

EXPERIENCE OF ACADEMIA-INDUSTRY COLLABORATION ON ACCELERATOR PROJECTS IN ASIA

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Abstract

An overview of Asian particle accelerators and academia-industry collaborations are reviewed. The recent progress of Asian contributions to global accelerator programs in cooperation with industry is discussed for LHC and European XFEL project, as well as that for R&D efforts for future advanced accelerators.

INTRODUCTION

Academia-industry collaborations in development of advanced accelerators are critically required. Recent progresses in Asian accelerator projects are introduced as well as contributions to global accelerator programmes and R&D efforts for future advanced accelerators are discussed. Experience with academia-industry collaboration on accelerator project in Japan and global Asia is also reviewed.

ACCELERATOR PROJECTS IN ASIA

Asian accelerator programmes have been progressed in physics research, synchrotron radiation (SR), spallation neutron source (SNS), and medical applications, and their major activities are listed in Table 1. Academia-industry collaboration has been much progressed especially in Japan and Korea, while in-house activities are much remaining in other countries.

Table 1: Asian Major Accelerators for Physics Research, Synchrotron Radiation (SR), Spallation Neutron Source (SNS), and Medical Applications [1]

Country	Physics	SR and SNS	Medical
P.R. China	IHEP-BEPC	IHEP-BSRF, -CSNS, SSRF,	<i>Shandong</i>
Taiwan		NSRRC	
Korea	PEFP	PAL	<i>Pusan</i>
India	<i>IUAC, TIFR, VECC</i>	RRCAT	
Japan	KEKB, JPARC, RIKEN, <i>Univ.</i>	KEK-PF, JPARC Spring-8, Subaru, <i>Univ.</i>	NIRS-HIMAC, <i>N' Centres, Univ.</i>
Jordan		SESAME	
Thailand		BSRC	

*Note: Names of Laboratories in Italics.

In physics research, Beijing Electron Positron Collider (BEPC), KEK B-factory (KEKB), and Japan Proton

Accelerator Complex (JPARC) have been leading high-energy and fundamental physics in Asia. Accelerator facilities at Proton Energy Factory Project (PEFP), Inter-University Accelerator Centre (IUAC), Tata Institute Fundamental Research (TIFR), Variable Electron Cycrotron Centre (VECC), RIKEN, have been actively progressed in nuclear and fundamental physics programmes. In synchrotron radiation science and applications, various light sources are in operation in Beijing Synchrotron Radiation Facility (BSRF), Shanghai Synchrotron Radiation Facility (SSRF), National Synchrotron Radiation Research Centre (NSRRC), Pohang Accelerator Laboratory (PAL), Raja Ramanna Centre for Advanced Technology (RRCAT), KEK Photon-Factory (KEK-PF), Super Photon Ring 8-GeV (SPRING-8), and Subaru. In the field of spallation neutron source and the neutron science, Chinese Spallation Neutron Source (CSNS), and JPARC are in operation. Cancer therapy in medical use has been progressed as a major and much active application of particle accelerators. National Institute of Radiation Science (NIRS) is leading this field by using Heavy Ion Medical Accelerator (HIMAC) for researching medical applications and for performing the therapy. Academia-industry collaboration has been progressed to seek for wider industrial applications and medical applications.

ASIAN CONTRIBUTIONS FOR GLOBAL ACCELERATOR PROJECTS

Asian accelerator laboratories have been contributing global accelerator projects such as LHC [2] and European XFEL [3] as a part of academia-industry collaborations as summarized in Table 2. RRCAT has contributed to the LHC accelerator corrector coils and magnet components in cooperation with Indian industry [4]. KEK has contributed to the LHC interaction region SC magnets in cooperation with FNAL and Japanese industry [5, 6], as the installed magnet system into the LHC shown in Fig. 1. Japanese industry has also directly contributed to manufacture superconductor [7] and other components.

