Research Director's Report

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Designing groups and detectors

Three concept groups have responded to the call for Expressions of Interest: ILD, SiD and the 4th concept group. Now we can go one step further, namely the common task groups will be formed by the members of each of these groups.

I know the detector concept groups will set up their own internal structure in the meantime and strengthen the effort for their detector studies. Designing a detector system always requires compromises between conflicting demands. A well structured group can be effective in solving such problems.

A general-purpose detector of very good performance for a high-energy electron-positron machine should have certain features like high hermeticity, high granularity, a good momentum resolution for charged particles, almost complete energy absorption for gamma rays and hadrons, as little dead material as possible in front of each detector, and so on. There are boundary conditions which often interfere with the above requirements. The beams must come in and go out freely. There is background radiation from the beams. There must be mechanical structures to support every detector component solidly. Electric power should be brought in and signals must be taken out with many cables. For some components temperature control is needed. Very often liquid helium or argon is applied in the detector. The magnetic field is essential for measuring the momentum, but it causes many complications, too. One should not forget the total cost. While it is impossible to realise all the desired features, we also want the detectors to be as powerful as possible.

Now every group tries to find its optimum solution. How they solve various conflicts depends on what physics aims each group puts emphasis on. In order to reach a well considered compromise, good communication within the group is indispensable. Hopefully a well structured organisation will make this easier.

Prototype of an electromagnetic calorimeter.

One preferred way of satisfying conflicting requirements has been the development of a new detector technology. For example, historically ever-thinner superconducting coils of the solenoid magnet have been developed to reduce the amount of dead material in front of the calorimeter which used to have to be placed behind it. Now, as an alternative approach, semiconductor photon detectors with high sensitivity replace conventional photomultiplier tubes and thus make it possible to put an electromagnetic calorimeter inside the magnetic field.

Going through the process of designing a total system is the only way to identify these challenges in detail and to pinpoint effective objectives for detector R&D. The groups will find many of them and continue their intensive R&D work by participating in the detector R&D collaborations. The new common task groups are intended to enhance such cooperation among the different groups that will submit a Letter of Intent (LOI). All of the research and development work going on now will produce various outputs. They will eventually be transferred to the real detectors to be constructed when the ILC will be built.

By that time some technologies might already be applied in other fields. This is desirable since mass production and/or enough experience in the industry could reduce the price.

The Letter of Intent is for detectors to be studied, not to be built. This is an unprecedented exercise for detectors for a collider. On the one hand, we need to integrate detector designs with machine design. On the other hand, it is a very useful step to advance detector R&D in order to pinpoint problems that otherwise are not likely to be identified.

-- *Sakue Yamada*