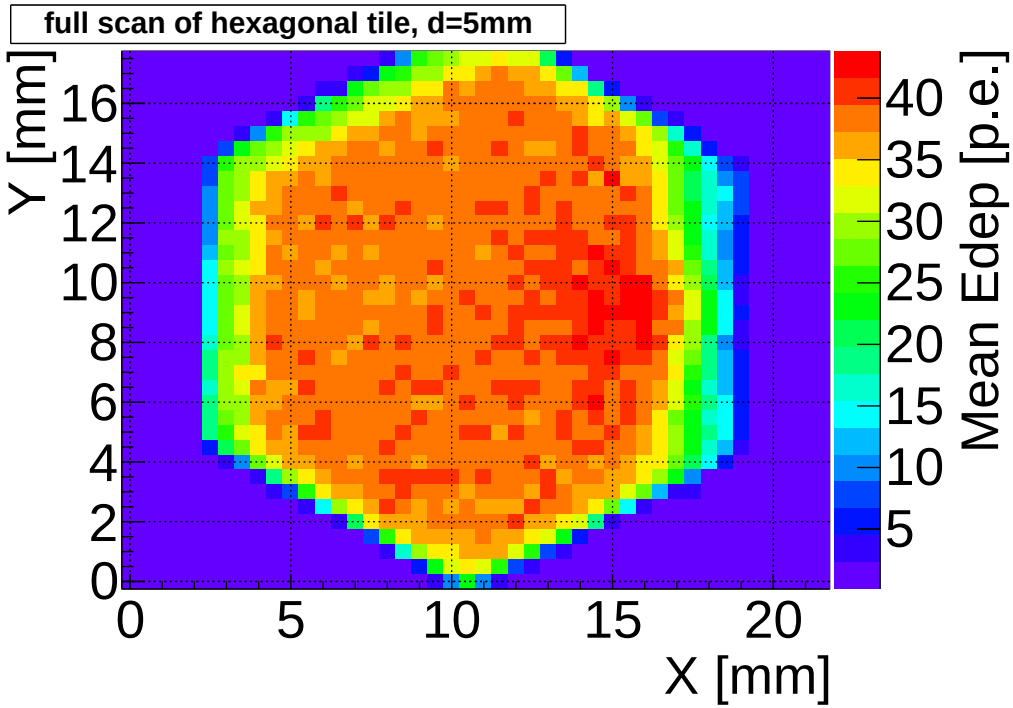




Results for 5mm thickness:

- For reference: 30x30x5mm^3 T3B tile, same MPPC ≈30 p.e
- Compared to bigger tiles slightly decreased uniformity

