



Cornell University
Laboratory for Elementary-Particle Physics



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

(Additional plots for electron beams and 0.2, 2.0 mA/bunch added 30 January 2009)

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Electron Cloud Simulations Meeting

Wilson Lab

28 January 2009





- CCSR 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, E_{pk} = 170 eV
- 150 steps per bunch length, 300 steps between bunches
- 11 field calculations during each of 55 bunches, filled and empty



$$76.329 < s < 85.578 \text{ m}$$

Lattice: bmad_12wig_2085_20081103

<i>Element</i>	<i>Length</i>	<i>Fraction</i>	<i><Beta X></i>	<i><Beta Y></i>	<i>Phot/m/e</i>	<i>Frac*Phot/m/e</i>
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

<i>Element</i>	<i>Length</i>	<i>Fraction</i>	<i><Beta X></i>	<i><Beta Y></i>	<i>Phot/m/e</i>	<i>Frac*Phot/m/e</i>
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

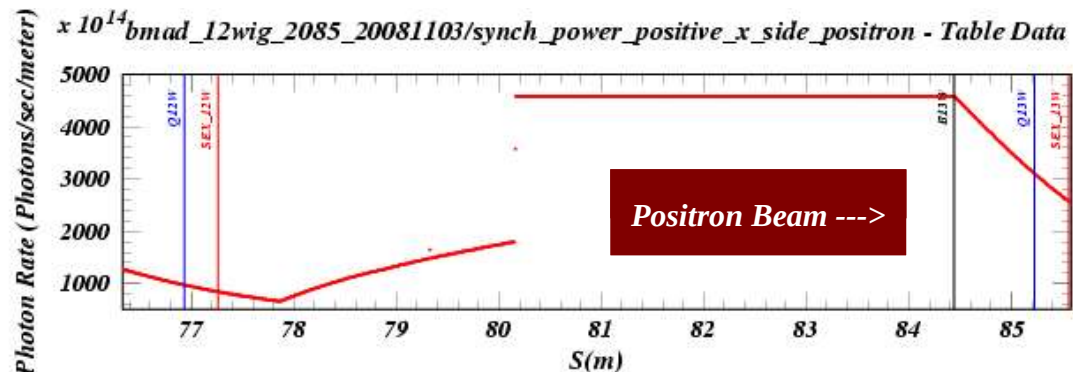
Electron Beam

Total length 9.3 m

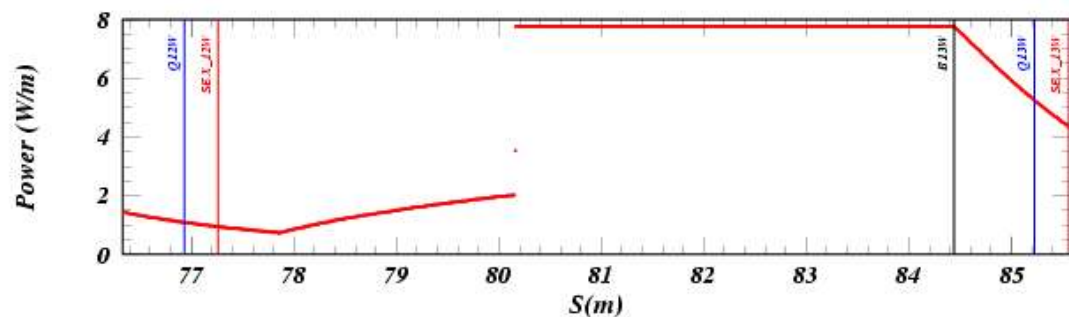


$$76.329 < s < 85.578 \text{ m}$$

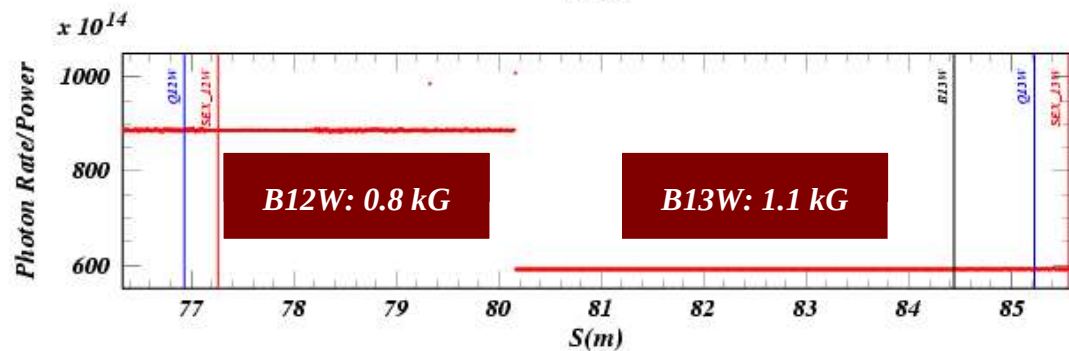
Lattice: bmad 12wig 2085 20081103



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



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

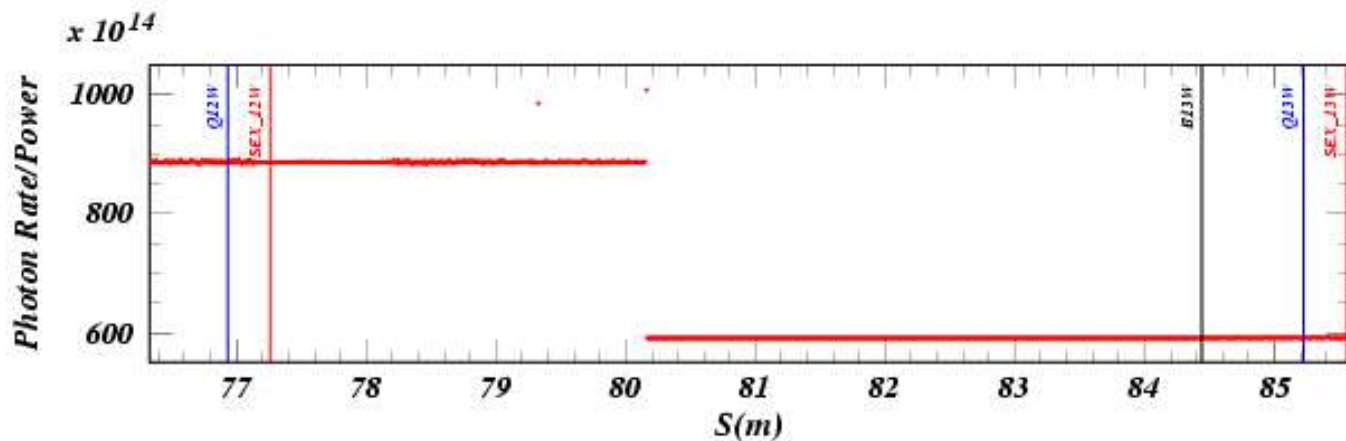


Photon Rate/Power

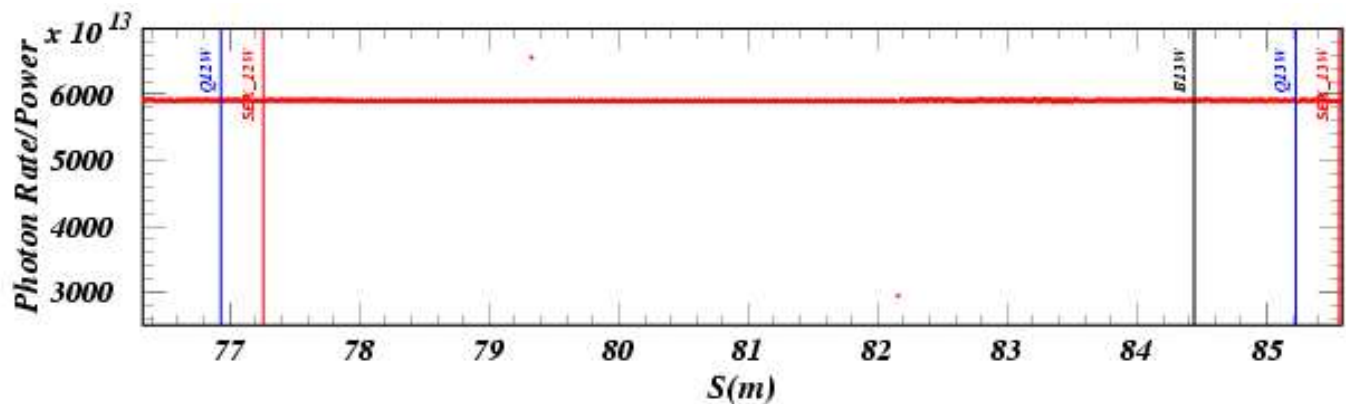


$$76.329 < s < 85.578 \text{ m}$$

Photon Rate/Power



Positron Beam --->



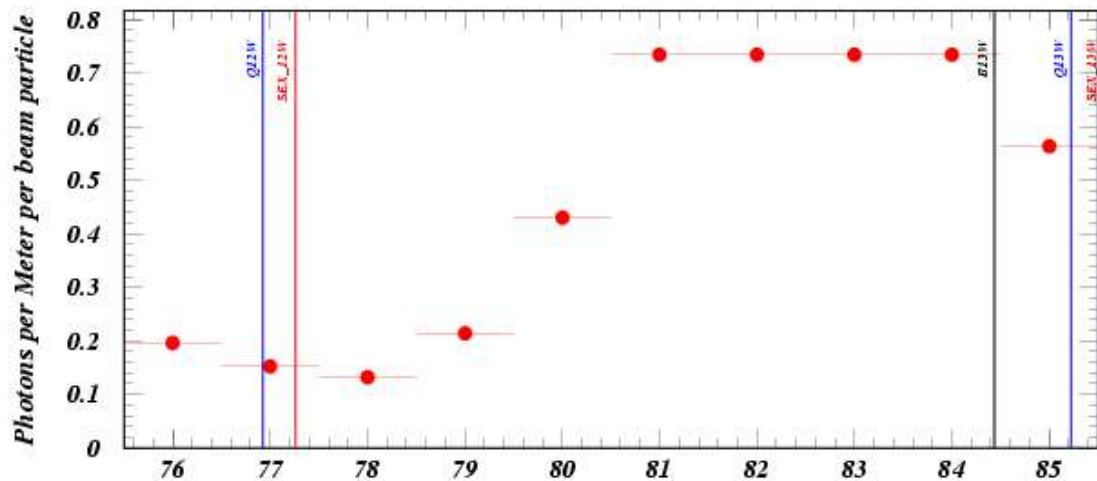
<--- Electron Beam

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.



