Comparison of old SYNRAD3D using the smooth elliptical wall file and the new SYNRAD3D including diffuse scattering using the realistic wall file

-- Witness bunch studies at 15E and 15W --

-- Coherent tune shift measurement/simulation comparison as published at IPAC10 --

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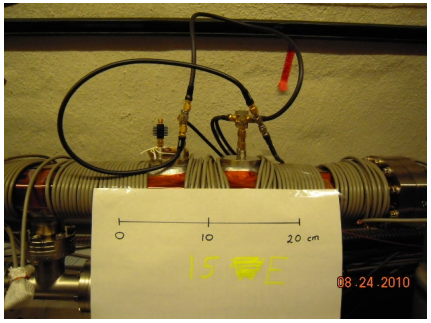
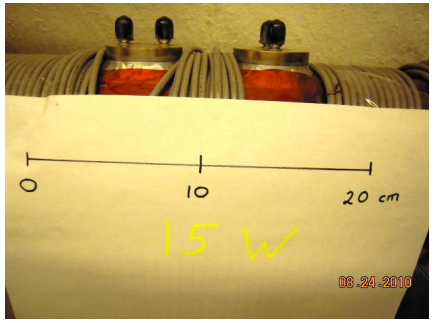
15E/W Geometry and SYNRAD/SYNRAD3D Comparison
Slide from talk of 8 September 2010

15E



15W



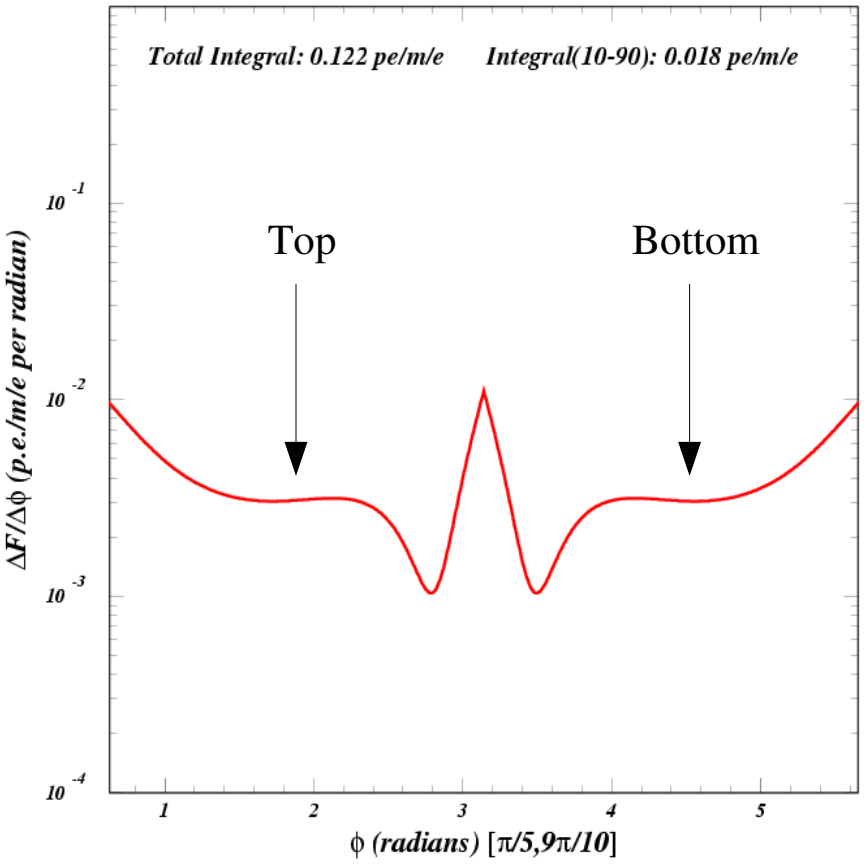
	15E		15W	
	e+	e-	e+	e-
Distance to source (m)	3.91	2.54	2.83	3.54
Source dipole	B16E	B15E	B15W	B16W
Field strength (kG)	2	3	3	2
Dipole length (m)	6.57	6.57	6.57	6.57
Distance to dipole	2.79	0.97	1.53	2.22
SYNRAD direct photon rate (γ/m/e)	0.4	1.2	0.9	0.5
ECLOUD reflectivity (%)	20	33	20	33
SYNRAD3D direct photon rate (γ/m/e)	0.17	0.57	0.44	0.22
SYNRAD3D reflectivity (%)	40	13	27	38

SYNRAD and SYNRAD3D calculate a similar e-/e+ direct rate ratio at 15E and 15W, but SYNRAD3D rates are lower because more than half the direct photons are reflected.

