Cornell University
Laboratory for Elementary-Particle Physics

First Attempt to Model Electron Cloud Buildup for the TE-Wave Experiments Presently Underway

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Electron Cloud Simulations Meeting

Wilson Lab

28 January 2009

Overview of Modelling Parameters and Data Sets

- CESR lattice bmad_12wig_2085_20081103 (similar to cta_2085MeV_20081107)
- Photon rate and relative drift/dipole contributions derived from DLR's sync rad tables
- Modelling uses the CERN ECLOUD algorithm with some modifications
- 45 1.0 mA bunches, followed by ten empty bunches, 14 ns spacing
- Beam RMS size 1.66 x 0.02 x 10 mm. Emittances 130 nm and 40 pm.
- ECLOUD bunch time +- 3.4 sigma: 0.23 ns
- Elliptical beam pipe 4.5 x 2.5 cm
- Positron beam: 0.27 (0.55) s.r. photons per beam particle in drift (dipole/1.2kG) region
- Electron beam: 0.45 (0.51) s.r. photons per beam particle in drift (dipole/1.2kG) region
- QE 10%
- 25k macroparticles generated per filled bunch
- SEY parameters: SEY=1.7, Epk = 170 eV
- 150 steps per bunch length, 300 steps between bunches
- 11 field calculations during each of 55 bunches, filled and empty

Sync rad between BPMs 12W and 13W
76.329 < s < 85.578 m

Lattice: bmad_12wig_2085_20081103

Element	*Length*	*Fraction*	*<Beta X>*	*<Beta Y>*	*Phot/m/e*	*Frac*Phot/m/e*
Dipole	*6.6*	*71.1%*	*14.9*	*16.9*	*0.551*	*0.391*
Drift	*0.9*	*10.2%*	*20.8*	*14.0*	*0.270*	*0.027*
Wiggler	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*
Quadrupole	*1.2*	*13.0%*	*18.2*	*17.8*	*0.380*	*0.049*
Sextupole	*0.5*	*5.8%*	*17.7*	*17.0*	*0.293*	*0.017*
Solenoid	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*
Octupole	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*

Positron Beam

Element	*Length*	*Fraction*	*<Beta X>*	*<Beta Y>*	*Phot/m/e*	*Frac*Phot/m/e*
Dipole	*6.6*	*71.1%*	*14.9*	*16.9*	*0.514*	*0.365*
Drift	*0.9*	*10.2%*	*20.8*	*14.0*	*0.449*	*0.046*
Wiggler	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*
Quadrupole	*1.2*	*13.0%*	*18.2*	*17.8*	*0.209*	*0.027*
Sextupole	*0.5*	*5.8%*	*17.7*	*17.0*	*0.272*	*0.016*
Solenoid	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*
Octupole	*0.0*	*0.0%*	*0.0*	*0.0*	*0.000*	*0.000*

