Preliminary studies on PSD components

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Simulation of light propagation inside the scintillator tiles

- Optimization of SiPM number and position
- Comparison between different types (size and number of cells)

Test on tile prototypes

- Scintillator tiles preparation
- SiPM board design
- DAQ chain setup

Simulation of light propagation

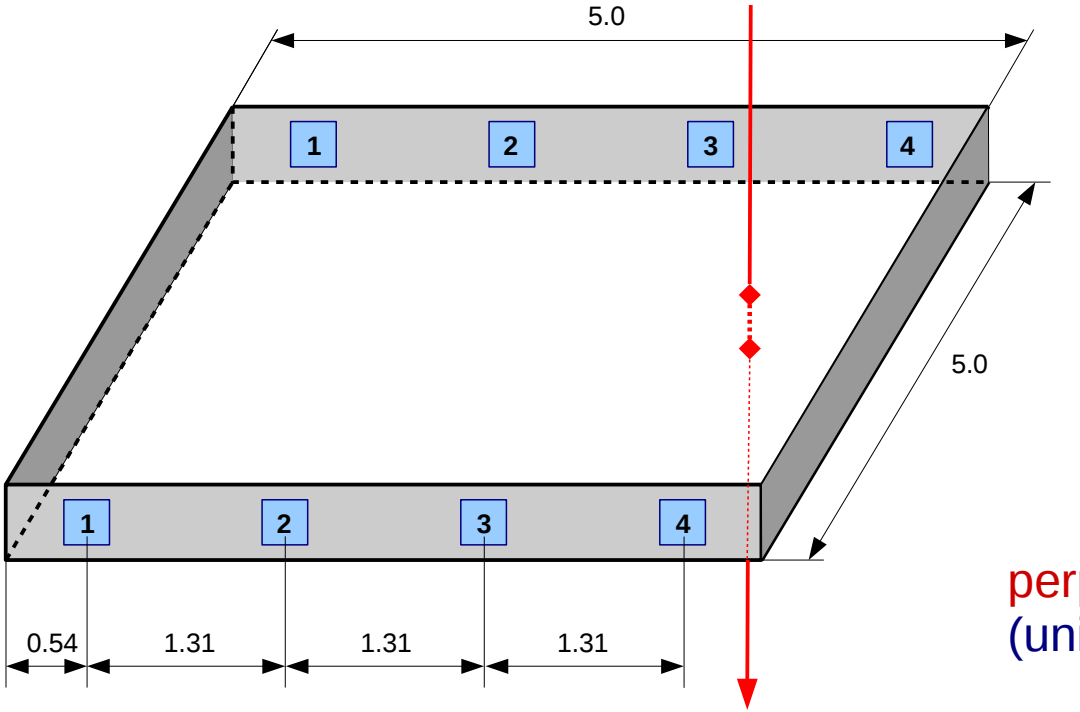
The light propagation inside the scintillator (reflection and attenuation) has been simulated using the *historical* GUIDE7 program (CERN, 1976)

The photons are generated along the track of a single *m.i.p.* crossing the tile perpendicularly

The number of photons collected by a single SiPM strongly depends on the track (and SiPM) position

The average over a conveniently large number of tracks, randomly distributed on the tile surface, is considered