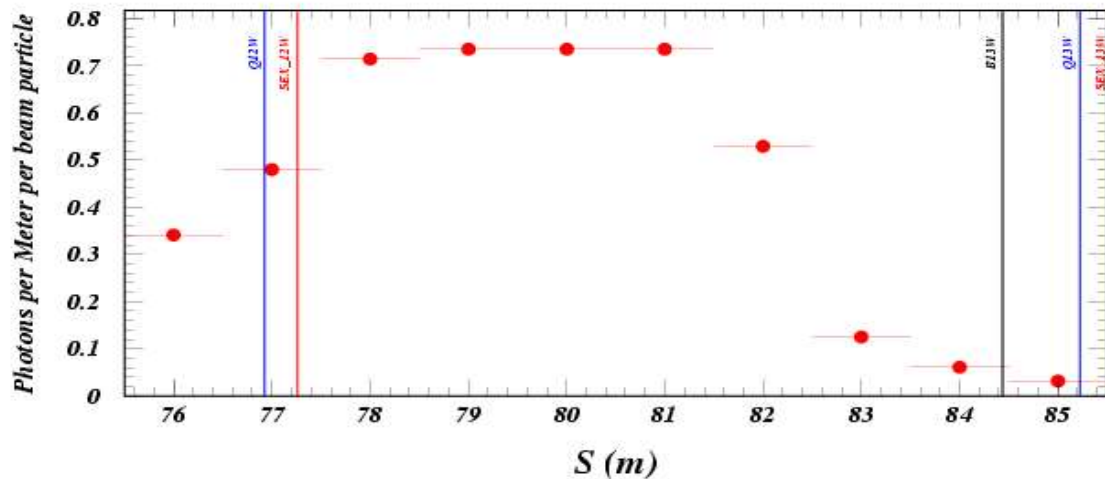
$$76.329 < s < 85.578 \text{ m}$$

bmad_12wig_2085_20081103/synch_power_positive_x_side_positron - 1-meter averages



Positron Beam

bmad_12wig_2085_20081103/synch_power_positive_x_side_electron - 1-meter averages

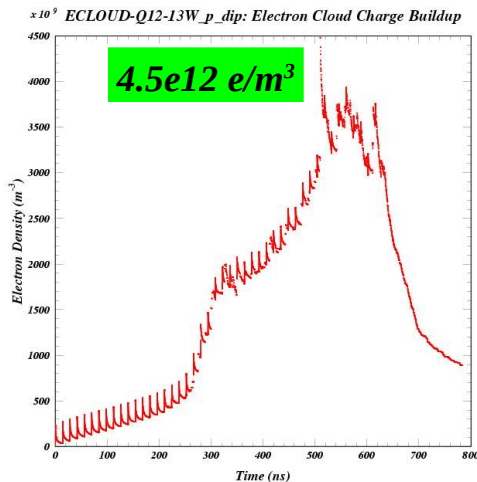
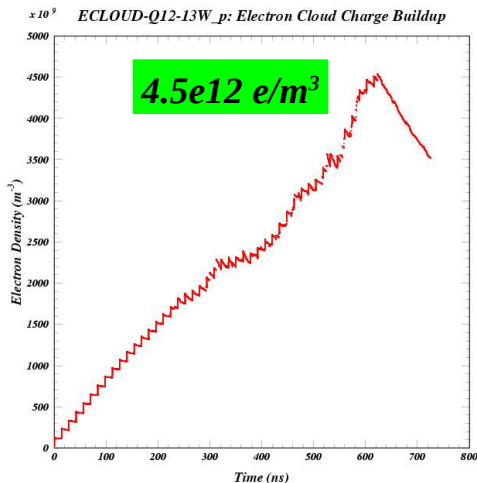


Electron Beam



Drift Region

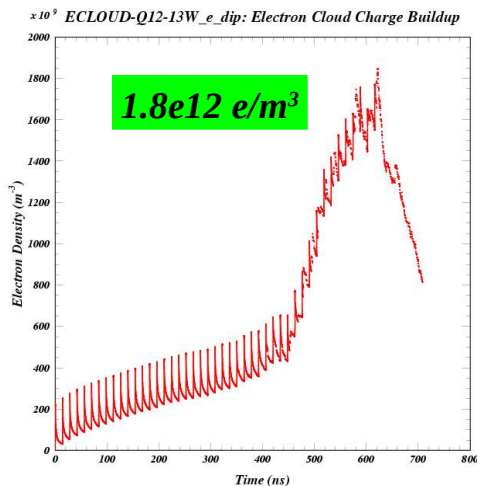
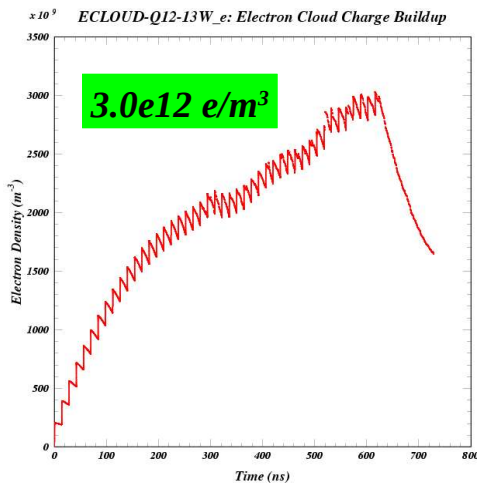
1.1 kG Dipole



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)

