Crossing angle for the photon collider at ILC

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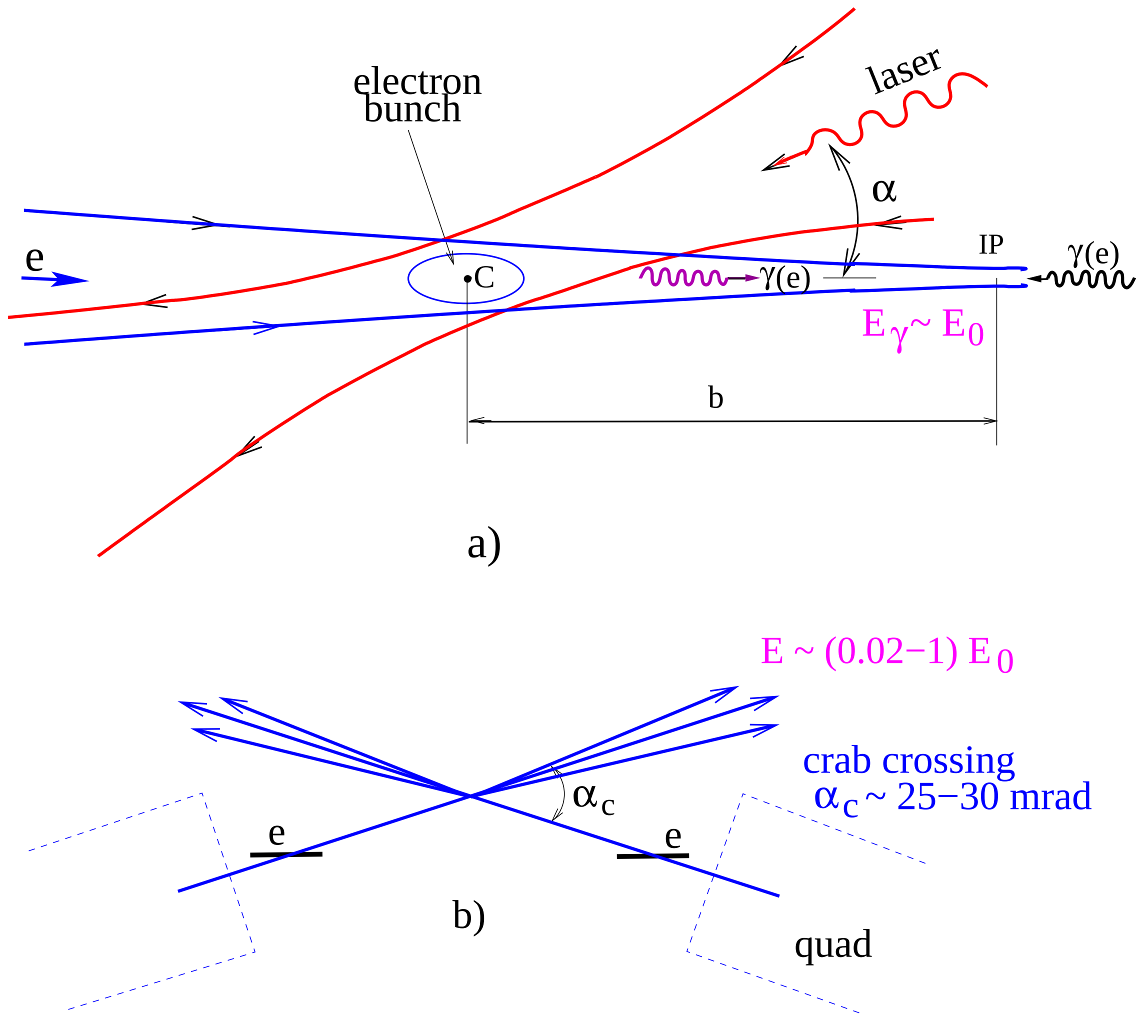
