First Look at the New SYNRAD3D Results

-- Comparison with previous simple vacuum chamber wall model (9x5 cm elliptical) --

-- Comparison of new simple wall calculation with new detailed wall model --

-- Comparison of absorbed photon energies with ECLOUD photoelectron energies --

Lots of work by Takuya Ishibashi, Laura Boon, Gerry Dugan, David Sagan and Sergey Milashuk

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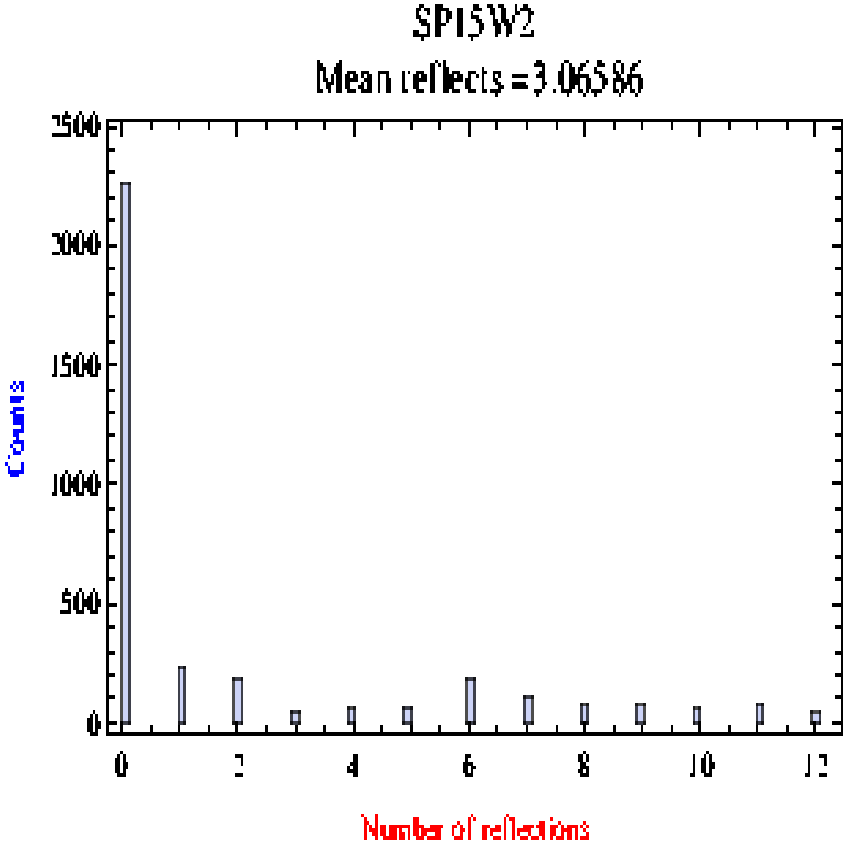
Cornell Laboratory for Accelerator-Based Sciences and Education
Electron Cloud Meeting
13 July 2011

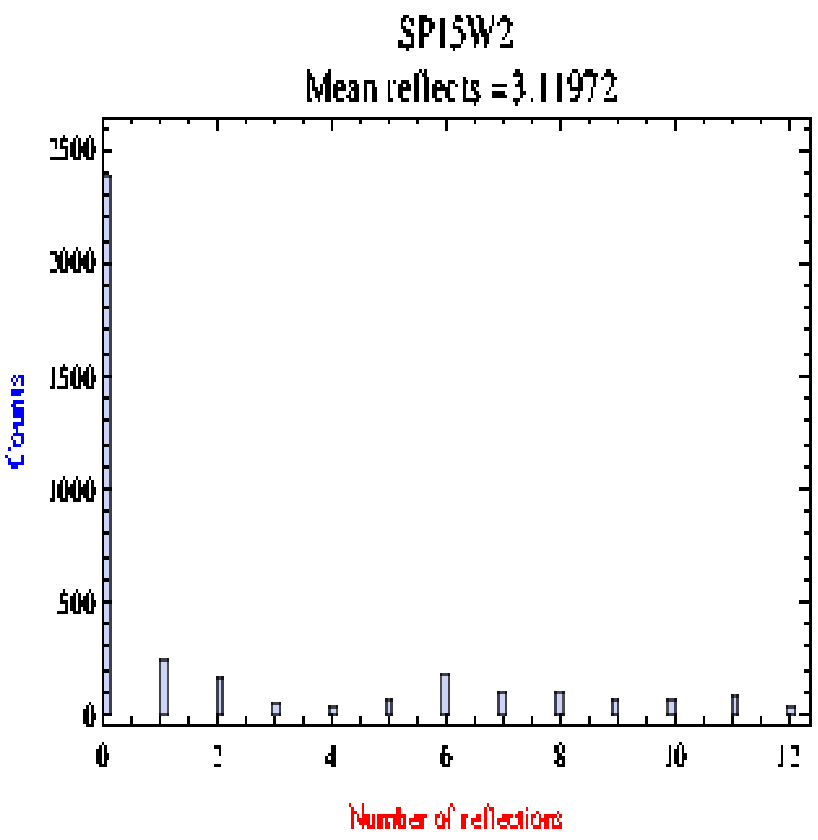
Compare old and new with smooth wall file

