INVESTIGATION OF CLIC 380 GeV POST-COLLISION LINE

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Abstract

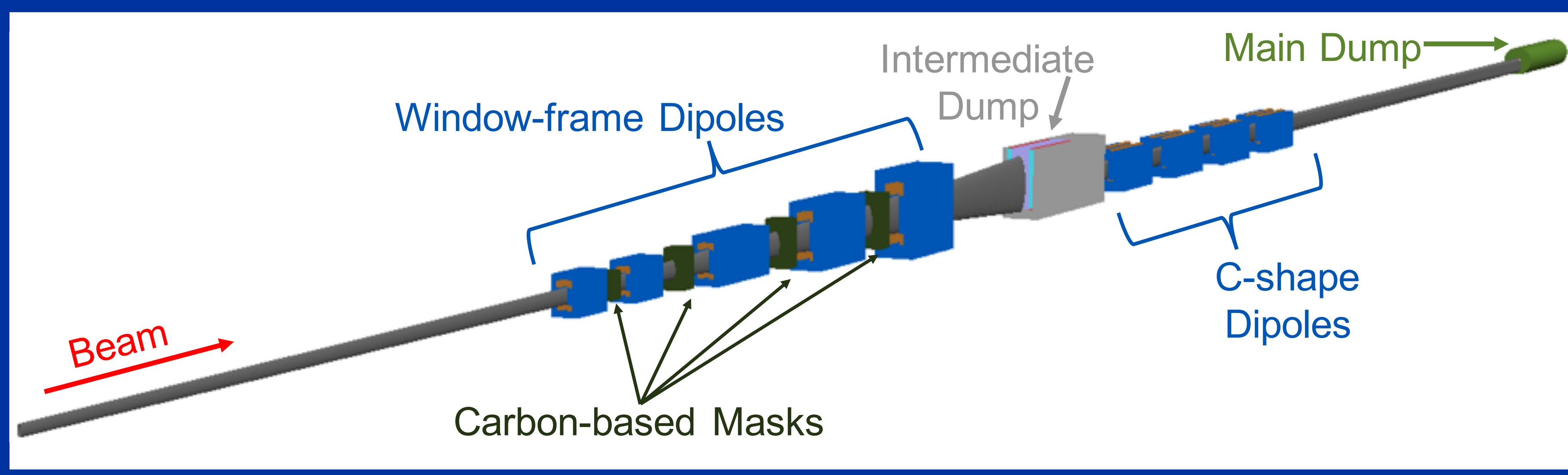
It has been proposed that the Compact Linear Collider (CLIC) be commissioned in stages, starting with a lower-energy, 380 GeV version for the first stage, and concluding with a 3 TeV version for the final stage. In the Conceptual Design Report (CDR) published in 2012, the post-collision line is described 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

Previous Work & Changes Made

- Previous designs described in various references - please see proceedings
- First pair of window-frame magnets described as 0.5 m and 3.5 m, but designed to be 2 m each - no difference for studies, so 2 x 2 m option used
- Apertures for carbon-based masks inconsistently reported - this study made them same as beampipe
- 50 m final drift length

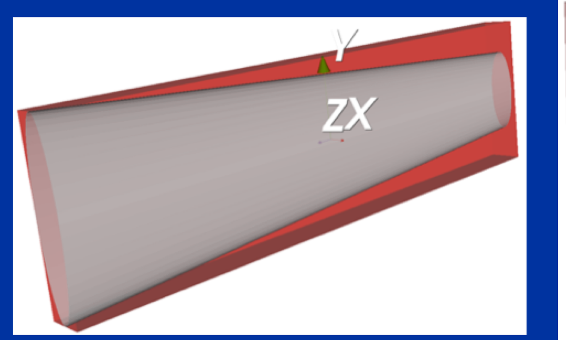


Geometry

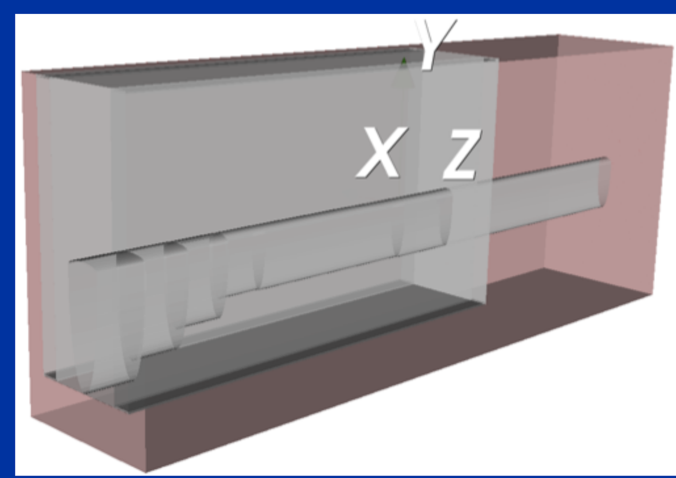
- BDSIM standard geometry used when possible
  - Features added to allow custom beampipe shapes inside magnets
- pyg4ometry toolkit used for custom components (nearly everything)
- Component geometries match previous designs

