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## Feasibility Study of the Construction of Synchrotron Radiation Facility in Thailand

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# Feasibility Study of the Construction of Synchrotron Radiation Facility in Thailand

Virulh Sa-yakanit

With the approval of the National Research Council of Thailand, a team of scientists led by Prof. Virulh Sa-yakanit visited four countries in Asia – the People Republic of China, Japan, the Republic of Korea and Taiwan. The purpose of the visit was to explore the feasibility of constructing synchrotron radiation facilities in Thailand. The team consisted of five members from various organizations namely,

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Asso. Prof. Jong-Orn Berananda (Chulalongkorn University)  
Asso. Prof. Thiraphat Vilaithong (Chiang Mai University)  
Asso. Prof. Dr. Wichit Sritrakool (Chulalongkorn University)  
Mr. Kajornsak Jaiyawat (National Research Council)

Our starting point was Beijing, P. R. of China and our activities within Beijing can be divided into two parts. The first part was to attend the International Conference on "Applications of Synchrotron Radiation in Crystallography" organized by Prof. Dingchang Xian of the Institute of High Energy Physics in Beijing. After the conference we were accompanied by Prof. Esheng Tang, Director of the Beijing Synchrotron Radiation Facility (BSRF) who had assigned other members of the BSRF to show and to give us the detailed design, and construction of the BSRF. The linac part was guided by Prof. Luo Ying Xiong while the storage ring was explained in details by Prof. Zhao Zhentang. Besides the detailed tour to both the linac and the storage ring we also visited the workshop, the magnetic labs, etc. All of us were very much impressed with the effort of the Chinese physicists to overcome the difficulties in constructing the BSRF despite the US ban on High Technology equipment to the P. R. China. Having seen all the facilities of the BSRF, Prof. Xian and Prof. Wu Jianwu had organized a small group of BSRF scientists to discuss in more details the technical aspects of the construction of BSRF. We were informed that the BSRF was approved in 1984 and incorporated into the Beijing Electron Positron Collider (BEPC) Project which consisted of four main items – a 1.55 GeV linac injector, a 2.8 GeV storage ring, a spectrometer for particle physics and a synchrotron radiation facility. Before leaving the P. R. China, we were hosted by Prof. Liu Zongtang, the Minister of the Aero-Space Industry, and we were assured by Prof. Liu that the P. R. China is willing to assist or train Thai scientists to construct the SR facility if Thailand is planning to construct one.

Our second stop was Japan. We first met Prof. T. Ishii who is a director of the Synchrotron Radiation Laboratory affiliated

to the Institute for Solid State Physics (ISSP) in the Institute for Nuclear Study located at Tanashi. At Tanashi Prof. Ishii gave a brief overview of the synchrotron radiation facilities in Japan. We were very impressed with the first synchrotron radiation facility constructed in Japan, and the SOR-Ring constructed in 1976 with 0.4 GeV. Then we were guided to see the most advanced SR facility at the Sumitomo Heavy Industry (SHI), the Super Compact SR Ring nicknamed AURORA. The AURORA developed by SHI is composed of three sections, namely: the Microtron Injector, the Storage Ring and the Beam Guides. The injector is capable of accelerating electrons up to an energy of 150 MeV. The electrons accelerated to 150 MeV in the Microtron are injected into the Storage Ring. In the Storage Ring the electrons orbiting in a circular path of 1 meter diameter are accelerated up to an energy of 650 MeV and generate the desired synchrotron radiation. The next day we proceeded to see one of the most well set up synchrotron radiation facilities in Japan, i.e. the Photon Factory located at Tsukuba about 60 km from Tokyo.

As soon as we arrived at Tsukuba, Prof. M. Kobayashi gave us a brief account of the Photon Factory facilities. The tour of the Photon Factory both the linac and the storage ring was completed in the morning. The Photon Factory (PF) is a National Synchrotron Radiation Research Facility affiliated with the National Laboratory for High Energy Physics (KEK) supervised by the Minister of Education Science and Culture. The PF consists of a 2.5 GeV electron/positron linear accelerator, a 2.5 GeV electron/positron storage ring as a designated light-source, beam lines and experimental stations for exploiting the SR in studying various research fields such as, physics, chemistry, biology, medical sciences, pharmacology, earth sciences and lithography. In the afternoon, we were invited to see the SORTEC facility at the ETL (Electrotechnical Laboratory), which is a booster type with 1 GeV SR source. The SORTEC cooperation was incorporated in 1986 with funds provided jointly by the Japan Key Technology Centre and thirteen private corporations. It will operate for a ten years period up to 1996 while continuing the development and application of SR. The aim of the SORTEC is to achieve application of SR to a variety of different industries, especially to develop SR lithography to the level of practical use. To complete our visit we proceeded to our final stop at the Accumulated Ring (AR), which has been operating for synchrotron radiation with energy 5.8 - 6.5 GeV. Our visit

