Report of the LCPAC 2005

Date : February 24 – 26, 2005

PAC members:

I.Bigi (Notre Dam), R.Brinkman (DESY), J.Butler (FNAL), A.Chao (Stanford), R. Heuer (DESY), K. Hikasa (Tohoku), N. Locker (Pennsylvania), H. Maruyama (Berkeley), T. Mori (Tokyo), T. Nakada (CERN and EPFL), K. Nishikawa (Kyoto－Chair), T. Sintake (Riken), C. Wyss (CERN), T.Yamanaka (Osaka)

Introduction

In the opening address M.Kobayashi, the Director of IPNS, welcomed and thanked the members of the committee for their participation.

The charge to the committee is:

(1) to evaluate the achievements and upgrade plans of the KEKB and Belle groups

(2) to evaluate the scientific merit and technical feasibility of 'Super B Factory at KEK', on which the letter of intent was presented to the committee

(3) to examine the accelerator R&D activities for ILC from the point of view of technical and international collaboration.

Executive Summary

(1) KEKB and Belle achievements and upgrade plan

After breaking world records and exceeding the design goal in a few years of operation, KEKB continued to make excellent progress in 2004. The Committee warmly congratulates the KEKB team. The first goal of the B factories to observe CP violation B meson decays has been achieved. However, there are strong theoretical reasons to conjecture a rich spectrum of new particles at or below the TeV scale and its flavor structure is expected to contribute to B decays at the one-loop level. Belle has indeed found hints for New Physics. It is mandatory to pursue these hints with vigor.

We commend the KEKB team to have established a clear path towards 2-3 ab^{-1} of luminosity in a few years with incremental improvements of the current accelerator. We urge the Laboratory to achieve at least this level of data sample. In this regards, the Committee strongly supports the KEKB Accelerator Review Committee's recommendation and very much looks forward to hearing about the crab cavities' commissioning at its next visit. The short-term upgrade of the Belle Detector should be supported to accommodate the luminosity increase.

(2) SuperKEKB/SuperBelle

The main objective of SuperBelle is to elucidate the flavor structure of anticipated new physics at or beyond the TeV scale. We find the presented scientific goal exciting. The Committee also notes that KEKB will very likely be the only electron-positron B-factory in the world beyond 2008. It is important to preserve this unique facility.
Unlike the short-term upgrades, many of the proposed upgrades still need active R&D both in accelerator and detector.
The Committee recommends to continue the accelerator and the detector R&D so that SuperKEKB can be proposed for construction when the time is ripe.

(3)International collaboration in Intenational Linear Collider (ILC)
The committee notes that the KEK management and staff have quickly and effectively responded to the technology decision with a program that is unique and takes full advantage of the staff's expertise. The particle physics communities in the Asian region have agreed that KEK should be their lead center for ILC R&D. The committee strongly endorses this leadership role for KEK.
The committee encourages the Asian community to establish a clear management structure and to identify a regional director of the ILC research program in order to facilitate the collaboration within the GDE and within the Asian community.

(4)Accelerator R&D in ILC
The committee notes the KEK has unique expertise in the superconducting technology and in beam dynamics. Both the ongoing R&D program at the ATF and the newly launched superconducting linac technology test facility (STF) are vital for the development of the ILC.
The continuation and planned extension of the R&D program at ATF will define this test facility as an international research center for injector/damping ring and beam delivery system issues within the ILC-GDE. The committee strongly supports this approach of broad collaboration and strongly urges the laboratory to provide sufficient technical and administrative support.
The long-term experience at KEK with superconducting RF systems and high performance cavities form a solid basis for establishing and further developing this key technology for the ILC at KEK. The plan to achieve even higher gradients is a valuable and unique contribution in the framework of a well-coordinated global effort.
The committee recommends in view of the scope of the planned activities and the aggressive time schedule that a careful analysis of the resources available for the project should be performed.

The committee applauds the effort by the Laboratory's management to make known the critical contribution of advanced accelerator technologies to a broad range of sciences as well as to society at large. Without a serious investment on advanced accelerator technologies, it is not clear how scientists could have uncovered the structure of various materials at the nano-scale, such as high-Tc superconductors, the structure of proteins relevant to biological systems, as well as developed medical applications such as MRI, radiation therapy, etc. The Committee urges the management to continue this important effort, and hope that the Japanese government will appreciate how critical advanced accelerator technologies are for the future.