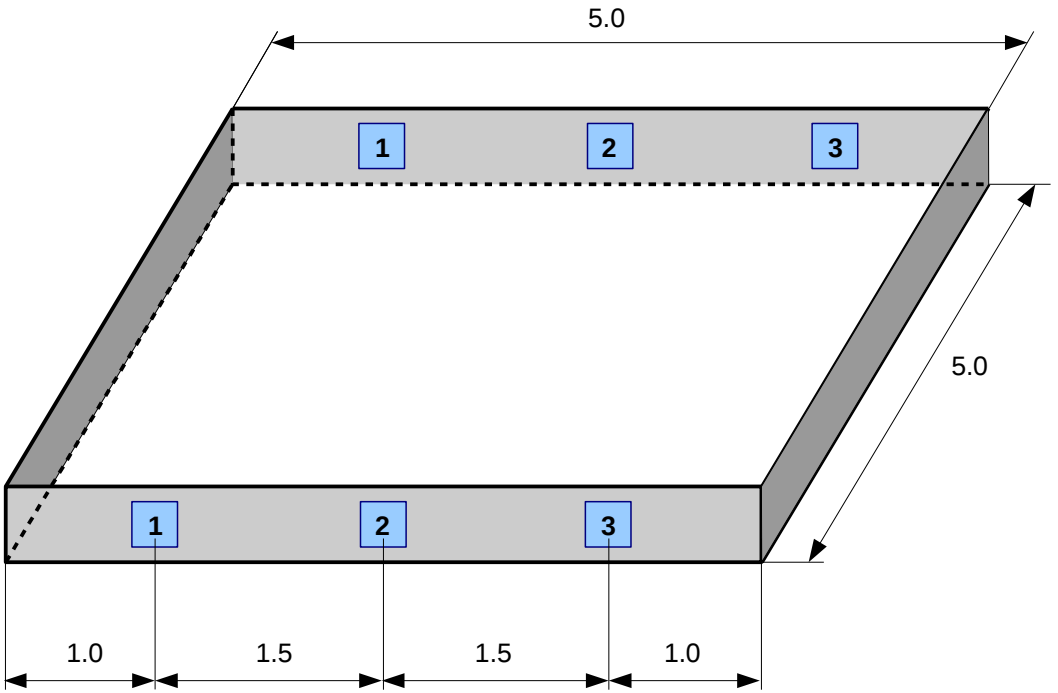
The signal given by the (normalized) sum of one or more SiPMs (n=1, 2, 3,...) is analysed



5x5 cm^2 tile (0.5 cm thick)

4 SiPMs (on 2 opposite sides)

perpendicular m.i.p. track
(uniformly distributed on the surface)



