Difficulties of Small Horizontal x-ing

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Suggested to apply CLIC 97 concept to TESLA and use 2 mrad H-crossing angle [P. Bambade et al, 2004]

[First look][385]

Need detailed main beam and halo background analysis

Design of a final focus system for CLIC in the multi-bunch regime

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December 10, 1997

<table>
<thead>
<tr>
<th>Quadrupoles</th>
<th>Length [m]</th>
<th>Aperture diameter [mm]</th>
<th>Gradient [T/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>QD1</td>
<td>1.2</td>
<td>48</td>
<td>250</td>
</tr>
<tr>
<td>QD2</td>
<td>1.378</td>
<td>13.7</td>
<td>219</td>
</tr>
<tr>
<td>QF</td>
<td>1.330</td>
<td>13.7</td>
<td>219</td>
</tr>
</tbody>
</table>

Table 2: Doublet parameters

Figure 5: Transverse profiles of the synchrotron radiation at the entrance (small rectangle) and exit (large rectangle) faces of: (a) QD1, (b) QD2 (right) and QF (left) in the extraction line.


Figure 3: Magnet layout with 5 mrad crossing-angle. The $e^+$ and $e^-$ orbits (solid lines) correspond to the nominal energy of 250 GeV.

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Check small H x-ing

- The small H x-ing idea needs to be checked with beam halo tracking
- The following study uses simple ray tracing, to determine photon trajectories
- More detailed and accurate analysis is being done with Geant by Takashi Maruyama
Assumptions

- NLC BDS optics is used upstream of IP
- $L^*=4.05$ m FD is used downstream of IP
- Beam halo tracking is done with Turtle
Nominal beam and $\gamma$ past IP
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Disrupted beam distributions

Nominal TESLA IP parameters, ideal beam, GP

To crudely model this beam in Turtle tracking, modify the beam at IP by reducing energy by 20% and adding rms spread of

$\Delta \sigma_x' = 400 \mu\text{rad}$, $\Delta \sigma_y' = 100 \mu\text{rad}$, $\Delta \sigma_E = 20\%$
“Disrupted” beam and $\gamma$ past IP

Photons from Geant
Disrupted beam from GP (units are cm)

Particle tracking and Beamstrahlung cone

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Takashi Maruyama
Photons from Geant
Disrupted beam from GP (units are cm)
“Disrupted” beam and γ past IP
Halo and $\gamma$ before and past IP

- Halo before IP
- Halo beam post IP
- Photons 4m downstream from IP
- Photons 6.89m downstream from IP

Particle tracking and Beamstrahlung cone

Red: FD $\gamma$, Blue: soft bend $\gamma$, Green: opposite QD0 $\gamma$, Yellow: beam

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Is it possible to shape the poles or increase QF1 aperture to avoid losses of the beam on the poles?
Opening the QF1 aperture would create field in the region of the beam, which would deflect it back to the beamline.

Is it possible to collimate the beam tighter by more that a factor of two?
It would create many other problems.
Halo and \( \gamma \) past IP vs crossing angle
Most likely, small H x-ing is not viable

\[ \theta_{c1} : 0 / V0.3\text{mrad} / \textbf{H2mrad} / H6-20\text{mrad} \]
Summary

• Preliminary studies show that, most likely, small horizontal x-ing (4mrad total angle), with beam going between QF1 poles, is not a viable solution

• Ongoing studies with Geant will give more info to make a well justified decision