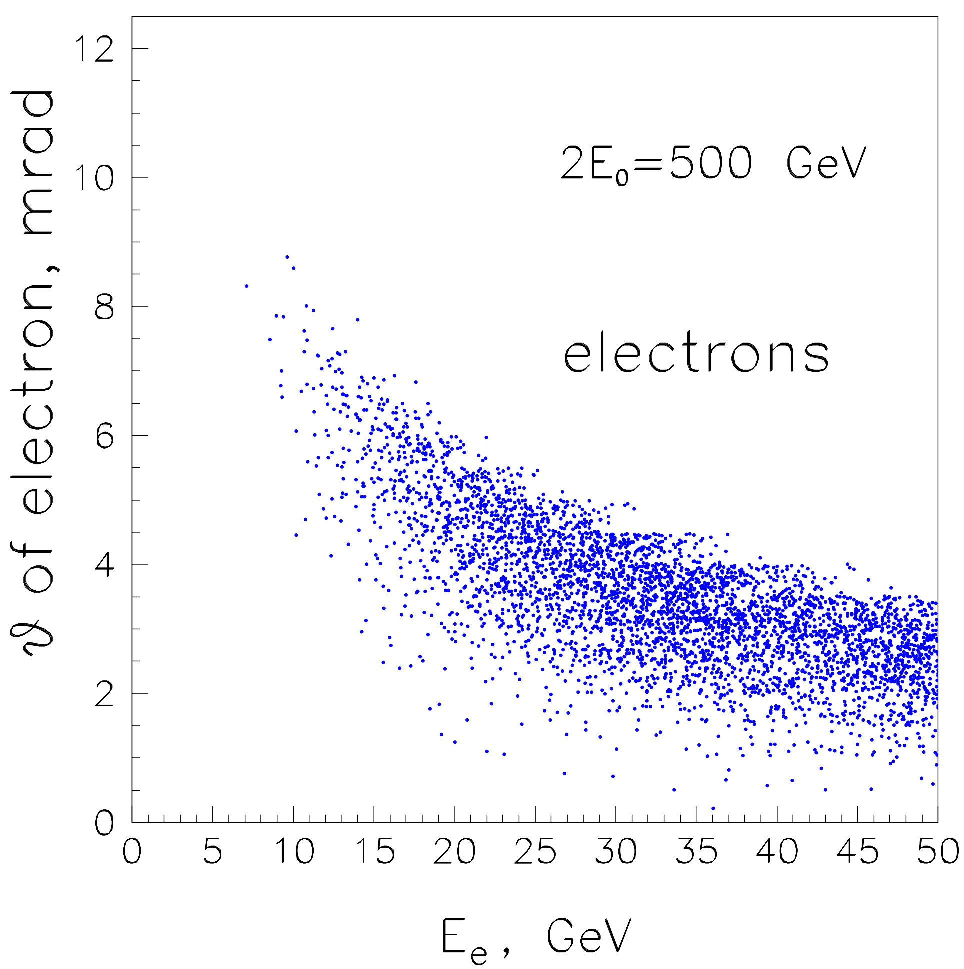
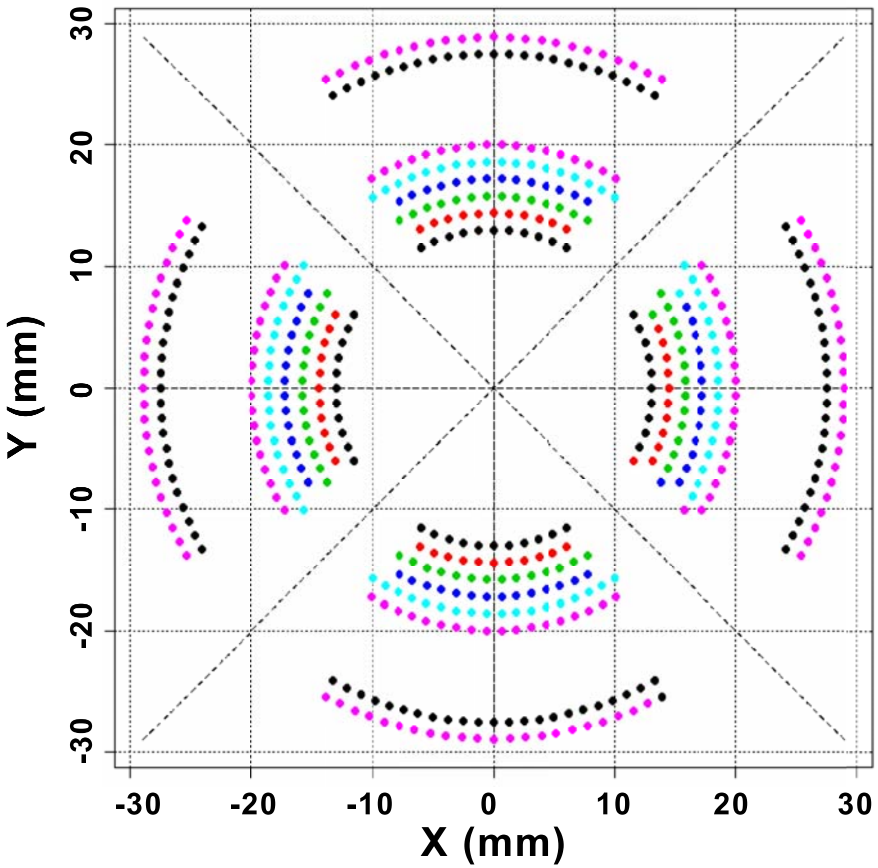
Scheme of the photon collider