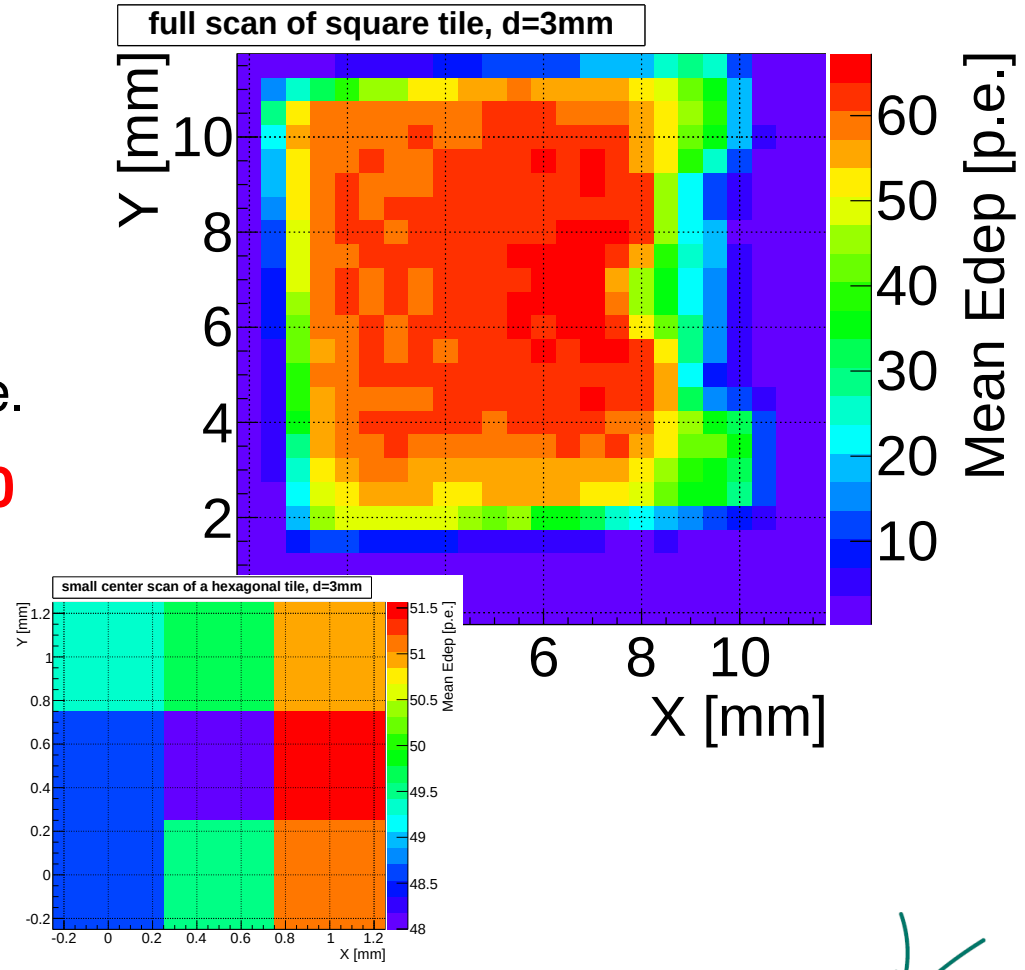




- Square tile 10x10x5mm^3 ≈40 p.e.
- Hexagonal(a=10mm,h=5mm) tile ≈40 p.e.
- ≈ 30% more light than T3B

Results for 3mm thickness:

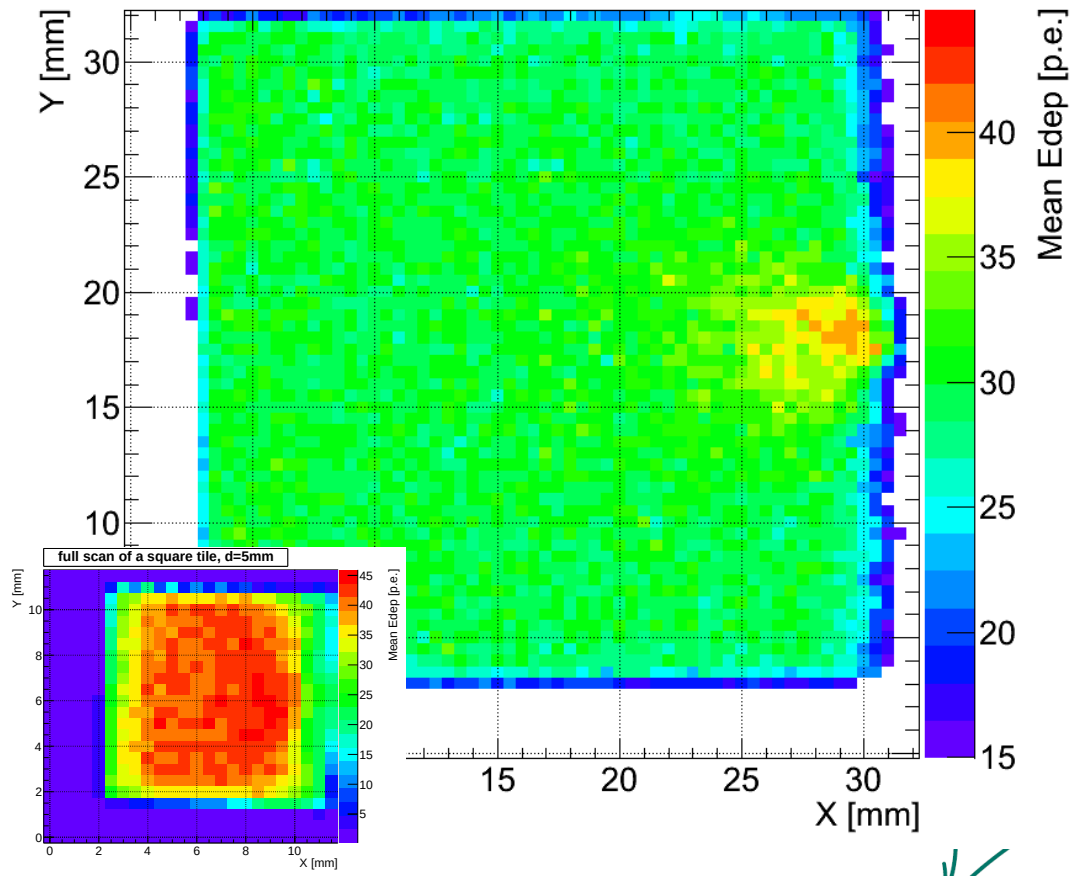
- Equal uniformity
- Preliminary hexagonal (a=10mm,h=3mm) tile ≈ 50 p.e.
- **Square 10x10x3mm^3 tile ≈ 60 p.e.!**



