Benchmarking of BDSIM and DIMAD using the ILC extraction lines

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Introduction

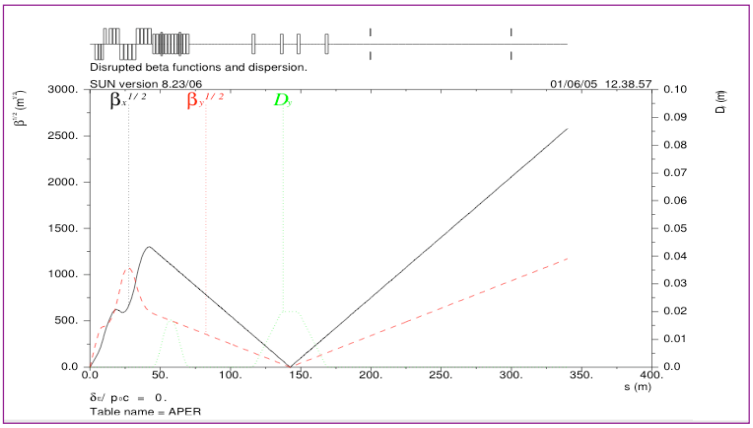
For the design of the ILC extraction lines, it is essential to have a reliable simulation program for particle tracking. We compared two codes DIMAD and BDSIM using the present versions of the ILC post-collision lines for benchmarking purposes, in both large and small crossing angle cases.
We consider both the 20mrad and 2mrad extraction lines of the International Linear Collider (ILC) and we perform tracking of the disrupted post collision electron beam

DIMAD[1] is a program specifically aimed at studying the behavior of particles in beam lines, by computing their trajectories using the second order matrix formalism";
BDSIM[2] is a Geant4 extension toolkit for simulation of particles transport in accelerator beam lines. Uses the closed solutions in linear elements, whilst for higher-order element a Geant4-like stepper integration method is used. This approach means that particles beams can be tracked efficiently when inside beam pipe, while also Enabling full Geant4 process when beam particles have left the vacuum beam pipe.

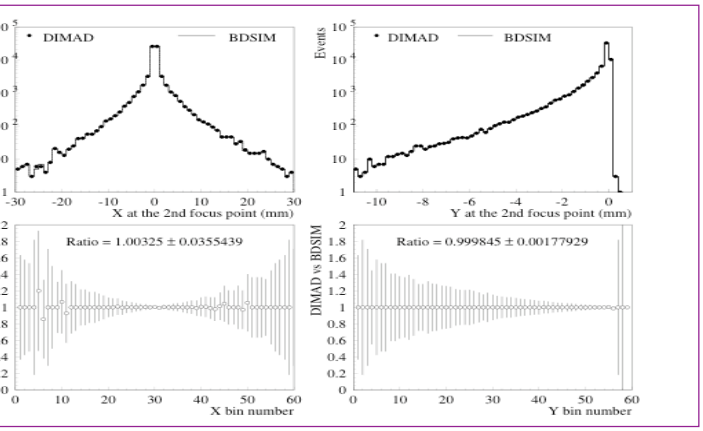
20mrad

Thanks to large crossing angle, one can use a dedicated line to transport each outgoing beam from Interaction Point to its dump.

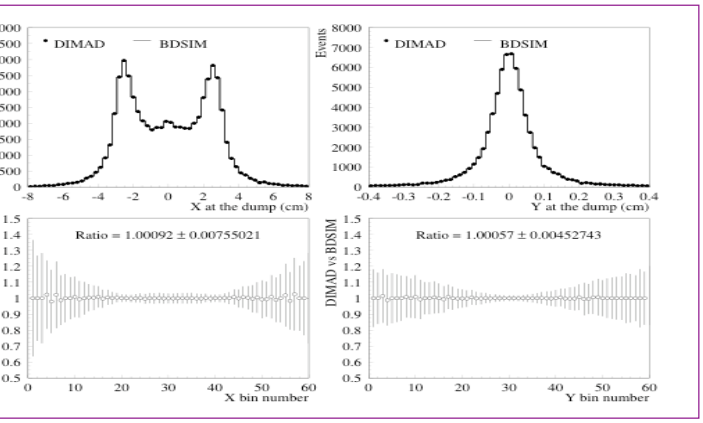
The optics used for the 2mrad study consists of a DFDF quadruplet, followed by two vertical chicanes for energy and polarization measurements and a long field -free region that allows the beam to grow naturally, with two round collimators to reduce the maximum beam size a the dump.



Betatron function and vertical dispersion along ILC extraction line with 20mrad crossing angle.



