MC simulations for SuperPIX0

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02.12.2011

Toy MC model

- Parameters for Landau distribution
- MC algorithm of deploying the charge
- Additional things

Results from MC

- Multiplicity comparison 0^o
- Other quantity comparison 0^o
- Multiplicity comparison 45^o
- Other quantity comparison 45^o

Summary

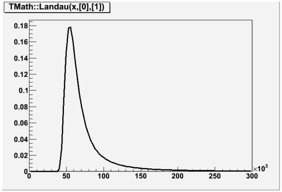
Thanks to A.Lusiani searches

- Parameters of Landau distribution as showed in Rev. Mod. Phys. 60, 663699 (1988) can be obtain in a simple function of thickness of the silicon bulk(z-distance in μm, p-MPV):

  if $(z < 110)$ $p = z(100.6 + 35.35 ln(z))$

  if $(z \geq 110)$ $p = z(190 + 16.3 ln(z))$

  w -FWHM



if $(z < 11)$ $w = z(298.3 - 53.53 ln(z))$

if $(z \geq 11 \wedge z < 30)$ $w = z(174.7 - 2.72 ln(z))$

if $(z \geq 30 \wedge z < 260)$ $w = z(259.6 - 28.41 ln(z))$

if $(z \geq 260)$ $w = 71.3z(1 + \frac{39.4}{z^{0.8}})$

ξ is the ROOTs second parameter for Landau distribution.

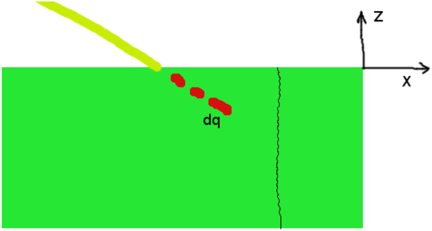
$$\xi = \frac{w}{4.018}$$

Assumption: $1e^- = 3.7eV$

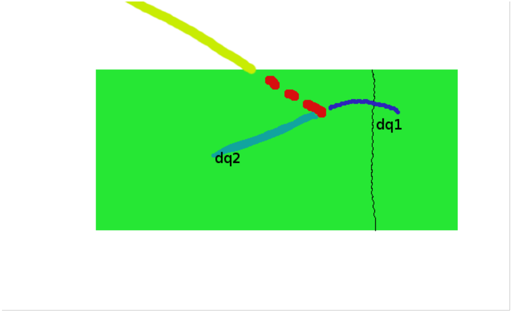
$p = 55272.5eV(14938.5e^-)$

$\xi = 5429.31eV(1467.3e^-)$

- For each angle of detector rotation a particle is considered hitting the pixel with uniform distribution in xy plane. Than the program calculates the distance that particle travels in each pixel on its track. For each distance program generates the charge deposited in each pixel according to Landaus distribution. Than for each step $dr = 0.01\mu m$ calculates equivalent of charge deposited dq on that way.



- Each dq charge is deposited among neighbouring pixels as a linear function of distance from the center of pixel.

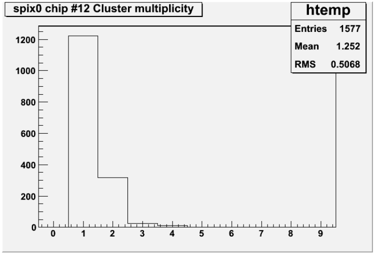


- After particle reaches the end of the bulk all collected charge on each pixel is summed up. The pixel fires up if the collected charge exceeds the threshold.
- The threshold used in the simulation divided the mip mpv in 200um of Si for the nominal threshold data

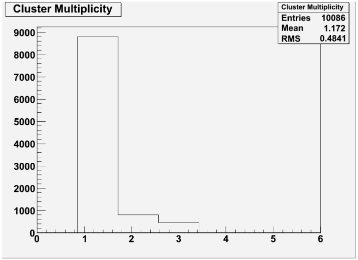
- We found that best threshold that simulates the real data is 0.34 MIP, opposed to the threshold set on the Test Beam to 0.25 MIP
- The algorithm was improved by adding:
- 1- Fluctuations of the threshold level,
- 2- 2D Gaussian spread of released charge (sigma $=23\ \mu m$),
- 3- Noise appearance (Gaussian distribution based on signal to noise ratio). We assume S/N$=$ 220 for a normal incidence MIP. .

Data analysed by A.Lusiani

Real Data



MC Simulation

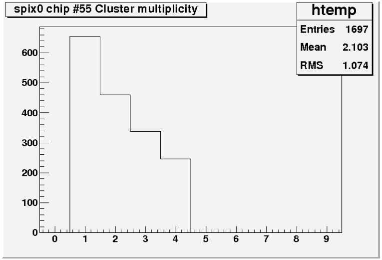


Real Data
residual $13 - 16 \mu m$
efficiency $= 0.9937$

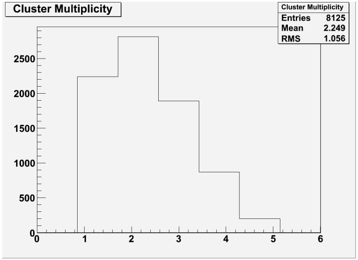
MC Simulation
residual $14.35 \mu m$
efficiency $= 0.9999$

45^o tracks

Real Data



MC Simulation



45^o tracks

Real Data
residual $46.09 \mu m$
efficiency $= 0.8472$

MC Simulation
residual $40.49 \mu m$
efficiency $= 0.80372$

- MC has reasonable agreement with data, except the threshold
- Simulation indicates that the effective threshold may be larger than $1/4$ of a m.i.p?