SYNRAD3D also shows the degree to which the ring symmetry reverses the reflectivity.

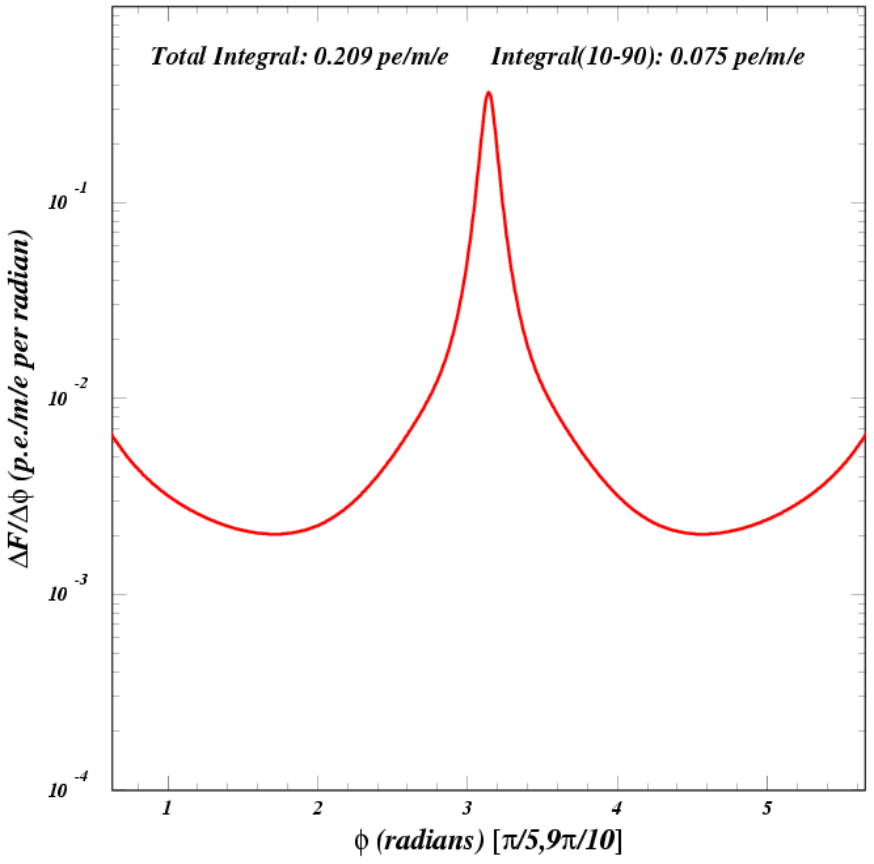
Compare old SYNRAD3d with smooth wall file and new code with realistic wall file including diffuse scattering 5.3 GeV e+, 15W Shielded Pickup