5.3 GeV e+, 15W Shielded Pickup

Old SYNRAD3d with smooth wall file



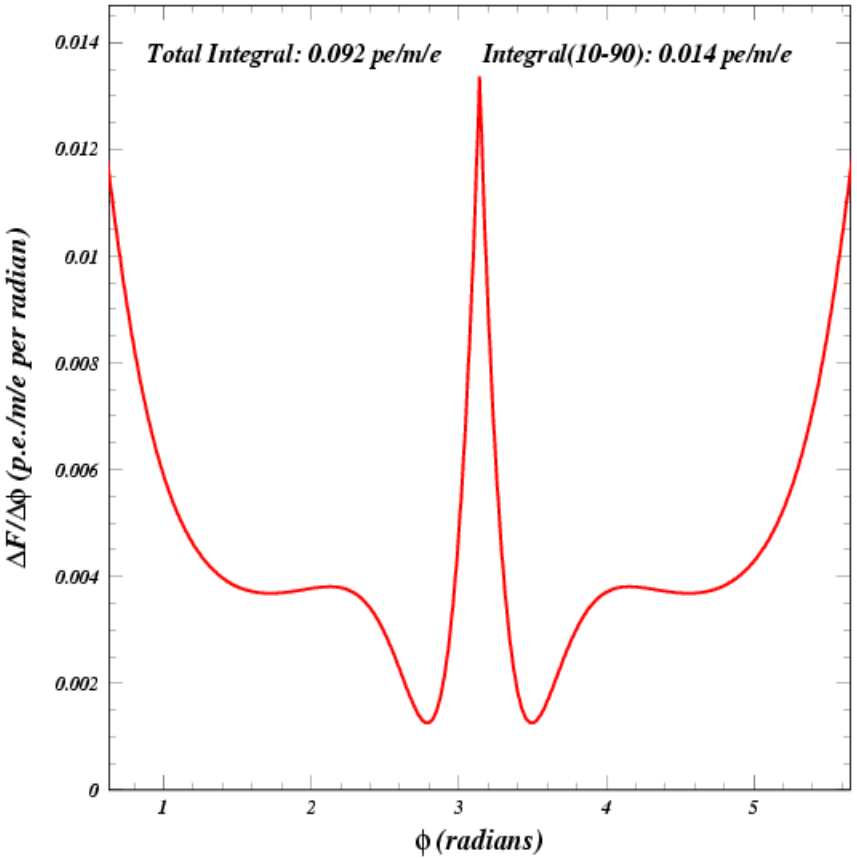
New SYNRAD3d with smooth wall file



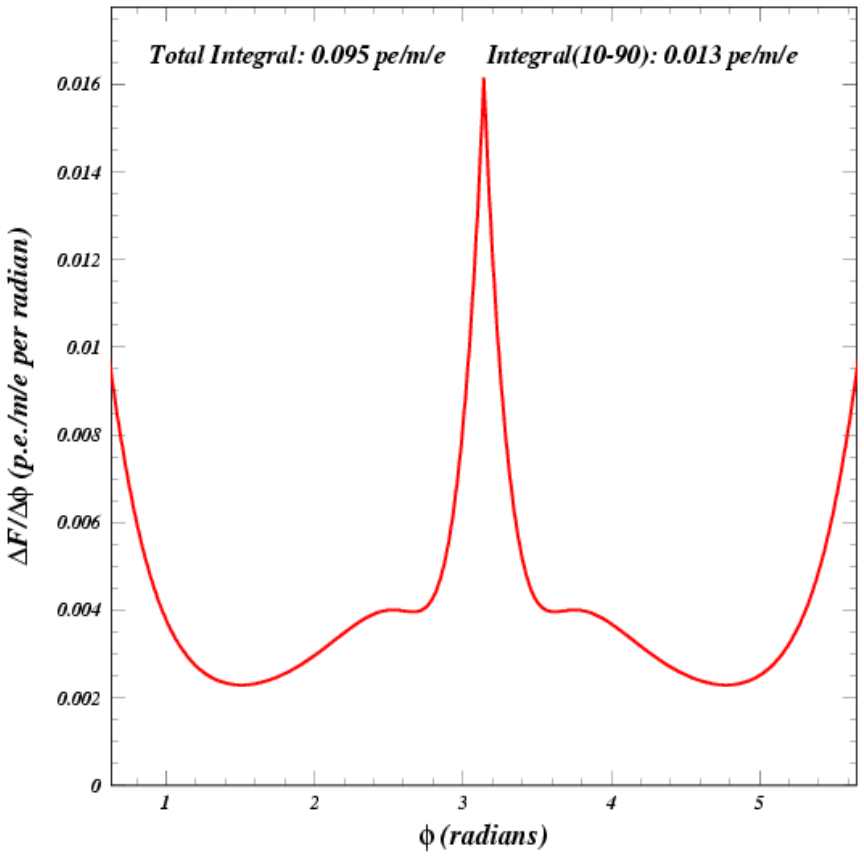
Similar results for the number of reflections prior to absorption.

