

SiPM-Tile Direct Coupling Simulations

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CALICE Collaboration Meeting,
Casablanca, Morocco

22 September 2010

- Direct coupling
- **Simulations: standalone & GEANT4**
- **Measurements at MPI München**
- **New simulation results**
- Outlook

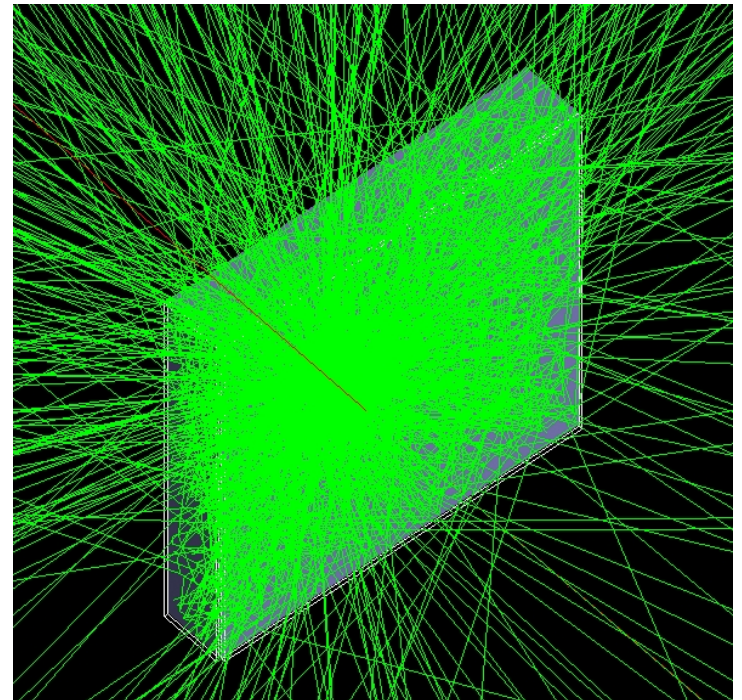
GEANT4 vs Standalone MC

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

- Straightforward C++ code, very fast, simple geometries
- Beam description, angle, ionisation, light emission
- Parameters for light propagation, reflection/absorption

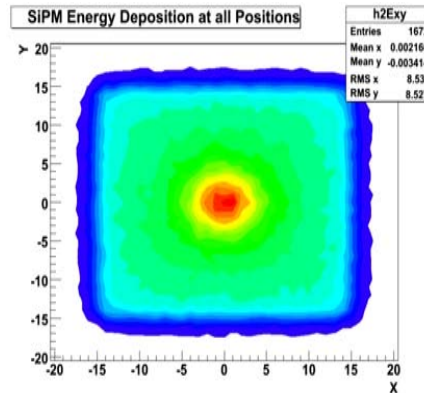
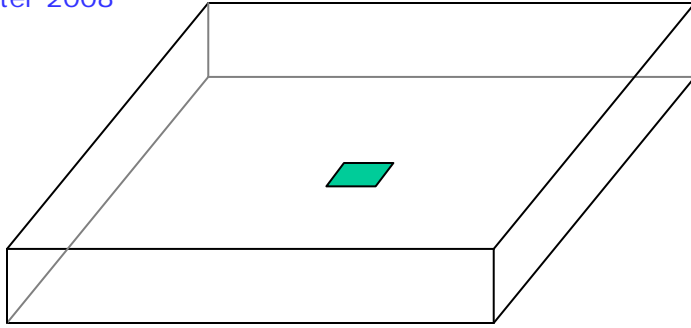
Geant4 code from V.Saveliev, developed by A.Thomson (2009-2010)

- Tile geometry and properties more flexible, physics handled by GEANT
- Many parameters (e.g. surface properties) are somewhat confusing and long to tune
- Most useful to have both simulations programs vs actual data



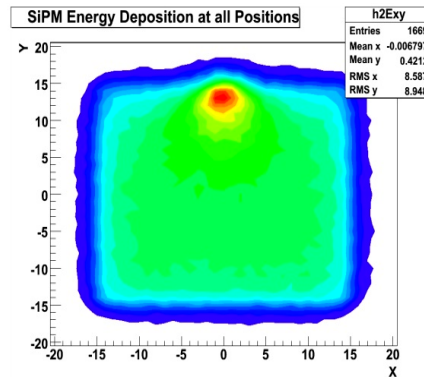
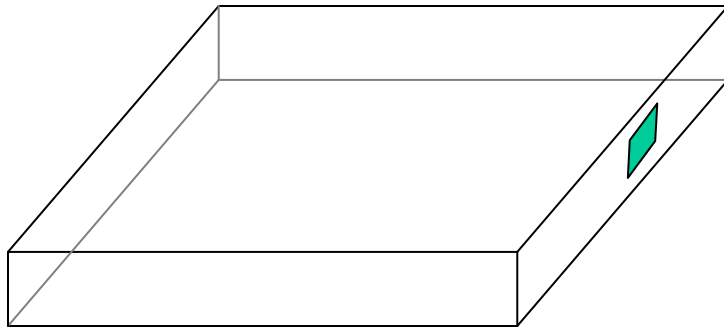
Standalone Configurations

Manchester 2008

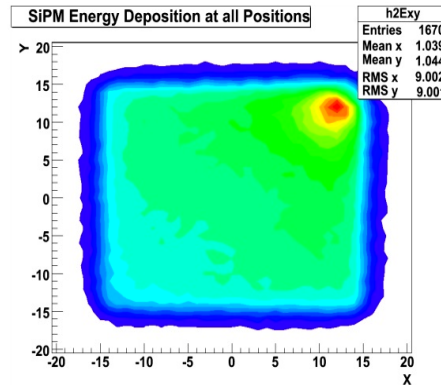
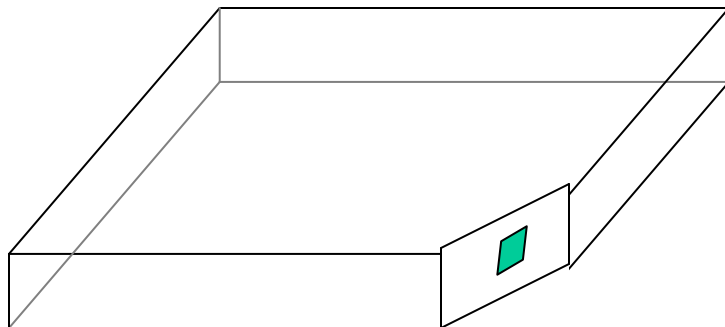


Fraction of light collected:

0.49%



0.62%

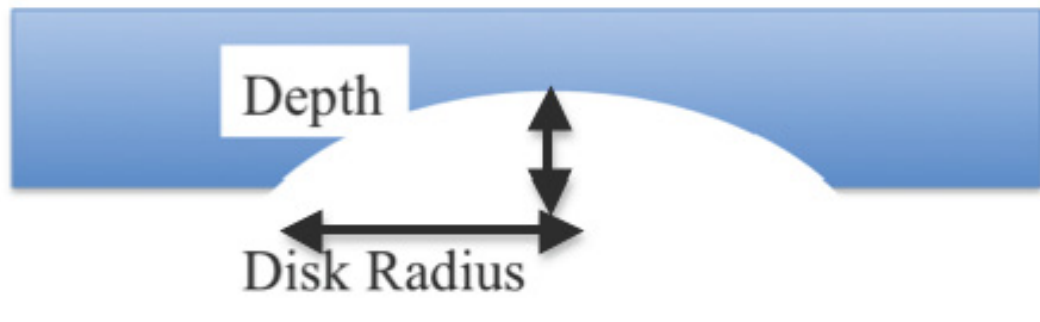


0.65%

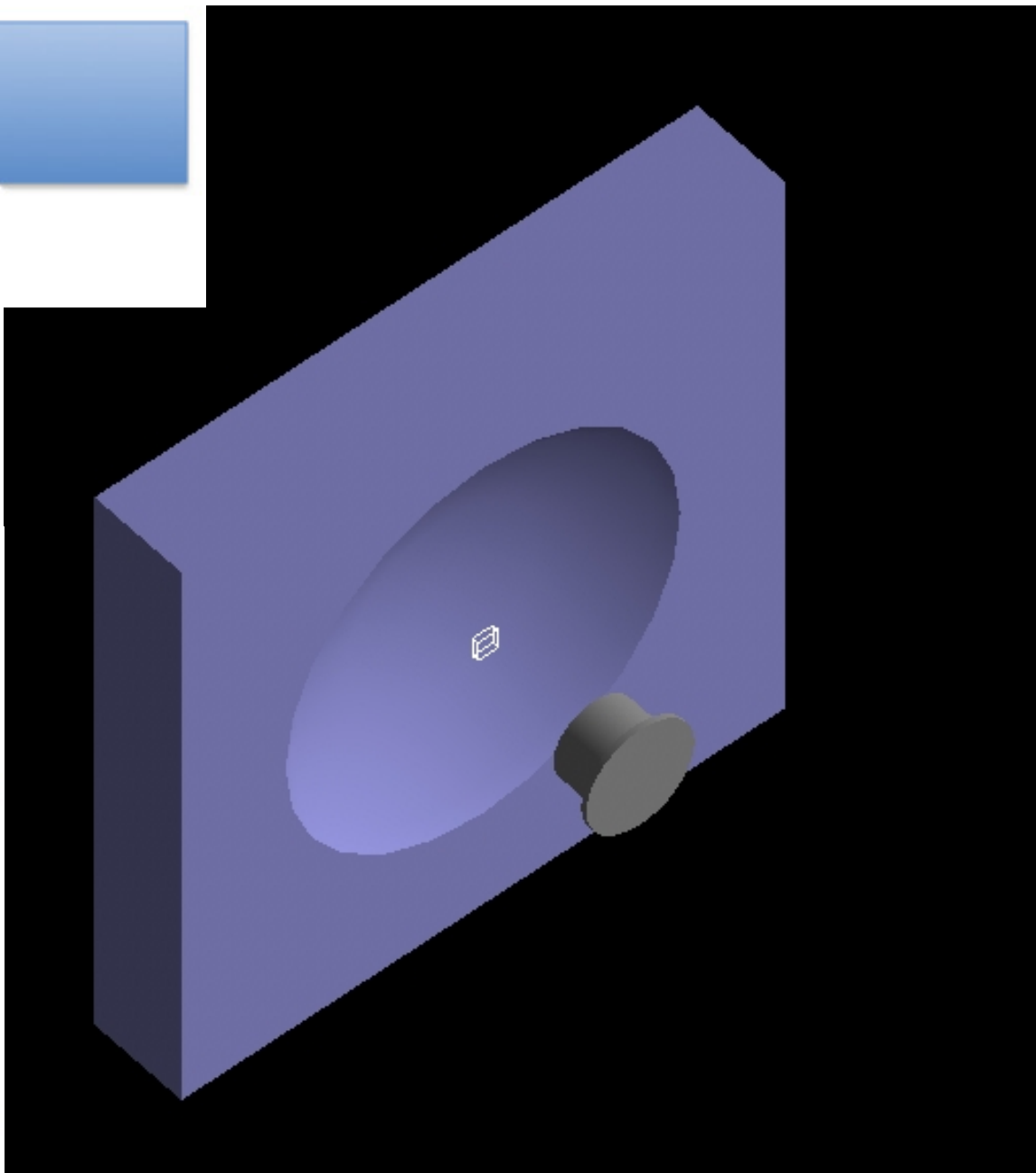
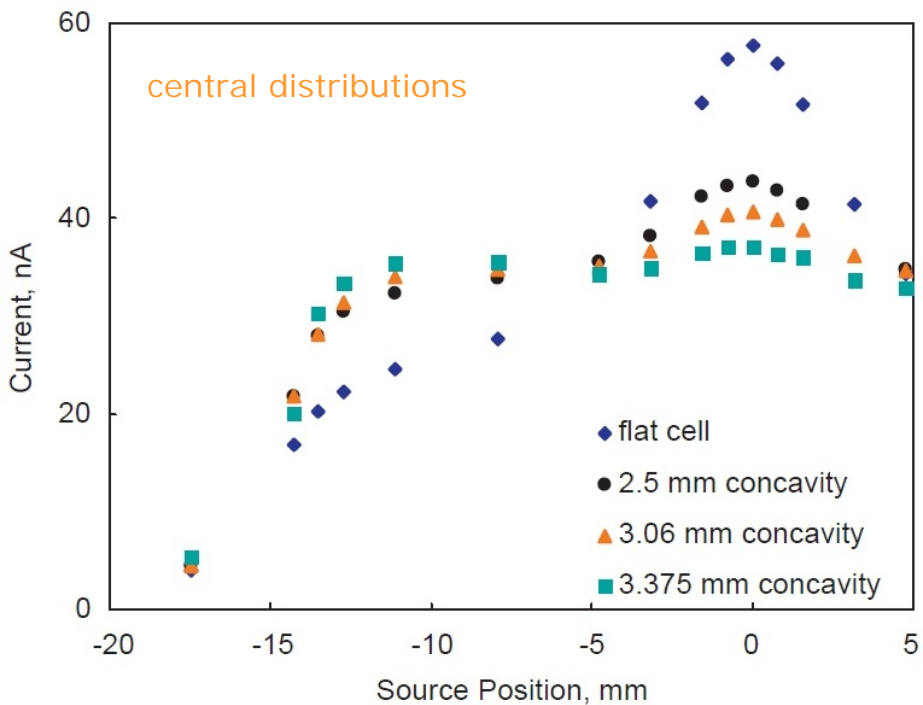
Still, uniformity
not achieved