Conclusion:

- Uniformity not equal but acceptable
- Decreasing thickness for
  - Square tile: 40 p.e. → 60 p.e.
  - Hexagonal 40 p.e. → 50 p.e.
- **Light collecion efficiency strongly depends on aspect ratio**

30x30x5mm^3 T3B tile for size comparison:

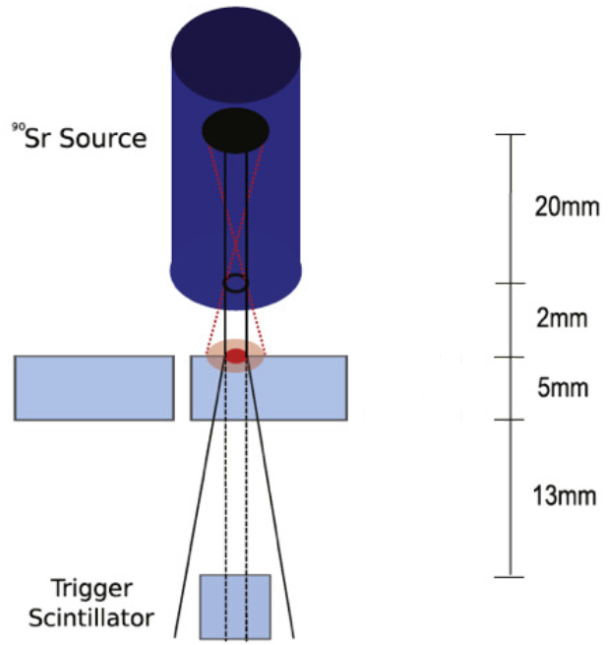


Motivation:

- In the real HCAL there will be a lot of tiles
  $\rightarrow$ how big are the dead zones in between?
- Percentage of reflection $< 100\%$
  $\rightarrow$ is crosstalk a problem?

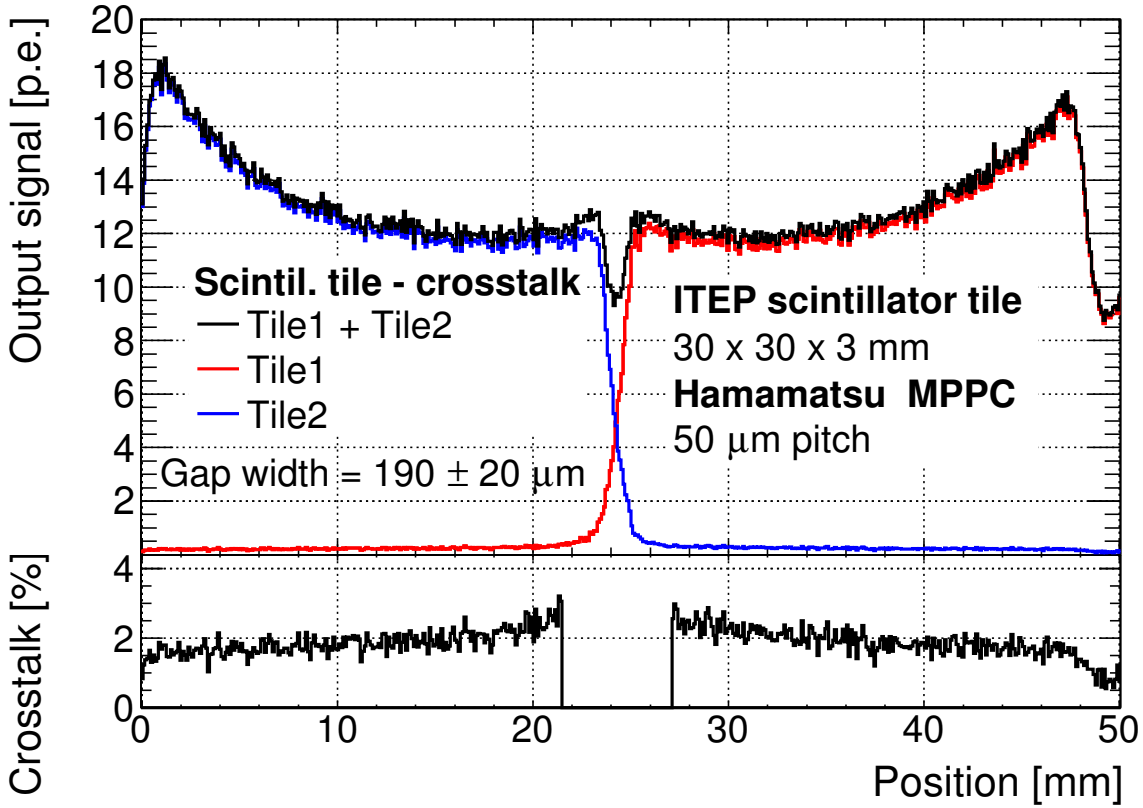
Test setup:

- Almost same setup as before
- Two tiles next to each other
- Xy-scan over both
- Russian ITEP tile with paint
- T3B tile with foil



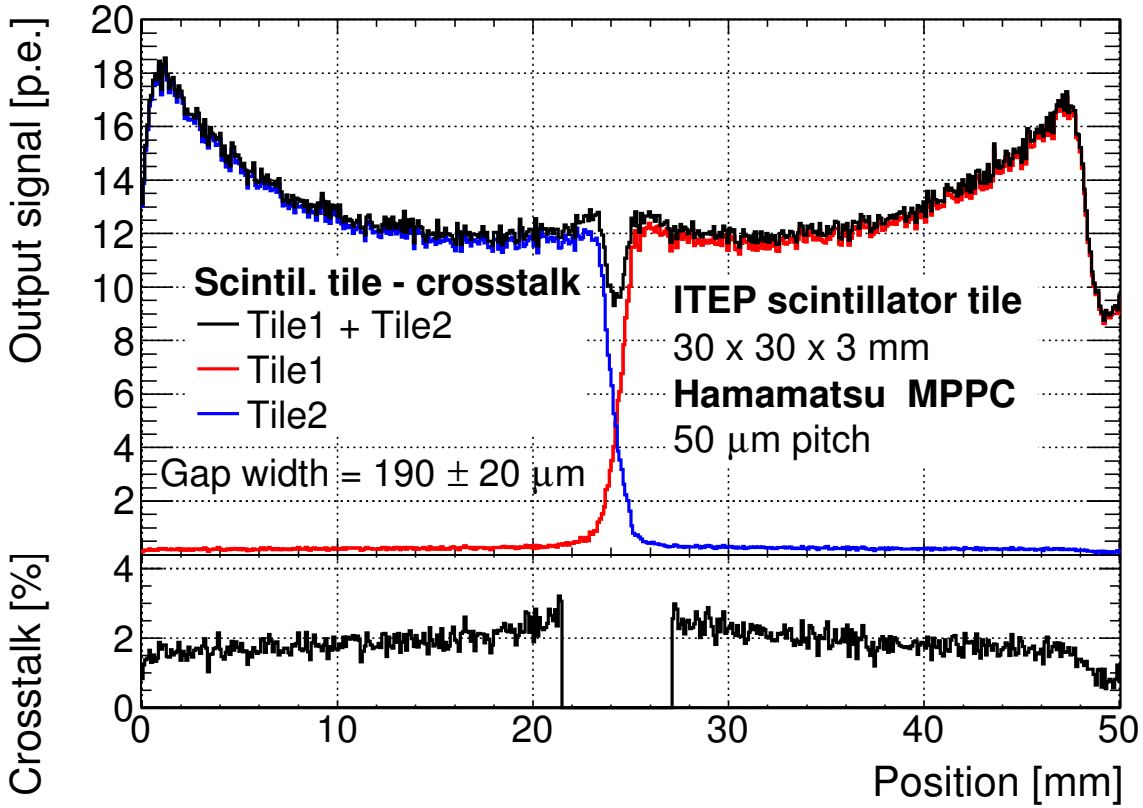
Results:

- Gap sizes in the order of magnitude of 100μm per tile
- Crosstalk
  - T3B tile $\approx$ 0.5%
  - ITEP tile $\approx$ 2%
- Both cases well beneath the threshold



Conclusions:

- Gap size
  → present but acceptable
- Crosstalk
  → **no problem!**



Questions?

