



Power losses estimation in the ILC 2-mrad extraction line for the High Luminosity parameters set without vertical offset at the IP at 0.5 and 1 TeV center of mass energy.

J. Brossard¹

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Abstract

This note presents the power losses estimation at specific locations for beam and Compton particles, in the ILC 2-mrad scheme extraction line for “High Luminosity” parameter set without vertical offset at the Interaction Point (IP) at 0.5 and 1 TeV center of mass energy. The power losses estimation has been performed with post-collision macro-particles distribution tracking. The used tracking code is DIMAD, the particle distribution after collision have been established using the C++ version of the “Guinea-Pig” (GP) software.

¹ LAL, Univ Paris-Sud, in2p3/CNRS, Orsay, France

1 Introduction

In the “Integrated Luminosity Performance Studies” (Work Package n°6, [1]) of the EuroTeV contract, the feasibility of post-collision diagnostics is mentioned. In order to start this latter study, it has been decided to first performed a cross-checked of previous power losses estimation in the International Linear Collider (ILC) 2-mrad extraction line, in order to verify that the particle tracking is mastered. The current analysis has been done for this purpose.

This note present the power losses estimation at specific locations (see Table 1) for beam and Compton particles, in the ILC 2-mrad scheme extraction line (as defined in [2]) for “High Luminosity” parameter set (as defined in [3]) without vertical offset at the Interaction Point (IP) at 0.5 and 1 TeV center of mass energy. The power losses estimation has been performed with post-collision macro-particles distribution tracking. The used tracking code is DIMAD [4], the particle distribution after collision have been established using the C++ version of the “Guinea-Pig” (GP) software [5].

2 Used macro-particles distribution

The GP files used in this study (downloaded from the “ILC-BDIR LAL activity” web page [6]) have been computed assuming ILC head-on collision without vertical offset (“new_cs15_hs” and “new_cs25_hs” cases). The format (with units) of the “beam” and “compton” particles files are detailed on this web page. For the beam particles, all “beam1.dat” and “beam2.dat” files have been used. For Compton files (“pairs.dat”), only particles with positive z' value have been selected for the tracking.

2.1 Beam particles files at 500 GeV center of mass energy.

At 500 GeV center of mass energy, there are 35 “beam1.dat” files (6 981 095 macro-particles) and 37 “beam2.dat” files (7 380 078 macro-particles). With these 72 input files, assuming an average particle energy of 250 GeV, the power losses deposition induced by one single macro-particles is 0.75 W.

2.2 Compton files at 500 GeV center of mass energy.

At 500 GeV center of mass energy, there are 37 “pairs.dat” files. For power losses estimation, only 5 files have been used (see [2]). The mean power losses deposition induced by one single particle is estimated to be lower than 1 mW.

2.3 Beam particles files at 1 TeV center of mass energy.

At 1TeV center of mass energy, there are 20 “beam1.dat” files (3 989 215 macro-particles) and 40 “beam2.dat” files (7 978 618 macro-particles). With these 60 input files, assuming an average particle energy of 500 GeV, the mean power losses deposition induced by one single macro-particle is 1.44 W.

2.4 Compton files at 1 TeV center of mass energy.

At 1TeV center of mass energy, there are 49 “pairs.dat” files. For power losses estimation, only 5 files have been used (see [2]). The mean power losses deposition induced by one single particle is estimated to be lower than 1 mW.