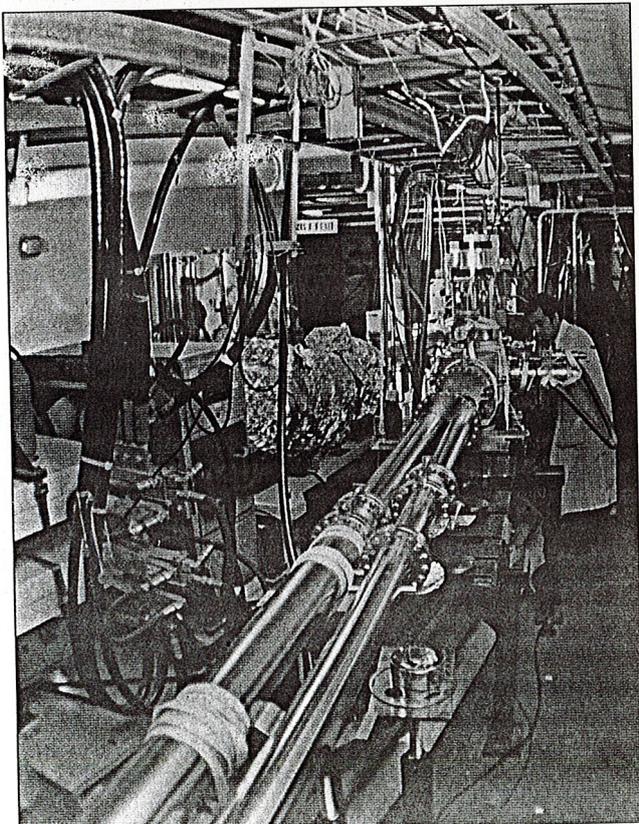
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ended up with an exchange discussion with some staff members of the Photon Factory and then with Prof. H. Iwasaki, director of the Photon Factory.

Our next visit was to Korea's SR facility in Pohang, which is located about 400 kms Southeast of Seoul. Prof. Tong Nyong Lee, Director of Pohang Light Source (PLS), gave a brief review of the PLS. The PLS is a 2 GeV with a Storage Ring circumference of 280 m. The PLS is still under construction and will be completed in the next two years. We were very fortunate to see the set up of both the linac and the storage ring. Since 1988, the PLS project has gone through conceptual, basic and detailed design periods and had entered into the major construction phase. Beginning in 1991, the ground breaking ceremony was held, and in early April the construction of the preinjector tunnel and the klystron gallery was completed. On the storage ring the prototype dipole, quadrupole and sextupole were delivered and were fabricated by the Hyundai Electrical Engineering Co. Ltd. It is interesting to note that the linear sections of PLS were made by the P. R. China. We were informed that the P. R. China had experience in making the linac. This confirmed our previous information. In fact, while visiting the P. R. China, Prof. Luo Ying Xiong had shown us the linac made for Korea under the exchange collaboration. Furthermore we were informed by Prof. W. Namkung that the P. R. China had a contract to make part of the linac for the Superconductor Super Collider (SSC) for the US.

Our last stop was Taiwan, the location of the SR facility is



**Front End of Synchrotron Radiation Wiggler beam Lines**

This is the front end of the synchrotron radiation beam line extracted from the wiggler in the IV Region of the storage ring on which application research of hard X ray will be carried out.

Hsinchu Science-Based Industrial Park, Hsinchu City, about 60 kms Southwest of Taipei. Prof. Liu Yuen Chung who is serving as the acting director of the Synchrotron Radiation Research Center (SRRC) met us and gave a review talk about the organization of the SRRC. We were informed that the idea of construction and establishing the SR facility was started in 1982 with a Study Group formed by the National Science Council. The construction was completed in early 1993. The SR facility consists of two major parts: the conventional injection accelerator and the storage ring. The injection accelerator was the booster type made by the Scanditronix AB of Sweden. After a briefing of the SRRC facility, we were invited to tour the SRRC facility both at the booster and the storage ring. Unfortunately, we were not able to get close to the machines since SRRC was operating. However, we were very fortunate to see the real operation in the control room. As usual, after completing the tour in the morning, we had enough time to discuss some technical aspects of the SR facility. We were informed that on August 12, 1993, SRRC will first achieve its design goal of a 200 mA beam current. Therefore, there will be a big celebration on 14 October 1993.

Having seen the SR facilities in four countries, we now have a clear picture about the design and construction of a synchrotron radiation facility. Our next step is to work out the conceptual report to be presented to the National Research Council for approval.

### Acknowledgements

The idea of constructing the SR facility in Thailand was originated when Prof. Virulh Sa-yakanit attended the lecture given by Prof. Dingchang Xian at a conference in the Philippines in 1992. Prof. Sa-yakanit was very impressed with the presentation of the construction of an SR facility in P. R. China and expressed an interest in carrying out a feasibility study for Thailand. This matter was brought up for discussion at the Committee on Mathematics and Physical Sciences of the National Research Council of Thailand. This Committee approved the carrying out of the feasibility study and set up a committee to carry out the SR facility study with Prof. Sa-yakanit as the group leader. The plan for visiting four countries in Asia that have the SR facility was then worked out. We would like to thank Prof. Dingchang Xian, and other members of the BSRF who have spent a lot of time showing us the BSRF. We are particularly grateful to Prof. Y. Yamaguchi, Dr. T. Kuroda, Prof. S. Sakai for arranging our trip to Japan, Prof. B. K. Chung, Prof. J. C. Woo, Prof. H. L. Yu for arranging our trip to Korea and Taiwan respectively.

Finally, we would like to thank Dr. Aphirat Arunin, Secretary General of the National Research Council who had expressed a strong support for the feasibility study of an SR facility and his continuing support of the trip. Finally, we would like to thank Dr. Payon Arunyaganondh, Chairman of the Committee on Mathematics and Physical Sciences and Prof. Dr. Sippanon Kerdudat for their strong moral support.