Backup

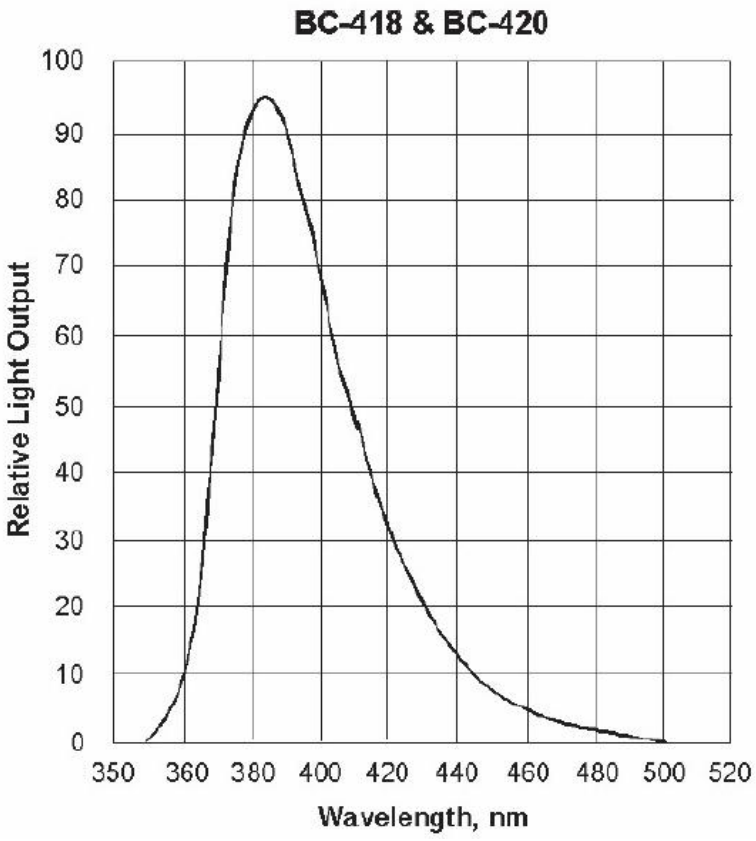


Abbildung: light output over wavelength for used scintilltors

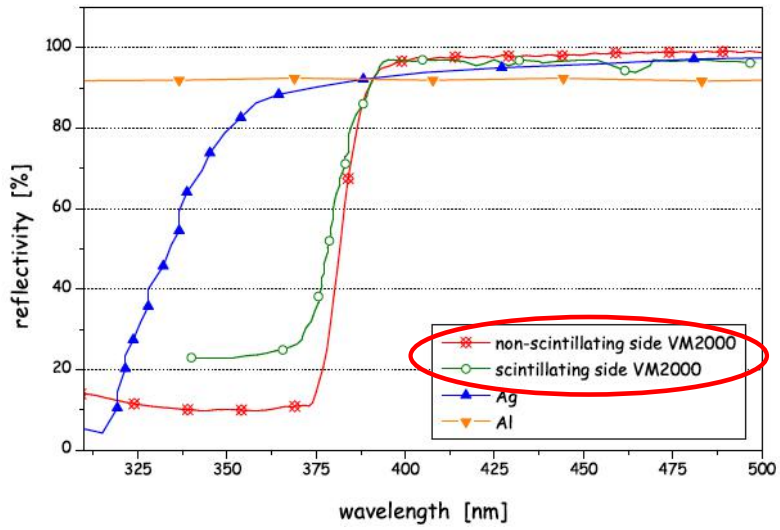