Angles of disrupted electrons after Compton scattering and interaction with opposing electron beam; ($N = 2 \times 10^{10}$, $\sigma_z = 0.3$) mm.



Principle design of the superconducting quad (B.Parker), only coils are shown. The radius of the quad with the cryostat is about 5 cm. The residual field outside the quad is negligibly small.



For compensation

G_{in} = 160 T/m

at I_o = 767 A

G_{out} = -20 T/m

at I_o = 517 A

for G_{eff} = 140 T/m

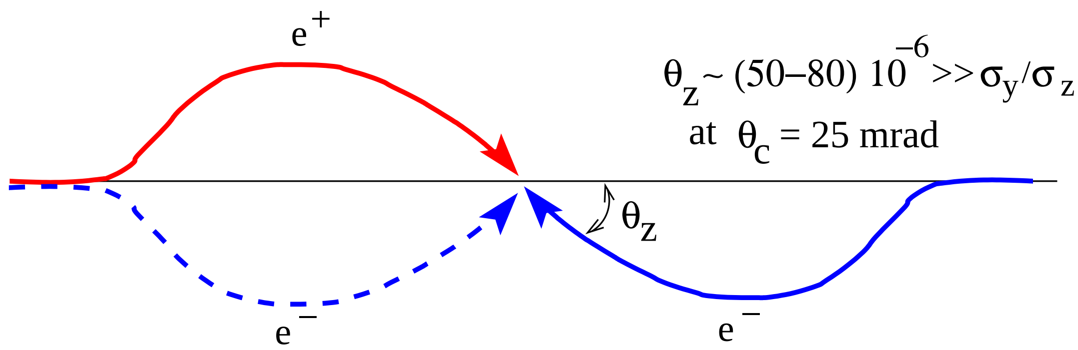
L_{mag} = 2.200 m

L_{coil} = 2.228 m

$$\alpha_c = (5/400) * 1000 + 12.5 \sim 25 \text{ mrad}$$

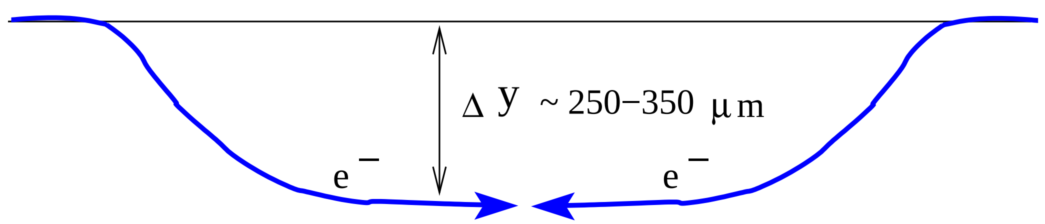
Influence of the detector field

Trajectories of electron(positron) in the presence of the solenoid field and crab-crossing angle. At the lower figure the e^-e^- collision angle is made zero using shifted quads.

