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, E pk = 170 eV
- 150 steps per bunch length, 300 steps between bunches
- 11 field calculations during each of 55 bunches, filled and empty
**Lattice: bmad 12wig 2085 20081103**

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

**Total length 9.3 m**

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**Positron Beam**

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**Electron Beam**

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ECLOUD Cloud Buildup Modeling for TE-Wave Experiments/ J.A.Crittenden
**Lattice: bmad 12wig 2085 20081103**

- **Photon Rate (m⁻¹ s⁻¹)**
- **Power (W m⁻¹)**
- **Photon Rate/Power**

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- **B12W: 0.8 kG**
- **B13W: 1.1 kG**

76.329 < s < 85.578 m
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

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

- **Positron Beam**
- **Electron Beam**
Modeled Cloud Buildup Profiles

**Drift Region**

<table>
<thead>
<tr>
<th>1.1 kG Dipole</th>
</tr>
</thead>
</table>

- No saturation for this case
- Expect dipole region to dominate
- Electron beam cloud less dense
- Multipacting effects manifest
  - They can be reduced by reducing the bunch current (measurements have been taken)

**Positron Beam**

**Electron Beam**
Modeled Cloud Shapes for Positron Beam

**Drift Region**

**1.1 kG Dipole**

**ECLoud-Q12-13W_p: Cloud Density (e/m³) Averaged Over 714 ns**

**ECLoud-Q12-13W_p_dip: Cloud Density (e/m³) Averaged Over 783.77 ns**
Modeled Cloud Shapes for Electron Beam

Drift Region

1.1 kG Dipole

**ECLOUD-Q12-13W_e**: Cloud Density (e/m³) Averaged Over 714 ns

**ECLOUD-Q12-13W_e_dip**: Cloud Density (e/m³) Averaged Over 700 ns