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

Spherical Cutout



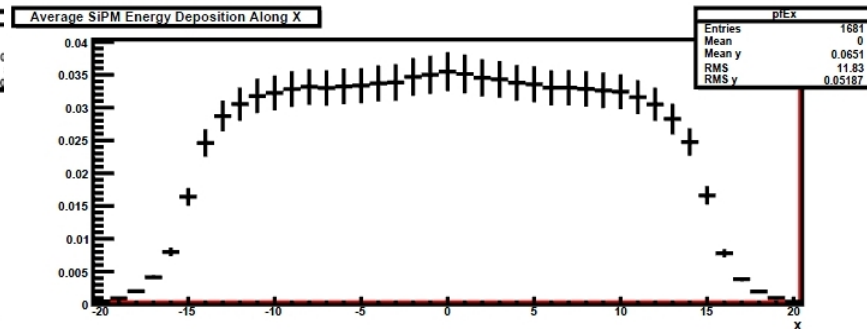
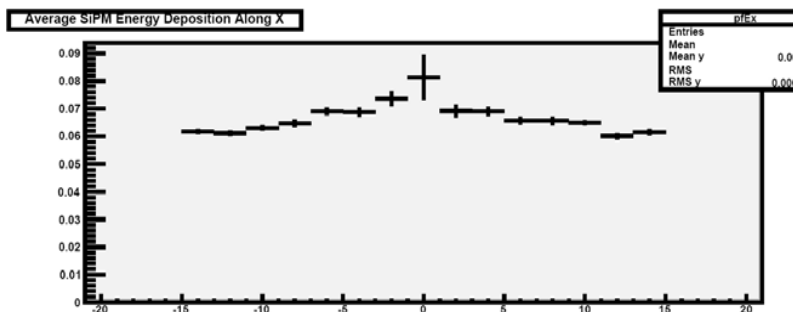
V. Zutshi et al., NIM, 2009



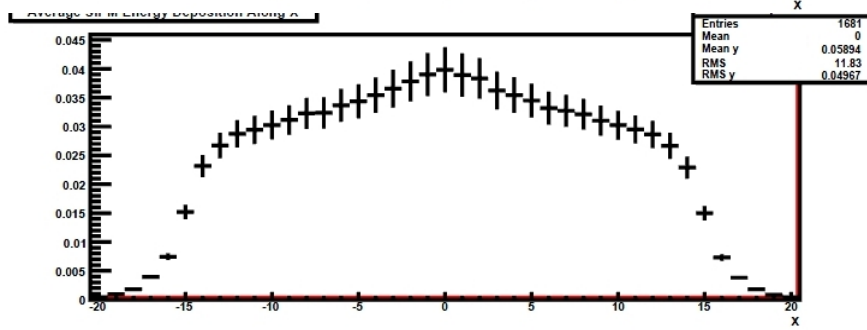
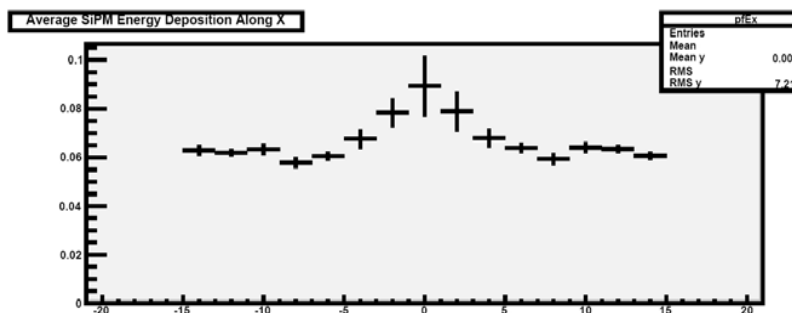
Bottom Spherical Cutouts

average distributions

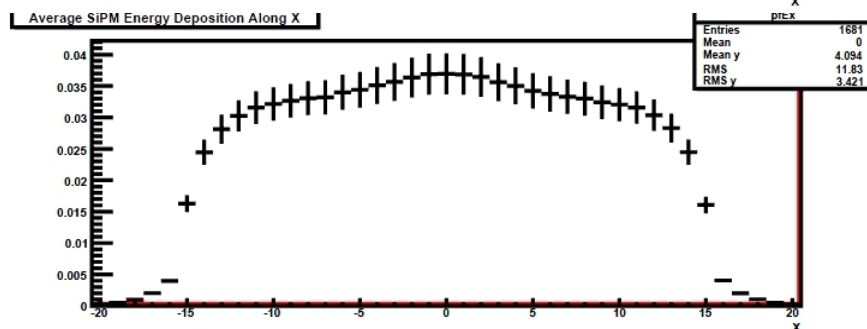
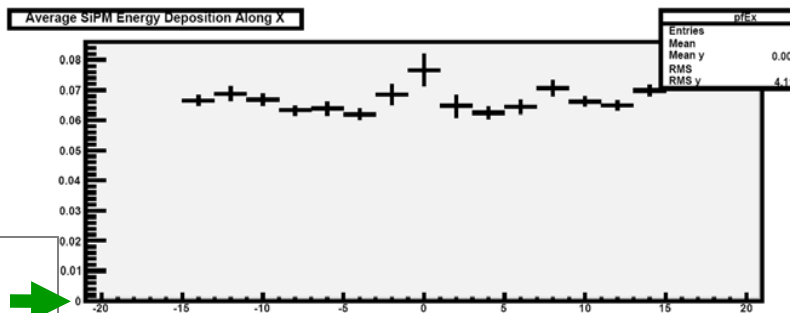
depth = 0 mm



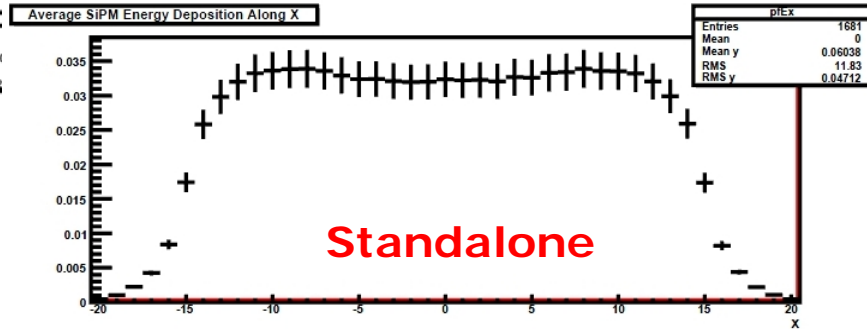
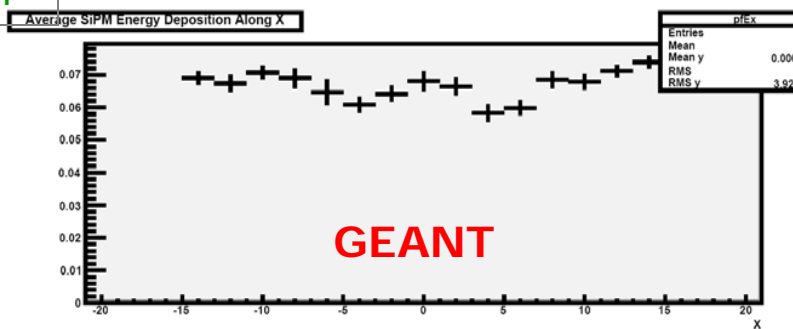
depth = 1 mm



depth = 2 mm



optimal depth around 2.5 mm



(radius = 10 mm)