Old SYNRAD3d with smooth wall file



Assuming QE = 24%

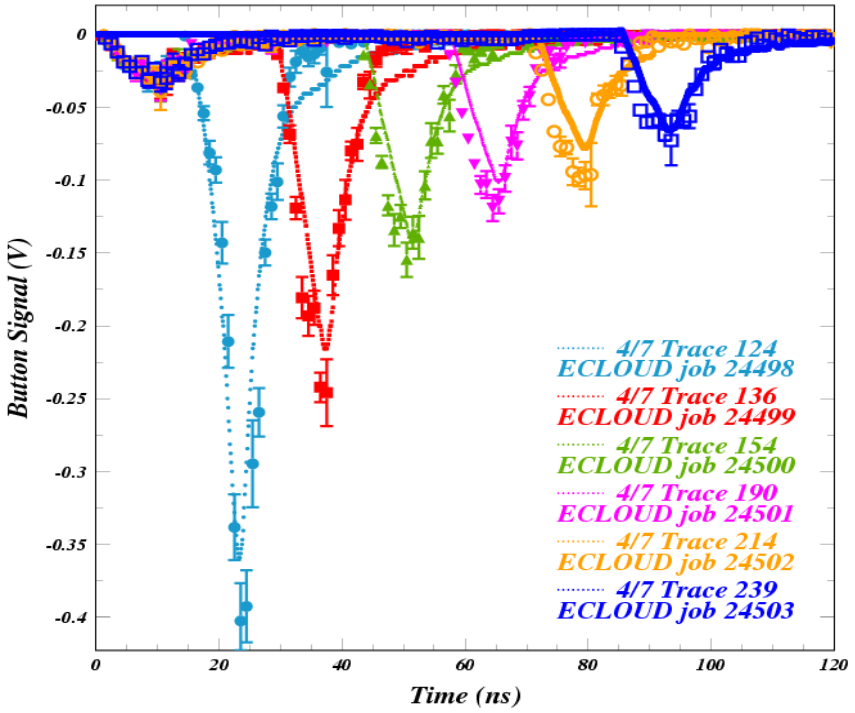
New SYNRAD3d including diffuse scattering with realistic wall file



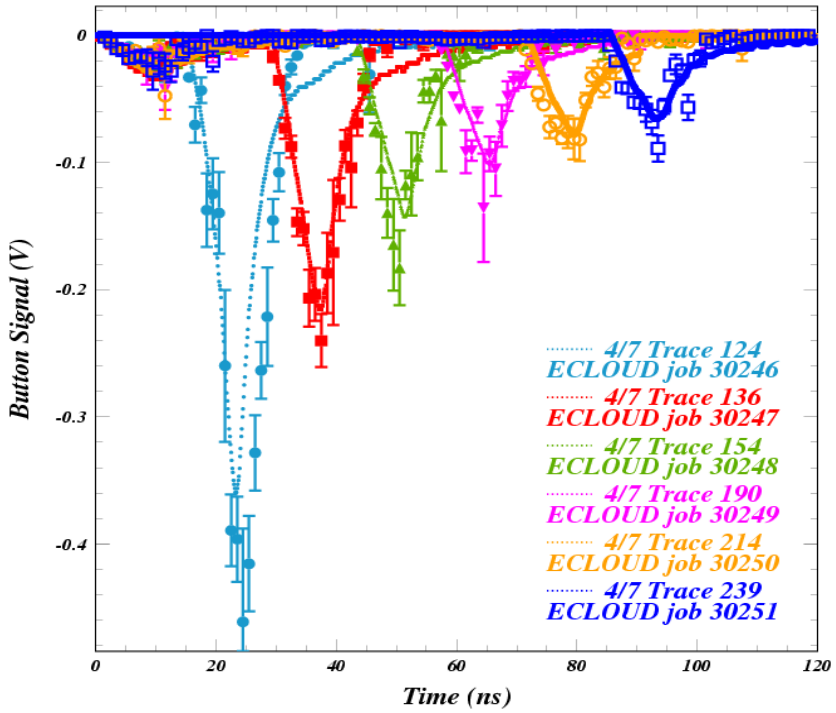
ECLOUD simulations to date have been done for p.e. rates on the bottom of the beampipe of about 0.003 pe/m/e. With the smooth wall file, the rates at the top and bottom of the beampipe are due to the (unrealistic) elliptical shape of the vacuum chamber at the outside wall. With the realistic wall file, the rates are due to the diffuse scattering component.

