Welcoming Remarks

Hiromichi Kamitsubo
RIKEN

Ladies and Gentlemen,

It is a great pleasure and privilege for me to give an opening address on behalf of RIKEN at the 17th International Conference on Cyclotrons and their Applications. I would like to express our hearty welcome to all the participants, especially to many of our guests who have come here far from abroad.

This Conference is organized by RIKEN, the Institute of Physical and Chemical Research, and hosted by the Cyclotron Center of RIKEN, who is now constructing the world's first superconducting separated sector cyclotron.

This conference is the 17th of the series and the second time for a conference of the series which was held in Japan. I remember that the 11th conference was held in Tokyo in 1986 when we had completed the ring cyclotron of K=540 MeV. At that time superconducting cyclotrons and separated sector cyclotrons were newly arrived to accelerate heavy ions in the energy range of several tens MeV/nucleon. Thanks to these accelerators, energetic heavy ions have played a leading role in the progress of nuclear physics in the past twenty years.

In these years the progress of the accelerator technology is remarkable and their applications have been widely developed. Taking this opportunity I would like to introduce you briefly the current status of accelerators in Japan, as an example of how accelerators are used widely in the modern society.

According to "Statistics on the Use of Radiation in Japan (as of March 31, 2003)" published by Japan Radioisotope Association, the following is the number of accelerators, licensed in use, by category of organizations; 65 accelerators in universities, 132 in research institutions, 837 in hospitals, 140 in industries and 19 others. The number is also given by category of accelerators as follows; 86 cyclotrons, 28 synchrotrons (including storage rings), 898 linear accelerators, 9 betatrons, 41 Cockcroft-Walton accelerators, 32 microtrons and 16 others. The above statistics does not include accelerators with an energy lower than 1 MeV or equivalent.

First of all, I would like to introduce high energy accelerators which are dedicated to basic researches and operated as national user facilities. At High Energy Accelerator Research Organization (KEK) are three facilities, B-Factory (KEK-B), Photon Factory (PF), and Proton Synchrotron (PS). The KEK-B is an electron-positron collider with the world's highest luminosity. It consists of an 8 GeV electron storage ring and a 3.5 GeV positron storage ring. The Photon Factory has two synchrotron radiation sources of 2.5 GeV (PF ring) and of 6 GeV (AR ring), respectively, and the PS is a 12 GeV proton synchrotron and has been used for

Kaon experiments as well as neutrino oscillation experiments in combination with Super Kamiokande. The PS is also used to produce muons and neutrons for materials and life sciences.

KEK and Japan Atomic Energy Research Institute (JAERI) are constructing jointly a high intensity proton accelerator complex (J-PARC) at Tokai Campus of JAERI. The J-PARC consists of a 400 MeV proton linac, a 3 GeV proton synchrotron ring, and a 50 GeV synchrotron ring. The 3 GeV synchrotron provides mainly proton beam power of 1MW to the spallation neutron source and 15 μA proton beam to the 50 GeV ring. The Phase-I of the J-PARC Project will be completed in 2007.

The SPring-8 is the world's largest synchrotron radiation source and was constructed jointly by RIKEN and JAERI. It consists of a 1 GeV electron linac, an 8 GeV synchrotron ring, and an 8 GeV storage ring and provides the most brilliant X-ray over a wide energy range from 0.1 keV to 300 keV. It provides also high intensity X-ray (called as LEP, laser-electron photon) in an energy region of a few GeV through Compton back-scattering of laser beam from 8 GeV electrons. The LEPs have been used for the studies of nuclear structures related to quarks.

The RIKEN is constructing a new facility, RIBF (Radioactive Isotope Beam Factory). Reports on this project are presented at this conference so that I do not touch here.

The statistics as of March 31, 2003, indicates that 837 accelerators are used in hospitals and clinics and 789 of them are electron accelerators (764 linear accelerators, 2 betatrons, and 25 microtrons) which are mainly used for X-ray radiation therapy or radio-surgery. On the other hand, 44 are cyclotrons used for radioactive isotope production for PET, and SPECT (Single Photon Emission Computed Tomography). It should be pointed out that the number of cyclotrons for PET is increasing very rapidly and total number will reach to 90 at the end of this year.

Five medical organizations have the accelerator facilities for proton/ heavy-ion therapy. The National Institute of Radiological Sciences is the pioneer in this field and it has operated more than ten years the HIMAC (Heavy Ion Medical Accelerator in Chiba), which provides ions of C, N, O, Ne, Si and Ar at 0.8 GeV/n for irradiation of various types of cancers. The others are Hyogo Ion Beam Medical Center (p and C ions, 0.32 GeV/n), National Cancer Center (p, 235 MeV), Tsukuba University (p, 250 MeV), Shizuoka Cancer Center (p, 235 MeV), and Wakasawan Energy Research Center (p, 230 MeV). All of them are proton and heavy-ion synchrotrons except for the facility at the National Cancer Center.

In the case of industrial applications low energy accelerators are playing more important role than high energy ones. Largest number of accelerators used in industries are ion implanters and more than one thousand implanters are presumed to be operational in Japan. Energy range of them is mainly from 200 eV to 3 MeV/atom and implanters of higher energy are used only for CCD manufacturing. As for acceleration, Cockcroft-Walton type is used for under 500 kV whereas tandem technology and series of double- or triple gap resonators are used for higher energy application. On the other hand, in the case of electron accelerators, more than 70 of low energy (E≦300 keV) accelerators and 110 medium energy (300 keV＜E ≦3 MeV) ones are used in the field of curing, cross-linking of wires and cables, foamed polyethylene, heat-shrinkable tubing and so on.

Finally I would like to thank all of you for coming to participate this Conference and I sincerely hope that the present meeting gives you a good opportunity to discuss various new technologies related to cyclotron and new directions of the cyclotron applications and serve you as a place of communication and international collaboration.

Please enjoy the conference and pleasant stay in this nice season in Japan.

Thank you for your attention.