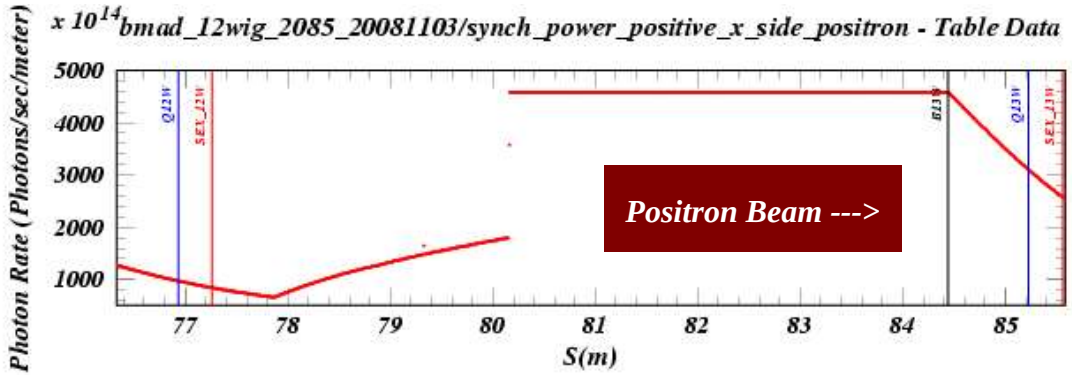
Electron Beam

Total length *9.3 m*

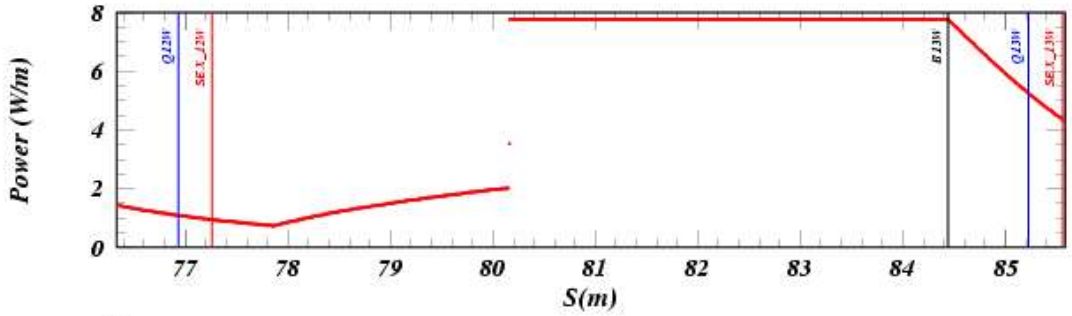
Sync Rad Photon Energy for Positron Beam

76.329 < s < 85.578 m

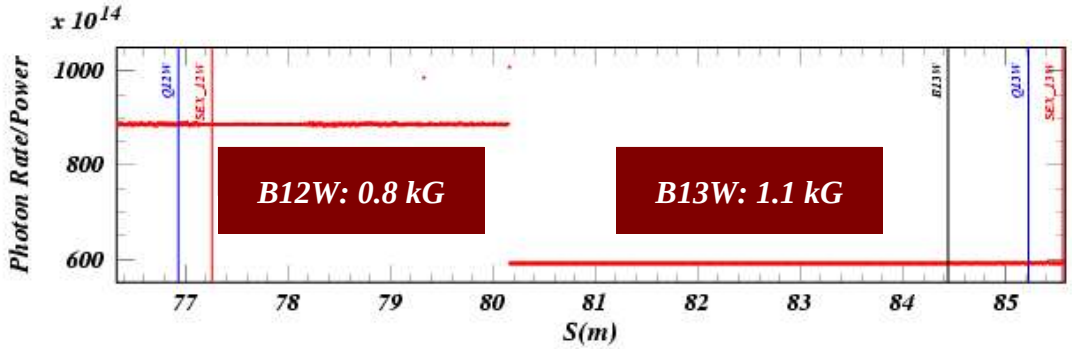
Lattice: bmad_12wig_2085_20081103



Photon Rate ($m^{-1} s^{-1}$)



Power ($W m^{-1}$)