Shielded Pickup Witness Bunch Study
5.3 GeV e+, 5 mA/bunch, 15W (TiN) Shielded Pickup

Old SYNRAD3d with smooth wall file



New SYNRAD3d with realistic wall file



Comparing witness bunch simulations with no further tuning of ECLOUD input parameters

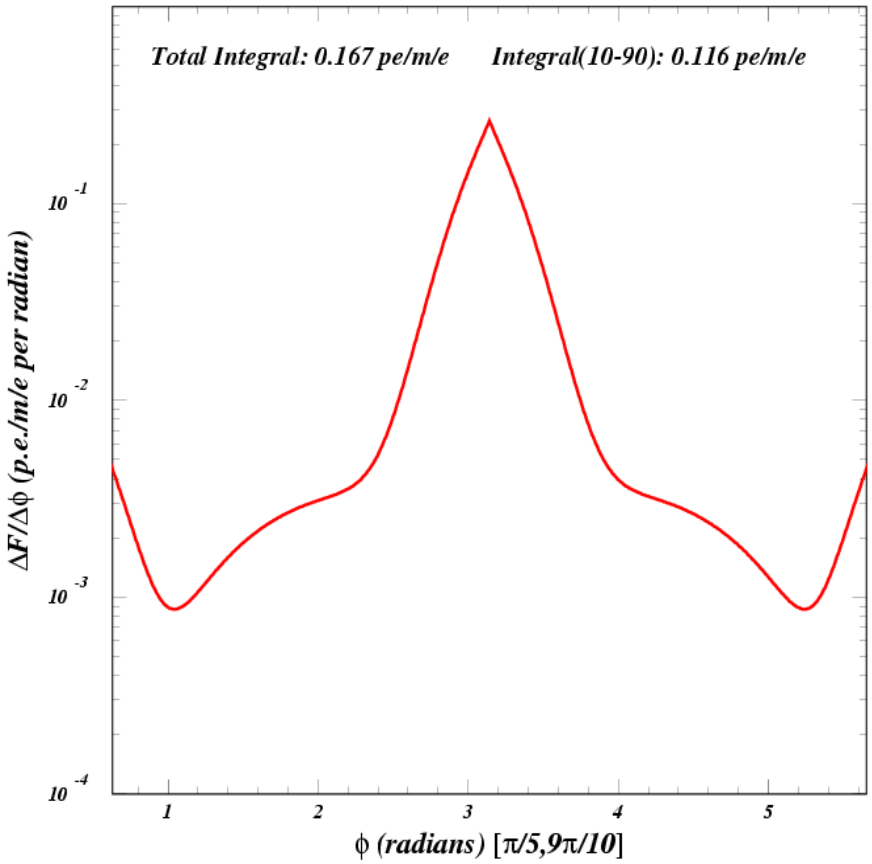
The comparison with the data is similarly satisfactory, even though the distribution of photoelectrons produced by scattered photons is substantially different.

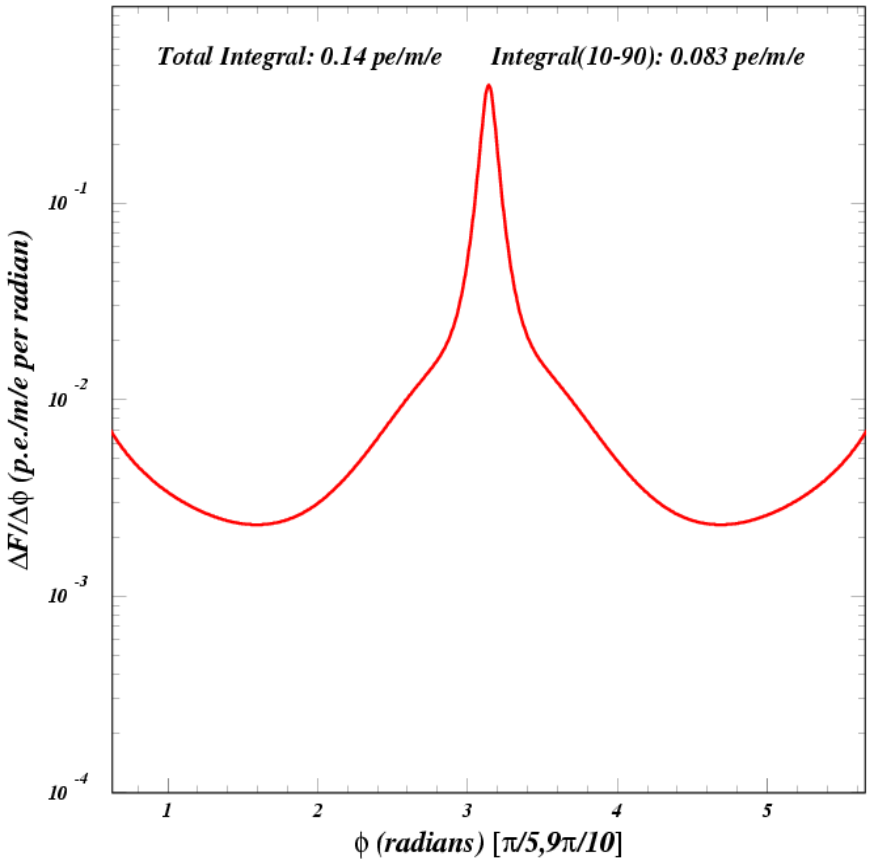
Compare old SYNRAD3d with smooth wall file and new code with realistic wall file including diffuse scattering
5.3 GeV e+, 15E Shielded Pickup

