Direct Coupling Simulations

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CALICE Collaboration Meeting,
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- Direct coupling (see talk by Frank Simon)
- **Standalone simulation**
- **GEANT4 simulation**
- **Results**
- Outlook

GEANT4 vs Standalone MC

Standalone simulation by F.Corriveau, Z.Niu (2008) and A.Thomson (2009)

- Straightforward C++ code
- Beam description, ionisation, light emisssion
- Light propagation, reflection/absorption
- Several parameters available for understanding and tuning
- Histograms handled through ROOT

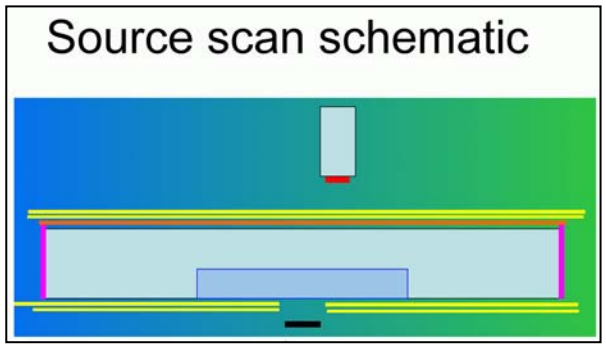
Geant4 code provided by V.Saveliev (Obninsk), developped by A.Thomson

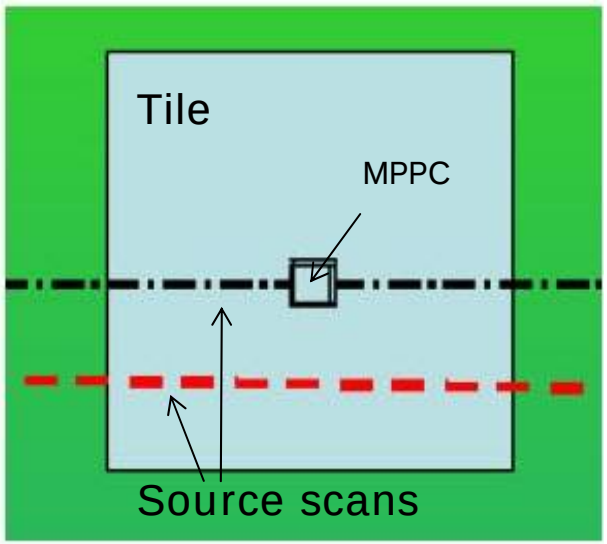
- Setup done at McGill under Scientific Linux
- Tile geometry and properties provided as input, more flexible
- GEANT handles the physical processes, histograms through ROOT
- Many parameters (e.g. surface properties) are somewhat confusing
- Very useful to have both simulations programs vs actual data