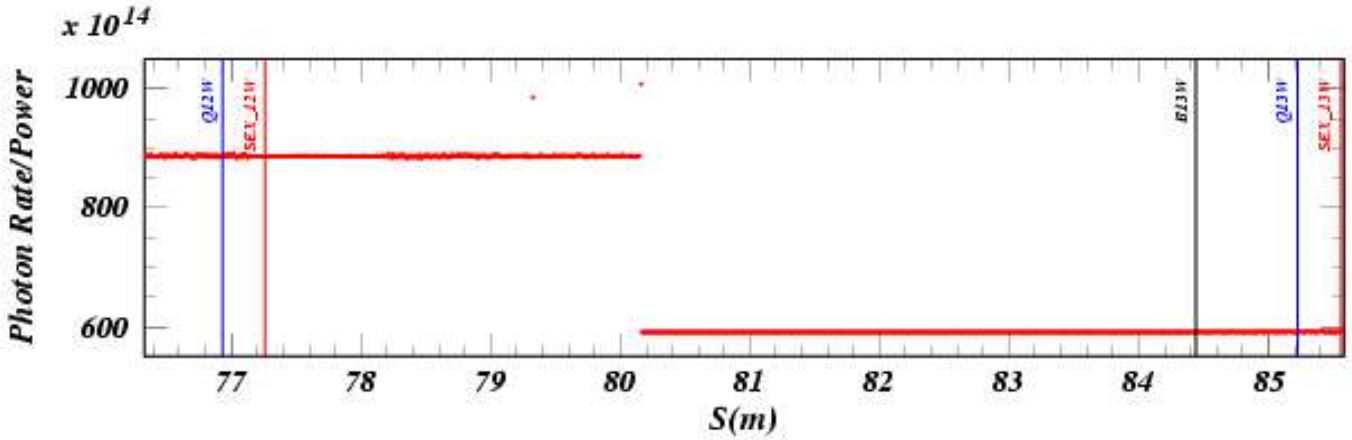


Photon Rate/Power

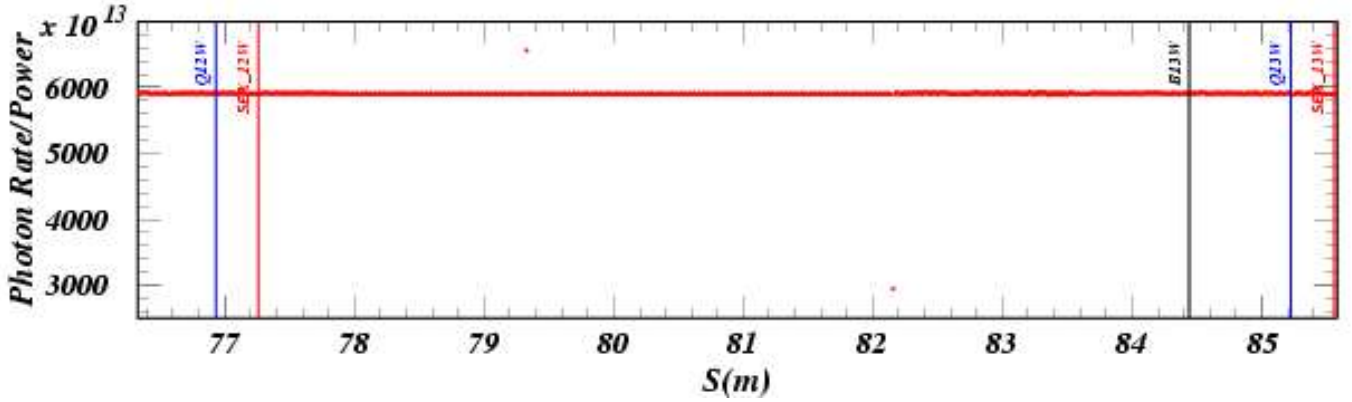
Sync Rad Photon Energy for e+ and e- Beams