Committee Report

1. The B Physics Program at Belle

The first goal of the *B* factories had been to observe CP violation outside the complex of neutral kaons and more specifically to test the paradigm of large indirect and direct CP violation predicted by the theory of Kobayashi and Maskawa. This first goal has been achieved now. In addition to the CP asymmetry in $B_d \to J/\psi K_S$, Belle has confirmed its signal of large CP violation in $B_d \to \pi^+\pi^-$, discovered it also in $B_d \to K^0\pi^0$, extracted K_s from a novel Dalitz plot based analysis of $B^{\pm} \to D^0/D^* K^{\pm}$, and established the existence of most interesting classes of rare *B* decays, including $B \to l^+l^- X$, during the last year.

The committee heartily applauds Belle/KEKB team for making historic contributions to fundamental physics. This has been achieved through impressive progress in and integration of machine and detector design and operation combined with innovative analyses.

On the other hand, we know there has to be New Physics, since the KM dynamics *cannot* generate the observed baryon asymmetry of the universe -- there must be other sources of CP violation. Furthermore there are strong theoretical reasons to conjecture a rich spectrum of new particles at or below the TeV scale and its flavor structure is expected to contribute to *B* decays at the one-loop level, in particular for CP asymmetries.

Most intriguingly Belle has indeed found hints for New Physics, in particular in $B_d \to \phi K_S$. It is mandatory to pursue these hints with vigor. For instance, if the central value of the CP asymmetry in $B_d \to \phi K_S$ stays the same, it requires well beyond 1 ab^{-1} to convincingly establish or refute the current hints for new physics.

We commend the KEKB team to have established a clear path towards 2-3 ab^{-1} of luminosity which can be achieved in about five years based on incremental improvements of the current accelerator. We urge the Laboratory to achieve at least this level of data sample.

2. KEKB Accelerator

After breaking world records and exceeding the design goal in a few years of operation, KEKB continued to make excellent progress in 2004. The luminosity has reached the level of 1.52 x 10^{34} $cm^{-2}s^{-1}$, or 15 nb^{-1}/s, and 1 fb^{-1}/day. The total integrated luminosity has reached 363 fb^{-1}. This accomplishment has been achieved by a continuous string of innovations, which has resulted in a rapid linear growth of peak luminosity in time over the past 5 years. As it stands, the next milestone of 1 ab^{-1} could be reached as early as 2008. The Committee warmly congratulates the KEKB team on this most impressive accomplishment.

The committee heard a report from Dr. Andrew Hutton, Chairman of the KEKB Accelerator Review Committee that met for three days immediately before this meeting. The committee thanks Dr. Hutton and the ARC for their competent and thoughtful effort, and endorses their report as is.

Progress made during last year included:

- Continuous injection into both rings, which led to a 30% gain in the integrated luminosity.
- Precision tune feedback has, which made it possible to hold the tune steady and very close to a half integer, which in turn allowed the luminosity to benefit from the dynamic-beta effect.
- An orbit feedback system which takes precisely into account the offset of the beam-position monitors relative to the sextupole magnets near the interaction point. This suppresses tune drifts and beta-function drift during optics changes.

3. Belle detector

Belle is now running at or above its design luminosity. Its physics output is outstanding and is the best evidence for the quality of the detector. Recent upgrades have allowed it to retain its excellent performance as interaction rates and backgrounds have risen. These include the upgrade from SVD1 to SVD2 and hard work on reducing the impact of the higher backgrounds on the detector and on deadtime.

4. KEKB accelerator upgrade

In the near term, further luminosity increases are suggested by the KEKB team to come from higher beam currents, more bunches per beam, optimal beat-functions, better working points, better way to correct chromaticity, and the crab cavities. The committee concurs with their evaluation. It further would like to emphasize that crab cavities will be the one and single most promising route to a substantial increase of luminosity and will deserve correspondingly focused attention.

Crab cavities are expected possibly to allow a luminosity improvement factor of ~ 2. A high priority was given to their development in the past few years. Two prototypes were built and both exceeded the design field strength. Recent design changes included a new all-Nb (instead of Nb-Cu) coaxial coupler, and a configuration with a single crab cavity per ring (instead of two) in the Nikko region. These crab cavities are scheduled for installation in February 2006. The committee endorses the highest priority being given to the crab cavity program, and concurs with the proposed design changes.

The committee very much looks forward to hearing about the crab cavities' commissioning at its next visit. It nevertheless wishes to make the cautionary remark that crab cavities are difficult technical devices which have never been tested in any storage ring before, and that substantial efforts will be required to make them function as designed. Studies before and during their commission are therefore strongly urged. In this regard, the committee strongly supports the KEKB Accelerator Review Committee's recommendation that a machine study time of 3-5% be maintained. This point is particularly relevant when it comes to the commissioning of the crab cavities.

