

# Tile and SiPM studies at Hamburg University

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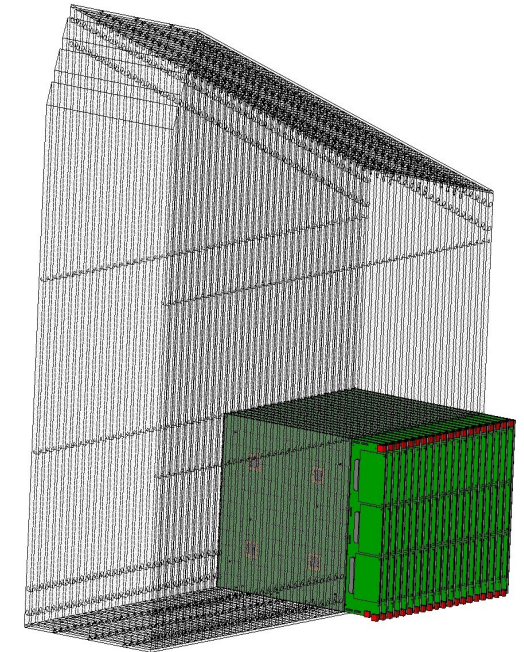
AHCAL Main Meeting – DESY, 11/12/2012

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- One layer of AHCAL engineering prototype in test beam in November 2012
- Commissioning of additional layers during 2013 – 2014:
  - 8 HBUs from DESY at Hamburg University
  - equipped with Uni Hamburg tiles

## UniHH tile design:

- Plastic scintillator tile
  - cut from 3 mm thick sheet and machined
  - SiPM dimple with MPI Munich design
- SMD Ketek SiPM
- Reflector foil 80  $\mu\text{m}$  thick wrapping
- Tile glued to the PCB



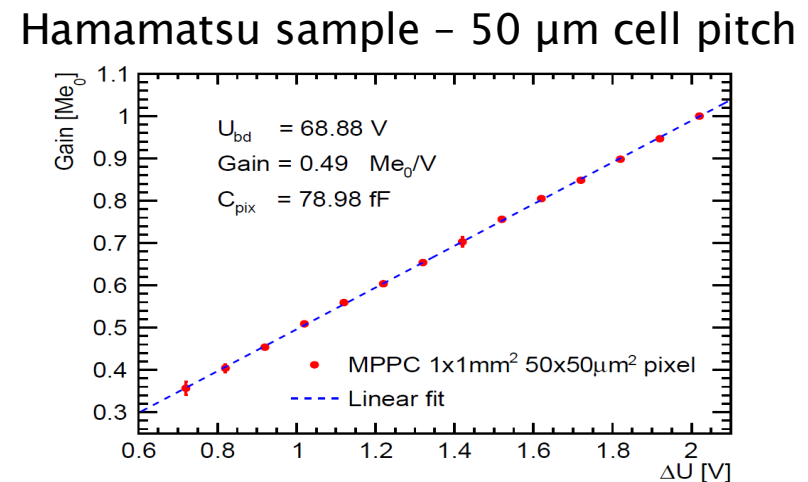
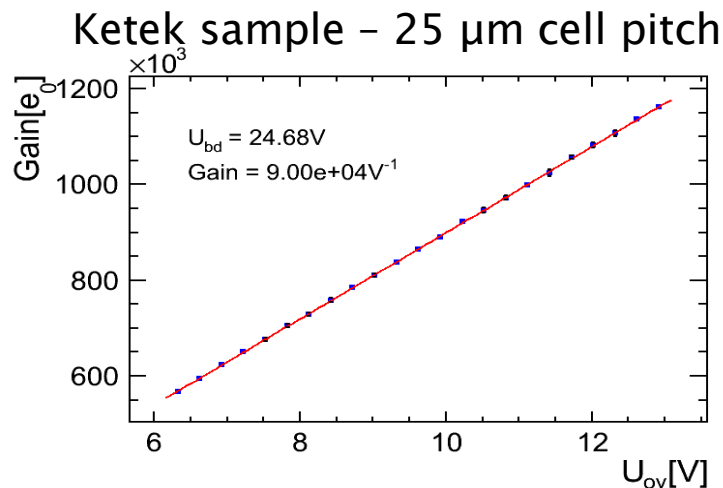
## Possible improvements:

- Tile homogeneity
- Tile uniformity
- SiPM+ tile performances (Light yield, tile light cross-talk, SiPM noise)

# SiPM choice

Producer	Active Area [mm <sup>2</sup> ]	Cell Pitch [μm]	N of pixels	Fill Factor [%]	PDE [%]	Peak sensitivity Wavelength [nm]	dV <sub>BD</sub> /dt [mV/deg]
Ketek	1.2 x 1.2	25	2300	48	> 30	420	23 (?)
Hamamatsu	1 x 1	25	1600	30.8	25	440	56

- Ketek SiPM with SMD mounting
- Performances similar to Hamamatsu MPPC S10362-11-25P
- Ketek show a less strong temperature dependence and overvoltage dependence
- Cross check through established characterization procedure

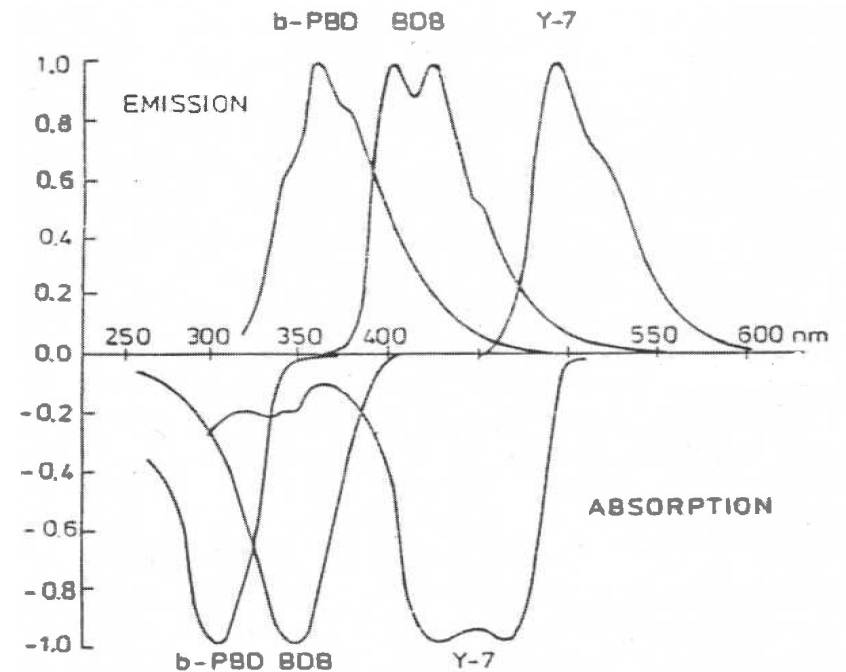


Ketek smoother dependence from overvoltage allows a more fine operational voltage optimization

# Tile – the scintillator

The plastic scintillator (BDB):

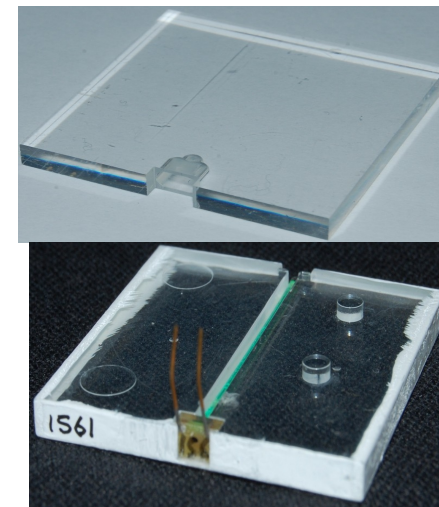
- Peak emission: **400 – 450 nm**
- Peak absorption: **350 nm**



tiles will be cut and machined  
not directly molded

Grant an **accuracy in the dimensions** of  $\sim 20 \mu\text{m}$   
Molded tile accuracy  $\sim 100 \mu\text{m}$