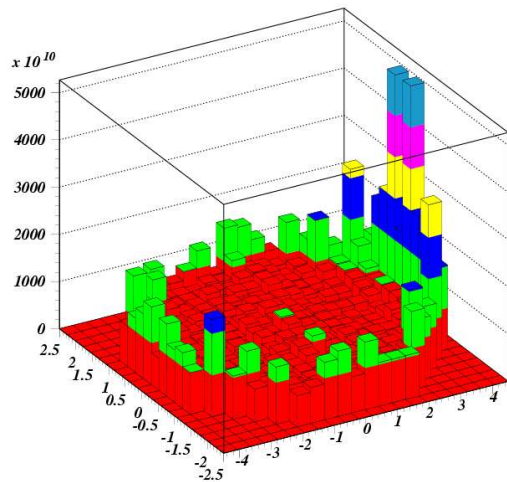


Electron Beam

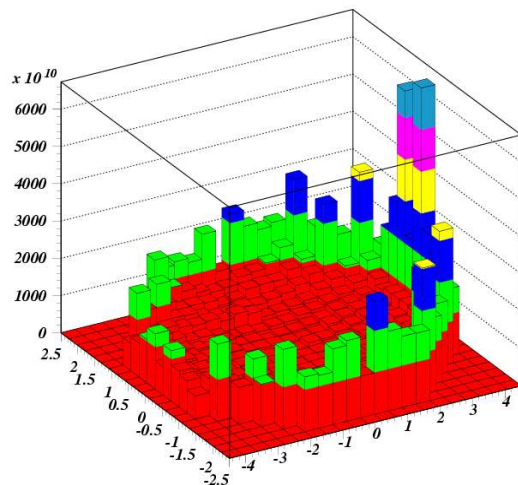


Drift Region

Q12-I3W_p: Cloud Density (e/m^3) Averaged Over 783.77 ns

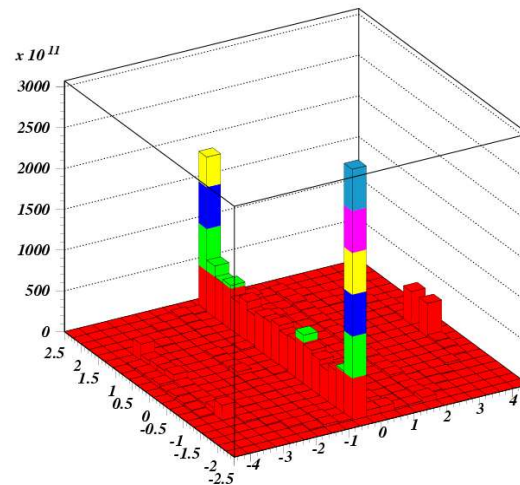


Q12-I3W_e: Cloud Density (e/m^3) Averaged Over 783.77 ns

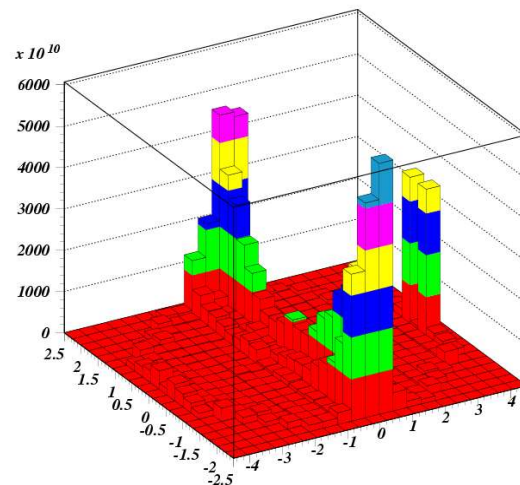


1.1 kG Dipole

Q12-I3W_p_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



Q12-I3W_e_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



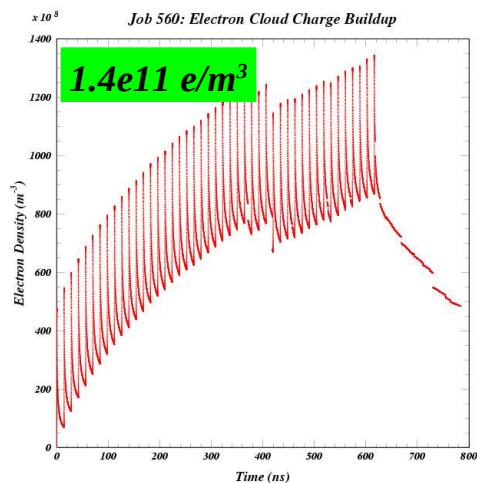
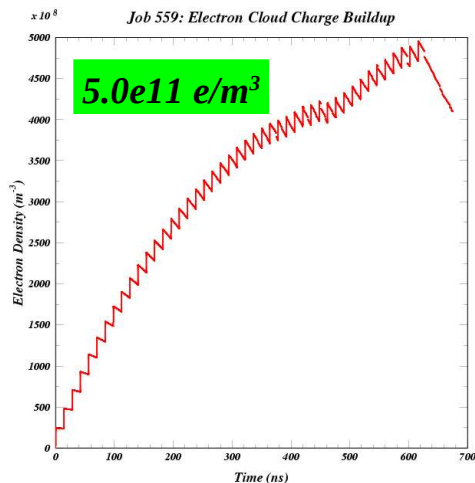
Positron Beam