Compare old and new with smooth wall file
5.3 GeV e+, 15W Shielded Pickup

Old SYNRAD3d with smooth wall file



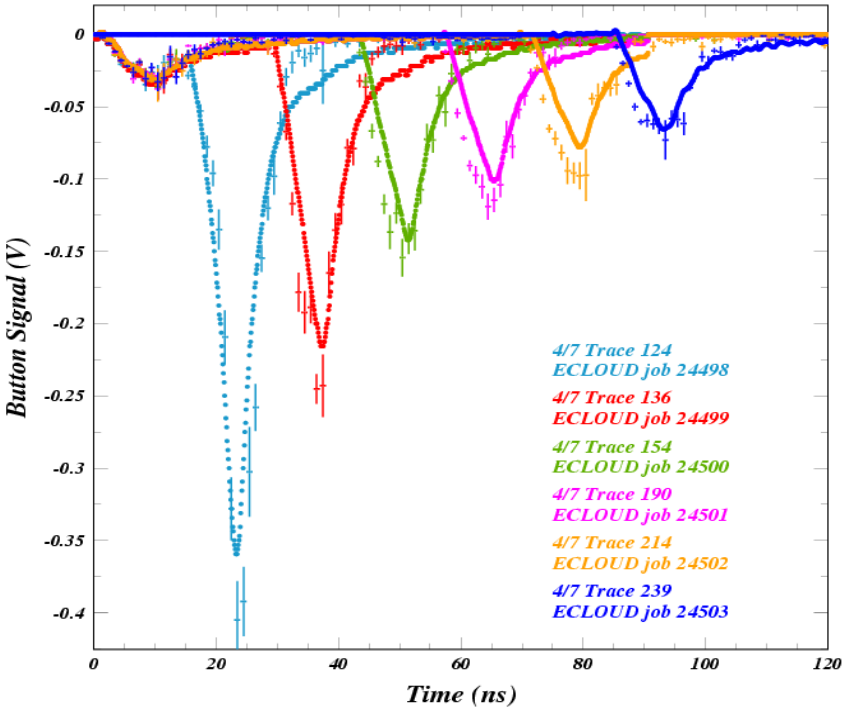
New SYNRAD3d with smooth wall file



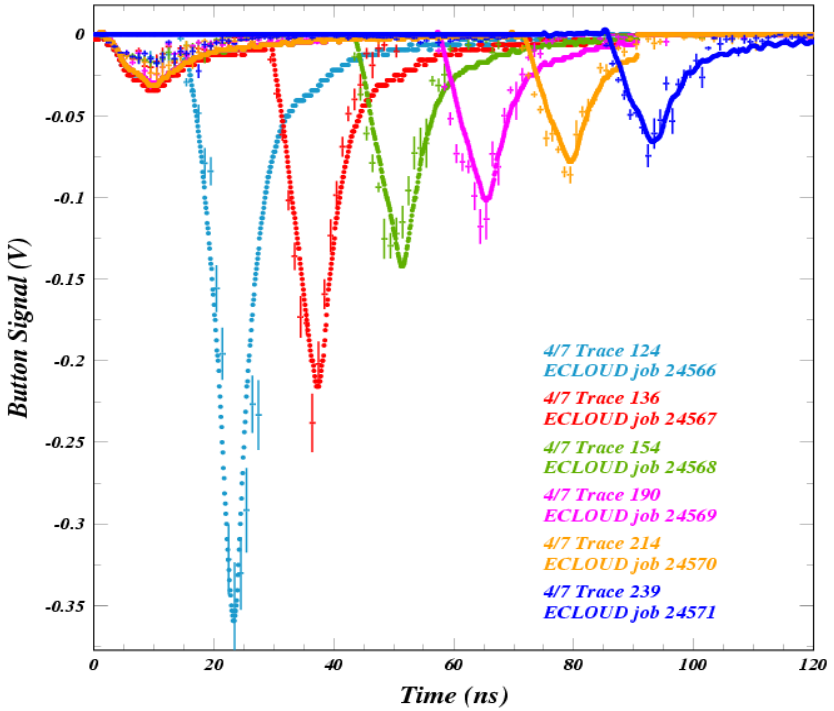
While the total reflectivity has changed little, the azimuthal distribution of absorbed photons is quite different. This will have significant consequences for the ECLOUD simulation of the SPU signal. How has SYNRAD3D changed?

Compare old and new with smooth wall file
5.3 GeV e+, 5 mA/bunch, 15W (TiN) Shielded Pickup

Old SYNRAD3d with smooth wall file



New SYNRAD3d with smooth wall file



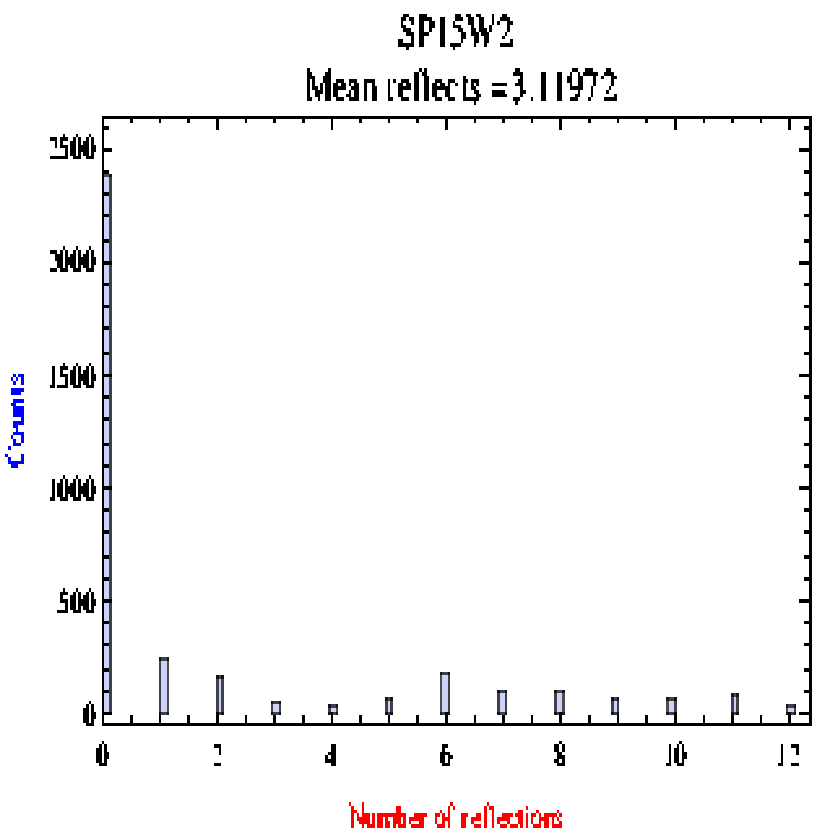
Comparing witness bunch simulations without tuning the ECLOUD input parameters

The witness bunch simulations have been much improved by introducing more flexible photoelectron energy distributions and tuning other input parameters such as the secondary energy distribution. In particular, the introduction of independent p.e. energy distributions and quantum efficiencies for direct and reflected photons will serve to adapt to the new SYNRAD3D calculations. The above comparison points to increasing the quantum efficiency for reflected photons.