No alignment pins foreseen



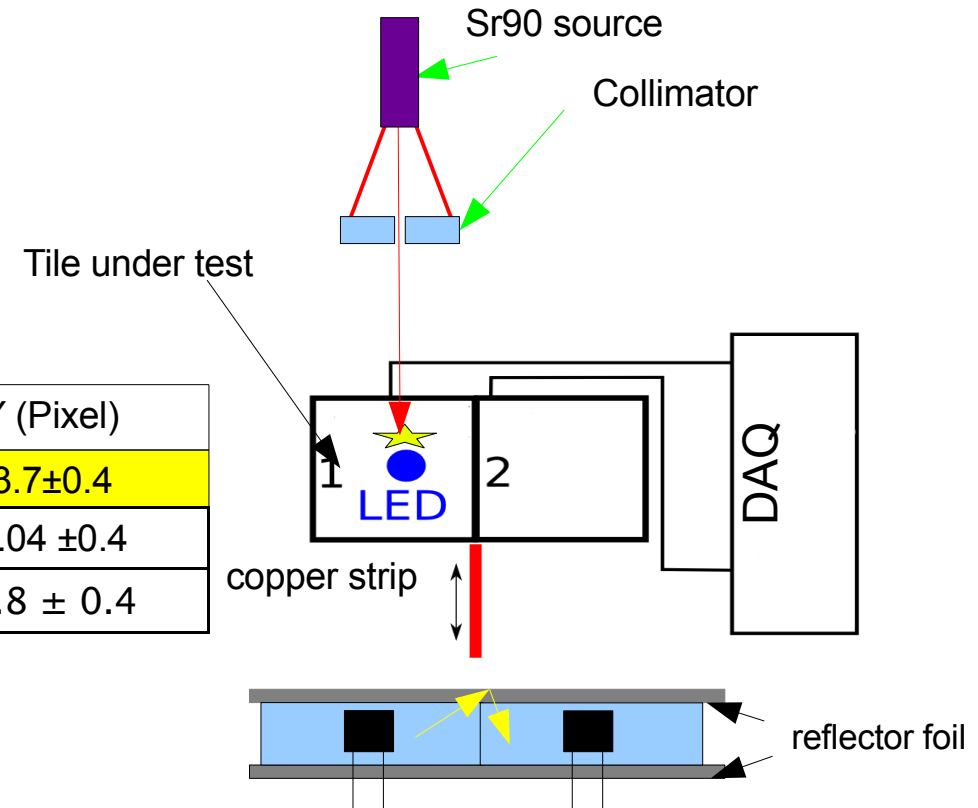
# Tile – the coating

The tile coating:

- Improve light yield
- Get rid of tile light-cross talk

## Very preliminary Light Yield results

SiPM	tile	borders	surface	LY (Pixel)
Ketek	BC-400	3M	3M	33.7±0.4
CPTA	ITEP	Acid polish	3M	15.04 ±0.4
Hamamatsu	BC-400	3M	3M	28.8 ± 0.4



## reflector foil wrapping

Proved to be best result out of several attempts (consistent with SciECAL results)

Two products under study:

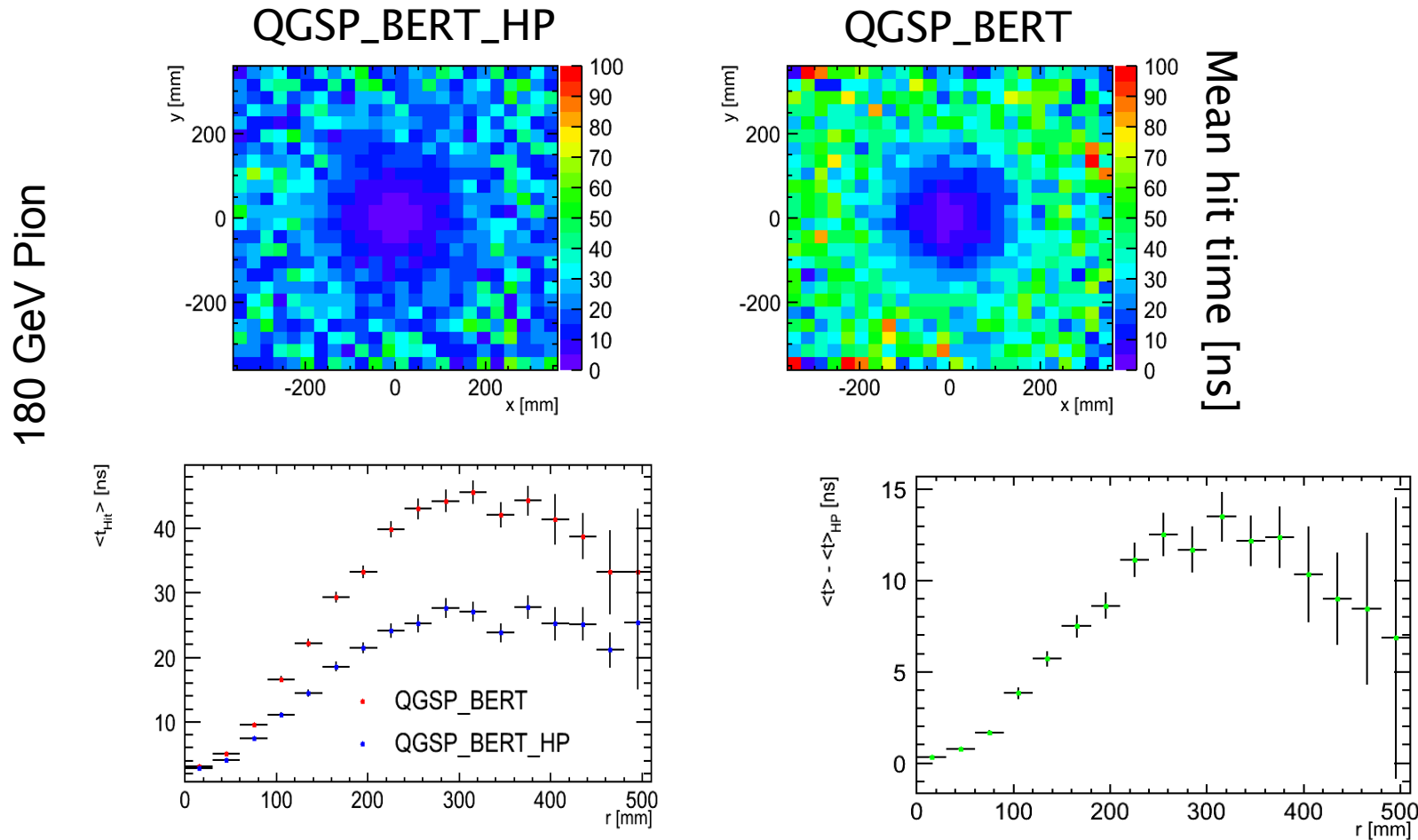
- Vikuiti ESR reflectance > 98%
- Kimoto film reflectance ~ 95%

} Performances to be verified with Light Yield setup

# Monte Carlo simulations

Preparatory simulations for the test beam:

- One layer of calorimeter prototype behind  $4\lambda$  of tungsten absorber
- Iron tail catcher 3 cm behind the layer



Outputs to be compared with test beam results: waiting for data analysis!

## GEANT4 results comparison with data:

- GEANT4.9.6 released in these days
- New total cross-sections for proton, neutron and pion had been introduced
- Comparison between new release and previous and with data needed!
  - Comparison between G4.9.6 and previous versions predictions
  - Comparison with data
  - Digitization implementation (including time digitization)

## Final goal: introduce time in PANDORA PFLOW

- Can the algorithm be improved?
  - Introducing time-stamping can improve shower separation?
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- Hardware:
- New tile design finalization
  - Ketek SiPM full characterization
  - Reflector foil tests
  - Tile+SiPM performances (Light Yield, linearity range, cross-talk)
- Software:
- November test-beam data/Monte Carlo comparison
- Evaluation of new GEANT4.9.6 release performances
- Studies of the implementation of time component in PANDORA



# Backup Slides

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