76.329 < s < 85.578 m

Photon Rate/Power



Positron Beam --->

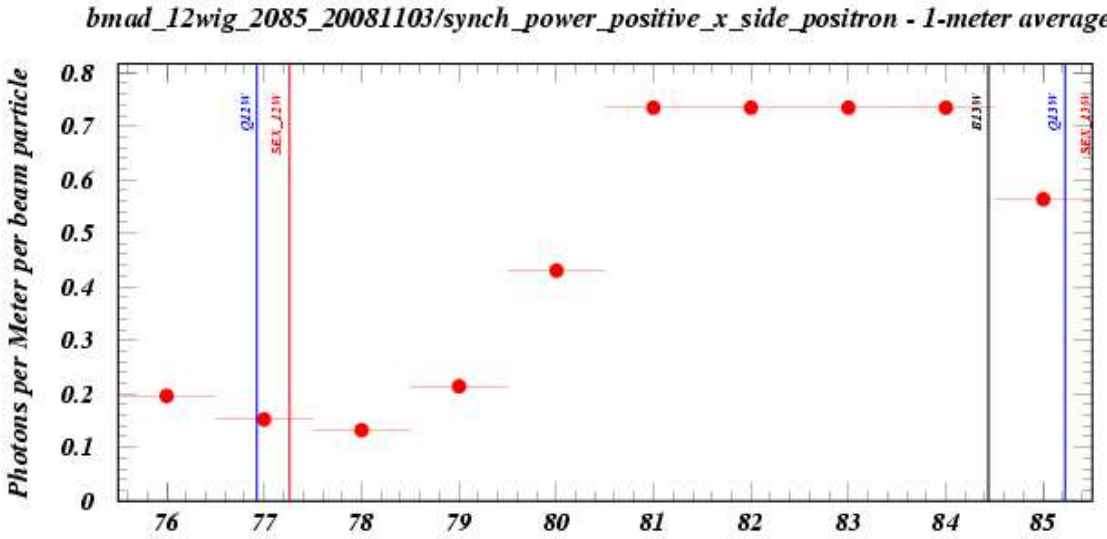


<--- Electron Beam

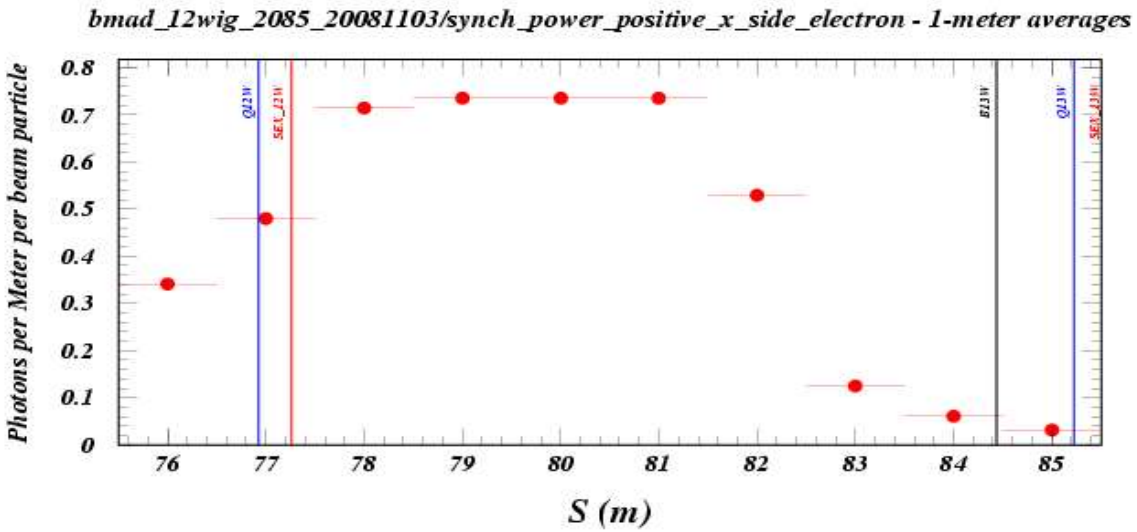
See Gerry's talk of 10 December 2008 for a discussion of photo-electron yield dependence on photon energy. The cloud buildup modelling presented here does not take into account a possibly higher quantum efficiency in the drift region for the positron beam.