Beampipes

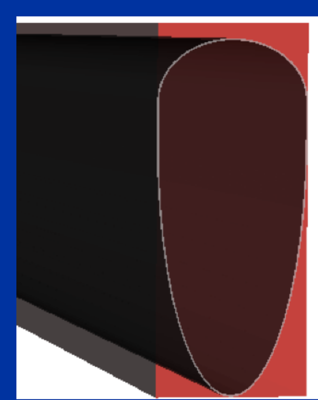
- Before intermediate dump, beampipes are shaped like elliptical cones expanding from the IP – growth primarily in vertical plane
- After the intermediate dump, beampipes vary gradually from two-half-ellipse shape to racetrack shape



Elliptical Cone



Intermediate Dump


Two-Half Ellipse


Racetrack

Intermediate Dump

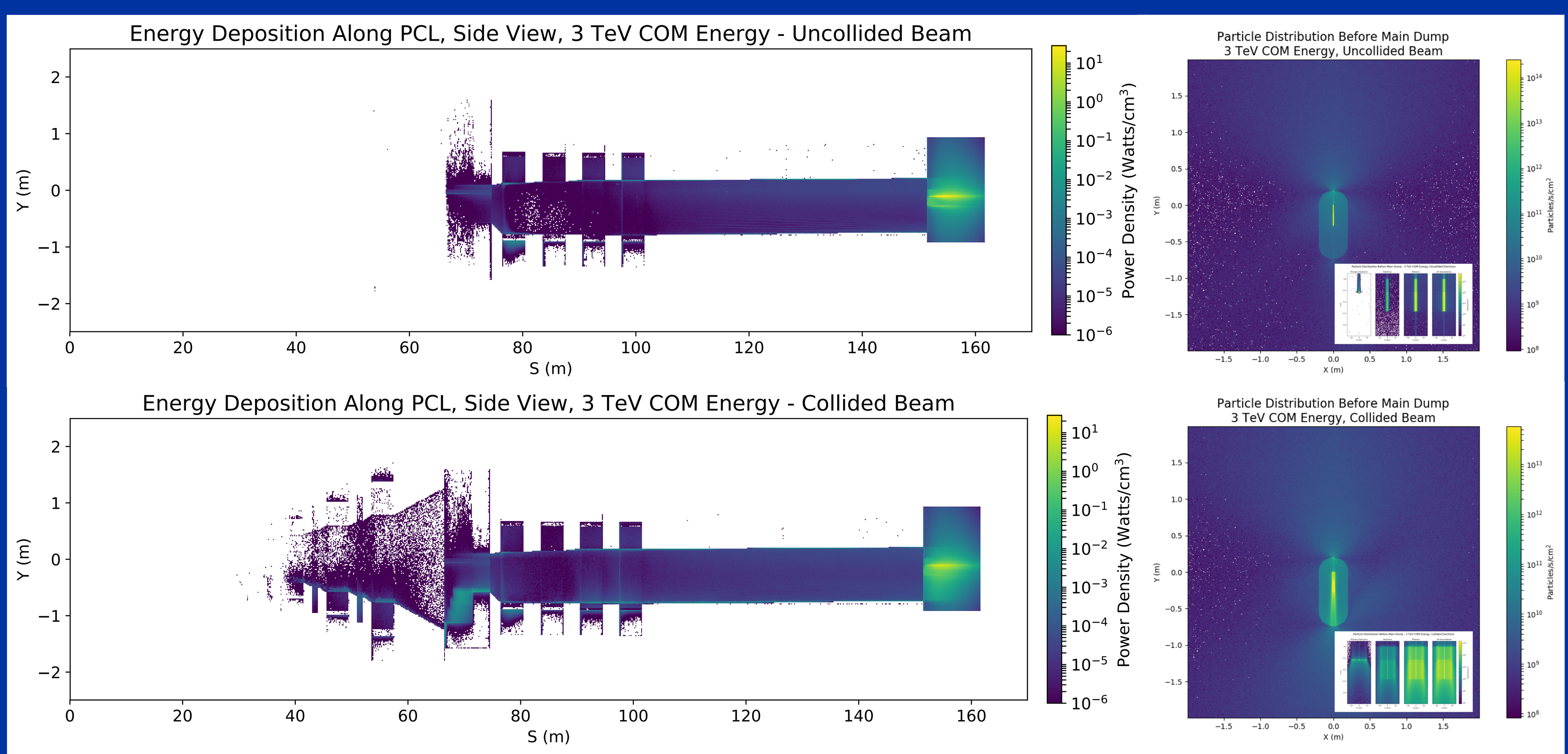
- CNGS style – iron jacket, carbon based absorber, water-cooled aluminum plates
- Wrong-charge particles bent up – deposited in upper part
- Low-energy particles deposited in lower part
- Near-nominal energy particles continue through aperture