Table 2: Asian Academia-Industry Collaboration for Global Accelerator Projects

Projects	Cooperating laboratories	Contribution in cooperation with industries
LHC	CERN-RRCAT	SC corrector coils, and magnet components
LHC	CERN-KEK	SC magnets, Cryogenics, SC conductor, and others
European XFEL	INFN/DESY-IHEP	Prototype Cryomodule (cryostat)

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Figure 1: Superconducting quadrupole magnet system installed in the LHC beam interaction region in cooperation of CERN, FNAL, KEK, and Japanese industry.

Recently, IHEP contributed to the European XFEL in a prototype cryomodule development in cooperation with Chinese industry under supervision of INFN/DESY. The first prototype cryomodule has been recently installed into the FLASH tunnel at DESY, as shown in Fig. 2 [8].



Figure 2: The first European XFEL prototype cryomodule developed in cooperation of DESY/INFN, IHEP and Chinese industry, and installed in DESY/FLASH.

R&D FOR ADVANCED ACCELERATORS

KEK and Japanese Industry are contributing to an R&D program for the CERN-LHC luminosity upgrade, especially in development of advanced superconductor, Nb3Al, for high field magnets.

Asian accelerator laboratories are collaborating for development of high-gradient superconducting RF cavity for International Linear Collider (ILC) projects as part of a global collaboration program (ILC-GDE) [9-11]. Indian laboratories are also collaborating FNAL toward

the Project-X, to be realized at FNAL [12]. The cooperation programmes are summarized in Table 3.

Table 3: R&D Cooperation for Advanced Accelerators

Project	Cooperation b/w lab's	Technical Subjects for cooperation w/ industries
LHC upgrade	CERN - KEK	High field SC magnet, Club-cavity
ILC	ILC - KEK, IHEP, PKU, TU, KNU, PAL, RRCAT, IUAC,	Superconducting cavity, beam monitors, and accelerator systems
Project-X	FNAL-RRCAT-IUAC-TIFR, VEC	Superconducting cavities, and others,

AN ASSOCIATION FOR ACADEMIA-INDUSTRY COOPERATION IN JAPAN

An association for academia-industry-government cooperation in Japan has been established, and is so called “Advance Accelerator Association Promoting Science and Technology (AAA)”, as the organization illustrated in Fig. 3 [13]. The association aims to broaden human intellectual prospect in the fields of particle and fundamental physics, matter and life science, and aims to seek for various industrial application of advanced accelerators and technologies. The association promotes technical activities such as:

- Symposiums, seminars, and lectures, and
- working-groups to seek for innovative technologies and industrial applications,

It is realizing a unique approach for academia-industry collaboration in accelerator science and technology.

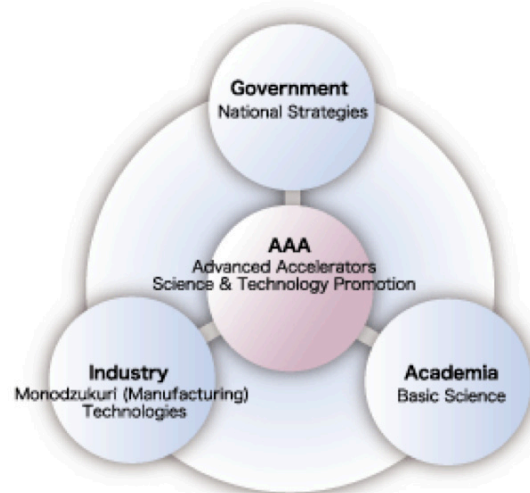


Figure 3: Organisation of Advanced Accelerator Association (AAA) promoting science and technology with academia-industry-government cooperation [11].

SUMMARY

Experience of academia-industry collaboration on accelerator projects in Asia has been reviewed, and the contributions to global accelerator cooperation programmes have been introduced. The cooperation with industry is getting crucially important to seek for and to create innovative industrial applications of advanced accelerator technology. Medical applications using advanced accelerator beams are leading the applications. Development of superconducting accelerator technology using superconducting magnets and RF cavities is getting important themes for future advanced accelerators, and is to be extended to the innovative applications.

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