Sync Rad Photon Rate per Meter: 1-m Averages

76.329 < s < 85.578 m



Positron Beam

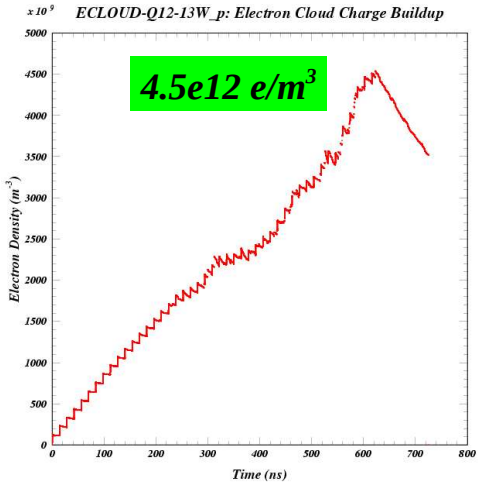


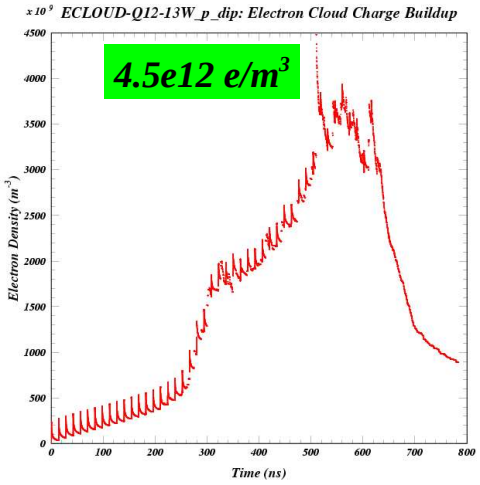
Electron Beam

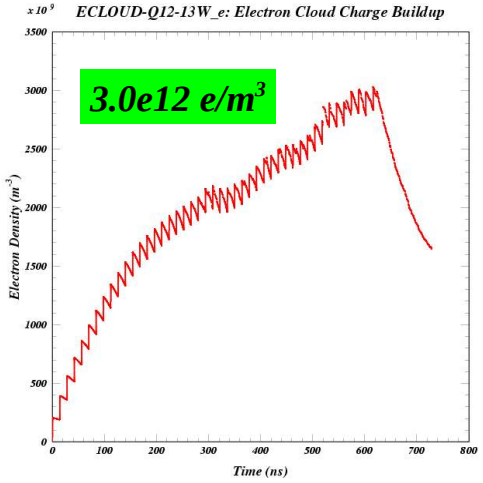
Modeled Cloud Buildup Profiles

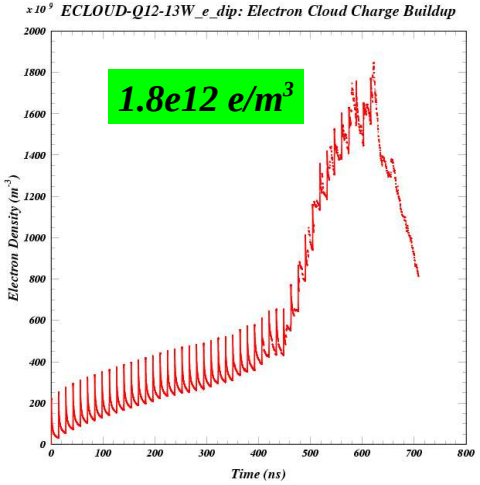
Drift Region

1.1 kG Dipole









Positron Beam

- *No saturation for this case*
- *Expect dipole region to dominate*
- *Electron beam cloud less dense*
- *Multipactoring effects manifest*

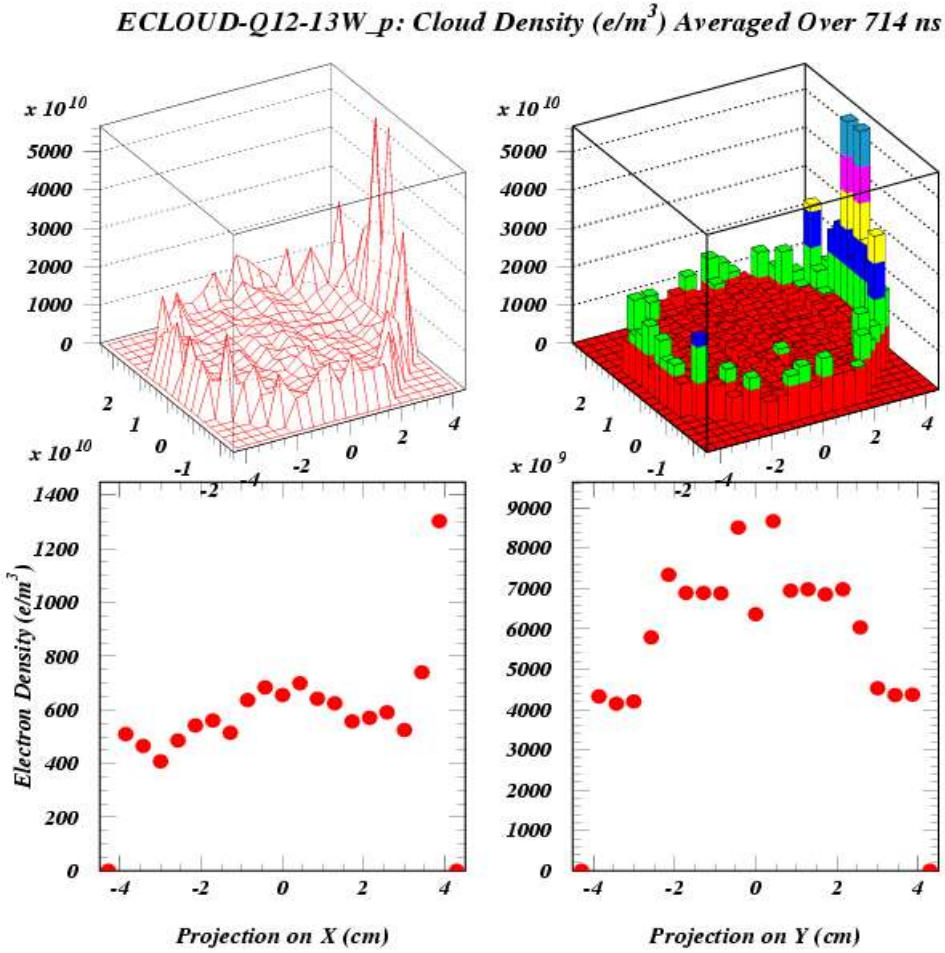
They can be reduced by reducing the bunch current (measurements have been taken)

