Beam Crossing Angle for $\gamma\gamma$

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Introduction

• $\gamma\gamma$ prefer large x-angle $> \sim 25\text{mr}$
• Strawman design
  – 2mr, 20mr

See:
if 20mr is possible
impact of 20mr on $\gamma\gamma$

No conclusion yet:
What has to be done
Crossing angle consideration for $\gamma \gamma$

- Bottom line
Simulation of Disruption angle

Simulation by CAIN w/ TESLA parameters

*Density is for visual effect only, not proportional to # of particle.
How to reduce crossing angle

1. Disruption angle

\[ \sqrt{\frac{E_0}{10^{910}}} \]

\[ d \]

\[ N_{\text{mm}} \]

\[ E_{\text{GeV}} \]

\[ \theta \]

\[ \sigma \approx \]

\[ \text{for} \]

\[ 10^{210} \]

\[ 0.3 \]

\[ z \]

\[ N_{\text{mm}} \]

\[ E_{\text{GeV}} \]

\[ \sigma \]

\[ = \]

\[ \times \]

\[ = \]

\[ = \]

\[ \text{physics of Compton scattering} \]

\[ N_{\text{mm}}: \text{controllable but reduce luminosity significantly} \]

\[ \Rightarrow \Rightarrow \]

\[ \text{not acceptable} \]

\[ \text{reduce } R/L^* \]
Compact SC Quad

Inner Beam Tube 20 mm ID
Outer Cryostat Tube 114 mm OD

Cryostat Outer Surface
Heat Shield
Vertical Support
Horizontal Support
LHe Flow Space
Coil Support Tubes

QDO Coil Parameters
- Inner Quad 63 T/m
- Outer Quad 81 T/m
- Total Quad 144 T/m

Inner: 5 double layers, single strand conductor
Outer: 4 double layers, of seven strand cable

G10, S-Glass & Epoxy

Design Concept: Two independent coil windings. Integrated helium flow.
Copper inside inner coil support tube.

at L*=5m
Compensator magnet has sextupole, quadrupole and dipole coil windings with 38 mm radius clear inner aperture (10 mr x 3.8 m).

Found that dipole coil can be made half as thick as shown.

Zero Field Point is at X = 76 mm (i.e. 3.8 m x 20 mr)

L*=3.8 m,
What these effort means?

• $\gamma\gamma$ w/ $\sim 20$mr crossing angle may be possible w/e+e- the beam parameters (beta-x/y at the IP)

Price to pay:

Need to study how small beta-x can be w/ fixed L* and QD

remember: photon collider wants/allows highest possible geometric luminosity as the beamstrahlung is not a problem.
What has to be done

Two case studies

- $\theta_x = 20\text{mr}$: minimum modification from $e^+e^-$
  - same $L^*$, smallest possible QD0, $e^+e^-$ parameters
  - detail investigation for disruption angle
  - QD0 design (for fixed $L^*$)
  - make sure if it is really possible to accommodate gg w/ $e^+e^-$ parameters
  - try to find FF optics to minimize horizontal beta function

- $25\text{mr} < \theta_x$
  - most reasonable design of QD0 to date
  - detail investigation for disruption angle
  - FF design
Summary

• need expertized work in 3 area
  – final focus optics
    • given $\theta x$ and $L^*$, find optics to maximize geometric luminosity
      – do not mind beamstrahlung
  – final focusing magnet
    • find smallest possible radius $r$
  – simulation of laser-beam and
    • detail investigation of low energy electrons with safe merging
      – disruption angle, track backgrounds