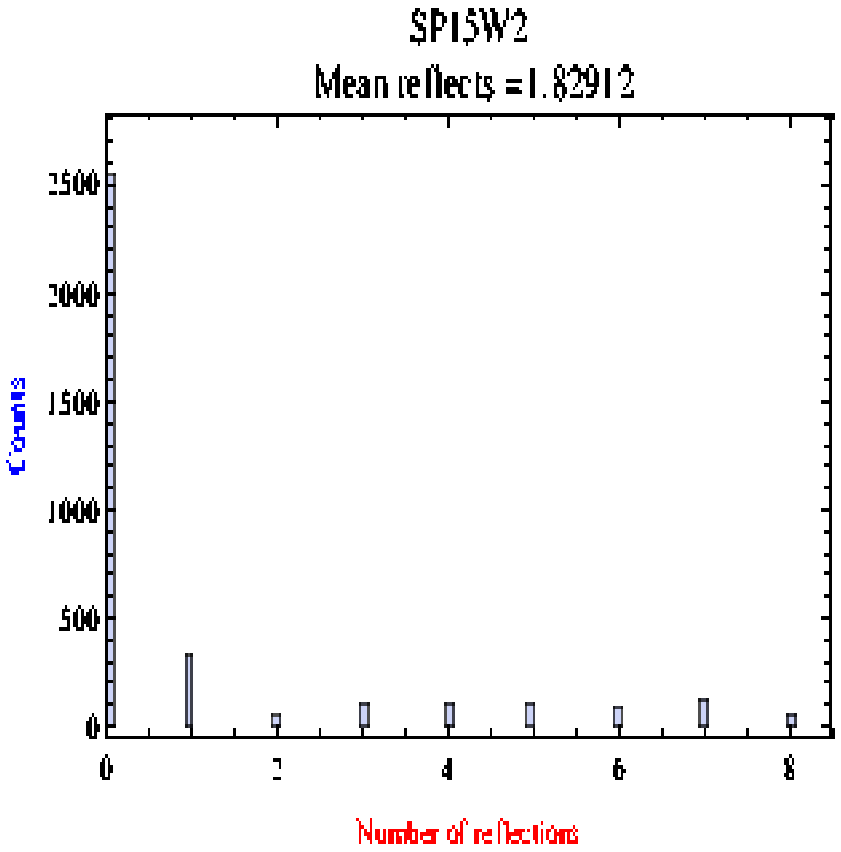
Compare new smooth and realistic wall files

5.3 GeV e+, 15W Shielded Pickup

New SYNRAD3d with smooth wall file



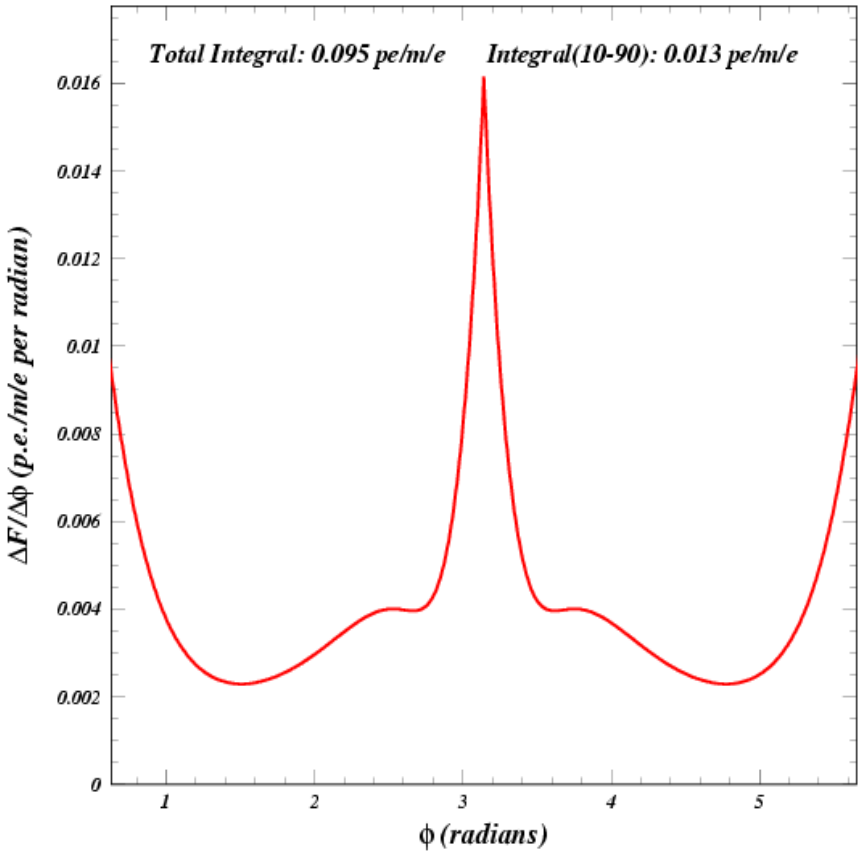
New SYNRAD3d with realistic wall file



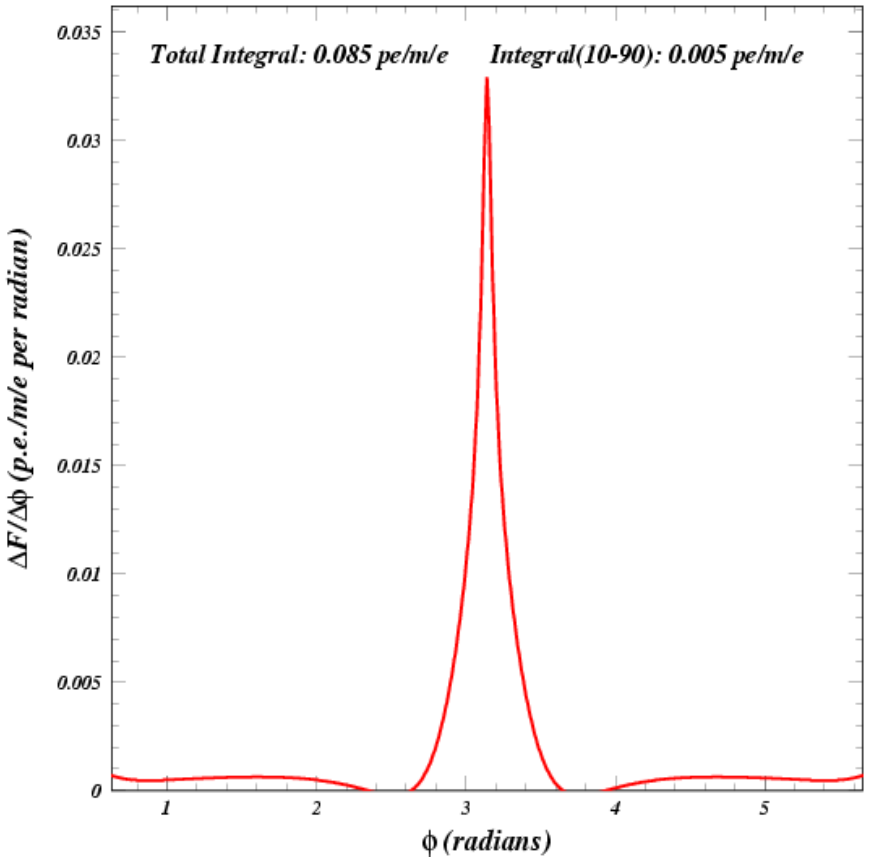
There are significantly fewer reflections with the realistic wall file.