GEANT

Standalone

Measurements at MPI

Scintillator Tile Uniformity Studies for a Highly Granular Hadron Calorimeter

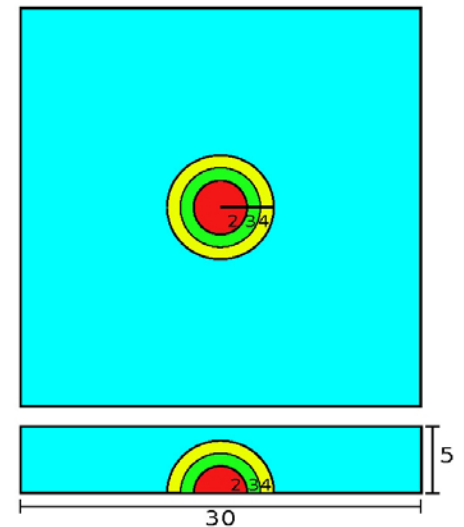
Diploma Thesis of Christian Soldner
Ludwig-Maximilians-Universität
Department of Physics



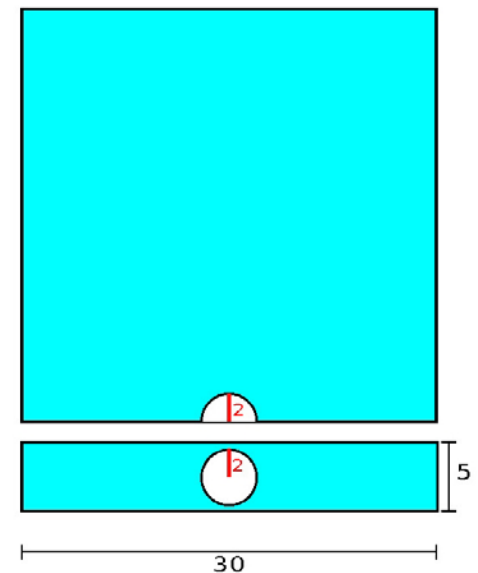
Max-Planck-Institut für Physik
2009

Dimples

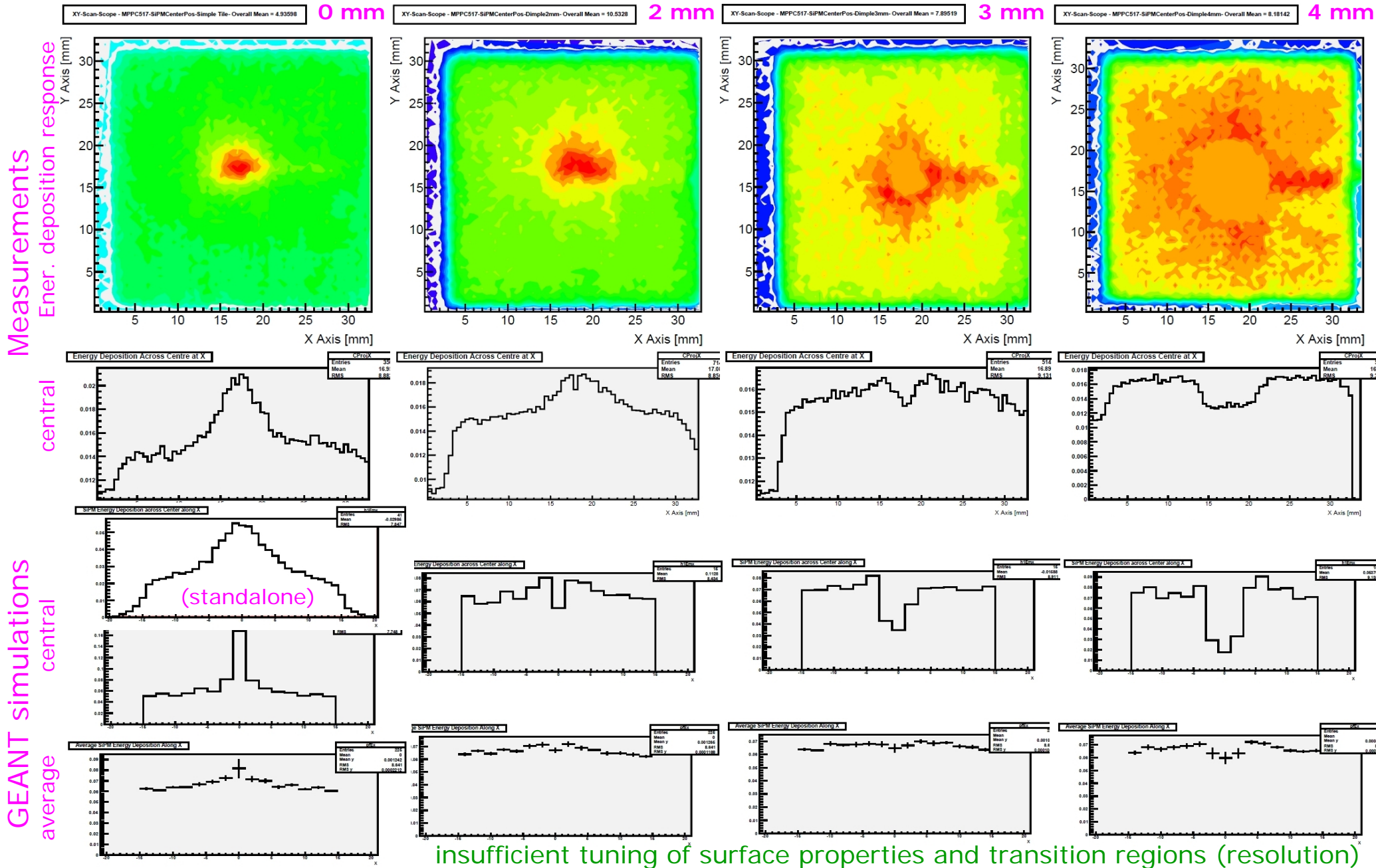
bottom:



