

Comparision of the efficiency of SciTil geometries

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Outline

- Motivation
- Assumptions
- Calculation
- SciTil
- SciRod
- SciMeg

Motivation

- Compare and study the influence of different geometries
- Simulations in Pandaroot will be necessary
 - More time needed for implementation
- First estimation by analytical calculation

Assumptions

– Most particles in forward direction

- For $20^\circ - 50^\circ \rightarrow$ 2 particles per event are expected
- As per simulations of the Dirc detector group

– Detector recovery time

- SiPMs ≤ 500 ns
 - Lukas Gruber, PhD thesis, TU Wien, 2014
- readout cards ~ 10 μ s
 - M.D. Rolo et. al., TOFPET ASIC for PET applications, JINST 8 C02050, 2013

– Eventrate

- $N_{avg} \sim 20$ MHz
- $N_{max} \sim 100$ MHz

Active Area:

- $L = 950$ mm
- $R = 500$ mm
- $A = 2997700$ mm²

Particles within the detector recovery time

- 20 – 2000

Calculation

$$P_{Hit\ wG} = \frac{A_{Module}}{A_{Active\ Area}}$$

$$P_{Hit\ oG} = \frac{1}{Modules}$$

$$P_{noHit} = (1 - P_{Hit})^n$$

$$P_{Single} = P_{Hit} * (1 - P_{Hit})^{n-1} * n$$

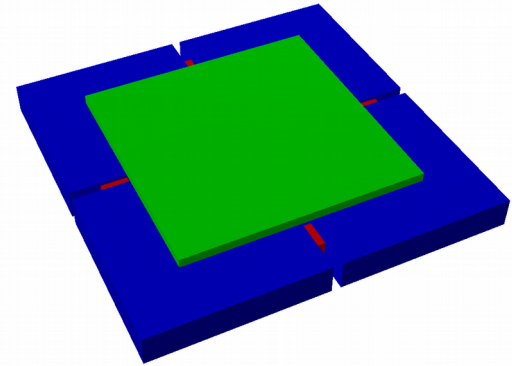
$$P_{DetHit} = 1 - (1 - P_{Hit})^n$$

$$P_{Multi} = 1 - P_{noHit} - P_{Single}$$

$$E = \frac{n_{det}}{n_{ges}} = \frac{P_{DetHit} * detectors}{n_{ges}} = \frac{(1 - (1 - P_{Hit})^n) * detectors}{n_{ges}}$$

SciTil

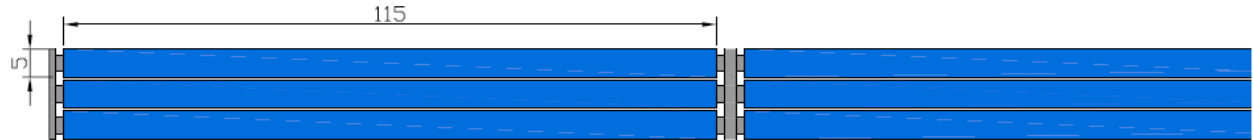
- Tile area: 28.5x28.5 mm²
- Relevant modules: 3040



		Per event (n = 2)	N _{avg} =20 MHz		N _{max} =100 MHz	
			0,5 μs (n=20)	10 μs (n=400)	0,5 μs (n=100)	10 μs (n=2000)
without geometry	P _{Multihit}	1.082e-5 %	0.002 %	0.792 %	0.052 %	14.129 %
	Efficiency	99.98 %	99.68 %	93.71 %	98.39 %	73.28 %
with geometry	P _{Multihit}	7.341e-6 %	0.0014 %	0.5454 %	0.0357 %	10.32 %
	Efficiency	82.36 %	82.16 %	78.07 %	81.28 %	63.60 %

SciRod

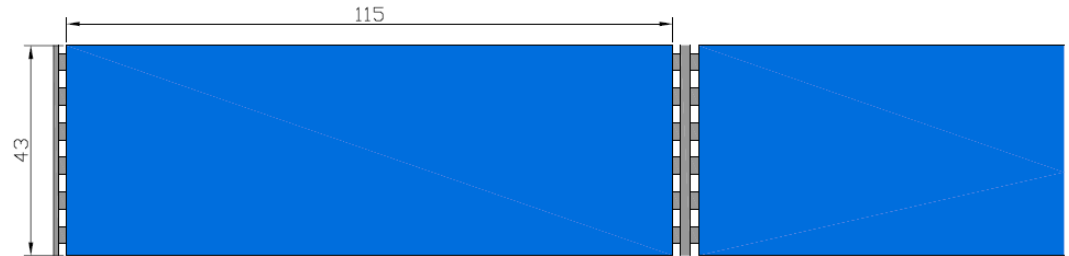
- Rod area: 5 x 115 mm²
- Relevant modules: 4080



