Physics and Detector Advisory Panel Report
December 2016

The PDAP, Paul Grannis, Junji Haba and Sandro Palestini, met during the Linear Collider Workshop in Morioka on Dec. 7, 2016. Presentations were made by Andy White for SiD, Ties Behnke for ILD and Jan Strube for the R&D liaisons.

SiD: Despite minimal funding, the SiD consortium has conducted a number of projects in the past year, and seems to be in a healthy state. The addition of new collaborating institutions in Tohoku and Glasgow is welcome and the contributions of these institutes are significant. There have been many useful optimization studies by students.

Progress on several hardware topics was presented. Problems of cross-talk and large sensor capacitance on the Chronopixel chip for silicon pixel readout and time stamping were fixed. New ECAL sensors ameliorating problems with previous version have been received and effort to procure the next round of tracking silicon strip detectors from Hamamatsu has re-started. A new kPIX submission has been sent to the foundry. The new HCAL baseline using a scintillator/steel sandwich with SiPM readout is now in the MC configuration, but needs optimization and engineering. The iron return yoke design of barrel-end interface was modified to reduce flux leakage and simplify assembly. Irradiation studies of candidate beamCAL sensors are ongoing. Work has started on possible new options, including a MAPs option to replace Si strips and new ideas for low mass tracking system supports.

A variety of simulation studies were carried out, including the effect of backsplash from FCAL on the vertex detector and the need for the anti-DID, the need for upstream muon shielding, the need for Z pole running for calibration (judged not needed), and the radius of the stay-clear region due to the pair background.

The program envisioned for the next year continues most of the themes of the past year, including further development of vertex detector chips, next stage prototypes of tracking detectors, test beam studies of ECAL, and engineering and tests of HCAL modules. The US Japan program offers the possibility of some modest funding for some, but surely not all, of these hardware prototype

projects. The PDAP urges the SiD group to prioritize them so as to focus available resources in such a way as to make real progress on at least one of them. This prioritization should take into account the urgency of providing those basic proof-of-principle demonstrations that are needed soon. We agree with the indicated priority for use of US Japan funds for ECAL studies, should they become available.

ILD: Despite the uncertainties on ILC approval and funding limitations, ILD has made clear progress over the past year. The PDAP applauds ILD for good progress under difficult circumstances. In this year the group has developed a new, more elaborated organization.

ILD relies heavily on R&D groups for developing and validating subdetector technologies. The group continues to carry several options for many subdetectors. In part this is because it allows for incorporating future new technologies (although no new options were added in the past year), and in part because it is felt that collapsing the options could lead to loss of collaborators. Retaining multiple options does however give added complexity in software, performance and integration studies.

ILD has now defined two versions for comparative study of performance and cost – one as originally proposed (ILD-L) and the other with a thinner TPC and surrounding subdetectors moved inwards. The length is the same in both versions. Partial compensation for the smaller TPC in ILD-S is made by raising field from 3.5 to 4 T. ILD-S is sized radially to be same as CLICdp (apart from the HCAL thickness) so that a comparison of Si and TPC tracking with similar geometries can be attempted.

Task forces have studied ECAL module boundaries and the need for an anti-DID. Study of cost reduction of smaller, higher field solenoid was made. The group is studying the need for Z pole calibration but there is no definitive recommendation yet.

Conversion of analysis software to the DD family is proceeding well, but more slowly than hoped. Some performance results with the new software agrees with the previous Mokka, but some (e.g. PFA energy resolution) does not. ILD notes that relatively small simulation details matter; for example the jet energy resolution depends on the width of ECAL sensor guard rings.

Necessary decisions on HCAL geometry, FCAL re-design and anti-DID should be made by mid 2017, by which time DD-xx software validation should have converged so that studies of the comparative performances in ILD-S and ILD-L can proceed.

ILD has begun the necessary exercise of rigorous definition of conventions and rules, and the careful definition of the interfaces between subdetectors. It expects these documents to be prepared over the coming year, with separate documents as needed for different subdetector options.

We note that embarking on the interface specification documents at this time may be somewhat risky since many technology choices remain to be made and interfaces may depend on these choices, as well as upon changes in the MDI and IR hall designs. Moreover, the interface specification will require scarce engineering resources and thus converging may take a long time.

ILD noted that manpower for the central silicon strip detectors is not identified. The PDAP has not fully appreciated the rationale for the various silicon strip subdetectors and believes that a review of the definition of their roles and specifications would be useful in this interim period before ILC project decisions.

Common: Both SiD and ILD are transitioning to the DDxx family of software packages also used by CLICdp for event simulation and reconstruction. This is a very positive development even though both groups are converging on operative versions more slowly than hoped. Collaboration on these projects has already occurred, and further efforts to share developments would be desirable.

Collaboration on other common subsystems such as the forward calorimeters, backgrounds and shielding designs, MDI should continue to be encouraged.

Concerns were expressed that computing resources for future campaigns of MC simulations of performance could be scarce as the load of LHC, Belle-II and CLIC analyses grow.

R&D: The status of the R&D groups was nicely summarized. The document detailing the R&D goals and achievements has not yet been released and the PDAP strongly urges that this occurs very soon. This document has value only to the degree that it is available for online consultation, with relatively frequent updates. Although the addition of more summary information could be

envisioned, we note that if the updates necessitate changes in the summary sections, the whole project becomes more unwieldy. Even without the summaries, the document should have considerable value.

The plan to have reviews conducted by the ECFA R&D panel, augmented by appropriate experts for a particular review, has been adopted. Such reviews would occur only if requested by the LCC Associate Director for Physics and Detectors. The PDAP believes that this is a good plan for the interim period before a formal ILC project begins.

Final note: The PDAP review of the detector concepts has been much lighter than the in-depth reviews that are typical for real detector programs. While it may be that this light review process has some value, we suggest that, at this time of transition in the LCC physics and detector leadership, that the need and form of such a review be re-examined.