A crystalline tungsten target for producing positrons will be tested in 2005. A plan to upgrade the linac with simultaneous injection capacity into 4 rings (KEKB e- KEKB e+, FP, FP-AR) has been planned. The committee endorses these efforts.

5. Belle detector upgrade

The Belle upgrade is designed to permit it to operate with the current efficiency, resolution, background rejection, and control of systematics at about two times the current peak and average luminosity and three times the background. The performance of nearly all subsystems will experience some degradation. Table 1 lists the subsystems to be upgraded, the cost, and the impact of not doing the upgrade. This upgrade could, in principle, be considered a short term upgrade not tightly coupled to the SuperBelle upgrade. However, all of the current systems that have to be replaced for the Belle upgrade obviously would have to be replaced for SuperBelle. In carrying out the Belle upgrades, the proponents take the possibility of SuperBelle into account and chose technologies and approaches that will be compatible with the SuperBelle upgrade,

Here, we comment on each part of the upgrade.

Item	Estimated Cost (M$)	Consequence of not upgrading
Pipelined DAQ	2.5	DAQ dead time will go up to >30%
ECL electronics	5 (1)*	Lose $B_d \rightarrow J/\psi + Ks$ ($K \rightarrow \pi^0\pi^0$) (~20% of $J/\Psi + Ks$)
SVD inner layer	0.5	-30% vertexing eff. For $J/\psi + Ks$ ($\pi^+\pi^-$)
CDC electronics	0.8	-21% tracking eff. For $J/\psi + Ks$ ($\pi^+\pi^-$)

Table 1: Proposed Belle Upgrade

ECL (Electromagnetic Calorimeter): With the expected background increase of a factor 3, they estimated that the detection efficiencies for low energy photons will degrade significantly. One of the solutions to this problem is to shorten the pulse width and do a pipelined readout and analyze the waveform to isolate out-of-time pulses. This is expected to suppress fake clusters by a factor of 7. The upgrade to shorten the pulse with new shaper electronics costs $1M, and the readout upgrade will cost additional $4M. The timescale of the upgrade is about a year. Another option that was proposed was to replace the end-cap calorimeter with pure CsI crystals. However, this should be considered as a part of the upgrade for SuperBelle, since it requires more leading time, and solid planning.

SVD (Silicon Vertex Detector): The increasing luminosity in the next several years will cause higher occupancy in the first layer of the SVD. Those accidental hits will degrade the momentum resolution for low momentum tracks. The proposed plan is to replace the first layer with a new front-end electronics (APV25) and DSSD striplet. Beam test for a prototype of new system was done at CERN, and the result looks promising. We think that their plan is reasonable and should be pushed forward.

CDC (Central Drift Chamber): The CDC readout was causing deadtime problems but this is now resolved by the installation of new S/QT cards. Degradation of the CDC from extra background can cause loss of tracking efficiency. This results in a loss of roughly 5% per charged track and therefore has an appreciable impact on higher multiplicity states. Some of the loss can be recovered by a better reconstruction algorithm that is being developed. The front end electronics will be upgraded with amplifiers with shorter shaping time to reduce this. There is also an upgrade to the trigger electronics to make it faster. This upgrade costs about $800K and is ready for implementation.

Data Acquisition and Event Building: As the luminosity increases, readout dead time would rise to ~10% (with a total dead time of ~15%) as the trigger rate increases from 400Hz to 1000Hz. The dead time needs to be reduced and processing power needs to be added to the event builder and the Level 3 trigger farm. A further consideration is that this system be consistent with the SuperKEKB upgrade.

The group is committed to a "smooth" upgrade path that replaces the current FASTBUS-based readout with a new pipelined readout system in a manner that does not jeopardize datataking. Development of the new readout system is nearly complete. The ECL system and the SVD readout are treated separately.

The Event Builder will be replaced with a new modular system utilizing a "transfer switch" to route data from the front ends to multiple reconstruction subsystems. Testing has verified the performance of the transfer network.

Computing Facility Upgrade: The yearly luminosity will increase from 200 fb^{-1}/year to 500 fb^{-1}/year. This will require more computing, disk storage and tape storage. There is a plan to make use of the GRID to expand the analysis capabilities for Belle collaborators, especially if SuperKEKB succeeds in reaching its full goal. Currently, the main use of collaborator computing resources is for Monte Carlo generation. Belle should work towards understanding how to do distributed computing for its event reconstruction and analysis and identify user sites with systems that can make a significant contribution to the Belle computing effort.