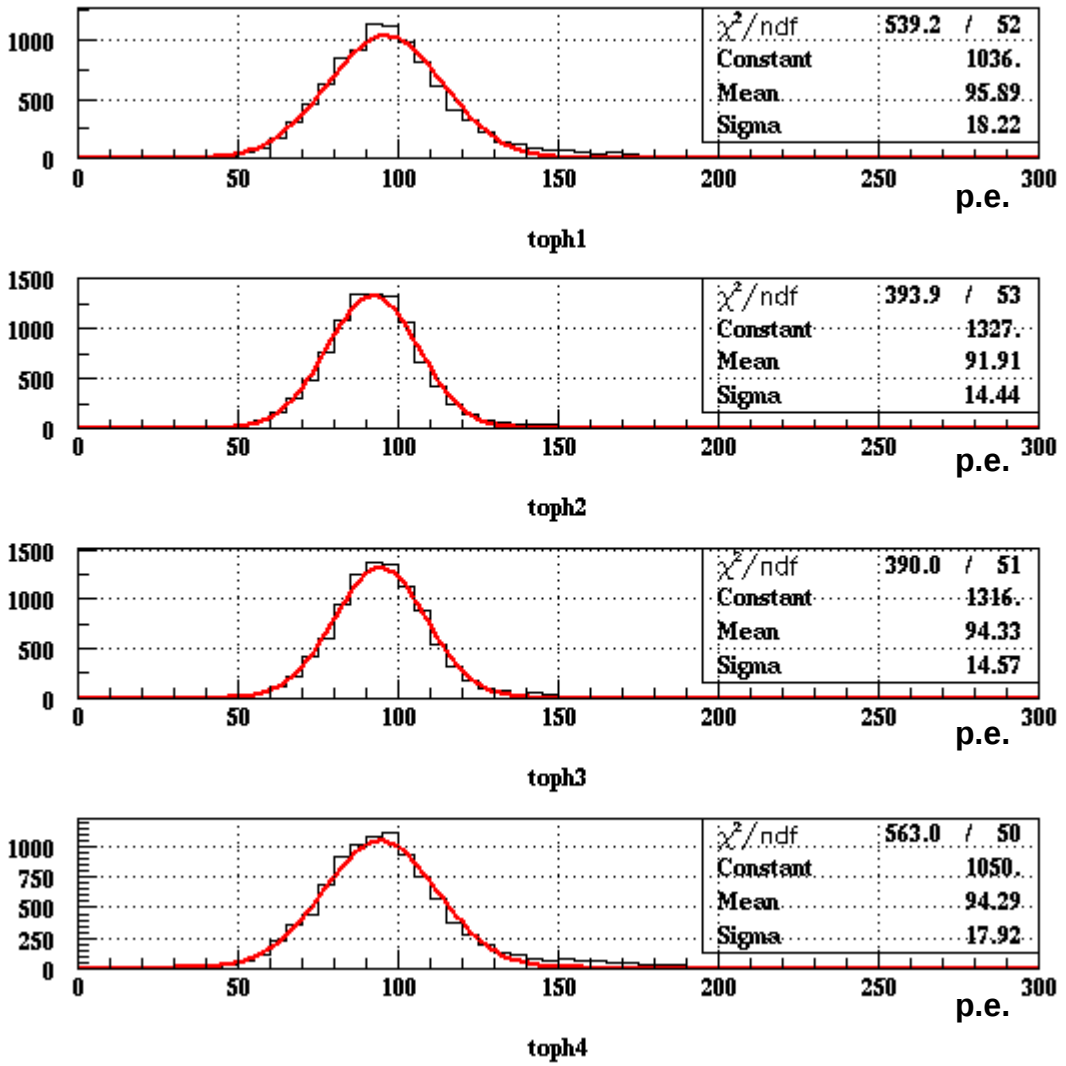
3x3 mm^2 SiPMs
50 μm pitch

EJ-200 scintillator
(λ_{att} = 380 cm)

3 SiPMs (on 2 opposite sides)

Signal spread for a 4-SiPM geometry – single SiPM readout

read SiPM



1 2 3 4

1 2 3 4

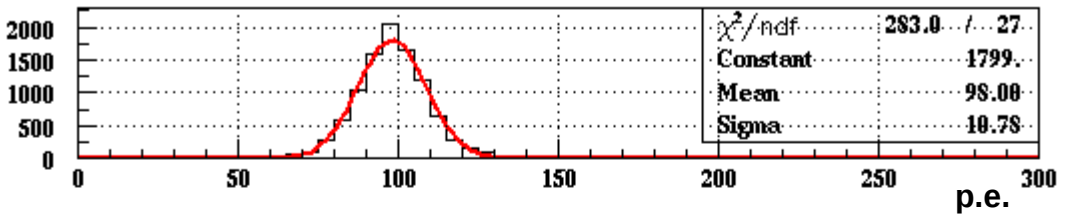
1 2 3 4

1 2 3 4

(perpendicular m.i.p. track)

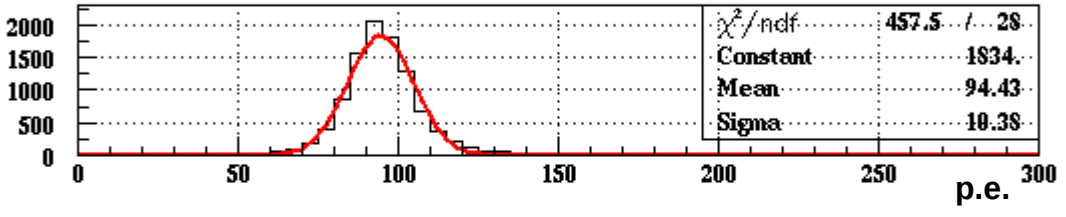
Signal spread for a 4-SiPM geometry – multiple SiPMs readout