Electron Beam

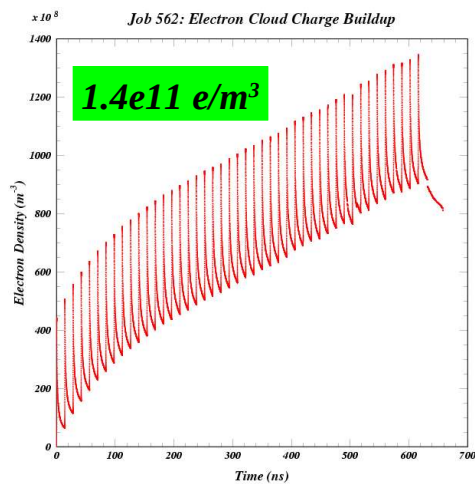
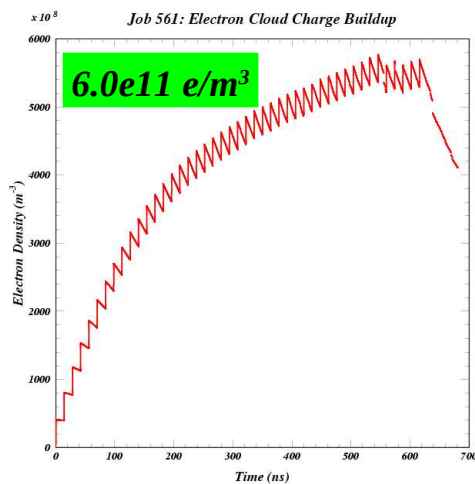