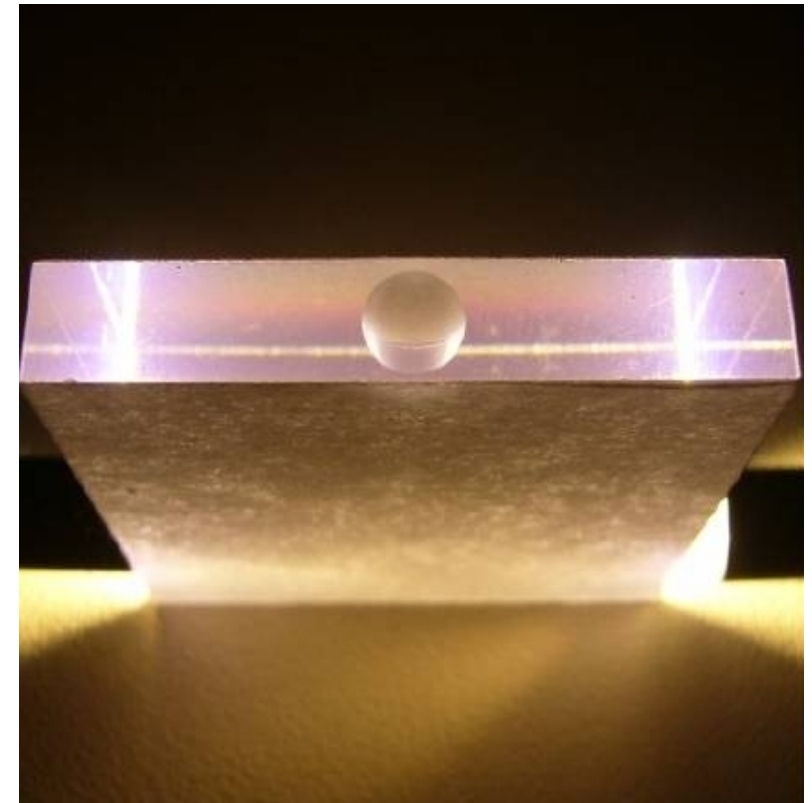
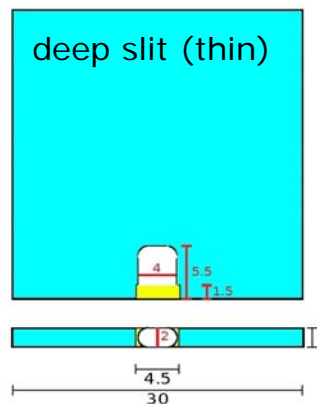
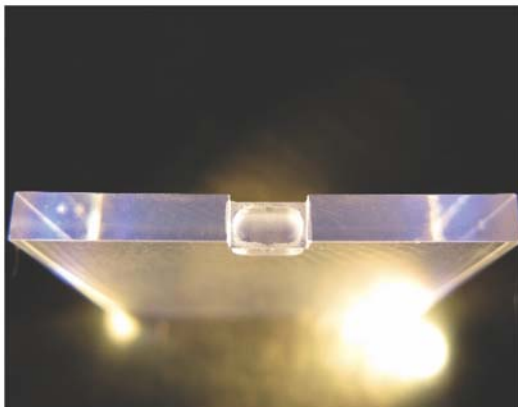
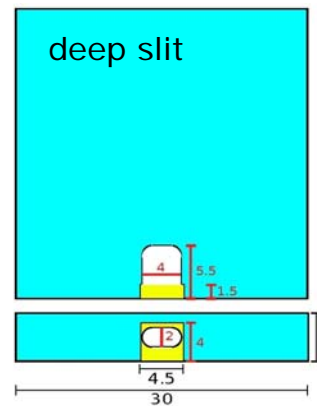
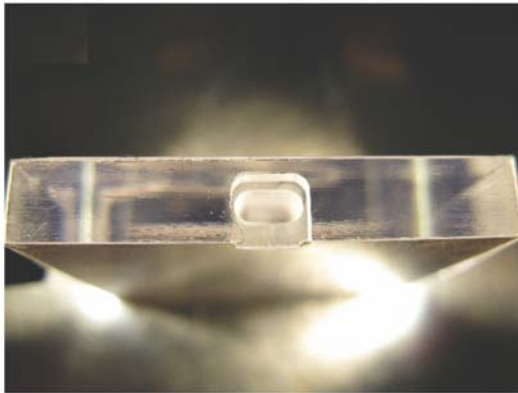
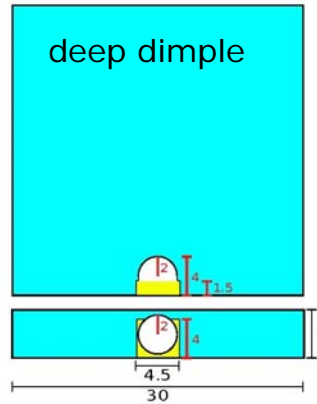
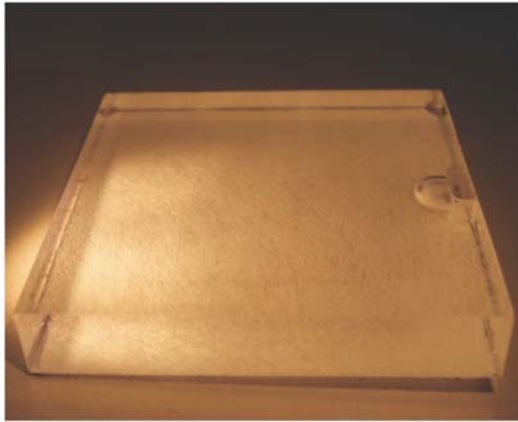
side:



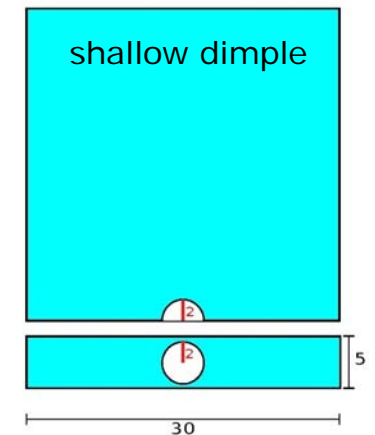
Bottom Dimples



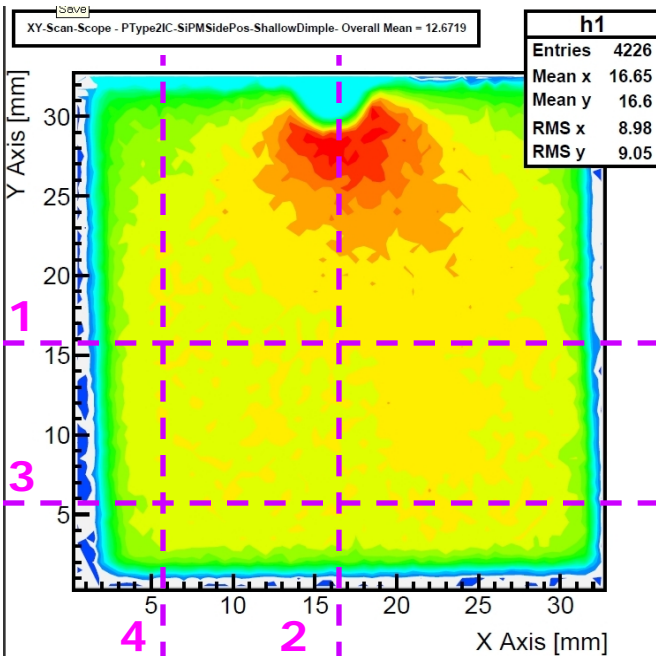
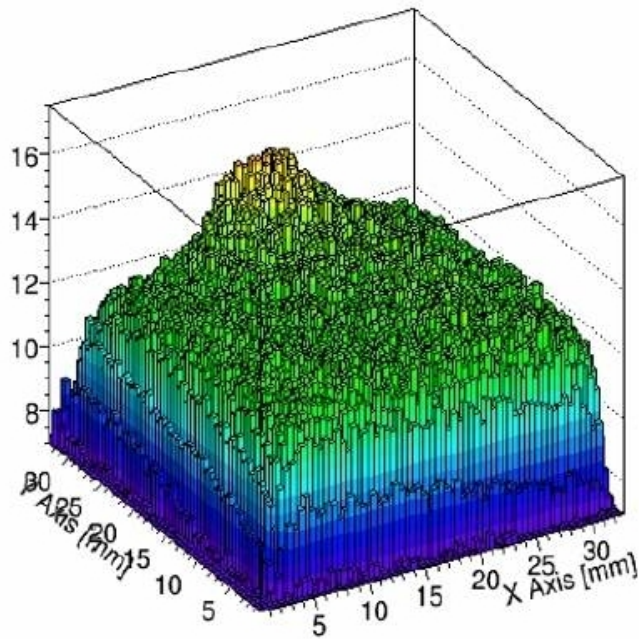
Side Dimples



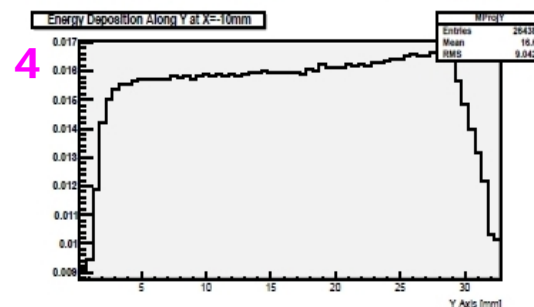
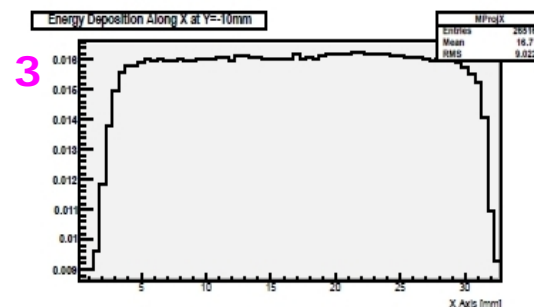
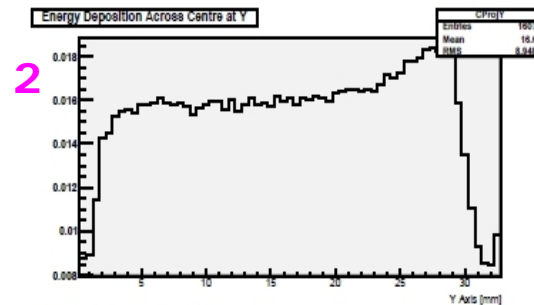
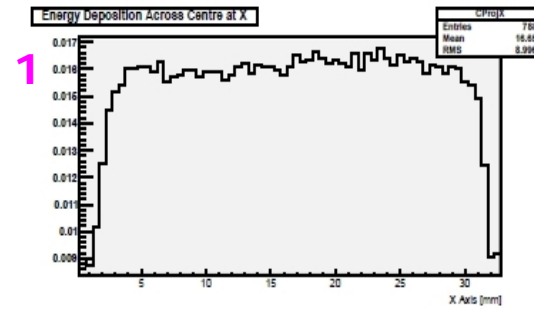
this configuration
was chosen first
for simulations



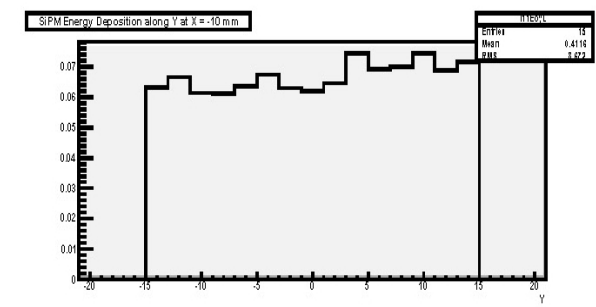
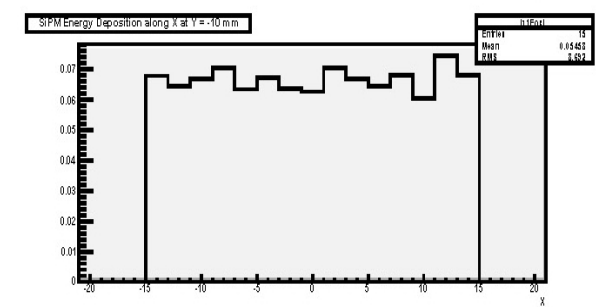
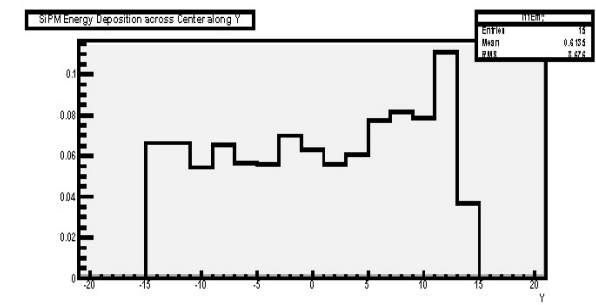
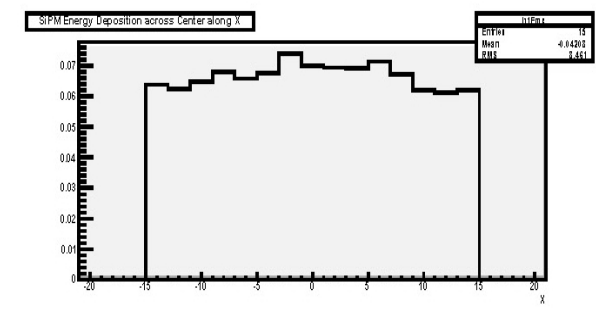
Shallow Dimple



