

Research Director's Report

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Optimising the value of the ILC

This month's Research Director's Report was written by Jim Brau, co-chair of the Worldwide Study and regional detector contact for the Americas.

Several years ago (in 2003), the parameters for the linear collider were defined by the ILCSC Parameters Committee chaired by Rolf Heuer. The Committee updated the parameters in 2006. In their [2006 report](#) based on the physics potential that served as a baseline to convince the worldwide community that the next facility should be a 500 GeV to 1 TeV electron-positron linear collider, the Parameters Committee listed the required parameters for the "Baseline Machine", in order of priority (paraphrased here):

1. The maximum centre-of-mass energy should be 500 GeV, allowing for operation at any energy in the range between 200 GeV and 500 GeV.
2. Luminosity and reliability of the machine should allow the collection of approximately 500 fb⁻¹ in the first four years of running, after one year for commissioning and short pilot physics run(s) (luminosity is scaled for lower energy by root(s).)
3. The collider has to allow for energy scans at all centre-of-mass energy values between 200 GeV and 500 GeV, to allow for operation at the top pair threshold, the Higgs production threshold, and thresholds for new particles. Limited change of energy times were prescribed.
4. Beam energy stability and precision should be below one tenth of a percent at any energy, and the design must allow measurements of the beam energy and of the differential luminosity spectrum with a similar accuracy.
5. The machine should be capable of producing electron beams with polarisation of at least 80 percent within the whole energy range.
6. The interaction region (IR) should allow for two experiments. Switching between experiments should be accomplished with less than a few percent loss of integrated luminosity.
7. Calibration capabilities down to 90 GeV are required.
8. Running with high levels of beamstrahlung was discouraged. Increased background increases the integrated luminosity required to reach desired levels of accuracy.

Please refer to the Parameters Document for the full statement on each of these points, which were paraphrased here for brevity.

The Parameters Document also stressed that the baseline machine has to be upgradeable to a centre-of-mass energy of 1 TeV, and discussed the requirements for the upgrade.

Finally, the Parameters Document discussed the possible physics-driven options that could be needed in the future (doubling integrated luminosity at 500 GeV in two years, e-e- running, positron polarisation, gigaZ, WW threshold, and gamma-gamma or electron-gamma collisions) without giving any priority.

Since its formation, the GDE has recognised the Parameters Document as the authority on what is required for the physics in any machine design. Some relaxing of the parameters has been necessary. For example, the 2003 document specified two interaction regions for the two experiments, while in the 2006 update the sharing of the interaction region between two experiments in a "push-pull" configuration was described, and accepted if necessary for cost and design considerations, provided a short changeover of one week was feasible.

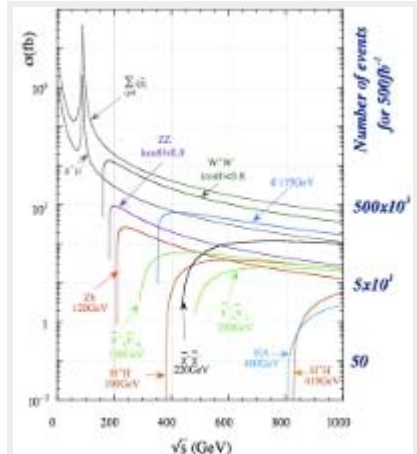
Over the past year, the GDE, led by the project managers, has been critically reviewing the ILC reference design, questioning key parameters, looking for less expensive options (see the [Director's Corner](#) in last week's *ILC Newslines*). A proposal for baseline changes aimed at cost reduction with an improved technical design has been developed, and is known as SB2009. It was presented at the Albuquerque ALCPG meeting. Subsequently, Barry Barish asked the Research Director, Sakue Yamada, for the reaction of the physics and detector community to SB2009.

Sakue has created a working group of people who are able to simulate the effect of SB2009 parameters on physics performance. Some changes are expected to have little effect on the physics performance of the ILC, while other changes potentially may have important negative implications, challenging the fulfillment of the Parameters and performance. The working group has been studying the SB2009 parameters to assess quantitatively the physics implications, and since December, when detailed SB2009 beam parameters became available, simulations have been started. Some preliminary studies will be completed in the coming weeks, others by LCWS 2010 in Beijing. Between now and then, the physics community and the GDE will be discussing and evaluating these results. We anticipate important discussions in Beijing in March.

-- Jim Brau



During the 2006 Valencia Linear Collider Workshop, the Parameters Committee updated the 2003 ILC Parameters Document. The welcome cocktail in the La Nau de la Universitat provided an opportunity to discuss this and other ILC developments.



The ILC Parameters Document calls for the ability to do energy scans at all energies between 200 and 500 GeV.