Old SYNRAD3d with smooth wall file

Assuming QE = 27%

New SYNRAD3d including diffuse scattering with realistic wall file

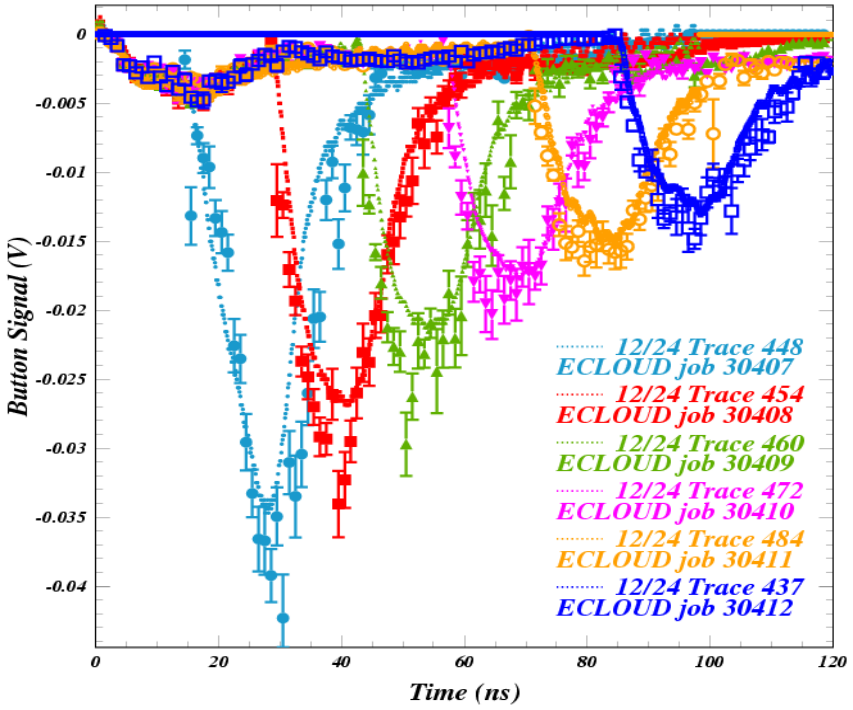




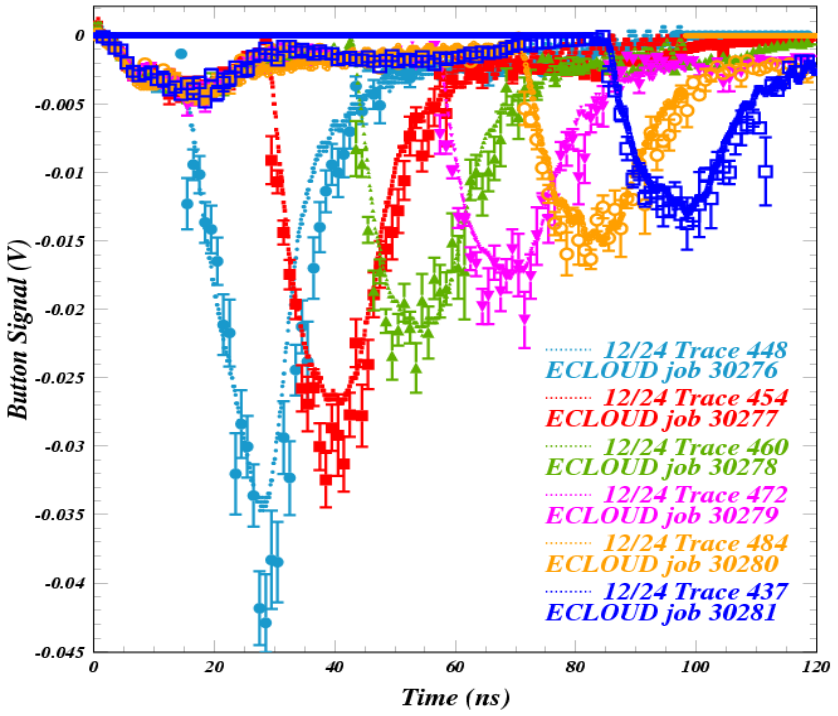
In contrast to 15W, both the old and new SYNRAD3d calculations give high rates of photons incident on the inner wall. (Reminder: my talk of 24Nov11 showed the rate on the inner wall to be important to match the SPU signal shapes.) The distributions of photons on the top and bottom of the beampipe are quite different.