Measurements

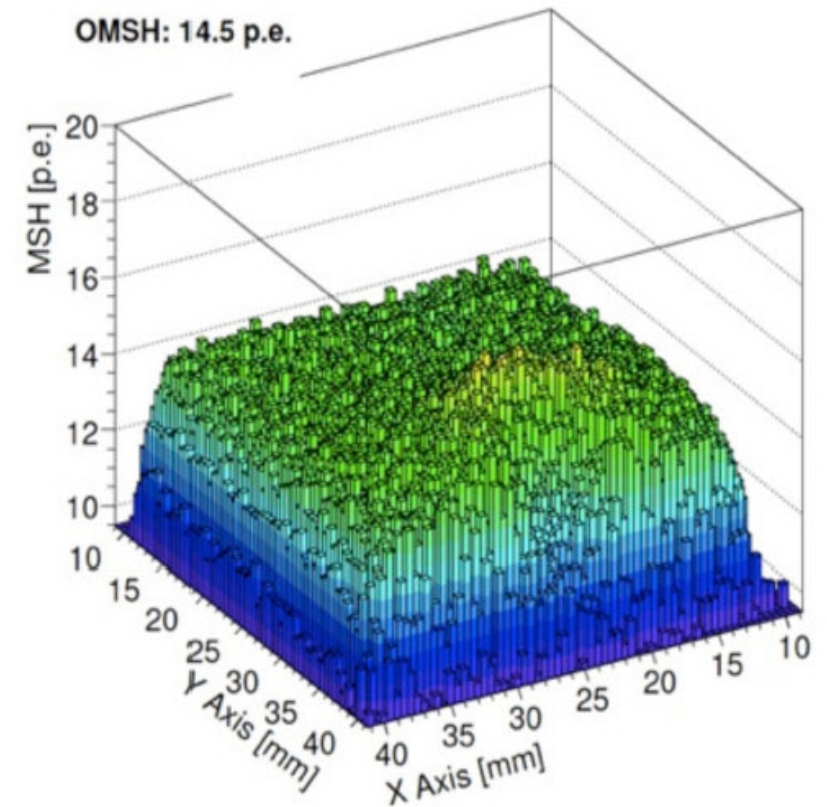
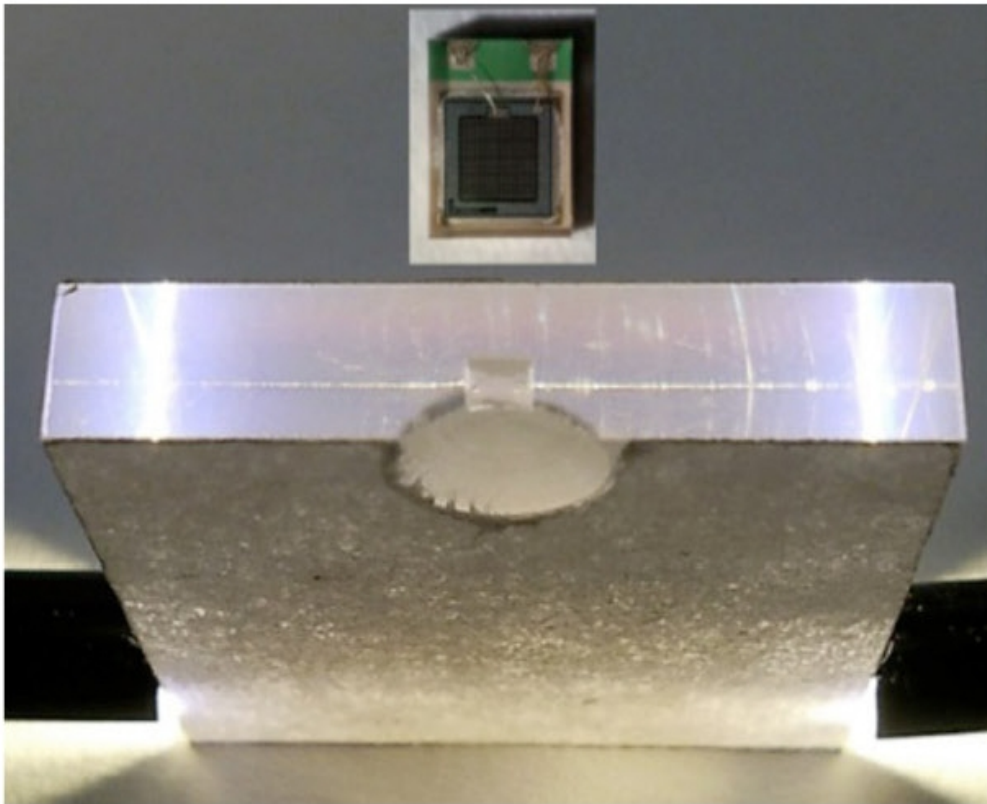


GEANT simulations



Corner Dimple

Most recent configuration, from Frank Simon's proceedings paper at CALOR 2010



not simulated yet

Summary

- A large number of configurations were tested with each of the standalone and GEANT simulation programs, many of them overlapping for cross-checks.
- The simulations reproduce the general features of all available measurements (NIU, Regina, MPI Munich), and details of the more simple configurations.
- In view of the limited manpower, an excessive amount of tuning (e.g. surface properties, thresholds) needs to be done to achieve precise predictive power in distributions and efficiencies for alternate configurations.
- Calculations could be resumed if necessary

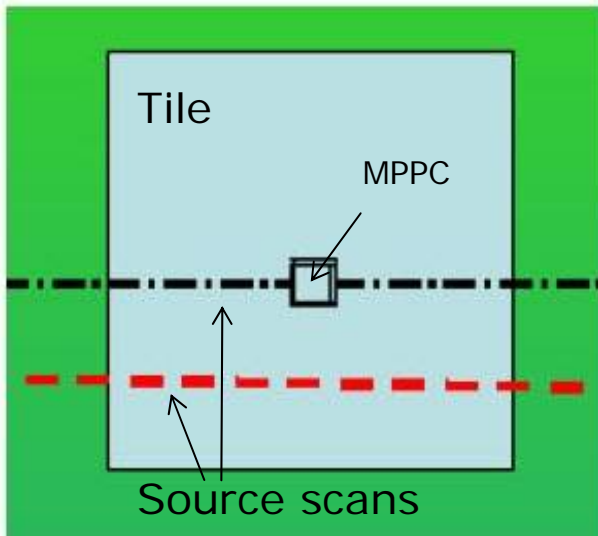
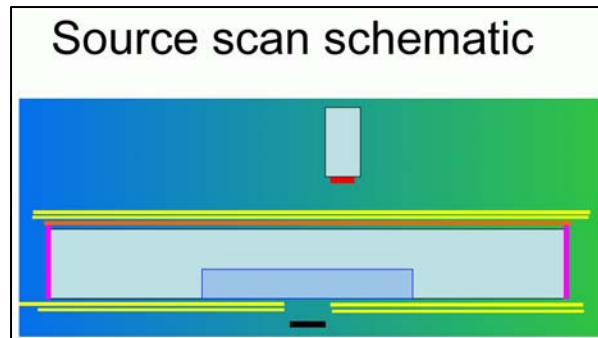
Backup Slides