Compare old and new with smooth wall file
5.3 GeV e+, 15W (TiN) Shielded Pickup

New SYNRAD3d with smooth wall file



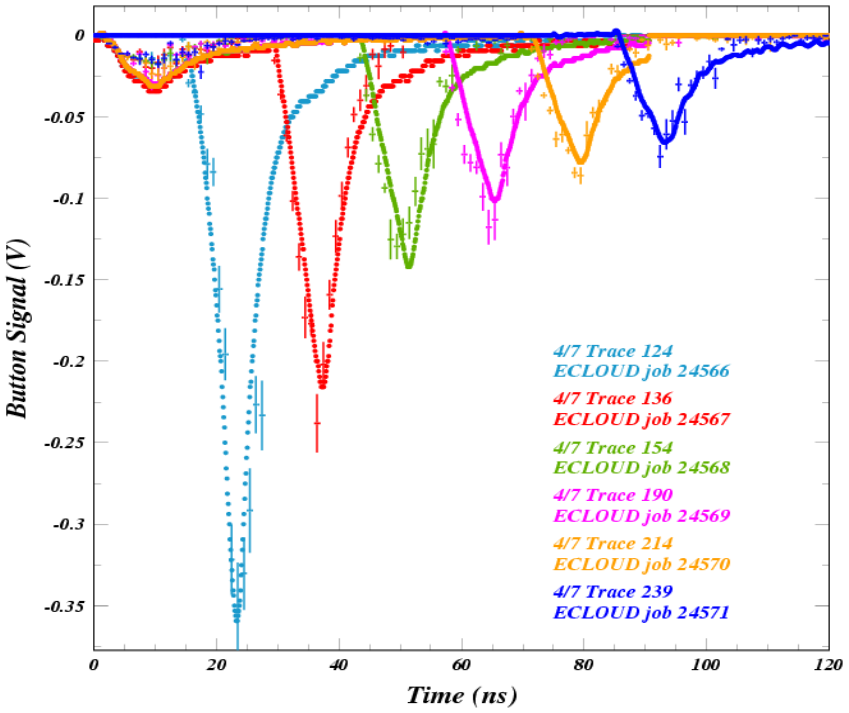
New SYNRAD3d with realistic wall file



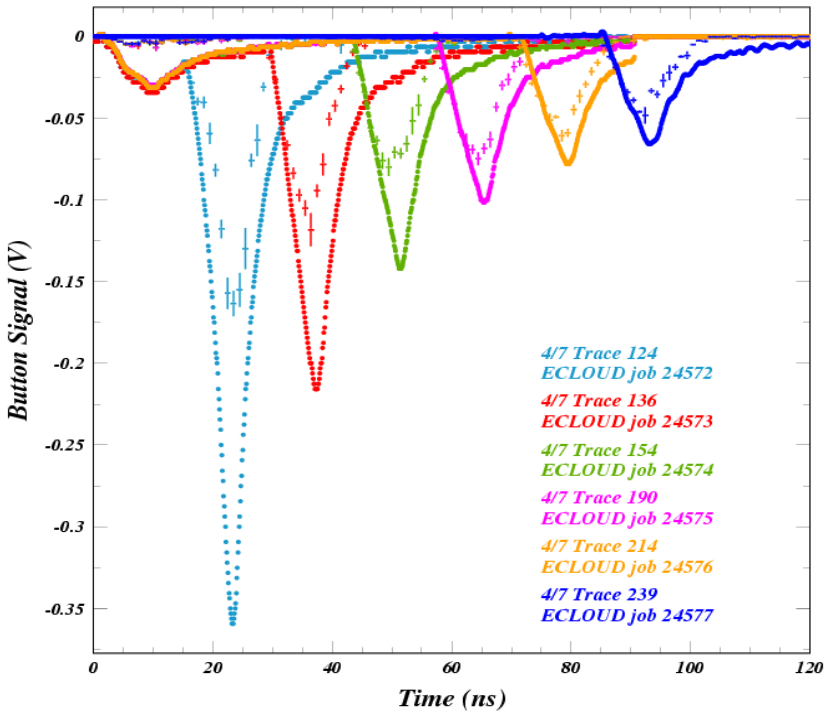
The new realistic wall file predicts dramatically less (factor < 0.5) reflected photoelectrons from scattered photons and that they will come primarily from the inside wall of the beampipe. The SPU measurements can be expected to provide stringent tests of these predictions.

Compare old and new with smooth wall file
5.3 GeV e+, 5 mA/bunch, 15W (TiN) Shielded Pickup