		Per event (n = 2)	N _{avg} =20 MHz		N _{max} =100 MHz	
			0,5 μs (n=20)	10 μs (n=400)	0,5 μs (n=100)	10 μs (n=2000)
without geometry	P _{Multihit}	6.00e-6 %	0.0011 %	0.449 %	0.029 %	8.72 %
	Efficiency	99.99 %	99.77 %	95.27 %	98.80 %	79.05 %
with geometry	P _{Multihit}	3.679e-6 %	0.0007 %	0.2791 %	0.018 %	5.720 %
	Efficiency	78.25 %	78.12 %	75.34 %	77.52 %	65.00 %

SciMeg

- Meg area: 43 x 120 mm²
- Relevant modules: 507

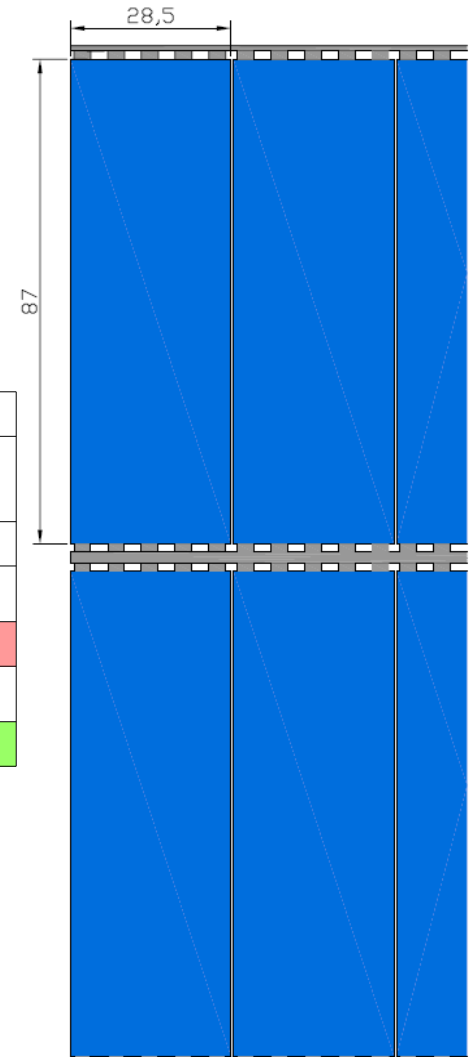


		Per event (n = 2)	N _{avg} =20 MHz		N _{max} =100 MHz	
			0,5 μs (n=20)	10 μs (n=400)	0,5 μs (n=100)	10 μs (n=2000)
SciMeg A= 43 x 115 mm ² , relevant modules = 507						
without geometry	P _{Multihit}	0.0004 %	0.072 %	18.72 %	1.69 %	90.45 %
	Efficiency	99.90 %	98.15 %	69.21 %	90.84 %	24.86 %
with geometry	P _{Multihit}	0.0003 %	0.0507 %	14.19 %	1.210 %	84.15 %
	Efficiency	83.57 %	82.34 %	61.26 %	77.15 %	24.41 %

SciMeg v2

- Meg v2 area: 28.5x87 mm²
- Relevant modules: 1013

		Per event (n = 2)	N _{avg} =20 MHz		N _{max} =100 MHz	
			0,5 μs (n=20)	10 μs (n=400)	0,5 μs (n=100)	10 μs (n=2000)
SciMeg v2 A= 28.5 x 87 mm ² , relevant modules = 1013						
without geometry	P _{Multihit}	9.74e-5 %	0.018 %	6.01 %	0.45 %	58.71 %
	Efficiency	99.95 %	99.06 %	82.65 %	95.26 %	43.62 %
with geometry	P _{Multihit}	6.84 e-5 %	0.0129 %	4.397 %	0.321 %	49.25 %
	Efficiency	83.75 %	83.13 %	71.36 %	80.45 %	40.97 %



Summary

		Navg=20 MHz		Nmax=100 MHz	
	Per event (n = 2)	0,5 μ s (n=20)	10 μ s (n=400)	0,5 μ s (n=100)	10 μ s (n=2000)
SciTil A= 28.5 x 28.5 mm ² , relevant modules = 3040					
Efficiency	99.98 %	99.68 %	93.71 %	98.39 %	73.28 %
Efficiency	82.36 %	82.16 %	78.07 %	81.28 %	63.60 %
SciRod A= 5 x 115 mm ² , relevant modules = 4080					
Efficiency	99.99 %	99.77 %	95.27 %	98.80 %	79.05 %
Efficiency	78.25 %	78.12 %	75.34 %	77.52 %	65.00 %
SciMeg A= 43 x 115 mm ² , relevant modules = 507					
Efficiency	99.90 %	98.15 %	69.21 %	90.84 %	24.86 %
Efficiency	83.57 %	82.34 %	61.26 %	77.15 %	24.41 %
SciMeg v2 A= 28.5 x 87 mm ² , relevant modules = 1013					
Efficiency	99.95 %	99.06 %	82.65 %	95.26 %	43.62 %
Efficiency	83.75 %	83.13 %	71.36 %	80.45 %	40.97 %

- Readout electronics could be a problem
- Need further check with Pandaroot and realistic geometry
 - Efficiency with geometry may increase