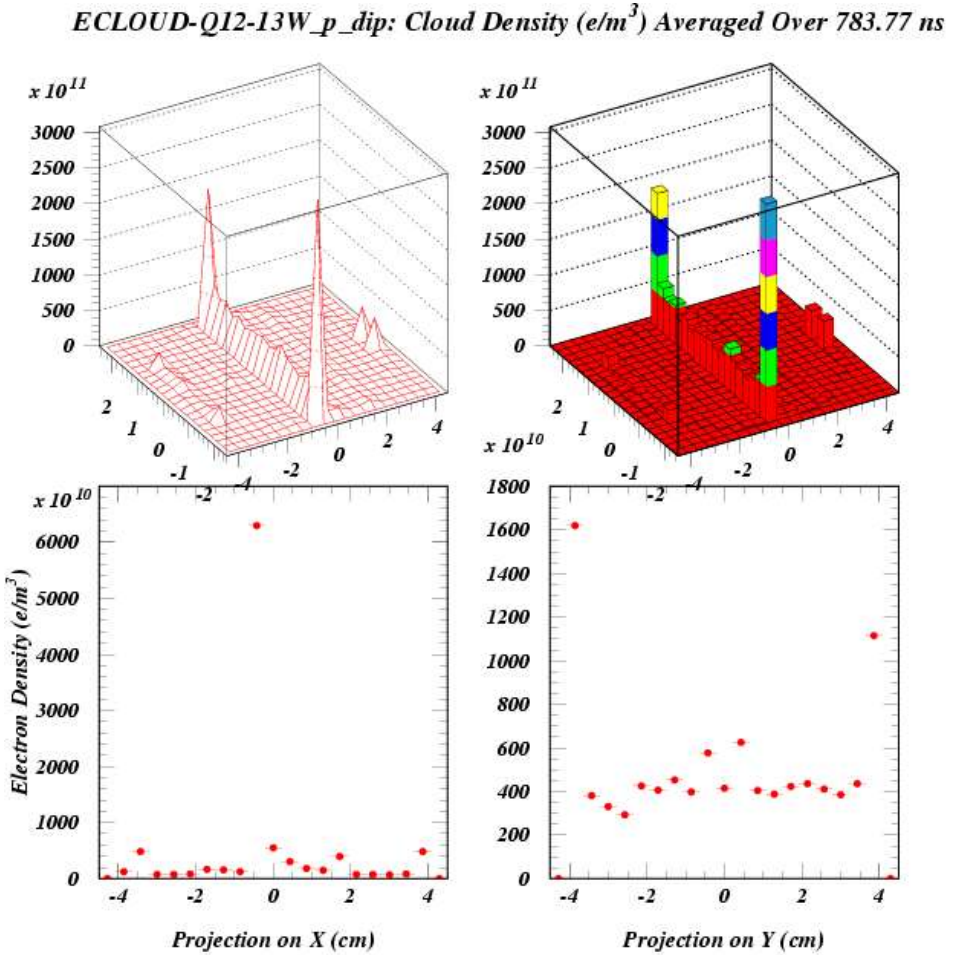
Electron Beam

Modeled Cloud Shapes for Positron Beam

Drift Region

1.1 kG Dipole





Modeled Cloud Shapes for Electron Beam

Drift Region

1.1 kG Dipole