New SYNRAD3d with smooth wall file



New SYNRAD3d with realistic wall file

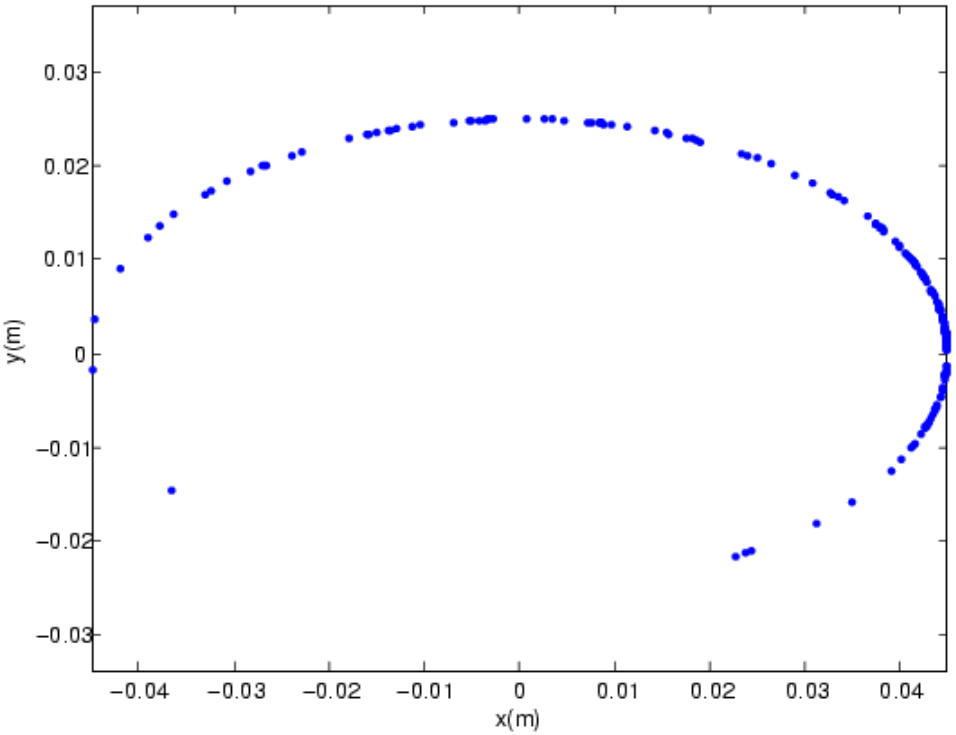


The SYNRAD3D calculation using the detailed wall file indicates almost no SPU signal from the bottom of the beampipe. Since we do see such a signal, we need to investigate the SYNRAD3D calculation in detail. Laura and Takuya have begun this work.

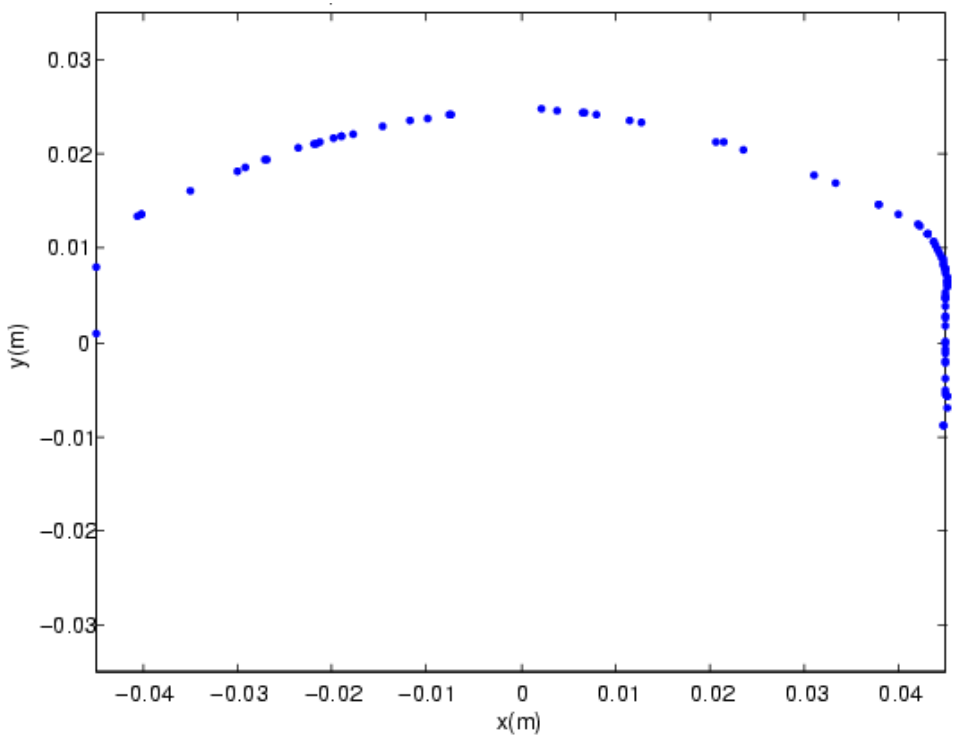
Synrad3d results courtesy Laura Boon

5.3 GeV e+, 15W, photons absorbed at Y < - 2 cm

New SYNRAD3d with smooth wall file



New SYNRAD3d with realistic wall file



Transverse position of the last reflection prior to absorption

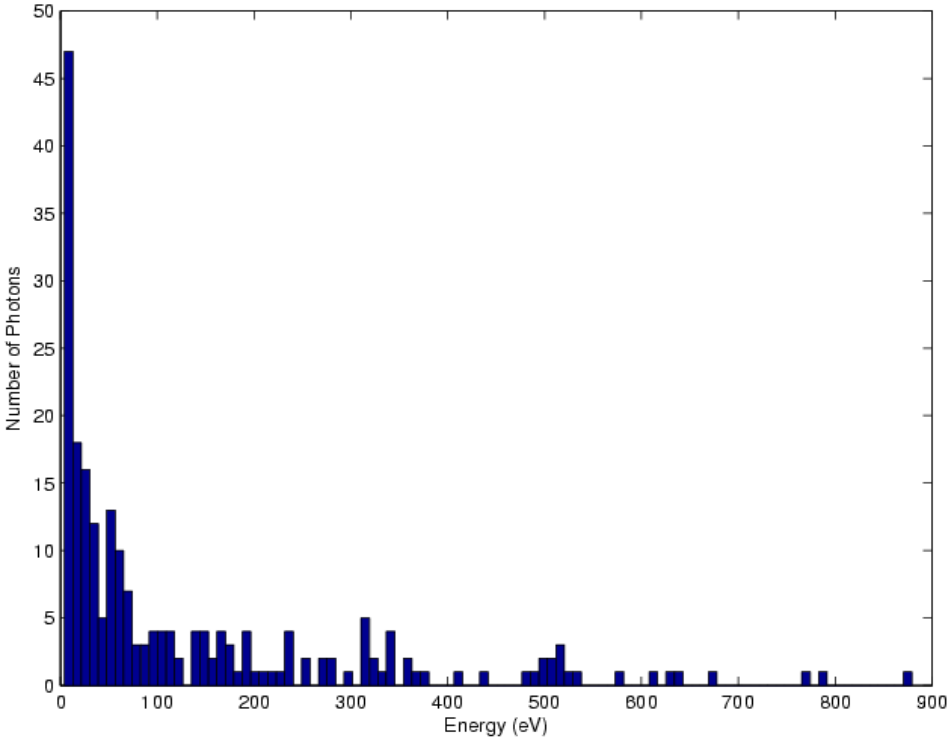
The rate of reflected photons absorbed on the bottom of the vacuum chamber at 15W is very sensitive to the v.c. Shape.