Standalone Results

The MPPC is located in the center of the bottom face

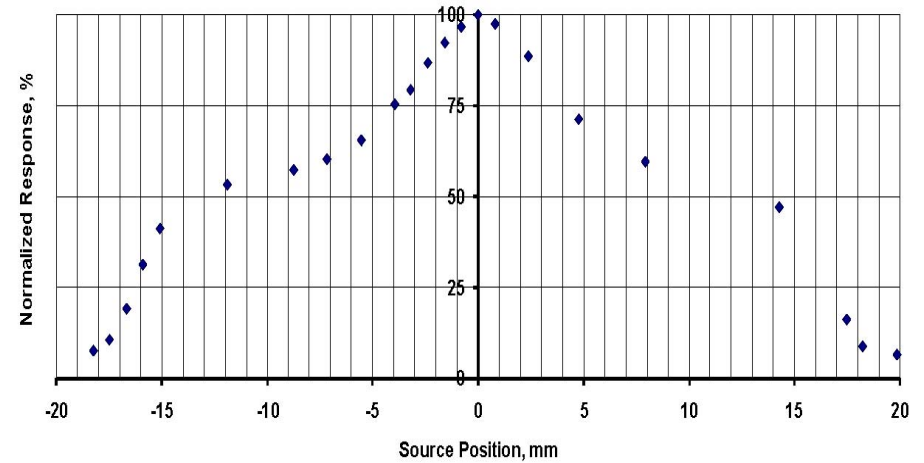
30x30x5 mm³ tile

Measurement from NIU (V.Zutshi et al.)

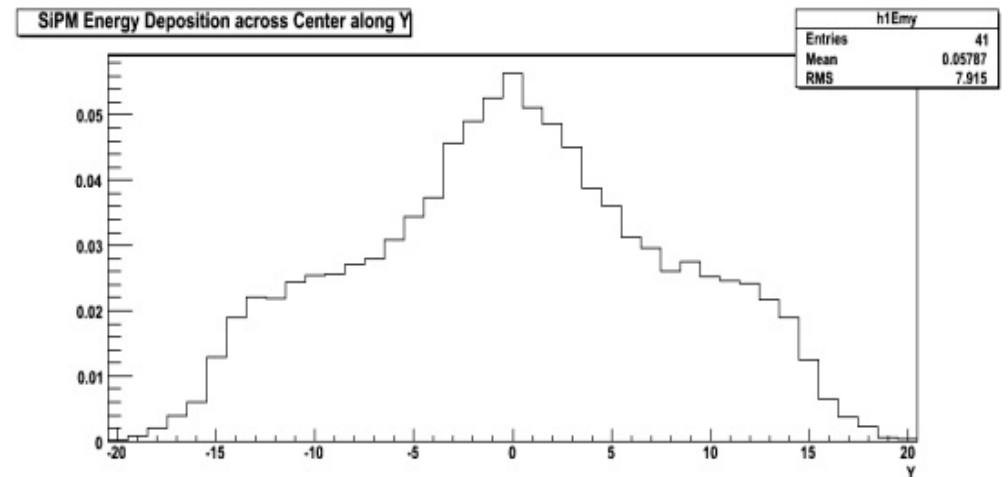


as shown last year in Manchester

Scan Across Green Square Cell with White Paint

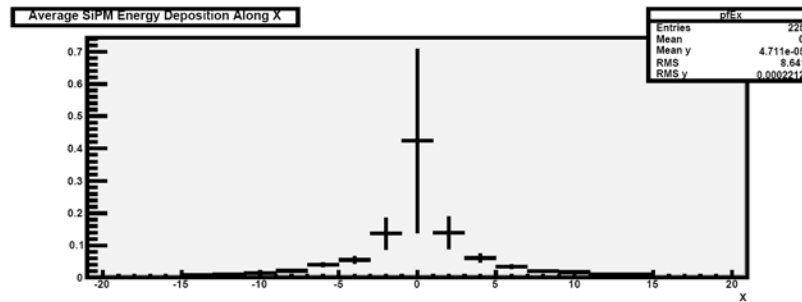


Simulation

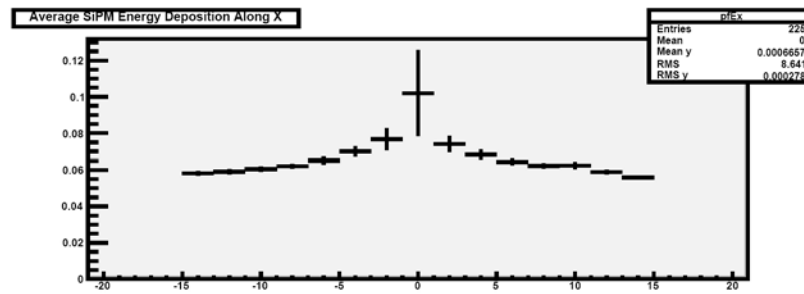


GEANT – Types of Surface

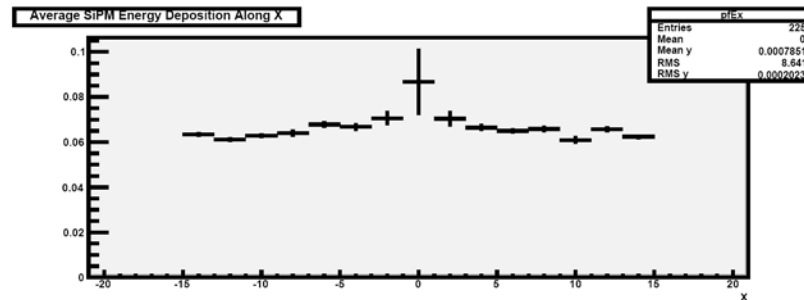
“polished”



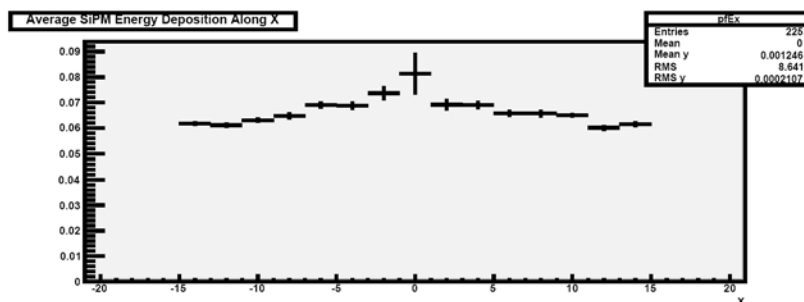
default



“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