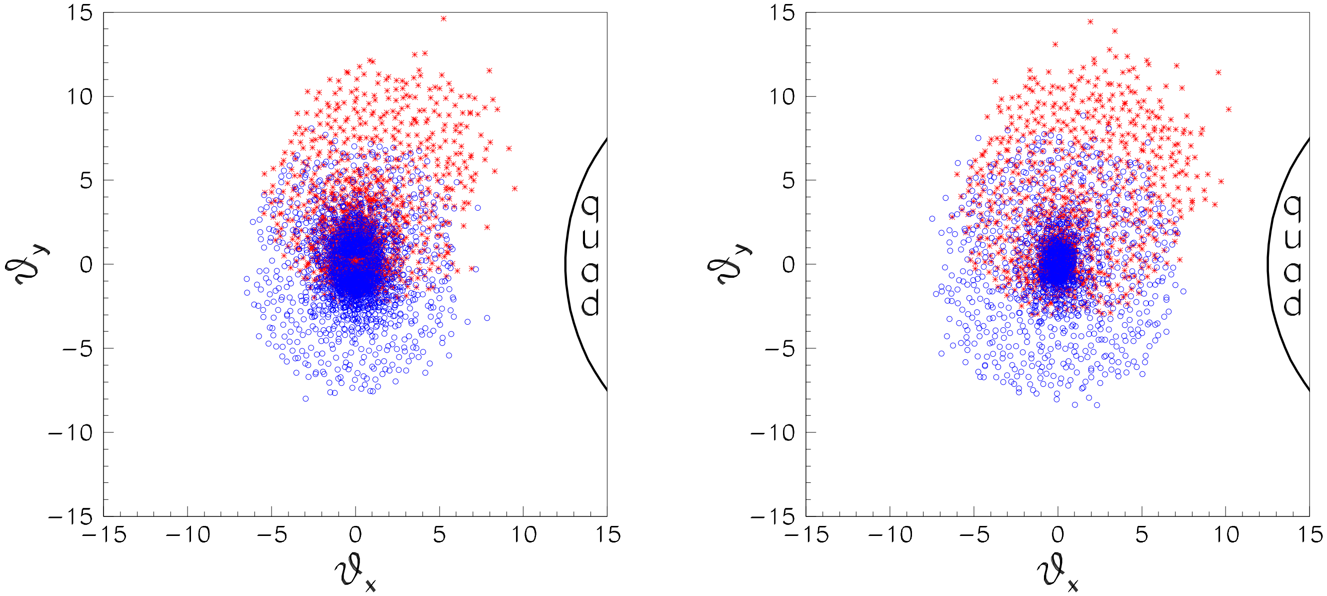


OK for e+e−, but not OK for e−e−(gamma−gamma)

Vertical shifts of final qurds helps
for e−e−($\gamma\gamma$)