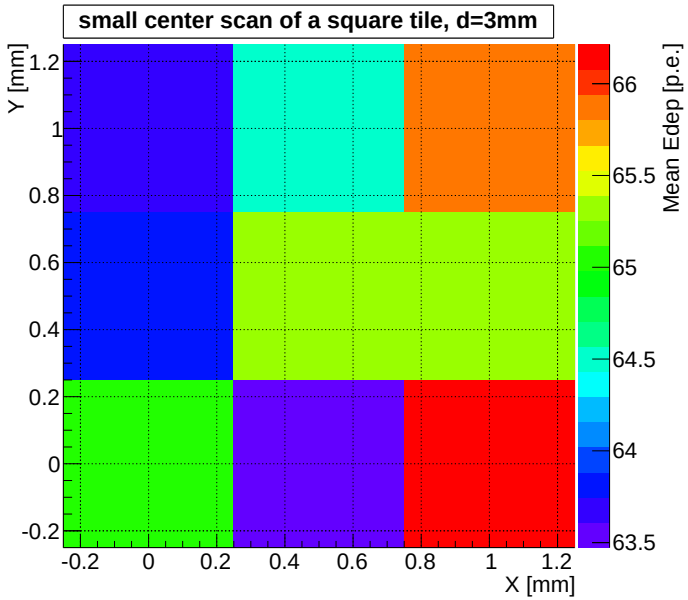
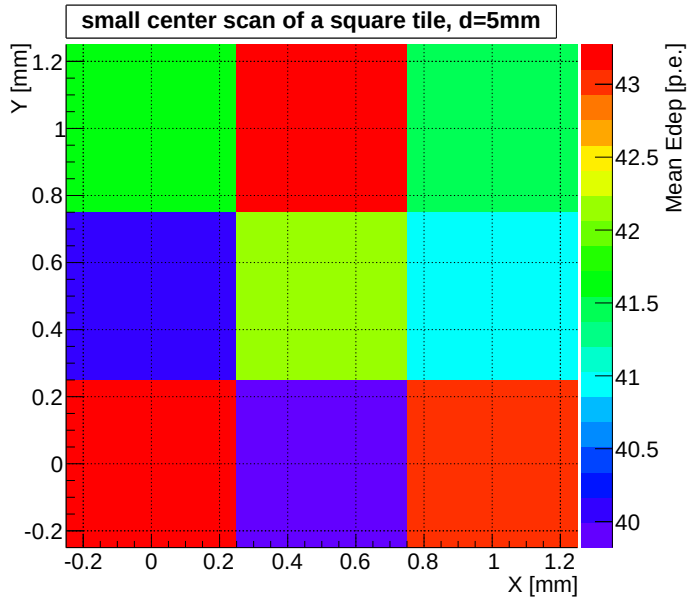
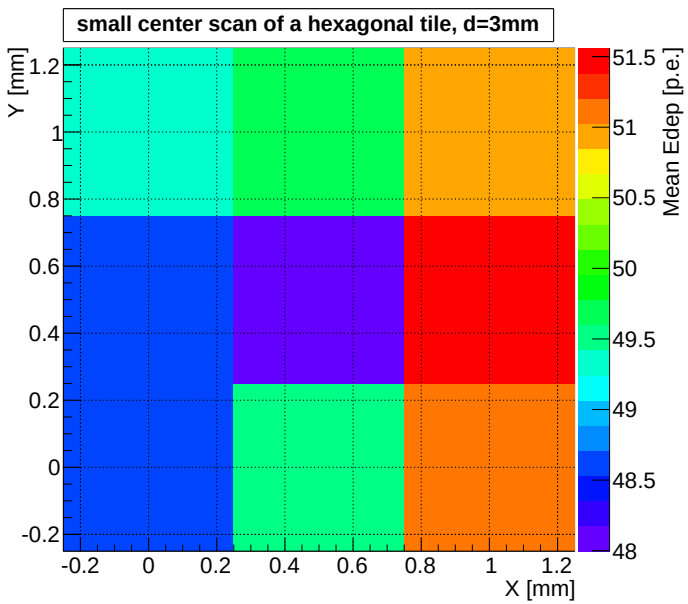
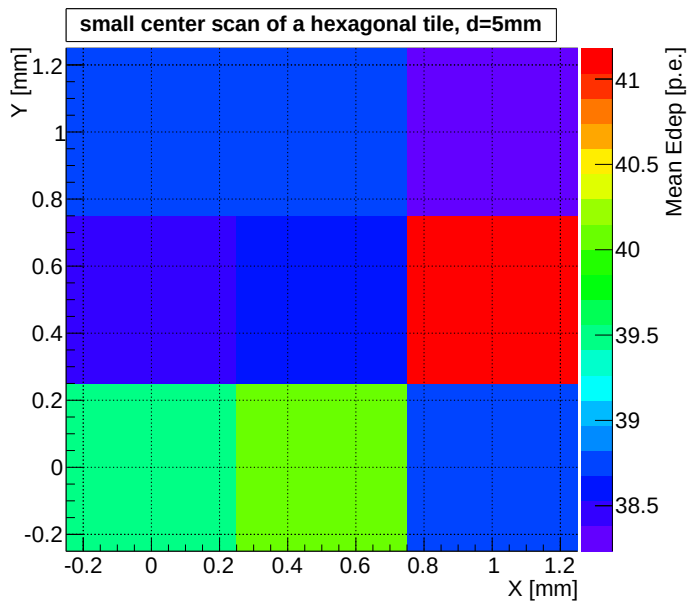