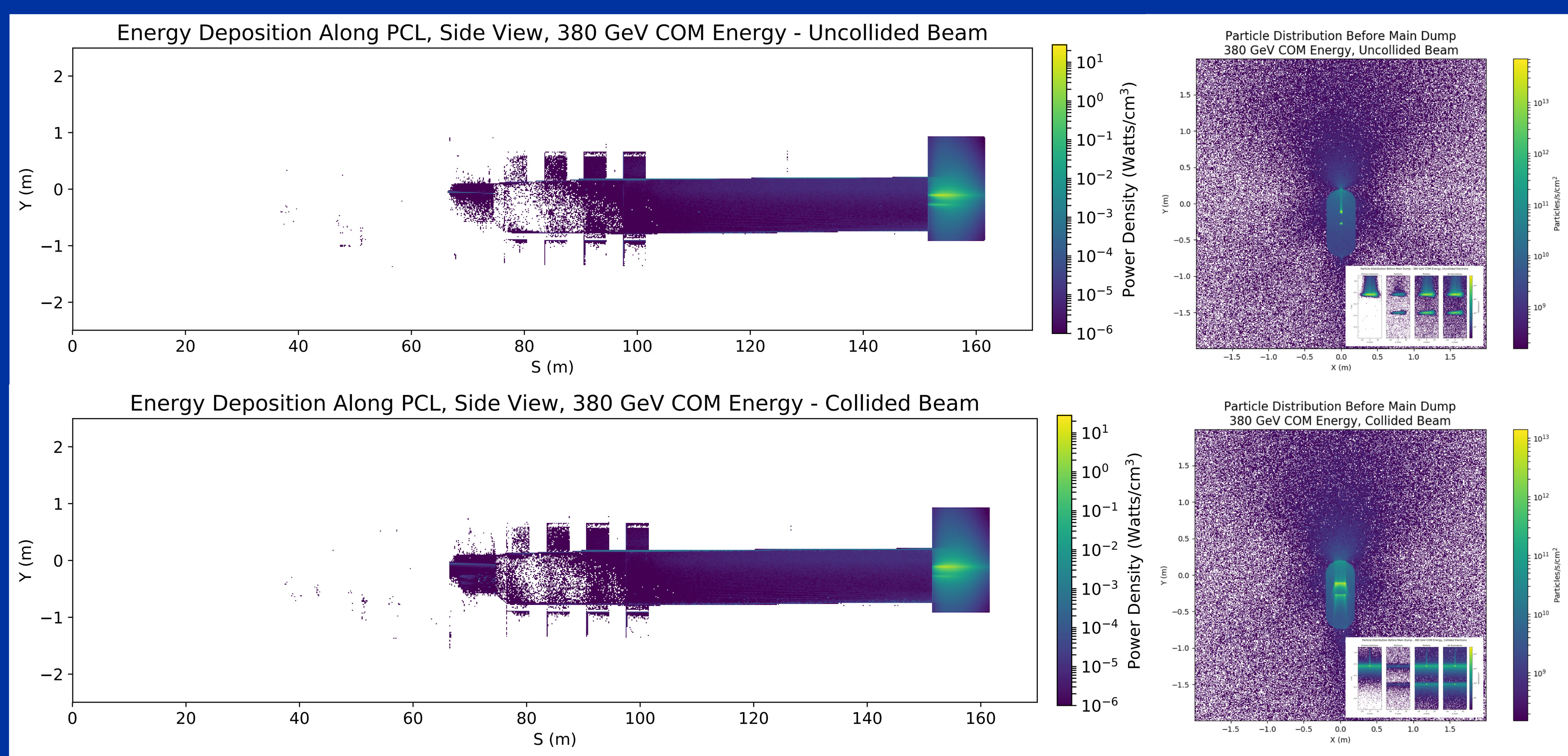
BDSIM Analysis

- ~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

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

Power Deposition in MW

	Intermediate Dump	Final Drift	Main Dump
3 TeV Uncollided	2.10×10^{-4}	1.97×10^{-2}	13.6
3 TeV Collided	3.67×10^{-2}	2.96×10^{-2}	10.2
380 GeV Uncollided	5.19×10^{-5}	4.08×10^{-3}	2.91
380 GeV Collided	7.77×10^{-5}	4.23×10^{-3}	2.70

Please see proceedings for references.

IPAC19

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