Drift Region

1.1 kG Dipole



Positron Beam

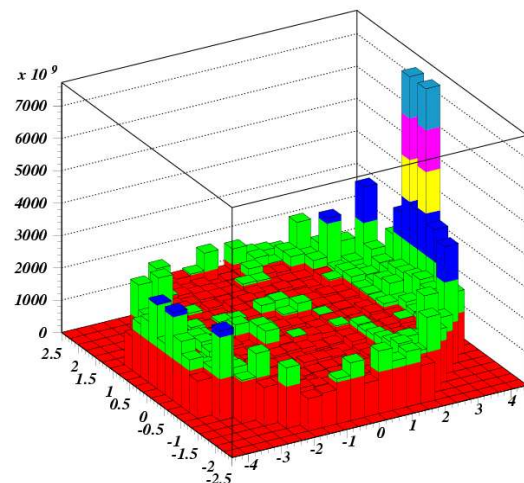


Electron Beam

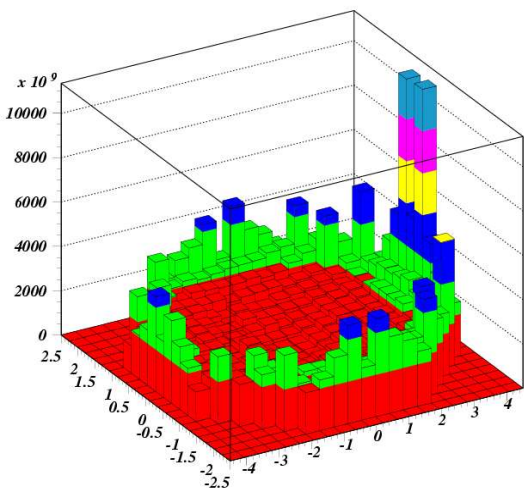


Drift Region

Q12-13W_p: Cloud Density (e/m^3) Averaged Over 783.77 ns

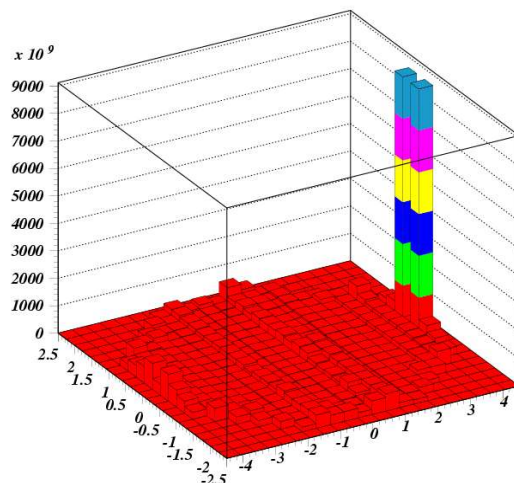


Q12-13W_e: Cloud Density (e/m^3) Averaged Over 783.77 ns

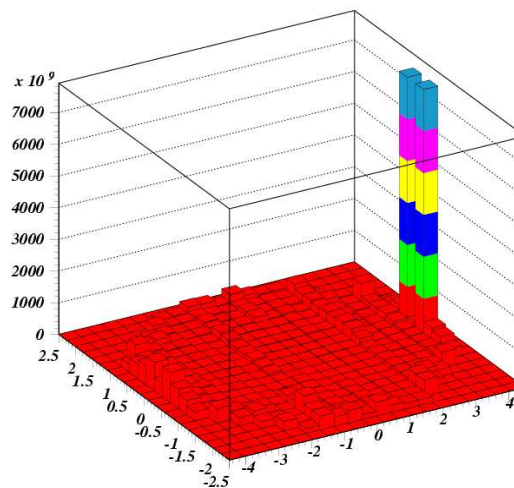