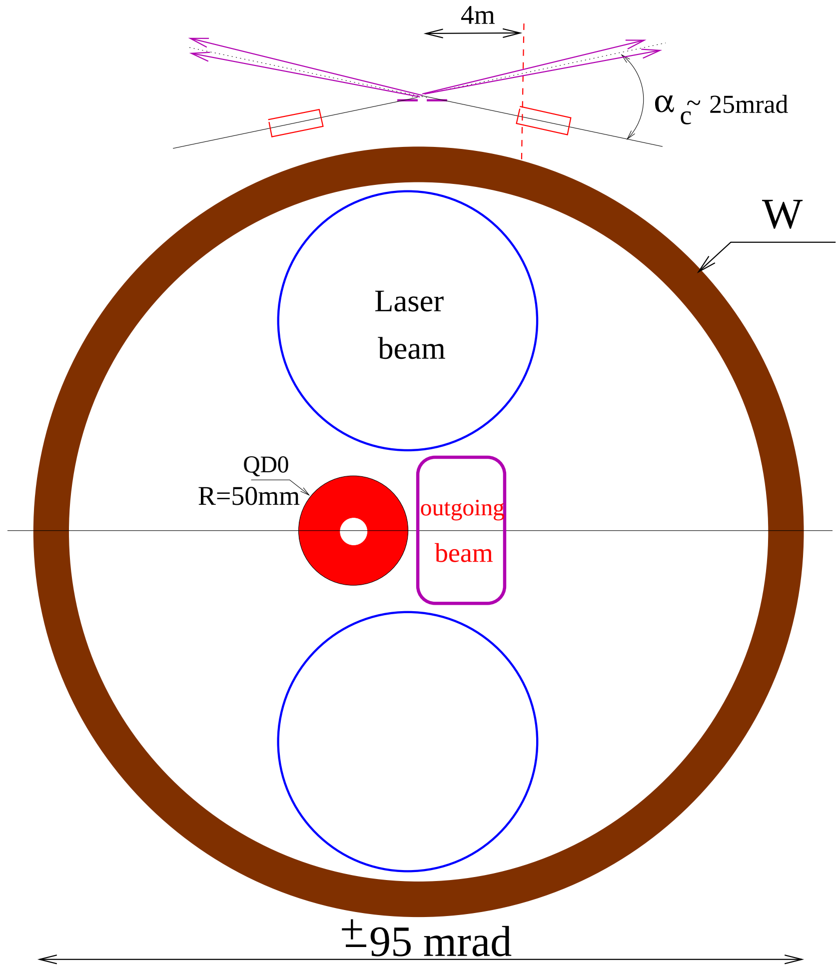


Shift of the disrupted beam by the detector field



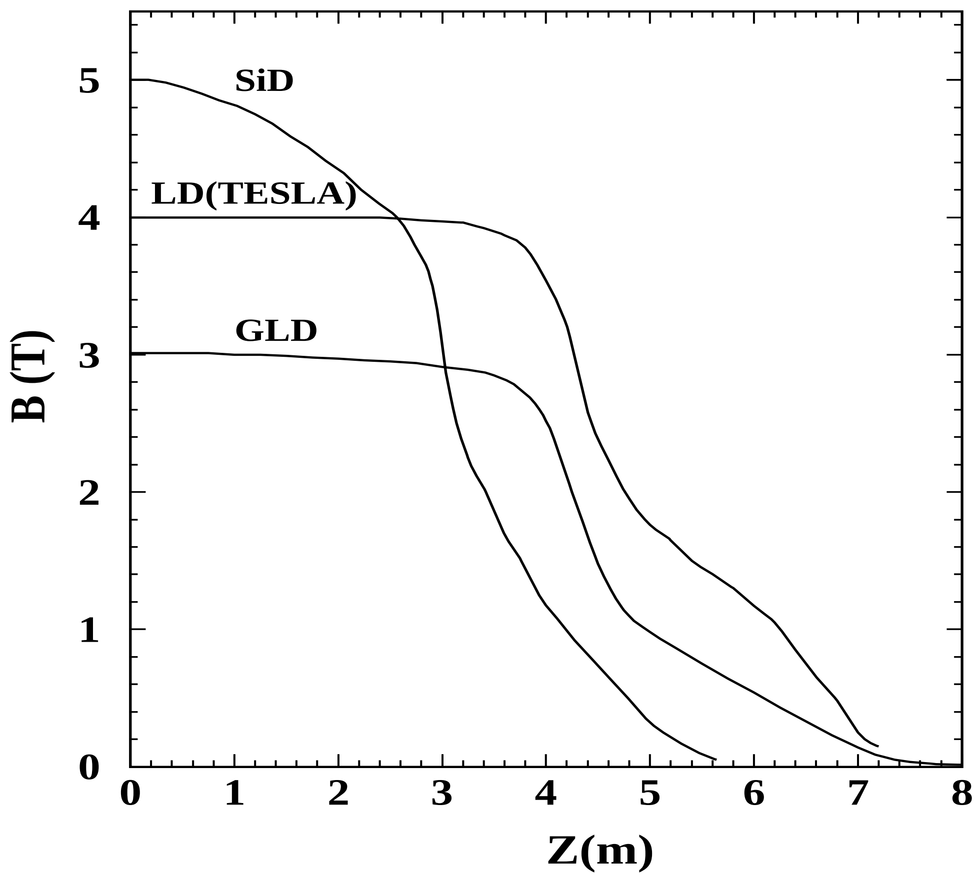
Blue points: only beam-beam deflection, red points: with the detector field 4T. The crab-crossing angle 25 mrad, $2E_0 = 500$ GeV. Positions of particles are taken at the distance 4 m from the IP. Left figure: $2E_0 = 200$ GeV, right: $2E_0 = 500$ GeV. The total number of macroparticles in the beam (several collisions) is about 150000. With account of tails (which can cause backgrounds) the save beam sizes are larger by about 20%.