Abbildung: reflectivity over wavelength for used foil


small center scan of a square tile, d=3mm
Y [mm]
X [mm]
Mean Edep [p.e.]


small center scan of a square tile, d=5mm
Y [mm]
X [mm]
Mean Edep [p.e.]


small center scan of a hexagonal tile, d=3mm
Y [mm]
X [mm]
Mean Edep [p.e.]


small center scan of a hexagonal tile, d=5mm
Y [mm]
X [mm]
Mean Edep [p.e.]

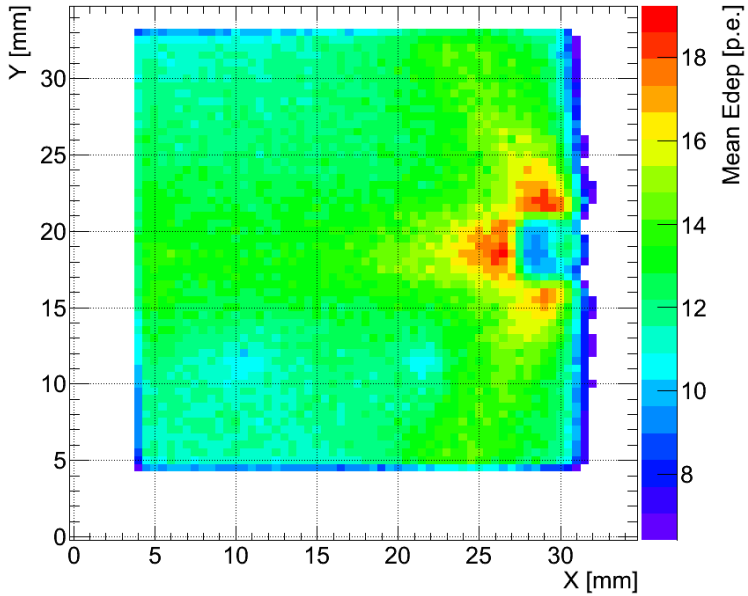


Abbildung: russian ITEP tile with thickness of 3mm and ≈15 p.e.

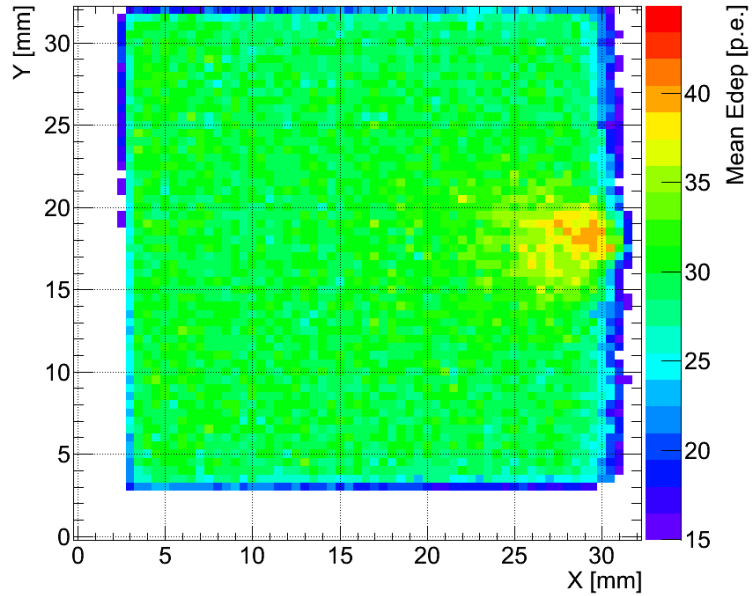


Abbildung: T3B tile with thickness of 5mm and ≈30 p.e.