

REPORT OF THE FOURTH MEETING OF THE ILC PROJECT ADVISORY COMMITTEE (PAC)

13/14 May 2010; Valencia, Spain

Committee: Jean-Eudes Augustin, Paris; Jon Bagger (ILCSC Chair—ex officio); Lyn Evans, CERN (Chair); Don Hartill, Cornell; Steve Holmes, Fermilab; Akira Masaike, Kyoto; Robert Orr, Toronto; Raj Pillay, TIFR; Roy Rubinstein, Fermilab (Secretary); Masakazu Yoshioka, KEK.

Apologies: Günther Geschonke, CERN

1. Introduction

The ILC Project Advisory Committee (PAC) was formed in 2008 to assist the International Linear Collider Steering Committee (ILCSC) in the ILCSC's oversight of the Global Design Effort (GDE) activities on ILC accelerator design and also of the ILC detector activities. The PAC mandate is given in Appendix I.

The fourth meeting of the PAC took place on 13/14 May 2010 at the Instituto de Fisica Corpuscular (IFIC), University of Valencia, Valencia, Spain. The PAC is very grateful to the IFIC staff for their excellent hospitality which made this meeting possible, and appreciated the introductory talks on particle physics activities both at IFIC and at other institutions in Spain. The meeting consisted of two days of presentations on the ILC accelerator status and plans and on the status and plans for ILC detectors. The Committee is also very grateful to the presenters and the leadership of the ILC accelerator and detector efforts for all of their work to allow this evaluation of their activities. The meeting agenda is given in Appendix II, and the presentations to the Committee are in Appendix III.

2. Accelerator Reports Presented to the PAC Meeting

A. Barry Barish gave the GDE project status, and also provided responses to the PAC questions from its previous meeting; he also discussed the report of the January 2010 AAP review. He noted that the technical ILC priorities are well matched to those of the laboratories where much of the work is carried out, except for the two areas of the positron system beam demonstrations and the CF&S criteria optimization and site development. The R&D Plan Release 5 is expected within a few weeks. Barish described the reasons for the changes made from the RDR design, with a major one being cost containment; the SB2009 proposals would

give ~13% cost saving. Following the AAP recommendations, there will now be a change control process for these proposals

In answer to questions, Barish noted that there will be a formal GDE response to the January 2010 AAP recommendations before any changes are made.

B. More details on SB2009 were given by Ewan Paterson. The AAP report supported the effort to reduce cost, but is concerned about the increasing risk that could be caused by some of the proposals, and recommends the need for more study; this additional study will take about a year. Paterson said that solutions exist to safety issues for a single tunnel, and he described the two alternative rf systems under consideration (klystron cluster layout and distributed rf system). More will be known about them by the end of 2010, but it is likely that both will be carried through at least 2011. The expected luminosity as a function of energy was shown, for both the RDR and SB2009 designs, and Paterson noted the experimental verification by DAFNE of the crab waist scheme. Several approaches to increasing the luminosity below 300 GeV are under evaluation. In the central region, Paterson commented on the large number of requested tune-up and abort dumps.

The discussion following Paterson's presentation was mainly about how to improve communications between the accelerator and detector communities, and the need for common goals for the two communities.

C. Akira Yamamoto reviewed the progress on SCRF, and gave the goals for this work. Following a second pass, 33% of cavities reached 35 MV/m in October 2009; 44% in January 2010; and 48% in March 2010, based on statistics of ~50 cavities; the newer cavities have an even higher yield. It appears that most problems are caused by cavity defects. Several schemes are under study for understanding and fixing cavities which fail a first pass. Yamamoto gave test plans for 2010, and for future tests with beam. Industrialization will require an increase from the XFEL's 0.5 cavity/day/vendor to 3.5 cavities /day/vendor if there are 6 ILC cavity vendors. There will be a meeting on ILC cavity industrialization in Kyoto in May 2010.

In answer to a question, Yamamoto said that a strategy still needs to be developed for incorporating cavities of different gradients into a cryomodule.

D. The tests at FLASH were discussed by John Carwardine, including the specific objectives of the 9 mA study. Significant progress has been made towards achieving the goals set for each metric, although Carwardine acknowledged that these tests are operationally very challenging. Additional study time is scheduled in 2011, and help may be needed to ensure that the time does indeed become available.

E. Mark Palmer described the test program at CEsrTA. He showed the effect of various beam pipe coatings to reduce the electron cloud in quadrupoles and dipoles, and the secondary emission yields for the coatings and as a function of time since installation. Palmer listed the studies still needed, and said that there will be a baseline Electron Cloud Working Group recommendation by October 2010.

F. A report on work at ATF and ATF2 was given by Toshiaki Tauchi. There are now ~2000 people-days of visits per year for this activity. He gave the plans for the period 2010 to 2015. In 2004, the ATF vertical emittance was 4 pm, and Tauchi gave plans for a reduction to 1 pm. The jitter from the fast kicker for single bunch extraction is well below ILC needs, but improvements are needed for multi-bunch extraction. Valuable work is being done in these studies on verification of the ILC chromaticity correction scheme, on ILC instrumentation development, and on the education of young accelerator physicists for the ILC.

