INVESTIGATION OF CLIC 380 GeV POST-COLLISION LINE

R.M. Bodenstein, P.N. Burrows, John Adams Institute – JAI @ University of Oxford, Oxford, UK
L.J. Nevay, A. Abramov, S.T. Boogert – JAI @ Royal Holloway University of London, Egham, UK
D. Schulte, R. Tomás – CERN, Geneva, Switzerland

Abstract
It has been proposed that the Compact Linear Collider (CLIC) be commissioned in stages, starting with a lower-energy, 380 GeV version for the first stage, and concluding with a 3 TeV version for the final stage. In the Conceptual Design Report (CDR) published in 2012, the post-collision line is described for the 3 TeV and 500 GeV stages. However, the post-collision line for the 380 GeV design was not investigated. This work will describe the simulation studies performed in BDSIM for the 380 GeV post-collision line.

Goals
• Guide collided and uncollided beams safely to dump - must account for large energy spreads, wrong-charge particles, and unwanted deposition along beamline components
• Double-check previous studies for 3 TeV COM CLIC design
• Check that 3 TeV COM design will work for 380 GeV COM design by scaling the dipole magnet strengths from ~0.8 T to ~0.1 T

Geometry
• BDSIM standard geometry used when possible
  • Features added to allow custom beampipe shapes inside magnets
  • pyg4ometry toolkit used for custom components (nearly everything)
  • Component geometries match previous designs

Beampipes
• Before intermediate dump, beampipes are shaped like elliptical cones expanding from the IP – growth primarily in vertical plane
• After the intermediate dump, beampipes vary gradually from two-half-ellipse shape to racetrack shape

Intermediate Dump
• CNGS style – iron jacket, carbon based absorber, water-cooled aluminum plates
• Wrong-charge particles bent up – deposited in upper part
• Low-energy particles deposited in lower part
• Near-nominal energy particles continue through aperture

BDSIM Analysis
• ~1,000,000 particles (electrons) in initial beam distribution
• Secondaries cut at energies below 20 MeV and less than 1 cm of motion
• Initial beam distributions calculated using GUINEA-PIG by Beam-beam Interactions group
• Primary analysis performed during simulation using ROOT
• Histogram data copied back for further analysis

3 TeV and 380 GeV
• First confirmed that using 0.8 T dipoles for the 1.5 TeV electron beams gives same results as previous studies
• Once confirmed, scale dipoles to 0.1 T for the 190 GeV electron beam to achieve same 0.64 mrad bends
• Compare power deposition along post-collision line and at the entrance to the main dump

Conclusions
• 3 TeV PCL design is adequate for 380 GeV version
• Dipole magnets can be scaled from 0.8 T to 0.1 T to achieve same 0.64 mrad bends in the 380 GeV version
• No unexpected beam deposition or "hot spots"
• All power deposition within design specifications (see table)
• Improvements can be made

Power Deposition in MW

<table>
<thead>
<tr>
<th></th>
<th>Intermediate Dump</th>
<th>Final Drift</th>
<th>Main Dump</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 TeV Uncollided</td>
<td>2.10 x 10^{-4}</td>
<td>1.97 x 10^{-2}</td>
<td>13.6</td>
</tr>
<tr>
<td>3 TeV Collided</td>
<td>3.67 x 10^{-2}</td>
<td>2.96 x 10^{-3}</td>
<td>10.2</td>
</tr>
<tr>
<td>380 GeV Uncollided</td>
<td>5.19 x 10^{-3}</td>
<td>4.08 x 10^{-3}</td>
<td>2.91</td>
</tr>
<tr>
<td>380 GeV Collided</td>
<td>7.77 x 10^{-5}</td>
<td>4.23 x 10^{-3}</td>
<td>2.70</td>
</tr>
</tbody>
</table>

Future Work for Improvements
• Optimize apertures for carbon-based masks to reduce deposition on dipoles
• Include wrong-charge particles, beamstrahlung, incoherent pairs, and muons
• Investigate opportunities for instrumentation
• For 380 GeV, investigate removal of some dipoles
  • Leave drift space for later upgrades in phased commissioning
  • Scale magnet strengths to achieve same total bends in vertical
  • Re-investigate masks for fewer magnets

Please see proceedings for references.