Standalone Results

The MPPC is located in the center of the bottom face

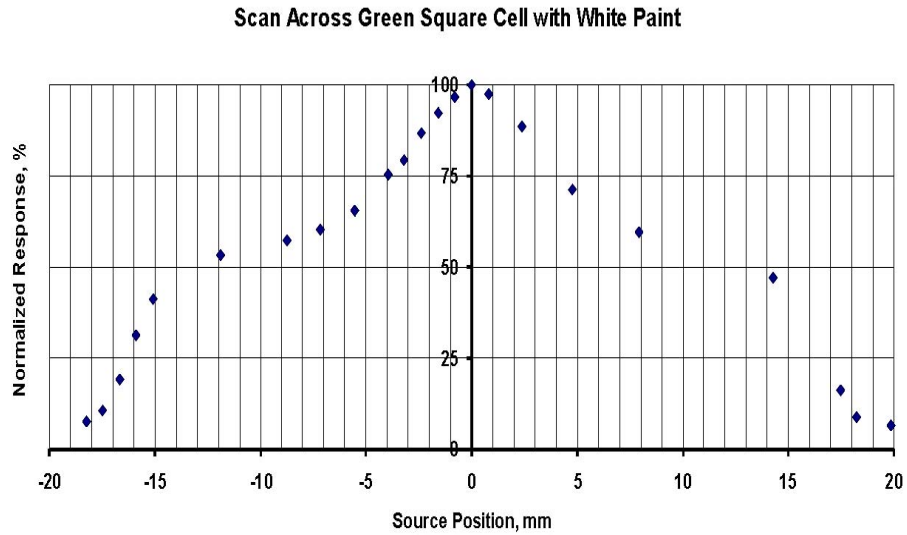
30x30x5 mm^3 tile



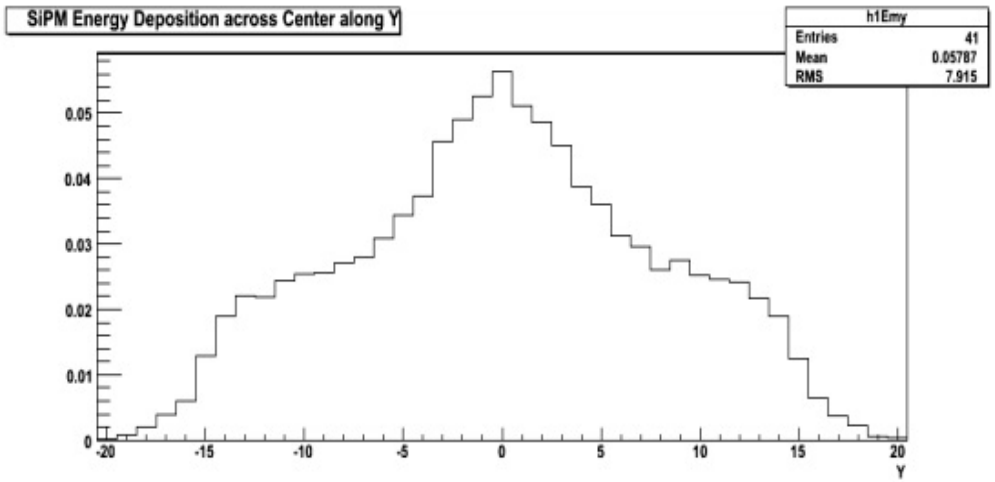


as shown last year in Manchester

Measurement from NIU (V.Zutshi et al.)