read SiPM



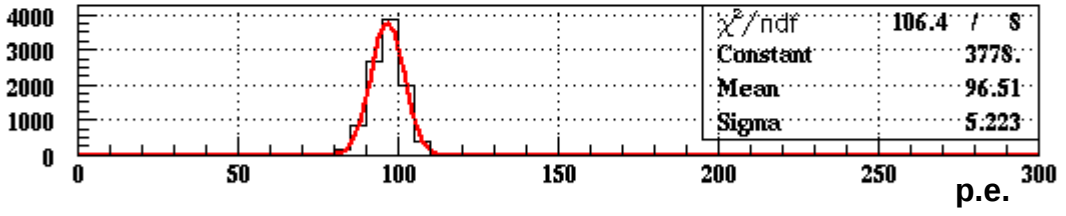
toph1+toph4

1 2 3 4



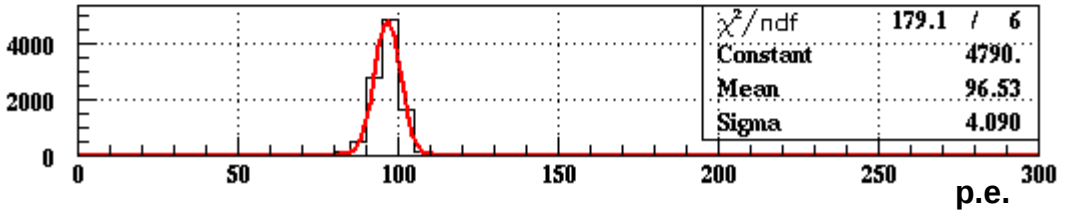
toph2+toph3

1 2 3 4



toph1+toph2+toph3+toph4

1 2 3 4



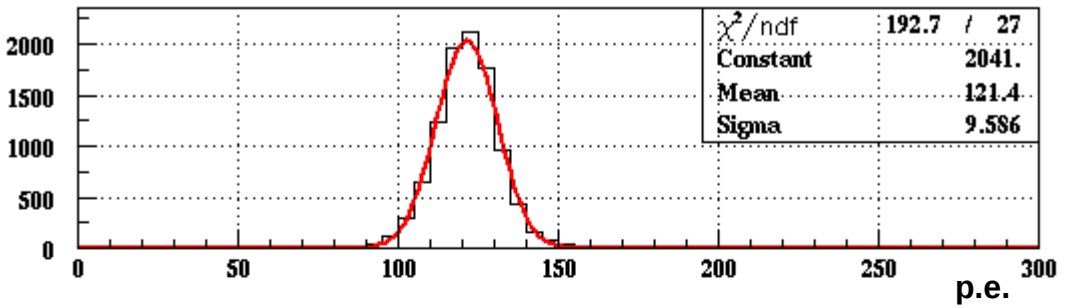
toph1+toph2+toph3+toph4+both1+both2+both3+both4

1 2 3 4

(perpendicular m.i.p. track)