Recommendation: The Belle Detector upgrade is to be supported. It is ready for implementation and motivated by its impact on Belle/KEKB physics. In light of tight funding, the collaboration might want to examine the impact of staging the upgrade for the ECL readout.

6. SuperKEKB Physics

We received the Letter of Intent as well as an oral presentation for the SuperKEKB project that aims at $2.5\text{-}5\times10^{35}$ luminosity leading up to 5 ab^{-1} per year. The main objective of this large data sample is to elucidate the flavor structure of anticipated new physics at the TeV scale, such as supersymmetry or extra dimensions. In some cases, precision measurements with such a large sample would constrain new physics even beyond 100 TeV, i.e. beyond the reach of the LHC. We thank the collaboration for the thorough presentation of the case, and we find the presented scientific goal exciting. We are also deeply impressed by the track record as well as the enthusiasm of the Belle Collaboration.

The Committee notes that the KEKB will very likely be the only electron-positron *B*-factory in the world beyond 2008. It is important to preserve this unique facility. The Committee is looking forward to see the performance of the crab cavities as well as the remaining R&Ds.

The Committee recommends enthusiastically to continue the accelerator and detector R&D so that SuperKEKB can be proposed for construction when the time is ripe.

7. SuperKEKB Accelerator

A concerted effort has been made by the KEKB team last year to produce a letter of intent for a Super KEKB project that was distributed before the review and presented to the committee during the review. The committee welcomes this effort and considers it a substantial advance from last year. The various aspects of beam dynamics, accelerator components and systems are thoroughly described and items to be further studied clearly identified. A tentative cost estimated was mentioned at $460M. A timetable has also been presented with a Super KEKB commissioning in 2010, assuming project approval by mid-2005, first budget allocations in FY2006 and a 18-26 months shutdown around 2009.

The Super KEKB is a demanding accelerator. Detailed experience from KEKB provides the solid basis for and gives confidence in the design elaborated in the letter of intent, leading to a peak luminosity in the $2.5\text{-}5\times10^{35}/\mathrm{cm}^2\text{-s}$. The committee concurs with the great potential of Super KEKB as assessed by the KEKB team, and further agrees that the estimated luminosity range is achievable.

The KEKB team has identified several technical items deserving further R&D, both in terms of accelerator physics studies and hardware designs and developments. The uncertainty in the outcome of these R&D items indeed has been reflected in the above luminosity range. The committee recommends strongly that R&D of these items be carried out in a timely fashion, and that appropriate and strong support from the KEK laboratory be provided.

Much effort will be needed to upgrade KEKB to accomplish the SuperKEKB goals. The beam currents will be 9.4 A in the HER and 4.1 A in the LER. Bunch length and beta-function at the interaction point are both to be compressed to 3 mm. The RF system will need a serious upgrade, including larger coupling cavities for the ARES cavities. The HOM dampers of the accelerating superconducting cavities and of the crab cavities will need to be redesigned. The former ones will absorb up to 60 kW in vacuum. The vacuum system will need to be completely replaced. Some of its components have already been prototyped, e.g. vacuum pipes, bellows and flanges. A 1-GeV positron damping ring will be added to bring the injection noise into control. New interaction region magnets will be installed closer to the IP. Background will increase approximately x20. Effect of reducing the SVD beam pipe radius from 1.5 cm to 1 cm needs evaluation.

In addition to the above, there are also a few items that are of critical nature and require particular attention. These are listed below:

- HOM power in vacuum chamber components and RF cavities will increase by a factor of ~ 4. How to absorb this high power requires detailed enginering and prototype tests.
- Simulation indicates a substantial increase of the beam-beam limit when moving to head-on collisions at the IP thanks to the installation of a crab cavity in each ring. This aspect needs to be demonstrated in the 2006 runs in KEKB.
- Charge exchange between the two rings has been proposed as a way to mitigate the electron cloud instability. It should be studied if the fast ion instability will come into play and become the new limiting factor after charge switch.
- There is some uncertainty if it is indeed possible to fill all 5000 buckets (leading to a 2 ns bunch spacing) without encountering limiting instability effects.
- Instabilities driven by coherent synchrotron radiation have been identified as a significant potential limiting factor for SuperKEKB. One way to control this effect is to reduce the vacuum chamber radius. Since this would have other negative impacts on the accelerator design, a careful study and an optimized choice is needed.