1.1 kG Dipole

Q12-13W_p_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



Q12-13W_e_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



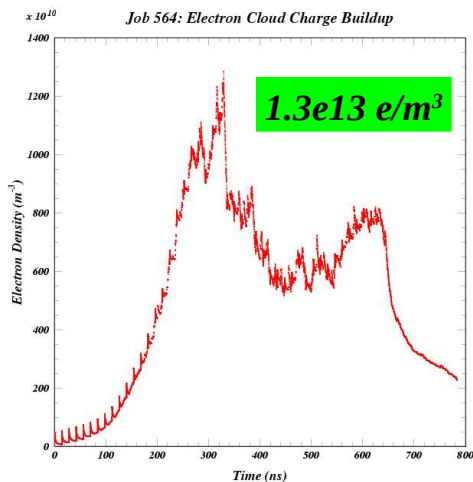
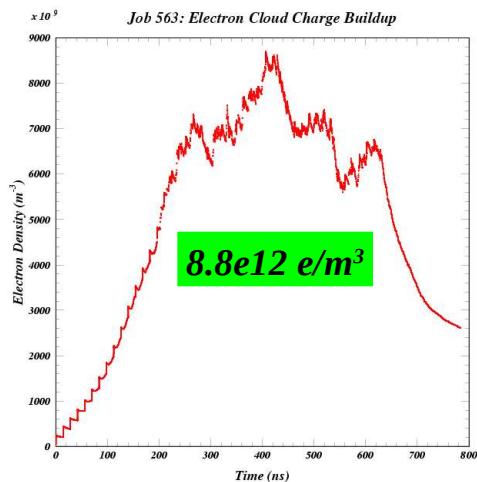
Positron Beam

Electron Beam

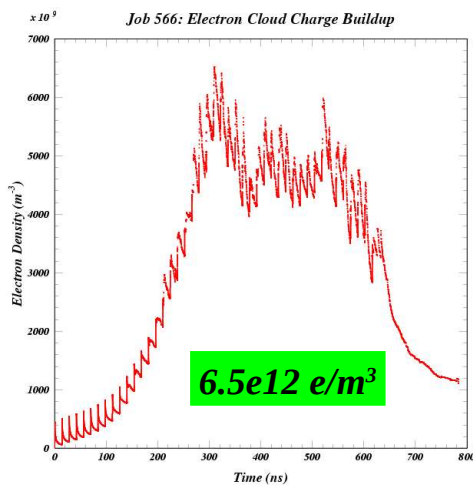
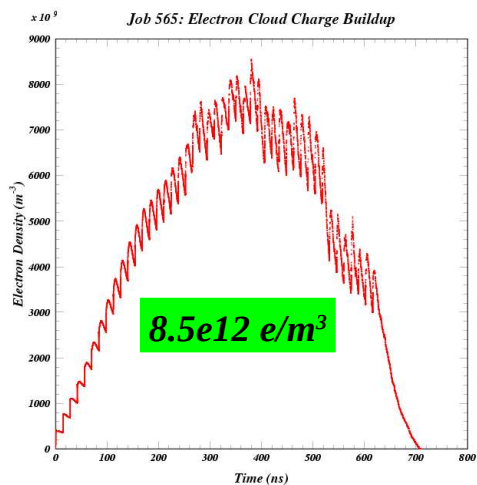