5.3 GeV e+, 3 mA/bunch, 15E (Carbon) Shielded Pickup

Old SYNRAD3d with smooth wall file



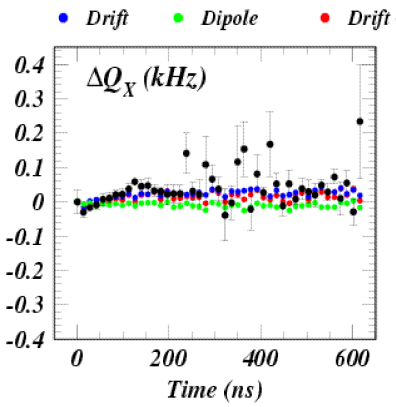
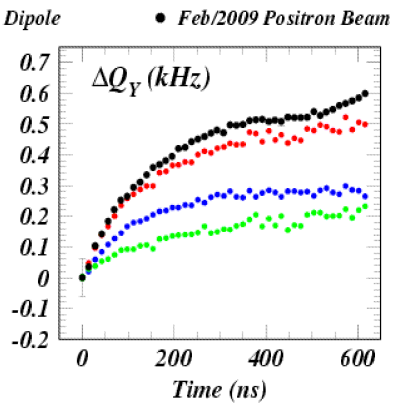
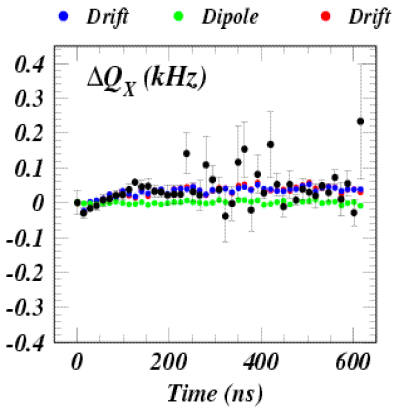
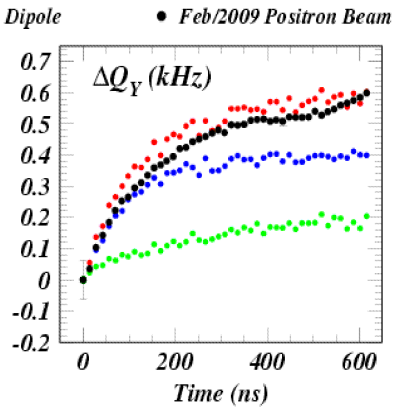
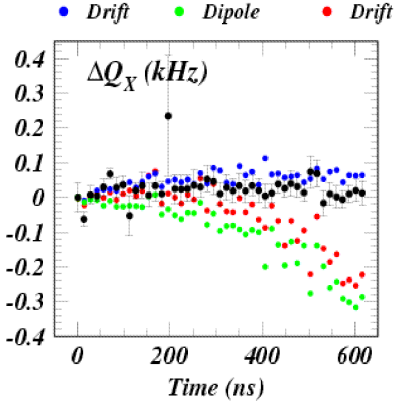
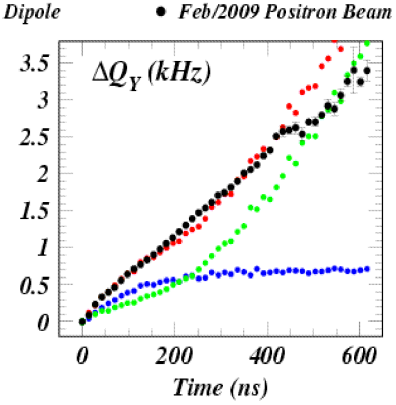
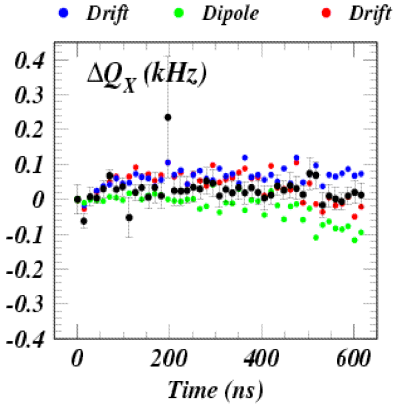
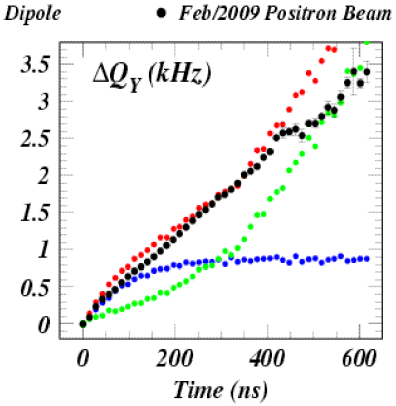
New SYNRAD3d with realistic wall file