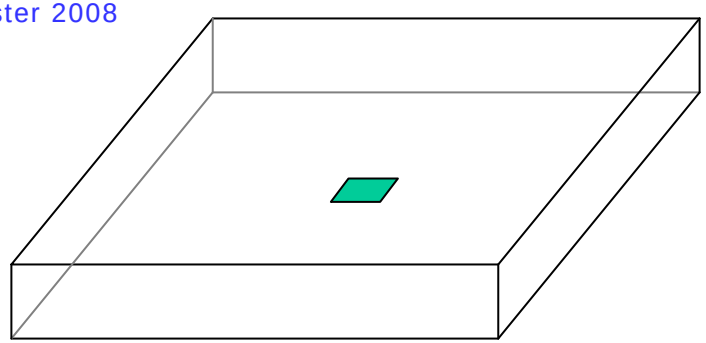


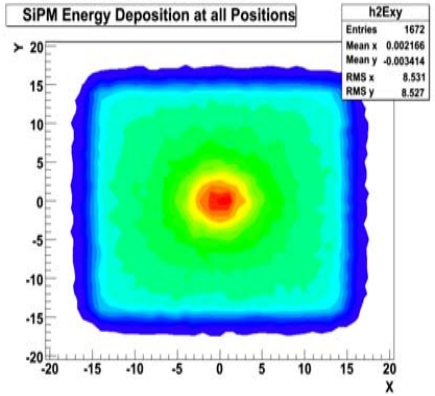
Simulation



2008 Configurations

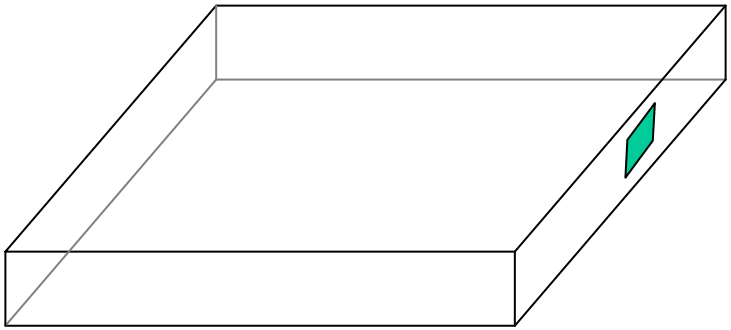
Manchester 2008

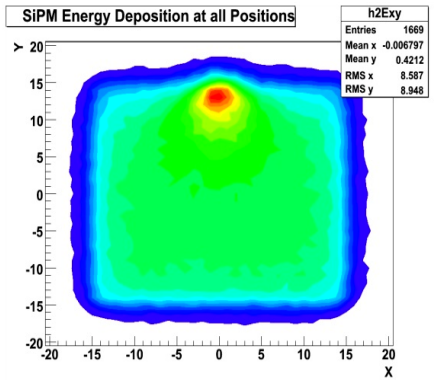




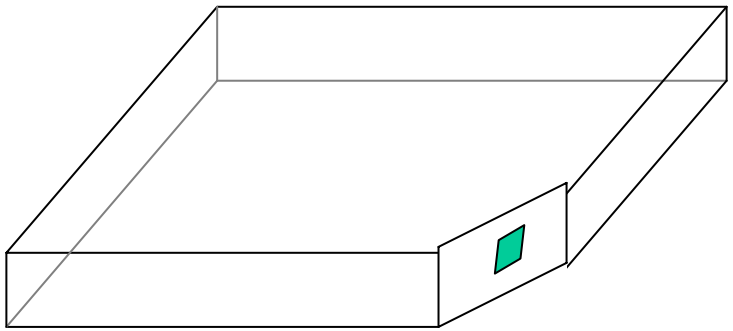
Fraction of light collected:

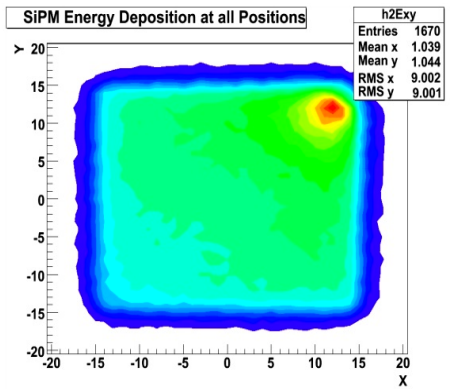
0.49%





0.62%



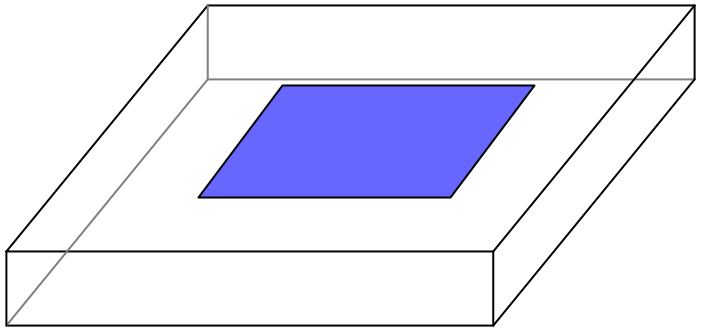


0.65%

Still, uniformity not achieved

.. and numerous variations in position, sizes, tuning of attenuation, threshold, surfaces, beam, etc..