The Committee does not consider these uncertainties as feasibility issues, but rather, consider them as important optimization issues. These uncertainties, as mentioned, have lead to define a luminosity range in the letter of intent design. As more knowledge is gained, this uncertainty range will be reduced. Before then, however, it is strongly urged that R&D efforts be invested to address these issues.

8. SuperBelle Upgrade

The detector will need to be upgraded to handle the full interaction rate at and background at $5x10^{35}/cm^2$-s while retaining its current excellent performance, a factor of 50 beyond the design of the original Belle detector. Unlike the short-term upgrades, discussed above, many of the proposed upgrades still need active R&D. Below we discuss briefly each upgrade and the problems we see with them.

SVD: The system will be replaced by one with two striplet layers and 4 DSSD. Other options, such as monolithic pixels, probably have too much schedule risk to be considered but that depends on the schedule. The R&D plan looks reasonable and the experience with the striplet detector in the short term upgrade and APV25 electronics should be valuable.

CDC: This will be replaced with a smaller cell version and will probably use a faster gas. The inner layers will be omitted so that the rates will be under control. A shorter shaping time will be used in the front end. This seems to be a reasonable approach. Some modest amount of R&D is required.

Particle Identification: A whole new approach will be developed here to replace the system of Aerogel threshold counters. In part, the goal here is to achieve improved particle identification with respect to Belle's current performance. The TOP counter, used in the barrel, is a ring-imaging counter that maps out the rings using time-of-arrival of individual Cherenkov photons. The photon detector must have excellent time resolution, count single photons, and operate in a magnetic field. For the endcap, they propose an "aerogel RICH". Cherenkov photons generated in a layer of aerogel traverse an expansion volume and the ring is proximity-imaged on photon detectors. A new technique using multiple radiators offers improved performance. The main challenge here seems to be to develop the photon detectors. The collaboration is working with vendors.

ECL: The plan for the barrel calorimeter is to keep the CsI (Tl) as it is, but use new shaper and waveform sampling. For the endcap calorimeter, the plan is to replace the crystals with pure CsI for its shorter pulse width, and also use shaping and waveform sampling. The production of pure CsI crystals is estimated to be 3 years, and cost $8M. The endcap upgrade will require a large effort, and thus should be well planned ahead of time. Also, careful R&D on the vacuum phototetrode is necessary.

DAQ: The SuperBelle upgrade only makes sense if SuperKEKB goes forward. On the other hand, there is significant lead time to prepare the components to be installed during the shutdown to install SuperKEKB. Before that can be done, a challenging but achievable R&D program needs to be completed.

Recommendation: R&D for SuperBelle is to be supported so that it can be completed on a schedule consistent with the decision to build SuperKEKB. Given the likelihood that money will be tight, the collaboration should establish clear priorities for R&D and be realistic about the number of options they can investigate.

9. International Linear Collider

The particle physics communities in each of the three regions of the world, Asia, North America, and Europe, have agreed that exploration of physics at the 1 TeV scalewill need to be studied with a e+e- linear accelerator operating at an energy between 90-1000 GeV. It is called the International Linear Collider or ILC. Progress towards realizing the ILC has been moving at a rapid pace in the last 12 months. After more than a decade of research by the world community into technologies appropriate for the linear accelerator, an international committee has recommended that superconducting technology should be used. The international community has accepted this decision positively and is now focusing on completing the R&D needed and is beginning to prepare the design of the accelerator complex. All three regions have had a strong ILC program in place for more than a decade, and in Europe this effort has been increasing in the last several years. DESY will host the European X-Ray Free Electron Laser facility that will be the main catalyst for industrializing superconducting RF technology in Europe. The benefits to the ILC industrialization will be immense. The US funding for ILC has been increasing and major R&D efforts are underway at SLAC, Fermilab, and other US laboratories. The US has underway a university-based R&D program for accelerator and detectors. Both Europe and the US are performing site studies in preparation for a possible “hosting” of the ILC.

The world community, through the ILCSC (International Linear Collider Steering Committee) has developed a schedule for setting up an organization and a central site to be used for coordination of the design reports. The Director of the “Global Design Effort” (GDE) will be in place within a few months. In addition, all three regions are represented in FALC (Funding Agencies for the Linear Collider) that is closely following the progress of the project.