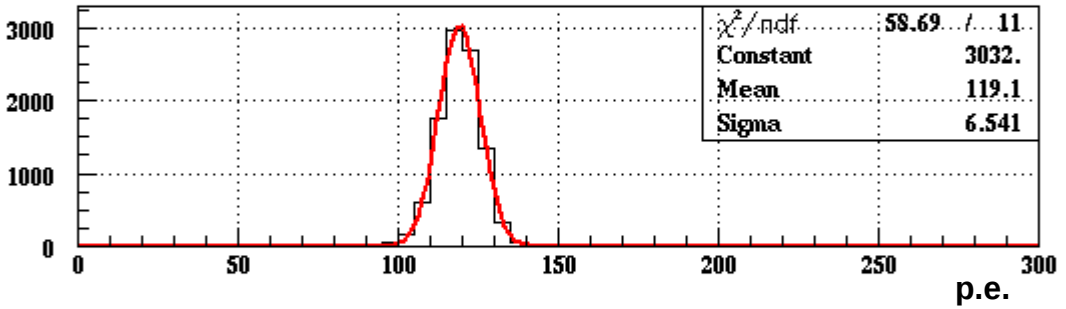
Signal spread for a 3-SiPM geometry

read SiPM



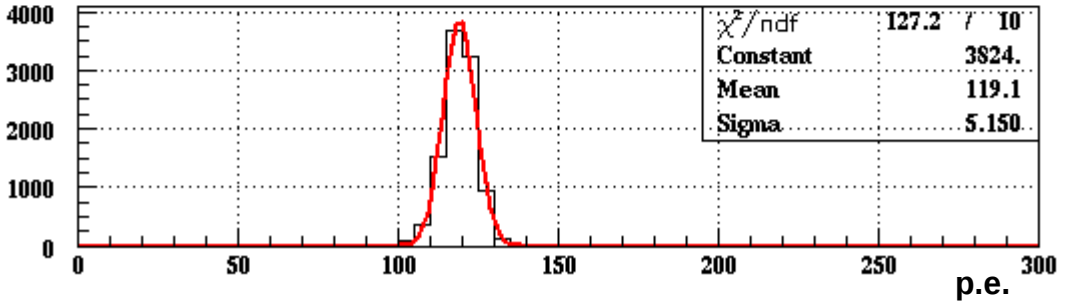
toph1+toph3

1 2 3



toph1+toph2+toph3

1 2 3

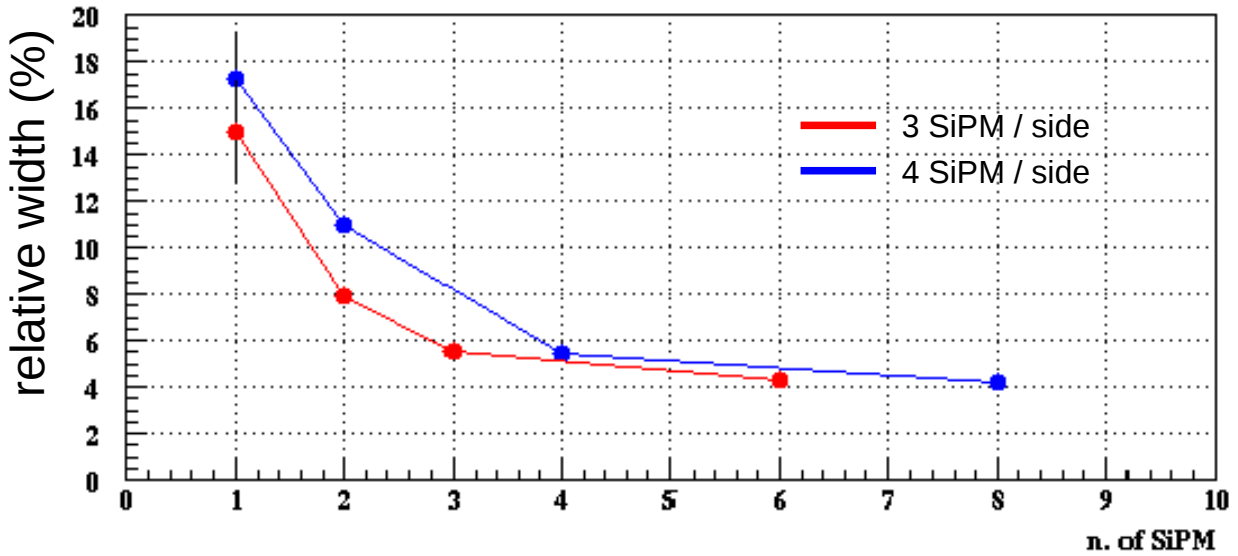


toph1+toph2+toph3+both1+both2+both3

1 2 3

(perpendicular m.i.p. track)