Drift Region

1.1 kG Dipole



Positron Beam

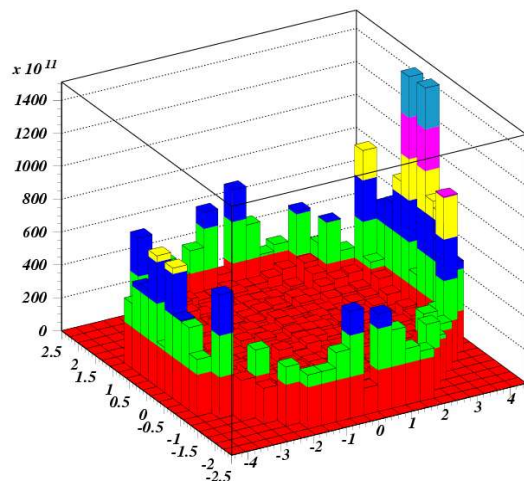


Electron Beam

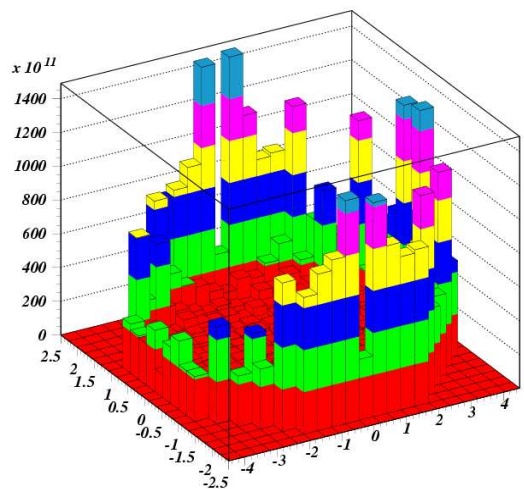


Drift Region

Q12-I3W_p: Cloud Density (e/m^3) Averaged Over 783.77 ns

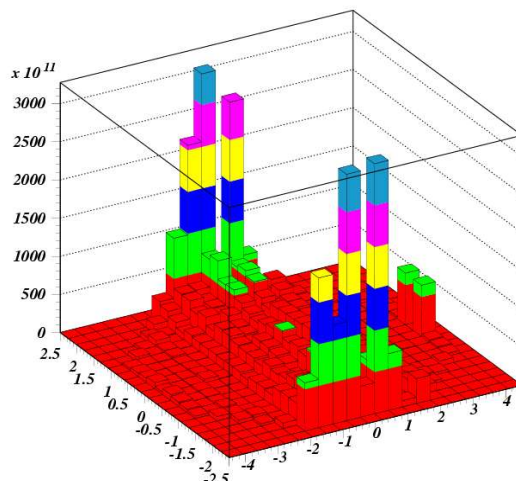


Q12-I3W_e: Cloud Density (e/m^3) Averaged Over 770 ns

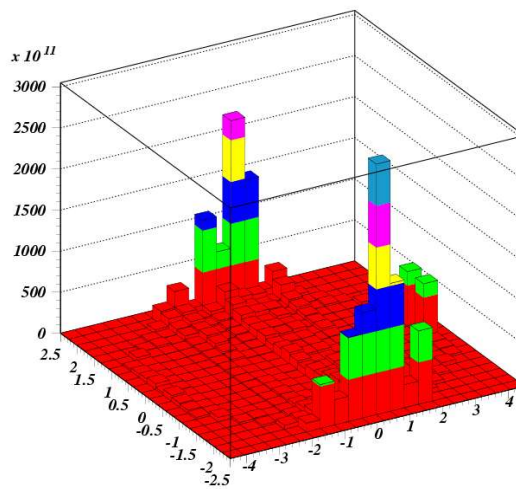


1.1 kG Dipole

Q12-I3W_p_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



Q12-I3W_e_dip: Cloud Density (e/m^3) Averaged Over 783.77 ns



Positron Beam

Electron Beam