Synrad3d experts: Should we investigate the effect of increasing wall roughness ?

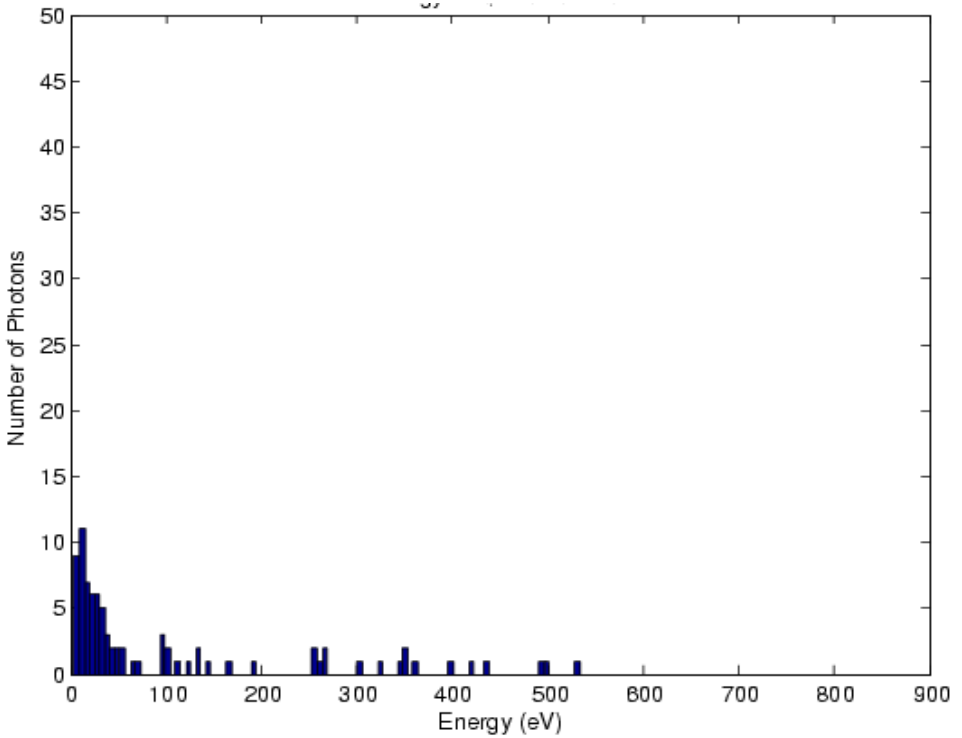
Synrad3d results courtesy Laura Boon

5.3 GeV e+, 15W, photons absorbed at Y < - 2 cm

New SYNRAD3d with smooth wall file



New SYNRAD3d with realistic wall file



The energies of the absorbed photons are significantly higher for the smooth wall calculation.