G. Mike Harrison described GDE collaboration with CLIC, and mainly concentrated on the activities of the General Issues Working Group. There will be a joint Linear Collider workshop at CERN in October 2010. Harrison discussed promotion of the linear collider; identifying synergies between the design concepts of the ILC and CLIC; and identifying points of comparison between the 2 approaches. Harrison said that there are considerations of what the ultimate synergy between the 2 approaches might be—for example, could the ILC later evolve into a higher energy CLIC? The CLIC CDR will include a scaled 500 GeV version. At present, it appears that CLIC is technically more challenging, while the needed positron flux is greater for ILC.

3. **Detector Reports Presented to the PAC Meeting**

A. Research Director Sakue Yamada reviewed the status of ILC detectors. The 2012 GDE report will show that detectors can be built to do the ILC physics. He described the 2 validated detector groups and the 5 common task groups, with IDAG reviewing all of them for Yamada. He also described the activities of the SB2009 Working Group. Yamada noted that all people in the detector groups work on a voluntary basis while they have an interest in ILC physics. Resources for ILC detector work are not sufficient, and it is hoped that the CERN Director-General's offer to work with other lab directors on this topic will be fruitful. A request is being formulated for engineering help in the push-pull system and in detector integration. Yamada noted that with limited resources, the work of the common task groups acquire increased importance. A start has been made on cooperation with CLIC on detectors.

In answer to a question following his presentation, Yamada said that the design goal for the interchange of the 2 detectors is 2 days from beam off to the other detector being ready for beam. There was much discussion of the SB2009 process, and how communications between the GDE and the detector community can be strengthened.

B. Philip Burrows described the SiD; its design philosophy is all silicon, compact, self-shielding and 5T field. The LOI had over 250 signers from over 80 institutions. There is a work plan for the detector up to 2012, but a resource shortfall in all categories, particularly by a factor of 2 in engineering. SiD works closely with ILD on push-pull compatibility, although there are still issues to be resolved. There is an evolving collaboration with the CLIC detector efforts.

C. The report on ILD was given by Ties Behnke; the LOI had 600 authors from 130 institutions. ILD relies heavily on R&D collaborations (such as CALICE) for its R&D. Some

technology options are not yet fixed, but by 2012 a detector will be defined which can be considered “ready”. Behnke described the subsystem material budgets and expected resolutions, etc. As for SiD, there are significant resource issues.

D. Jim Brau discussed the activities of the SB2009 Working Group. He noted that the RDR design met the parameters set earlier by the ILCSC subcommittee; the SB2009 parameters announced in Autumn 2009 met the parameters at the highest energy with the traveling focus, but not at lower energies; without the traveling focus, the parameters were not met at any energy. There was particular concern at the lower luminosity at Higgs threshold, together with the increased beam energy spread and increased backgrounds. These effects gave rise to a loss of precision for the Higgs mass, degradation of stau detection, and a stretchout of low mass state studies. The significant reduction in luminosity at lower energies would have a very negative impact on the ILC physics program. Brau noted that the GDE is now studying changes to the SB2009 proposals which will give improved luminosity at lower energies, and the Working Group will reassess the physics impact when that new parameter set becomes available.

The discussion following Brau’s presentation was mainly on how to improve communications between the GDE and the detector community.

E Collaboration between ILC and CLIC on detectors was discussed by Francois Richard. The CLIC effort on detectors is growing quickly, and CLIC has joined ILC R&D teams and signed MOUs with the major R&D collaborations. Collaboration between CLIC and the ILD and SiD groups is progressing well, and CLIC has decided to adapt these two detector concepts to its CDR. CLIC has benefitted from ILC tools for detector simulation and reconstruction, and it is hoped that CERN will help ILC detectors. Richard noted some of the detector challenges at CLIC which are not present at the ILC. The CLIC/ILC Working Group on detectors will report to both ILCSC and the CLIC Steering Committee.

Richard noted that future WWS workshops on physics and detectors will cover both ILC and CLIC activities. There is a need to combine scarce resources and avoid duplication in the design of detectors for the 2 machines.