Absorbing Patch

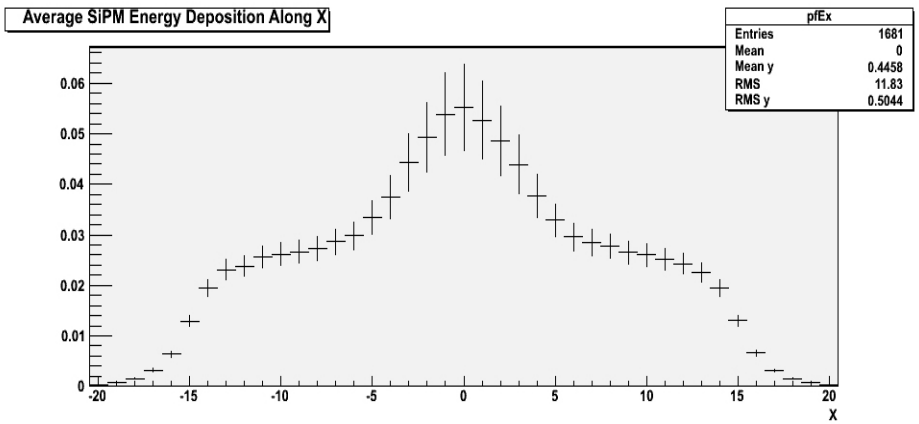


0.34%

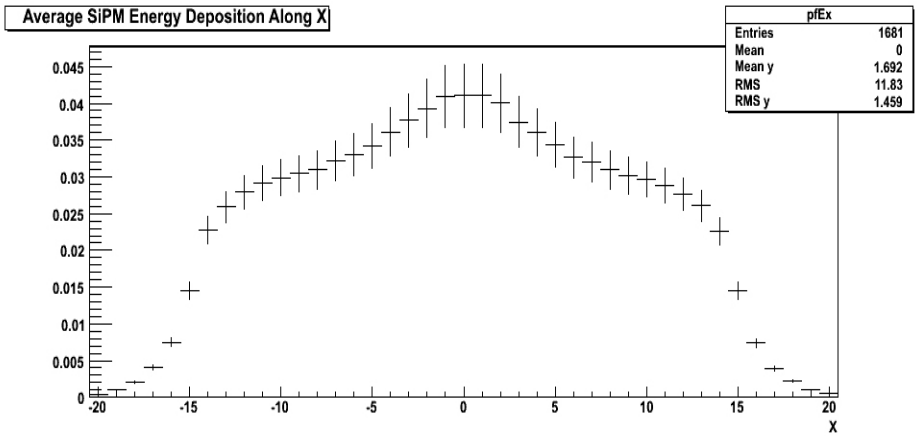
Absorbing patch of various sizes and reflectivities located on top of the tile, above the position of the Si-PM.

The result was the opposite of the naïve expectations, since the light produced further away was cut even more than the “central” one through repeated reflections.

with 7x7mm^2 patch



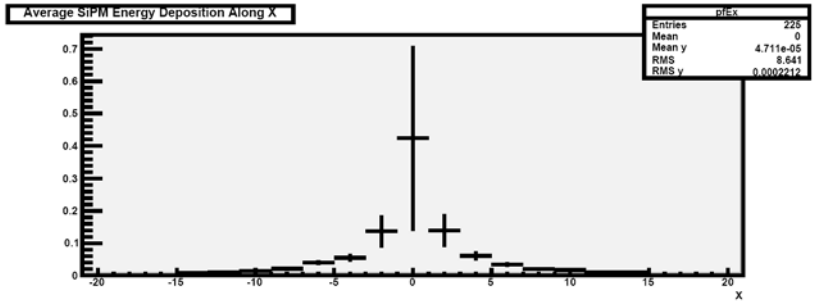
without patch



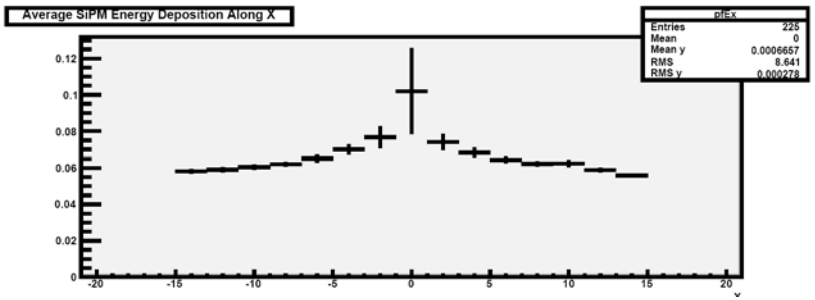
average distributions across full tile for 90% patch absorption

GEANT – Types of Surface

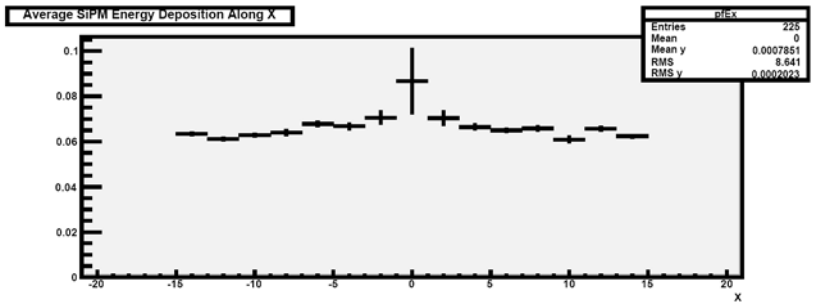
"polished"