Comparing witness bunch simulations without tuning the ECLOUD input parameters

Again, the new SYNRAD3d calculations provide a good description of the data.

IPAC10 & Phase 1 Report Tune Shift Measurements
1 February 2009 2.1 GeV 45-bunch train e+

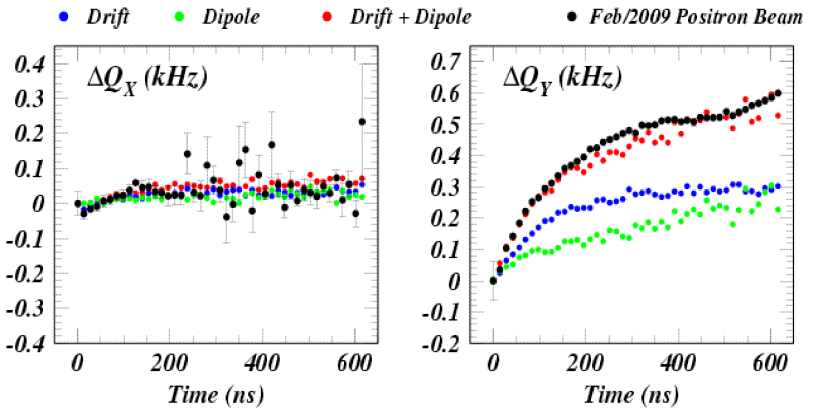
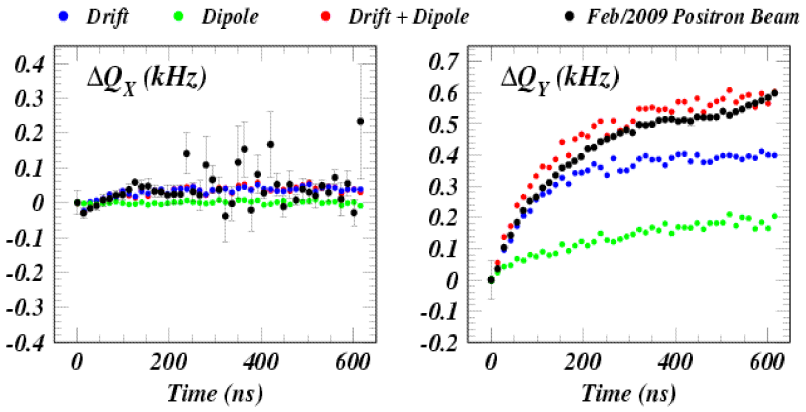
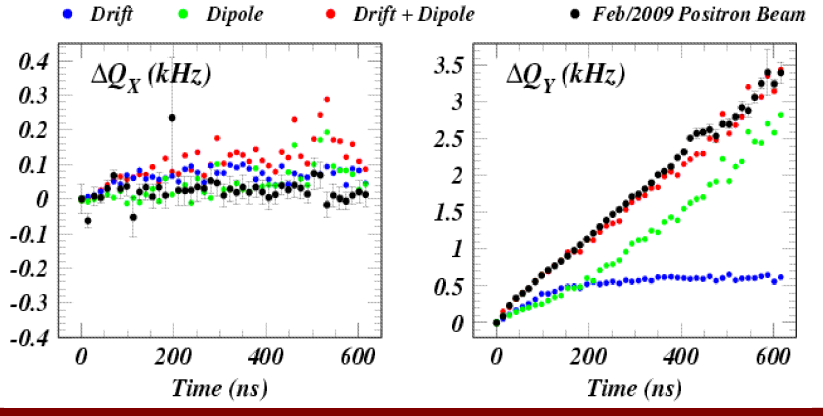
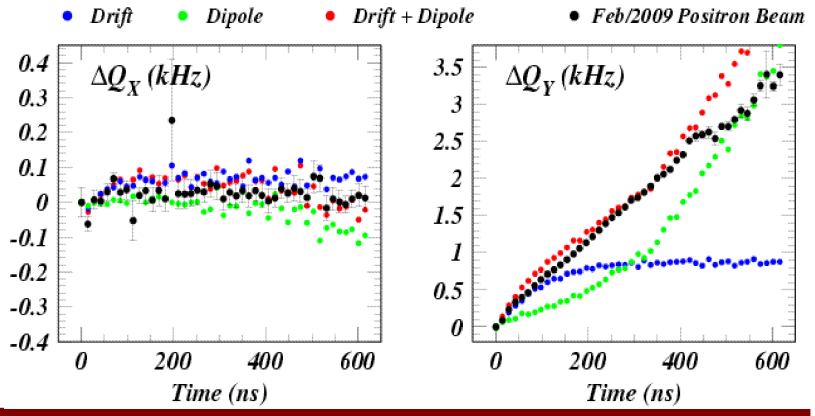
	Old SYNRAD3d with smooth wall file		New SYNRAD3d including diffuse scattering with realistic wall file	
0.4 mA/bunch				
0.8 mA/bunch				

The ECLOUD calculations using SYNRAD (no photon scattering, refl=15%) published at IPAC10 have been repeated using the old and new SYNRAD3D results without tuning of any other input parameters.

In both cases the drift contribution to the tune shift increases significantly, more so with the realistic wall and diffuse scattering.

The match to the data is about as good. The match to the new SYNRAD3D would improve with a trivial 5% reduction in QE.

IPAC10 & Phase 1 Report Tune Shift Measurements
1 February 2009 2.1 GeV 45-bunch train e+

	IPAC10 Results SYNRAD (no photon scattering, refl=15%)	New SYNRAD3d including diffuse scattering with realistic wall file
0.4 mA/bunch		
0.8 mA/bunch		

These comparisons substantiate the claims made on the previous slide concerning the consequences of photon scattering calculations for the modeling of coherent tune shift measurements. The IPAC10 results required extensive tuning, including the introduction of the rediffused SEY component and statistical approximations such as electrostatic grid size.

With no further tuning, the SYNRAD3d photon scattering model gives a good match, with dramatically different drift and dipole contributions.