3 Extraction line definition & tracking procedure

3.1 Tracking procedure along the extraction line

Due to the small crossing angle configuration at the IP, the vacuum chamber of the accelerator is (from the IP to the exit of SF1 element) shared by injection and extraction lines. Thus, in this extraction line section, the outgoing particles will pass in magnetics elements (quadrupole, sextupole ...) with an x-offset position (“x axis” being in the horizontal plane). As a consequence, the tracking procedure (performed using DIMAD [4] software) in the extraction line is done in 2 steps :

- from the IP to the exit of SF1 element (extraction line section named “fd”)
- from the exit of SF1 to the dump (extraction line section named “xl”)

In order to take into account (in a first approximation) this geometrical effect, 2 mrad is added to the x' coordinate of all the macro-particles (or particles) just after the IP (the used GP files have been computed assuming head-on collision). The tracking is then performed in the “fd” section, and before the “xl” tracking, the mean value of x (resp. x') coordinate is subtracted on all x (resp. x') individual macro-particle (or particle) coordinate (in the “xl” section, all magnetic elements are center on the nominal outgoing particle trajectory).

3.2 Line definition at 500 GeV center of mass energy

The “fd” (header_dimad_fd_500.txt) and “xl” (header_dimad_xl_500.txt) lines used in this study at 500 GeV can be downloaded from [2] in DIMAD software format.

3.3 Line definition at 1 TeV centre of mass energy

The “fd” (header_dimad_fd_1000.txt) and “xl” (header_dimad_xl_1000.txt) lines used in this study at 1 TeV can be downloaded from [2] in DIMAD software format.

4 Power losses for HL parameters set without vertical offset at the IP

Table 1 shows the power losses (at specific locations) obtained in the ILC 2mrad extraction line at 500 GeV and 1 TeV center of mass energy for High Luminosity parameters set with no vertical offset at the IP for beam and Compton particles. In round bracket can be found the preceding results taken from [7] for QD0 and SD0 and from [8] for all the other elements. The grey cells are in kW units.

	500 GeV				1 TeV			
	Beam		Compton		Beam		Compton	
QD0	0.14 (<1)	[W]	0.43 (0.46)	[W]	102 (<1)	[W]	1.6 (0.82)	[W]

SD0	0.33 (<1)		0.04 (0.2)		74 (<1)		0.14 (0.04)	
QEX1	0.19 (0.2)	[kW]	31.4		7.13 (7.9)	[kW]	3.9	
QEX2	0 (0)		0		0 (0)		0	
BHEX1COLL	0.14 (0.1)		0		0.5 (0)		0.4	
COLL1	106 (52.3)		0		218 (111)		7.6	
COLL2	200 (207.5)		0		202 (206)		6.7	
COLL3	0 (0)		0		0		0	

Table 1 : power losses (at specific locations) obtained in the ILC 2mrad extraction line at 500 GeV and 1 TeV in center-of-mass energy for High Luminosity parameters set with no vertical offset at the IP for beam and Compton particles. In bracket can be found the preceding results taken from [7] and [8] .

1 Conclusions

The results obtained in this study are partially compatible with the previous ones (see [7] and [8]).

At 500 GeV, the power losses are at the same order of magnitude as previous study excepted at one location (COLL1 element). The source of this discrepancy is still unknown. "

At 1 TeV the beam particles power losses in QD0 and SD0 elements are about one hundred bigger than the previous results [7]. The level of the current beam particles power losses estimation (at 1 TeV for QD0 and SD0 elements) in the extraction line has been validated (using 20 input Guinea-Pig files) inside the working group. As a consequence of this result, a new extraction line design is required at 1 TeV (assuming High Luminosity parameters set will be used).

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References

- [1] : https://www.eurotev.org/work_packages/wp6_ilps/
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- [3] : http://flc-mdi.lal.in2p3.fr/IMG/pdf/ILC_new_beam_parameters.pdf
- [4] : <http://www.slac.stanford.edu/accel/ilc/codes/dimad/>
- [5] : <https://trac.lal.in2p3.fr/GuineaPig>
- [6] : <http://flc-mdi.lal.in2p3.fr/spip.php?rubrique17>
- [7] : <http://www.eurotev.org/e158/e1364/e1391/e2726/EUROTeV-Memo-2007-001.pdf>
- [8] : R. Appleby, private communication "extractionlineandmagnetsandcolls.500GeV.xls" and "extractionlineandmagnetsandcolls.1TeV.xls".