



Tile digitization: LUT model Bari, 28/5/2020

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- Physics
 - Physics List for Geant4 FTFP_BERT*
 - Delta-ray generation is disabled
- Source
 - Proton beam $\beta=1$ uniformly fired on tile large surface
- Geometrical parameters
- Geometry (5mm Tile) :
 - Tile size (100x100x5) mm³
 - SiPM (0,1,2) 3x3 mm2 on one side
 - SiPM (3,4,5) 1x1 mm2 on opposite side
 - Wrapping (Mylar) Thickness 500 um





*<u>http://geant4-userdoc.web.cern.ch/geant4-userdoc/UsersGuides/PhysicsListGuide/html/reference_PL/FTFP_BERT.html#ftfp-bert</u>

















3 mm SiPM

1 mm SiPM





MPV collection percentage







Sigma collection percentage







Mean number of photon collected for a particle in a specific sub position



What next



- Already done:
 - Optical photon tracking simulation
 - Clustering algorithm
 - Corrections: PDE, DCR, Cross-Talk, cell saturation
- Do next:
 - Birk's saturation in core and halo ionization
 - Comparison with experimental data (beam test, ⁹⁰Sr, ...)







Proton beam







Carbon beam







Iron beam



















- All the previous plot was made only with absorbed photons
- Next plot will show SiPM PDE and Cross-Talk implementation for a statistic obtained with random fire position perpendicular to tile.
- PDE was first applied using an average collection value and photons really detected was calculated individually for each absorbed photon.
- Dark Count Rate can be neglected thanks to fast collection time and small active SiPM area.
- Cross-Talk was calculated using a compound gaussian* with:

$$E[X] = \frac{\mu}{1-p} \qquad Var[X] = \frac{\mu \cdot (1+p)}{(1-p)^2} \qquad \mu = Number \ of \ detected \ photons \\ p = probability = 0.3 \ in \ this \ case$$



SiPM Broadening







Conclusion



- SiPM strings look generate a better uniformity in light collection.
- Geoemetry 1 and Geometry 2 show, more or less, the same performances in term of Uniformity
- \sim 30 ns look enough to collect all the photons for all the configurations.
- We are improving the SiPM simulation adding PDE, DCR and Cross-Talk effects, in this specific case DCR can be neglected.

In	this	preliminary	analysis	the	SiPM	cell	segmentation	are	not
tak	ken ir	to account:							

- Saturation effects and cell positions/dimensions were not considered.
- We simply consider a statistical approach by using Vinogradov pdf correction on the whole photons collected on the SiPM area.
- We will better modelize this in future simulations.

Μ	IPV	SiPM size				
values o	collection	Large	Small			
	Absorbed	177	19			
Proton	PDE	65	8			
	PDE+CT	80	5			
	Absorbed	4778	531			
Carbon	PDE	1921	218			
	PDE+CT	2661	287			
	Absorbed	23080	2583			
Iron	PDE	9146	1040			
	PDE+CT	12880	1429			