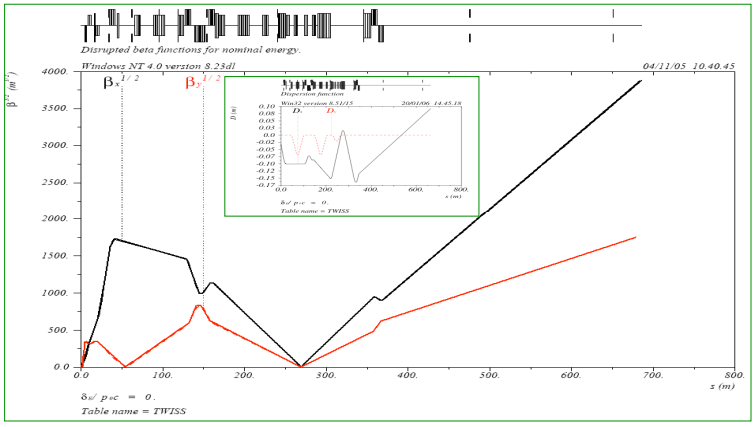
Comparison of the transverse beam distributions at the secondary focus Mexfoc



… and at the end of the extraction line.

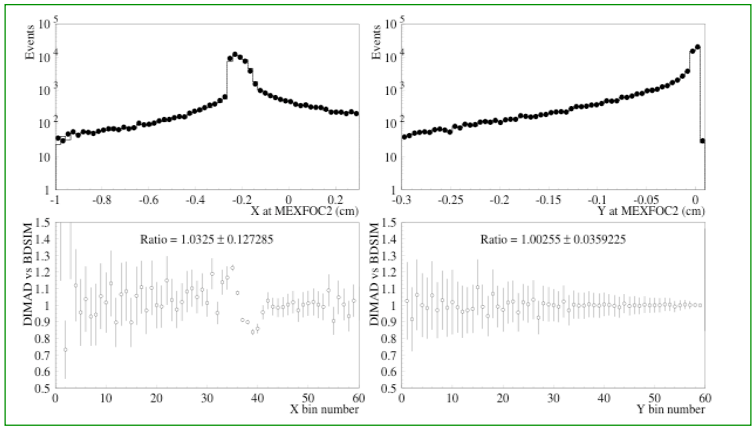
2mrad

When the colliding beams cross with a small crossing angle of 2mrad the outgoing beam passes off-axis through the bore of the final quadrupole QD0, both final sextupoles, but not the second-to-final quadrupole QF1.
However, the outgoing beam sees the pocket field of this latter magnet. These are followed by a vertical energy clean-up chicane, diagnostic chicanes. For the purpose of energy spectrometry and polarimetry, and finally a long field-free region to allow the beam to grow to the dump, in the same way as in, the 20mrad scheme.

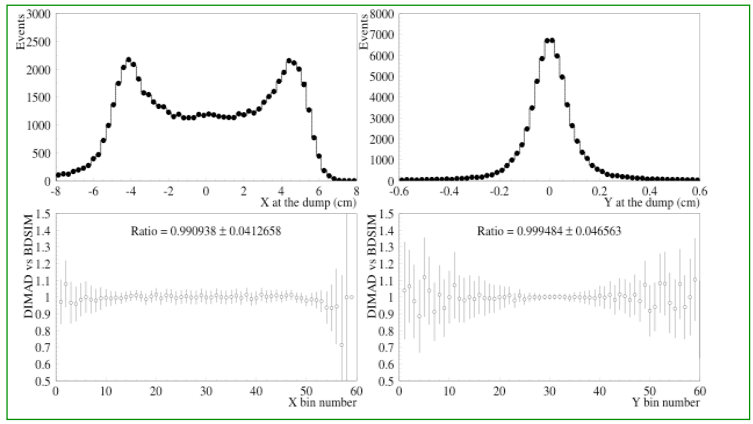


Betatron and dispersion function downstream of the final doublet of the incoming beam line.

At several locations of interests, we project the transverse beam distributions obtained with each program into binned histograms and we compared them quantitatively.



Comparison of the transverse beam distributions at the secondary focus Mexfoc2



… and at the end of the extraction line.

Conclusion

We find that both programs give an equivalent description of the beam transport in all parts of the post-collision lines expect at the secondary focus for the 2mrad design, where a small difference is visible.

[1] On the web: http://www.slac.stanford.edu/accel/ilc/codes/dimad/
[2] I. Agapov and al., the BDSIM toolkit 2006 Eurotev Report-2006-014