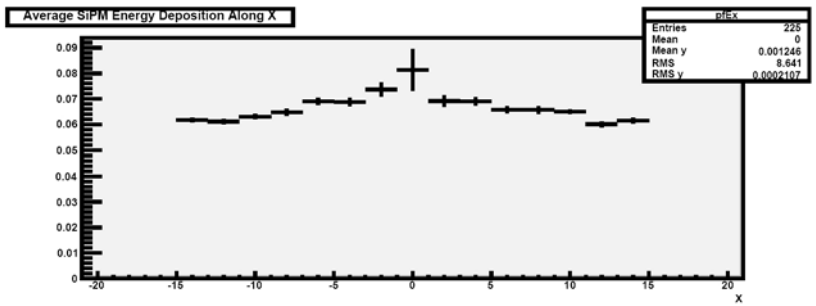
default



"ground frontpainted"



"ground backpainted"



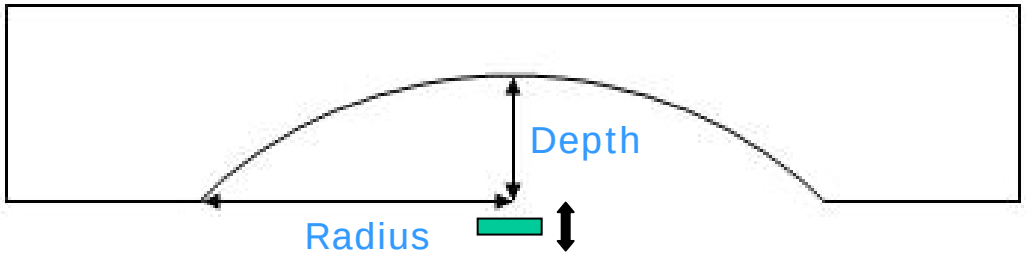
poor GEANT documentation on surface types

not included yet: smearing due to source

very large differences observed

need more sets of measurement data to tune the simulation

Spherical Cutout



Special example		GEANT Simulation			Standalone
Radius [mm]	Depth [mm]	Deposited Energy [MeV]	Detected Energy [MeV]	Fraction Detected	Fraction Detected
	0	17.90	0.1766	**0.987%**	**1.182%**
10	1	17.30	0.0583	**0.337%**	**0.017%**
10	2	16.64	0.0585	**0.352%**	**0.020%**
10	3	15.89	0.0568	**0.358%**	**0.019%**