4. PAC Summary and Recommendations

A. General

1. The PAC supports the GDE in its raising of the SB2009 accelerator proposals, but is concerned that communications between the GDE and the detector community are currently not ideal, as illustrated by their recent interactions over these proposals. It is also shown by the request for independent accelerator and detector Closeout Sessions at this meeting for what is, after all, a common project; for future PAC meetings there will be only one common Closeout Session at the conclusion of the meeting which will address both accelerator and detector issues.
2. The GDE cost containment efforts are strongly supported by the PAC, and the Committee notes that the detector community needs to also be supportive of them; the PAC is very concerned that increases in the ILC costs above those given in the RDR could jeopardize the project.
3. The Change Control process initiated by the GDE for the SB2009 proposals is very valuable. The PAC believes that more detector representation on the Change Control Board will improve communications between the two communities.
4. The PAC supports the low-power rf program, but strongly recommends that studies should be pursued to evaluate what is involved in keeping the high-power option open.
5. The loss of luminosity at low energies, which was of much concern to the detector community following the release of SB2009, appears to have now been significantly addressed by the GDE. The PAC favors keeping the rf system upgradeable until it is definitively shown that the alternative rf system proposals are viable. The PAC supports the doubling of the low-energy repetition rate and the final doublet modification in order to increase luminosity in this energy range.
6. The Committee urges caution on Damping Ring design changes until the electron cloud studies provide significant guidance.
7. The PAC acknowledges that efforts are needed to develop a strategy for ILC activities after 2012.

B. Accelerator

1. The PAC was impressed with the GDE presentations, and noted that much progress has been made since the previous PAC meeting.
2. The Committee supports the location of the positron source at the end of the electron linac.
3. The Committee would like a future presentation on positron source activities.
4. The PAC is concerned on how to go from 50% first pass SC cavity yield to 90% yield after a second pass in a mass production environment, since the only viable quality control options seem to be visual inspection and X-rays.

5. The GDE should consider cavity industrialization strategies soon. It is very unlikely that building to a performance specification will be cost effective. More realistic is to specify minimum acceptance criteria.
6. Differential cavity yield plots will provide valuable information not readily apparent in the integral yield plots presented to the PAC. For example, one can readily see if the processed cavities are drawn from one or more populations, and can more easily determine the meaning of the mean, and variation of the distribution(s).
7. The R&D programs on FLASH, ATF and CesrTA are all excellent, and also have an important by-product in the training of young researchers. The PAC will do all that it can to help these studies continue.
8. The Committee notes that much ILC accelerator R&D is also valuable for the design of CLIC, and hopes that CERN will become more involved in ILC heavy engineering and cryogenics design.

C. Detectors

1. Loss of detector personnel to other projects such as CLIC and LHC detectors, even though they are important projects, is a significant concern. Given these detector manpower issues, and noting that there are many subsystems of ILD and SiD in common, there could be some strengthening of common group activities on these subsystems.
2. The PAC supports the efforts of the CERN Director General to help coordination of the support by labs for ILC detector activities.

5. **Next PAC Meeting**

The next PAC meeting will be take place at the University of Oregon, Eugene, Oregon, USA on 11/12 November 2010.

Appendix I

ILC Project Advisory Committee (PAC) Mandate

1. The International Linear Collider Steering Committee (ILCSC) is responsible for the oversight of the Global Design Effort (GDE) activities and of the ILC experimental program.
2. PAC will assist ILCSC in this function and report to the ILCSC.
3. PAC will review the GDE accelerator activities and, in addition, the ILC detector activities.
4. In its review activity, PAC will examine the overall consistency and realism of the project, in relation to physics, technical design, cost, and schedule.
5. PAC shall comprise about nine members, appointed by the ILCSC for terms of two or three years, and will meet a few times per year until the completion of the Technical Design Phases I and II.
6. The PAC Chair will be appointed by the ILCSC, normally for a two-year term.

Appendix II

PAC Review, Valencia 13/14 May 2010

Thursday 13 May 2010

8:00	Executive Session (35)	
8:35	Welcome by U. Valencia (35)	
9:10	Introduction (30+10)	B. Barish
9:50	SB2009 – Accelerator Design and Integration (45+15)	E. Paterson
10:50	Break (15)	
11:05	SRF R and D and Preparation for Industrialization (45+15)	A. Yamamoto
12:05	Executive Session (55)	
13:00	Lunch (60)	
14:00	Flash (45+15)	J. Carwardine
15:00	CesrTA (45+15)	M. Palmer
16:00	Break (15)	
16:15	ATF (45+15)	T. Tauchi
17:15	GDE Collaboration with CLIC (20+10)	M. Harrison
17:45	Executive Session (60)	
18:45	GDE Closeout (30)	

Friday 14 May 2010

08:30	Executive Session (30)	
09:00	RD Report (Including IDAG, Common Task Groups) (60+10)	S. Yamada
10:10	SiD (30+10)	P. Burrows
10:50	Break (15)	
11:05	ILD (30+10)	T. Behnke
11:45	SB2009 Working Group (30+10)	J. Brau
12:25	CLIC-ILC Cooperation on Detector Activity (30+10)	F. Richard
13:05	Lunch (60)	
14:05	Executive Session (60)	
15:05	Detector Closeout (30)	

Appendix III

The presentations given to the PAC are available at

<http://www.fnal.gov/directorate/ILCPAC/ILCPACMay2010/AttachmentsILCPACMay2010.htm>