

ACFA Holds First Workshop on Physics/Detector at the Linear Collider in Beijing, China

Angelina Bacala
Department of Physics,
Mindanao State University

An atmosphere of intense hopefulness and urgency could very well describe the First ACFA Workshop on Physics/Detector at the Linear Collider held in Tsinghua University, Beijing, China on November 26-27, 1998. More than eighty participants coming from member nations of ACFA (Asian Committee for Future Accelerators) gathered to hear and discuss about the physics and detector aspects of the future Asian Linear Collider. For this ACFA study activities, contact persons have been nominated from the following nations/regions: Australia, China, India, Japan, Korea, Philippines, Singapore, Taiwan and Vietnam. The workshop was opened by He-Sheng Chen (Director of IHEP, Beijing) and there followed a warm welcome by You-Neng Liang (Vice-president of Tsinghua University) with both speakers expressing hopes for the success of the workshop.



Figure 1: The participants from Asia and Pacific regions gathered on November 26-27, 1998 at Tsinghua University, Beijing, China for the First ACFA Workshop on the Physics/Detector at the Linear Collider.

The Linear Collider will be situated in Japan. The center-of-mass energy of electron-positron collisions in the first phase will be in the range 250 to 500 increasing further in future upgrades depending on the first phase data. G. P. Yeh (Fermilab/Taipei) was very convincing in his emphasis regarding the time scale of the first collisions - it should be around the year 2008 if the linear collider is made to complement the physics at LHC and Tevatron. And for this to be in order, a high luminosity as possible is needed, on the order of $10^{33} \text{ cm}^{-2} \text{ sec}^{-1}$ or more, as well as a good particle detector.

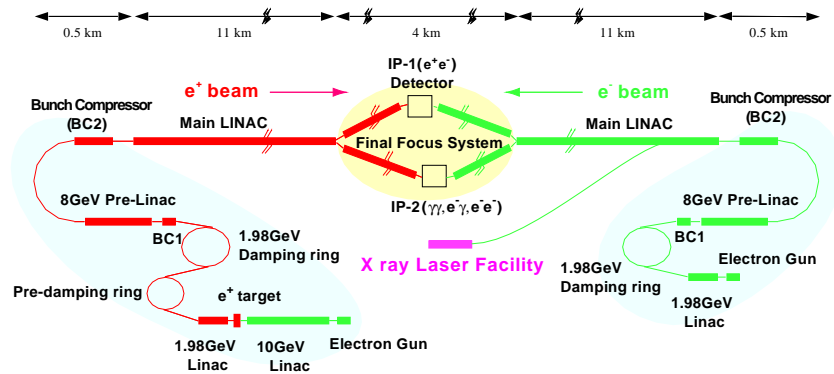


Figure 2: A sketch of the Linear Collider proposed to be built in Japan.

The workshop speakers generally succeeded in painting a vast, panoramic map of the world of physics for the Linear Collider to explore. Yu-Ping Kuang (Tsinghua) and Keisuke Fujii (KEK), in their excellent overviews, underlined that new physics related to next generation measurements of the Standard Model parameters is a task for future linear colliders. But the most important target at present is the search for the Higgs boson which should manifest itself in the Linear Collider energy range. Yamashita, in his comprehensive review of Higgs physics, remarked that indeed it is possible to detect and measure the Higgs. Although the Linear Collider is better positioned than LEP2, the measurement is not really that easy because background processes are at least 100 times higher than the expected signal. Efficient b-tagging provided by a good Si vertex is the key to this measurement.

The search and discovery of new electroweak particles and those required by supersymmetric theories was discussed by several speakers: Mike Bisset (Tsinghua), Kuang, Fujii and Sun Kun Oh (Konkuk). If a light Higgs is found and SUSY cannot be discounted, there will be a need to find at least one SUSY particle in order that the minimal supersymmetric models can be really tested.

Status reports from LEP and Tevatron experiments were also given. Talking about the Collider Run I data from CDF and DZero experiments, Sun Keen Kim (Seoul) reported an average top quark mass of $174.3 \pm 5.1 \text{ GeV}$ while the Higgs mass has been constrained to be less than 280 GeV at 95 % CL. With the Tevatron upgrade, Run II prospects with 20 times more data at 2 TeV are expected to result in higher sensitivities in the measurements of the masses of the top quark, the W bosons and the Standard Model Higgs among others. A report by Chang-Gen Yang (IHEP) on LEP precision

electroweak data show cross sections and asymmetries for fermion pair production are in agreement with the standard model expectations. Atul Gurtu (TIFR) gave a comprehensive report on new particle searches at LEP: from the standard model and MSSM Higgs to SUSY particles and the search for excited, heavy sequential leptons. He cited one particular result which is the failure to observe the Higgs-strahlung process in the recent 189 GeV - thus implying the standard model Higgs should be larger than 95.5 at 95% CL using L3 preliminary data.

Even with these recent measurements, G. P. Yeh remarked that top physics is just beginning. For one, precision measurements await at the Tevatron in the next five years and top rare decays are expected to be measured at the LHC. But more precise measurements of the top quark and many more nice studies to be done await at the Linear Collider in t-tbar threshold and beyond; as was also shown earlier by the talk of Kuang and Fujii.