Standalone: large variations due to arbitrariness of the threshold parameter

GEANT – Spherical Cutouts

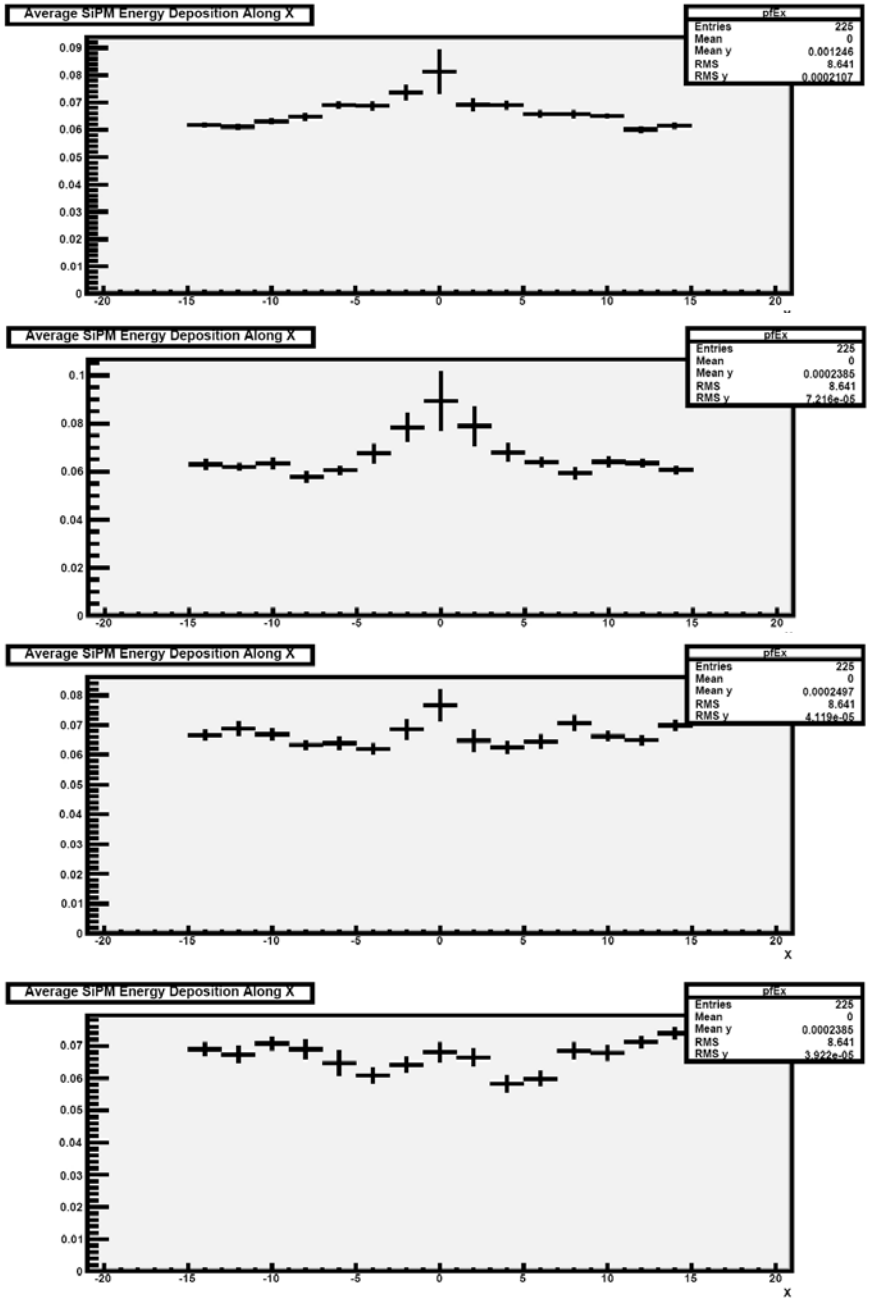
depth = 0 mm

depth = 1 mm

depth = 2 mm

depth = 3 mm

(radius = 10 mm)



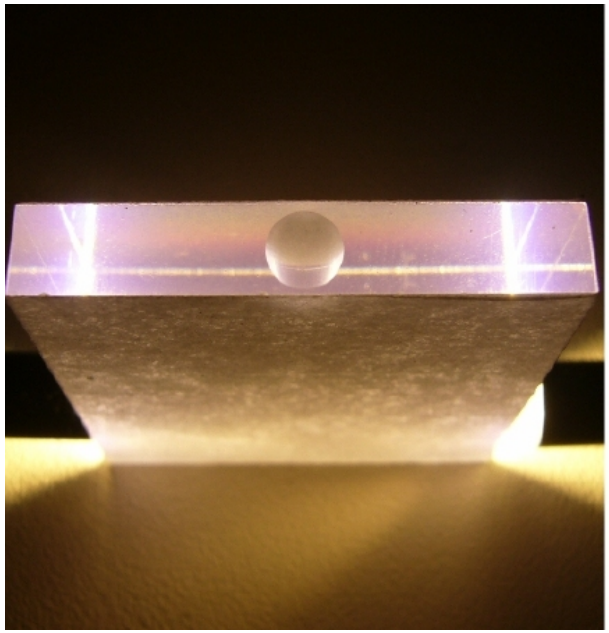
less energy deposition and higher losses due to geometry