The KEK laboratory management and staff have quickly and effectively responded to the technology decision with a program that is directed to areas in which they have unique expertise in the superconducting technology and in beam dynamics. The ATF accelerator at KEK is a unique facility that is attracting research groups from Asia, the US, and Europe to perform critical measurements for preparing the design criteria of the ILC. In addition KEK is leading the world in the design and fabrication of higher gradient accelerating structures.

The particle physics communities in the Asian region have agreed that KEK should be their lead center for ILC R&D. The committee strongly endorses this leadership role for KEK. The committee encourages the Asian community to establish a clear management structure and to identify a regional director of the ILC research program in order to facilitate the collaboration within the GDE and within the Asian community. In order to strengthen this role, KEK should strive to enable the Asian particle physics community to participate in research at KEK by providing support for young researchers from neighboring Asian countries. KEK is also encouraged to continue and expand its research partnership with the US and Europe. KEK has scheduled several experiments at the ATF involving physicists from all three regions. The committee strongly supports this international approach to the ATF. The Superconducting Test Facility (STF), the only such facility in Asia, should identify areas in which common equipment, software tools, and instrumentation can be shared with the test facilities in the other two world regions. This commonality allows for a greater ease of exchange of R&D data, reduces costs, and exploits expertise at other institutes.

10. ILC Accelerator R&D

The committee heard reports on the ongoing and planned Linear Collider R&D program in the KEK accelerator division. The presented status and work plan clearly showed the reorganization of the group after the ICFA technology decision of August 2004. The LC team has adjusted to this technology decision in a truly impressive fashion. The committee is convinced about its strong commitment and capability to play a major role in this worldwide collaboration pursuing the future linear collider project. Both the ongoing R&D program at the ATF and the newly launched superconducting linac technology test facility (STF) are vital for the development of the ILC.

The continuation and planned extension of the R&D program at ATF will define this test facility as an international research center for injector/damping ring and beam delivery system issues within the ILC-GDE. The ATF damping ring program has reproducibly demonstrated record low values for the beam emittance, as it is required for the ILC, and developed instrumentation for high precision measurement of beam position and profile. Experimental studies of the fast beam-ion instability have started and will be continued and analyzed with computer simulations. The investigation of the effect of wigglers on the dynamic aperture is another example of beam dynamics studies relevant for the future damping ring of the ILC. The development of fast and stable kickers, one of the critical components of the ILC damping ring, is ongoing. The development of a fast intra-bunch train feedback system will be continued and tests are planned in the damping ring extraction line with a beam time structure similar to the one of the ILC.

In a second phase of ATF, the construction and test of a final focus system (FFS) as an extension of the beam extraction line is planned. Both the verification of beam demagnification to 37nm with the new Raimondi FFS layout and of the beam stabilization at the level of a few nm will be possible with this setup. First results from the extended test facility can be expected in time before the ILC Technical Design Report, scheduled for the end of 2008.

The international participation in the ATF R&D program has over the past year further grown and will continue to do so in the future. As already pointed out above, the committee strongly supports this approach of broad collaboration, which is also important in view of the limited resources at the KEK laboratory. Nevertheless, it has to be assured that the laboratory provides sufficient technical and administrative support in order that the ATF collaboration be able to perform its ambitious program successfully and in a timely fashion.

The main goals of the STF will, starting from the existing technology developed by the TESLA collaboration, be the further development of high gradient superconducting cavities, the construction and test of complete accelerator modules and the optimization of the technology in view of cost effective industrial production. The long term experience at KEK with superconducting RF systems in storage rings (TRISTAN, KEKB) and the pioneering work on high performance cavities of the TESLA type (being the first to very successfully apply the electropolishing surface treatment) form a solid basis for establishing and further developing the key technology for the ILC at KEK. The plan to achieve even higher gradients (45MV/m) than the latest generation TESLA cavities by using an optimized low-loss shape is reasonable in view of the possibility to shorten the ILC linac and have more freedom to choose a site for the project. Furthermore, this high gradient part of the STF program can at present not be done at the existing TESLA Test Facility and is therefore also a valuable and unique contribution in the framework of a well-coordinated global effort.

Regarding construction of complete accelerator modules in the 2nd phase of STF, the committee recommends that this activity should be embedded in the GDE organization and coordination, such as to assure that inconsistencies with or unnecessary duplication of linac technology programs at other laboratories in the ILC collaboration are avoided.

While the committee is convinced that the expertise for successfully performing the STF program is available at KEK, it recommends in view of the scope of the planned activities and the aggressive time schedule that a careful analysis of the resources available for the project should be performed. In addition, a well defined management structure for the KEK activities in the frame of the ILC-GDE appears advisable.