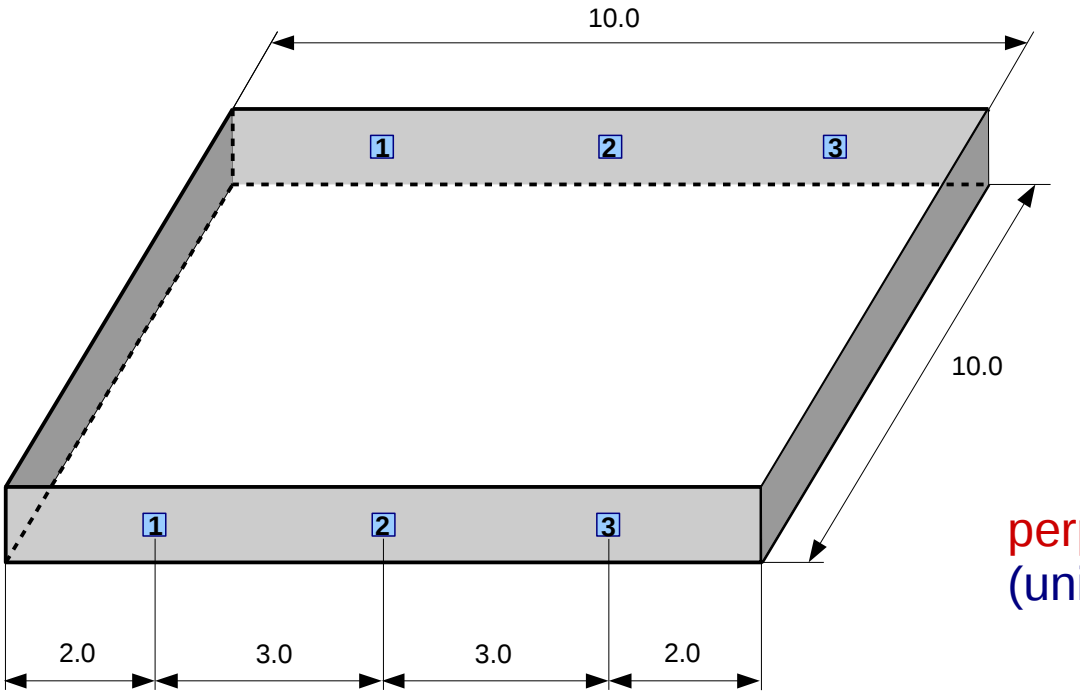
Comparison between 3 and 4 SiPMs geometries (5x5 cm^2 tile)



3x3 mm^2 SiPMs
50 μm pitch
λ_{att} = 380 cm

(perpendicular m.i.p. track)

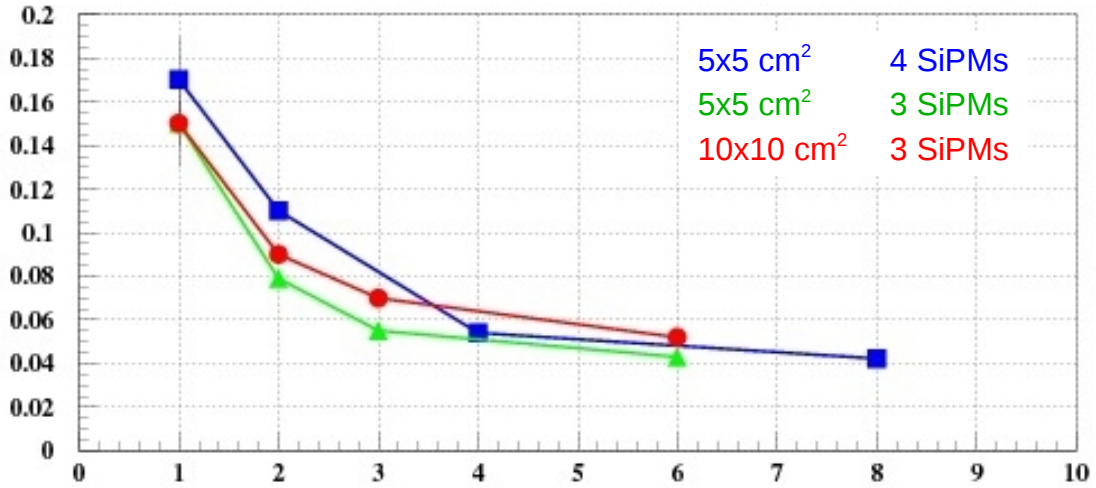
Note: the number of collected photons is higher in the 3 SiPMs geometry, because the reflecting area (on the tile's edges) is larger



10x10 cm^2 tile (0.5 cm thick)

3 SiPMs (on 2 opposite sides)

perpendicular m.i.p. track
(uniformly distributed on the surface)



3x3 mm^2 SiPMs
50 μm pitch

Test on tile prototypes

A certain amount of scintillator is available to build some prototypes

Scintillator type: EJ-200 (Eljen Technology)
Ligth yield: 64% of anthracene
λ = 425 nm
λ_{att} = 380 cm

Tile size: 5x5 cm^2, 10x10 cm^2 (eventually also 5x10 cm^2)
(0.5 cm thickness)

Different 3x3 mm^2 SiPM available:

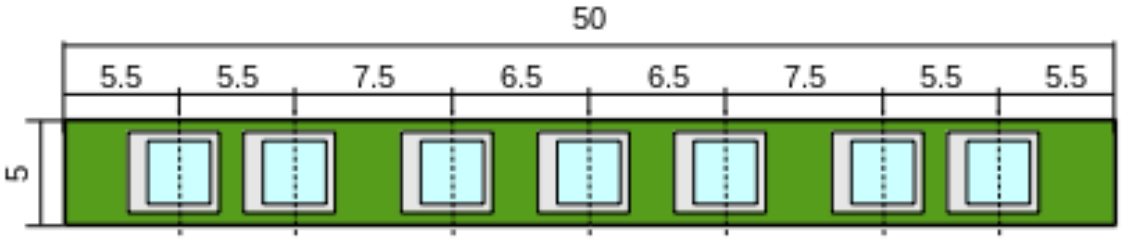
Hamamatsu S12572-050P (50 μm pitch)
AdvanSiD RGB (40 μm pitch)
AdvanSiD NUV (40 μm pitch)

SiPM board designed to allow different different geometric arrangements with 1, 2, 3 or 4 (and event more...) SiPM

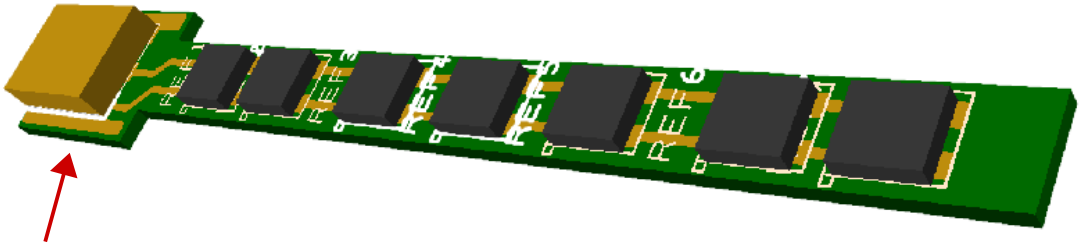
AdvanSiD RGB
3x3 mm^2 40µm cells

AdvanSiD NUV
3x3 mm^2 40µm cells

HAMAMATSU S12572-050P
3x3 mm^2 50µm cells

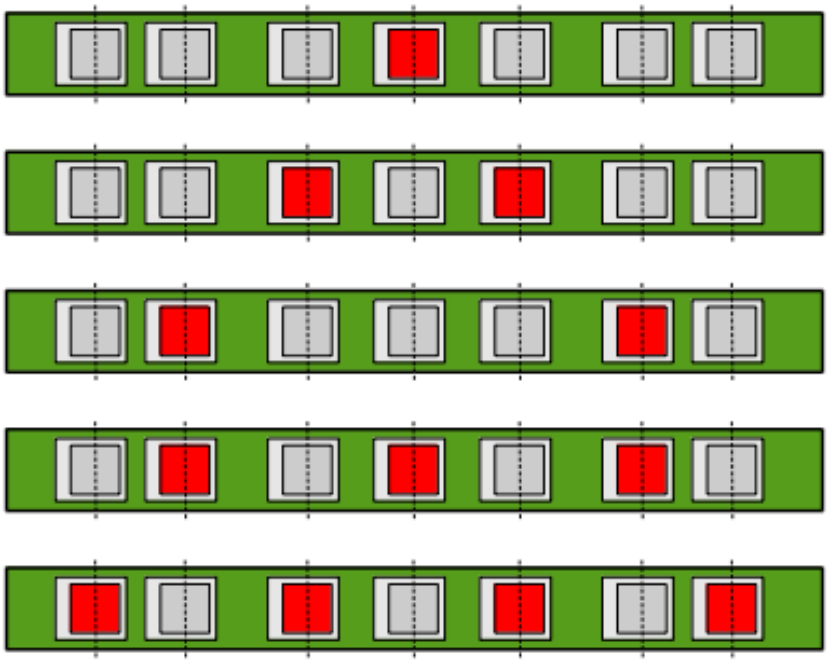


SiPM positions (mm)
(x2 for the 10x10 cm^2 tile)



Output connector

printed board layout
(parallel connections)



SiPMs placing