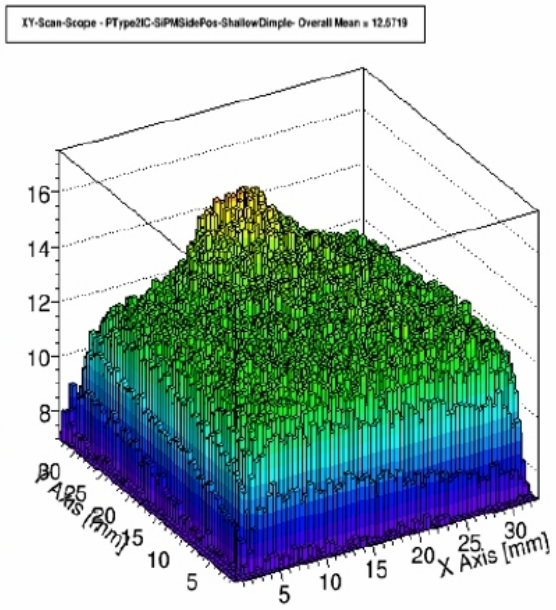
other tunings not yet done

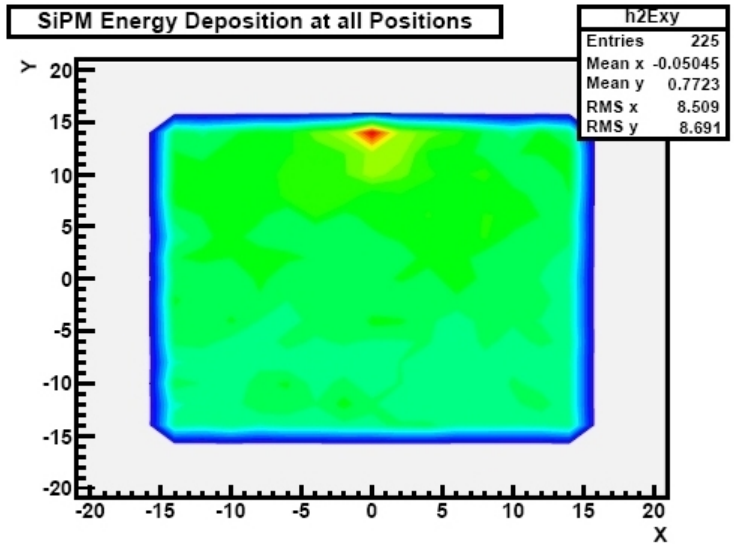
optimal depth around 2.5 mm

GEANT - Side Cutout

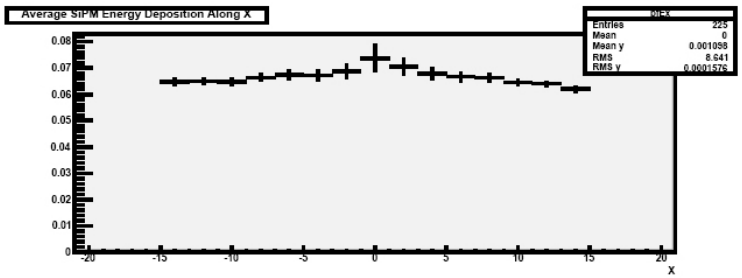
From C. Solner, July 2007:
2mm spherical dimple

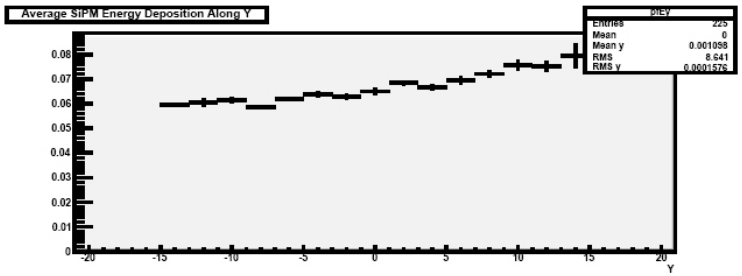






Our GEANT simulation: energy deposition and average profiles





still non-uniformities

Summary

- More than 200 different variations in many configurations tested with each of the standalone and GEANT simulation programs, some overlapping
- The simulations reproduce the general features of the available measurements (NIU, Regina, MPI Munich)
- Both simulations contain a too large number of loosely defined parameters
- Eagerly awaiting the release of the full data for tuning the simulation programs and have real predictive power in other configurations