Layout of the quad, electron and laser beams at the distance 4 m from the interaction point (IP).



Synchrotron radiation in the detector field.

(Fields on Jan.2005)



Results on $L(\alpha_c)/L(0)$. e^+e^- collisions

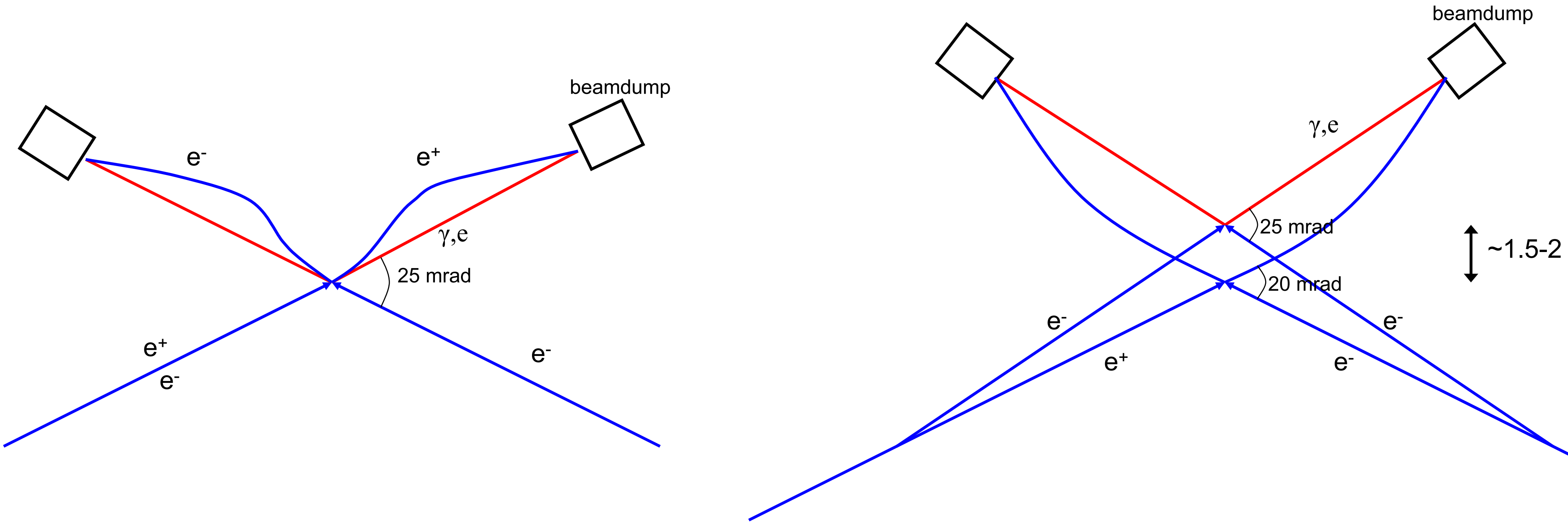
α_c(mrad)	0	20	25	30	35	40
LDC(TESLA)	1.	0.98	0.95	0.88	0.83	0.76
SID	1.	0.995	0.985	0.98	0.95	0.91
GLD	1.	0.995	0.98	0.97	0.94	0.925

$\gamma\gamma$ collisions

α_c(mrad)	0	20	25	30	35	40
LDC(TESLA)	1	0.99	0.96	0.925	0.86	0.79
SID	1	0.99	0.975	0.955	0.91	0.86
GLD	1	0.995	0.985	0.98	0.97	0.93

So, the crab-crossing angle of about 25 mrad is compatible with e^+e^- and $\gamma\gamma$ modes of operation.

Possible configuration of the IP



The second scheme looks very attractive (including e^+e^- community). The required shift of the detector is not a problem (but the beam dump is the same for e^+e^-). The bend of disrupted beam before the beamdump in the e^+e^- case is good for suppression of backward neutrons (shielding between the beamdump and IP is not shown).

The scheme without the shift of the detector is also possible but needs an extra space for bends of beams before the IP.