Research Director's Report

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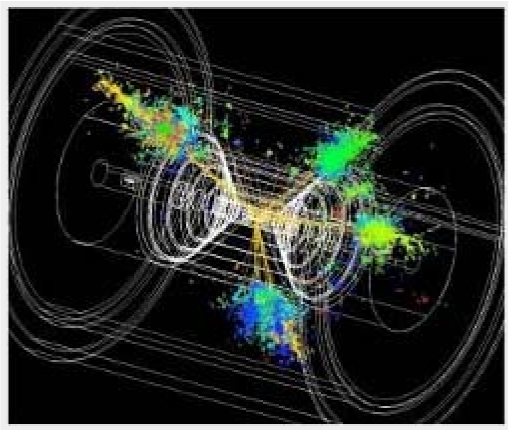
Linear collider detector development

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

I have just attended the CLIC09 workshop at CERN and am writing this column in the plane on the way back home. The number of registrants was about 250 from more than 20 countries, of which the attendance to the physics and detector sessions was about 50. The workshop was the third in the series, and attendance by the ILC community has been increasing each time. I acted as a convener of the physics and detector working group. It was not a participation as a regional contact of the ILC research directorate; nonetheless, I would like to share some information with readers of the ILC *NewsLine*.



An event in the SiD detector, CLIC version.

The Compact Linear Collider (CLIC) Study is a linear collider based on beam-driven radiofrequency (RF) technology where a high-current low-energy beam will power the RF for the main linear particle accelerator (linac). The plan is to start at a centre-of-mass energy of 500 GeV which will be upgraded to 3 TeV. The nominal luminosity goal for the 500-GeV machine is 2.3 10^{34} $cm^{-1}s^{-1}$ (about the same as ILC) and that for 3 TeV machine is nearly three times larger at 5.9 10^{34} $cm^{-1}s^{-1}$. Since the technologies are quite challenging, there also are more conservative luminosity goals called the 'relaxed' parameter sets that are a few times smaller. Now, CLIC people are busy working on the CDR (Conceptual Design Report) to be produced at the end of 2010. The 'shortest and success-oriented' long-term plan is to write the Technical Design Report (TDR) around 2016 and to have first beam in around 2024. Even though the RF power source for the main linac is very different from that of ILC, there are large areas of common issues between CLIC and ILC where close collaboration can benefit both parties. This is even more the case for the physics and detector activities, and indeed a joint working group is being formed now to foster collaborations between CLIC and ILC in this area.

The design of the CLIC detector can take almost direct advantage of what has been done for ILC. In fact, so far the detector models for CLIC are modified versions of SiD and ILD. These detector models have shown that, with modest modifications, they can provide reasonable performances at CLIC. For instance, the particle-flow algorithm developed for ILC was found to give adequate energy resolution (3-4 percent) for up to 500 GeV of jet energy. These modest modifications, however, are quite important. First, due to higher energies of jets, the hadron calorimeters have to be thicker than that of ILC. In addition, the greater intensity of background due to the low-energy electron-positron pairs forces the beam pipe radius to be larger by about a factor of two. At higher centre-of-mass energies, more and more important physics events will hit the forward and backward regions where background due to hadronic two-photon interaction is much more intense than for the ILC. In order to cope with the high rates of these backgrounds, a time-stamping capability of around 10 nanoseconds is considered necessary. The time stamping is a critical and challenging issue for CLIC, and there was a special panel discussion session in the workshop dedicated to the topic. Currently, for example, there is no technology available for vertexing that satisfies the requirements.

A large fraction of work done on physics and detectors is common to both CLIC and ILC, and ILC detectors are already benefitting from CERN expertise in detector integration and push-pull design. Even for the issues specific to CLIC such as the tight time-stamping requirement and the high rates in forward and backward regions, solutions to them would be useful for ILC detectors. If anybody thinks that all problems for ILC detectors are already solved and is not interested in issues that may seem specific to CLIC, that person may be missing a great opportunity to improve ILC detectors. It is true that there is now a large disparity between CLIC and ILC in the amount of work done in physics and detectors, and also one cannot expect that ILC efforts to be spent on something that does not benefit ILC. However, the small amount of effort spent for CLIC by the ILC physics and detector community could easily be more effective for ILC itself than the same amount of effort spent exclusively for ILC.

-- Hitoshi Yamamoto