To investigate all these possibilities, the need for more detailed detector simulation directly connected to detector design and incorporation of realistic beam-related backgrounds were emphasized by the above-mentioned speakers. And indeed, these issues were directly addressed during the second day of the Workshop the most of which was devoted to the Linear Collider detector topics. Toshiaki Tauchi (KEK) showed how a seemingly perfect experiment would be killed by unshielded background reactions near the interaction point. While he showed that the basic design of the detector remains the same as that given in the 1992 JLC-I Report, he made mention of the fact that other options for the sub-detector components exist and need to be evaluated. Among these basic issues are whether the choice of a smaller, compact central tracker would be better than a large one, if other choices of crystals in the calorimeters would yield better energy resolution or whether CCD or pixel detectors should be used in the vertex detector. In a very interesting progress report on pixel detectors, Hitoshi Yamamoto (Hawaii) showed that radiation-hard monolithic pixel detectors are now proven to work while 3D and hybrid pixel detectors bring quite a promise.

There has grown a significant and valuable store of knowledge gained through many years of R&D pursuits of the working group of the Linear Collider since the publication of the JLC-I Report. In his status report of the vertex detector, Yasuhiro Sugimoto (KEK) showed that due to its many desirable qualities and the fact that CCD technology is quite established, CCD is still one of the best candidate as a vertex detector for the Linear Collider experiment. The only concern left to be ascertained is the radiation tolerance of CCD, thus detailed studies for the radiation hardness are still continuing. Sugimoto also announced a change in the baseline design of the 2-layer vertex detector to a 4-layer detector in a systematic and extensive presentation, Norik Khalatyan (KEK) reported the results of several studies on the central tracker system. For the Linear Collider detector, the baseline design remains a large central drift chamber with small jet cell. Some of their results have already been published, yet another list of more R&D works were mapped out by Khalatyan in the short and long terms. The calorimeter status report of Yoshiaki Fujii's (KEK) is also quite extensive. Like the vertex detector, a change in the baseline design from a lead/scintillator sandwich with wave length shifter bar type to one of tile-fiber type is reported. Already many detailed studies have been done and a high-energy beam test is scheduled in the year 1999.

No detector is ever complete without a data acquisition/trigger system, and a 2-level architecture of the Linear Collider detector was presented by Il Hung Park (Kyung-pook). He remarked that the system is more relaxed compared with LHC's because of the long bunch crossing interval. Hong Joo Kim (Seoul) strongly suggested the multi-purpose data analysis framework called ROOT to be used for the Linear Collider experiment even as Akiya Miyamoto (KEK) gave a report on the software already available for the Linear Collider and those in the making. There was also a talk on an event generator given by Jian-Xiong Wang (IHEP) while Toru Takahashi (Hiroshima) presented the rich physics possible with a $\gamma\gamma$ option of the Linear Collider. Tsunehiko Omori (KEK) in the most animated talk of the workshop entitled "A Polarized Positron Beam for the Linear Collider" showed the many interesting possibilities when not only the electron beam but also the positron beam is polarized. Among the advantage this will offer is the significant reduction of backgrounds to the Higgs signal and also the wide array of exotic physics possible with electron and positron beams polarized.

Commenting that the LHC is not enough to explore all important and essential physics, Sachio Komamiya (ICEPP) gave a stimulating discussion on the interesting array of physics offered by the Linear Collider. Then he gave a report about the world-wide study group of future linear colliders and noted the level of activities are high. Angelina Bacala (Mindanao) expressed the hope that other Asian nations whose high energy physics program are still developing will really have the opportunity to contribute in a significant way towards the physics and detector of the Linear Collider and that the Linear Collider will really be an international laboratory for Asia as CERN is for Europe.

After the last talk of the workshop, the conveners and members of the different ACFA working groups gathered separately and engaged in serious discussions about the next and future concern of the working groups. Finally, the head of ACFA LC studies, Seigi Iwata (KEK) rendered a concise and hopeful summary of the First ACFA Workshop which he announced to be a big success as far as the workshop objectives are concerned. Much credit goes to the organizers headed by Yu-Ping Kuang and Takayuki Matsui (KEK) for the stimulating and very friendly atmosphere of the workshop.

The different sessions of the workshop were chaired by Joo Sang Kang (Korea), Wei-Shu Hou (Taipei), Chao-Shang Huang (ITP), Kuang-Ta Chao (Peking), Toshinori Mori (ICEPP), Ren-Cheng Shang (Tsinghua), Tao Huang (IHEP) and Takayuki Matsui. The next workshop is slated to be in Seoul while the ACFA workshop 2000 will be done in Taipei. Some of the participants stayed on in Beijing even after the workshop ended. Having journeyed into one of the world's greatest wonder, Great Wall of China, and having seen the vast, magnificent Imperial Palace (also called the Forbidden City), the participants left Beijing with the belief that the physics to be unfolded by the future Linear Collider would not be less grand and awe-inspiring as these wonderful sights of Asia.