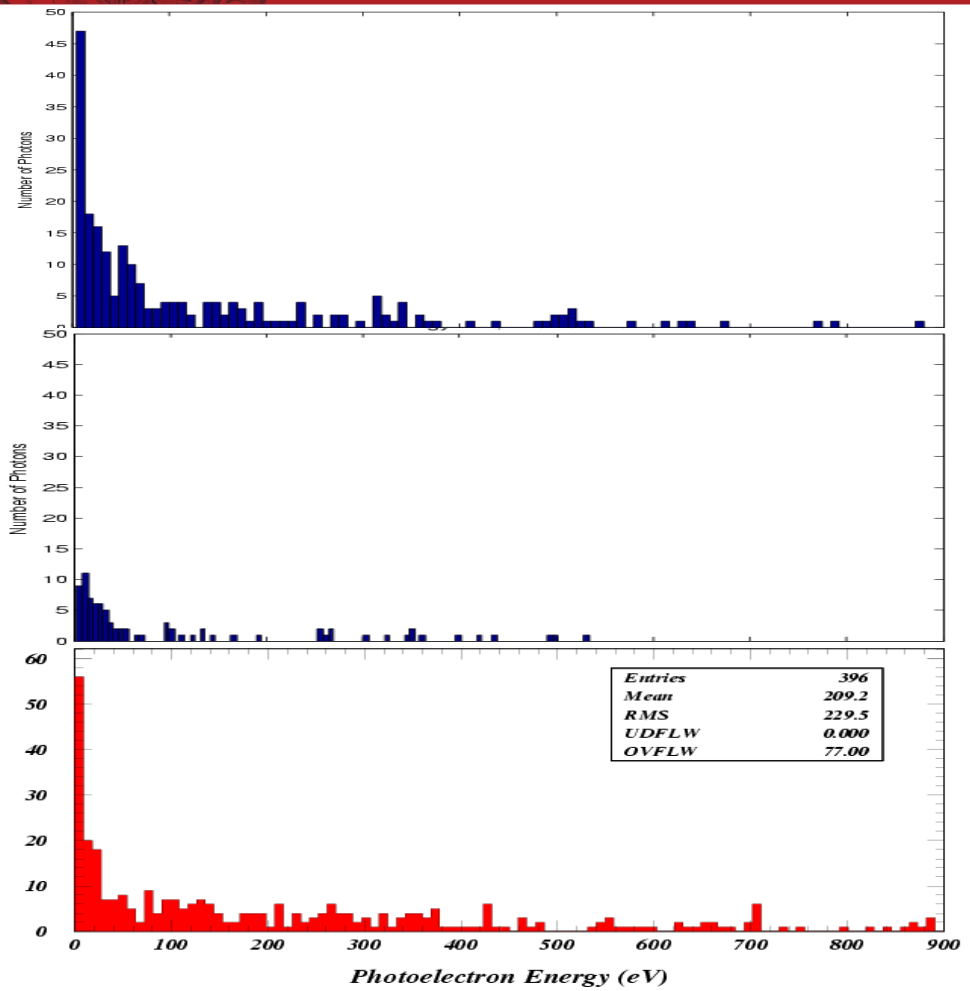
Synrad3d results courtesy Laura Boon

5.3 GeV e+, 15W, photons absorbed at Y < - 2 cm

New SYNRAD3d with smooth wall file
Absorbed photon energy

New SYNRAD3d with realistic wall file
Absorbed photon energy

ECLOUD photoelectron energy distribution which reproduces SPU leading bunch signal shape

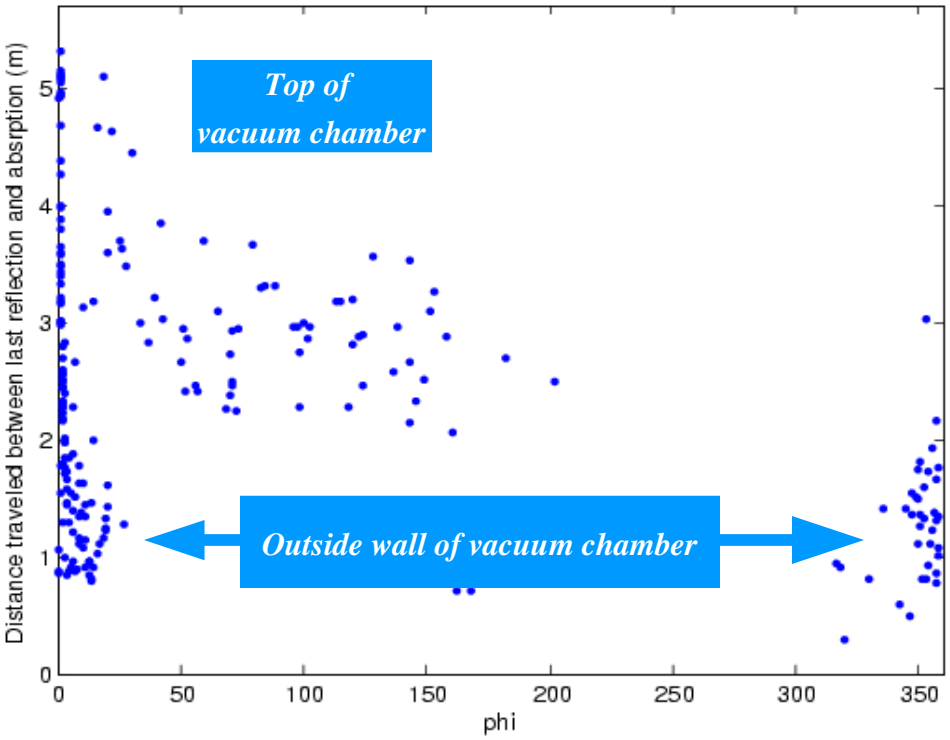


The leading bunch signal shape is primarily sensitive to photoelectron energies above 5 eV, with the risetime given by photoelectrons with energy greater than 100 eV.

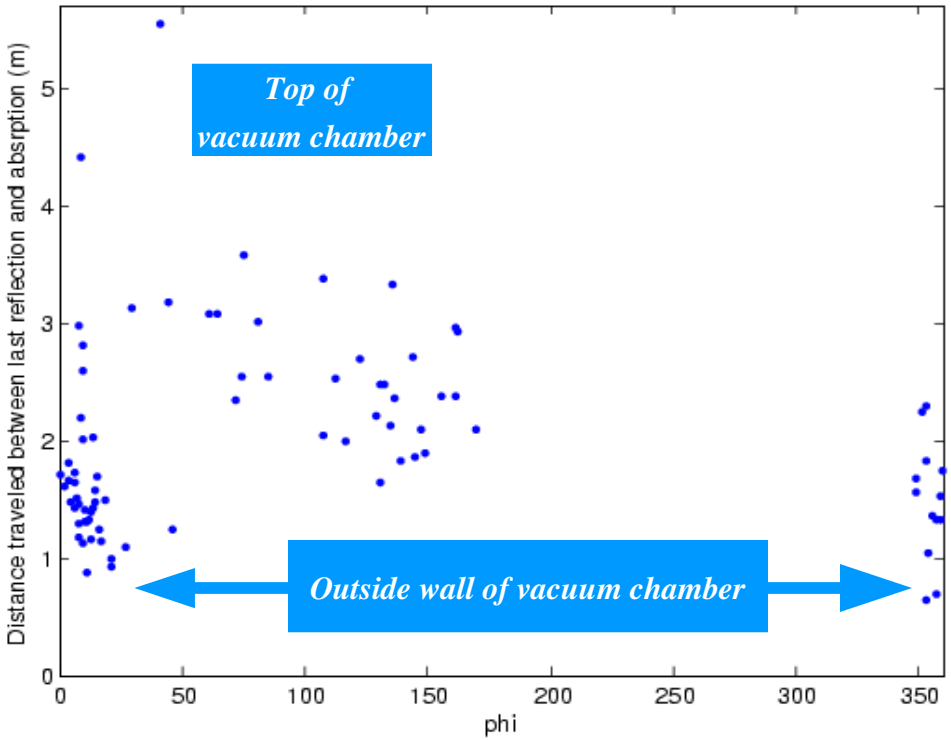
Synrad3d results: Distance of last reflection

5.3 GeV e+, 15W, photons absorbed at Y < - 2 cm

New SYNRAD3d with smooth wall file



New SYNRAD3d with realistic wall file



The end of the upstream dipole B15W (6.57 m long) is 1.53 m from the 15W shielded pickup. Do the higher-energy absorbed photons come from further upstream, inside the dipole?