PRESENT STATUS OF KEK 12 GeV PROTON SYNCHROTRON AND SOME ASSOCIATED PROJECTS

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12GeV Proton Synchrotron

The main ring synchrotron was shut down during three months at the last summer, and the vacuum chambers were replaced by new ones made of stainless steel 316LS, which show magnetization effects less than the old. The field distribution of higher multi-pole components was considerably improved inside of the vacuum chamber[1], and the maximum beam intensity of the main ring synchrotron has reached above 4 x 10^{12} protons per pulse in this May. Owing to the enlarged acceptance of the main ring, the booster synchrotron is in operation with full intensity above the designed intensity of 6 x 10^{11} protons per pulse. Fig. 1 shows the evolution of the output beam intensity at each stage of the 12GeV accelerator complex.

Booster Synchrotron Utilization Facility

Since 1978 Booster Synchrotron Utilization Facility was being under construction, and has been completed in this spring. The layout of the facility is shown in Fig. 2. The first beam from the booster synchrotron was delivered to the new facility on June 18 on schedule. Production of thermal, epithermal and cold neutrons from a tungsten target for the neutron scattering experiments was found to be satisfactory by preliminary surveys. On July 16, one month later from the first beam delivery, the beam was switched to also the meson experimental area, and the production of mesons and muons was comfirmed at the output of a 5 Tesla superconducting solenoid magnet. At present, whole beam pulses, except for the pulses for the main ring injection and the spectrum monitoring of the linac beam, are transfered to the new facility as shown in Fig. 3. The transmission of the new beam line is 100% with an uncertainty of 5%. Fig. 4 shows the horizontal beam profiles at some of profile monitors set along the beam line. Tuning of various kinds of the neutron diffraction spectrometers, meson and muon spectrometers are in progress. The construction of a new facility for the medical use of the booster beam will start soon.

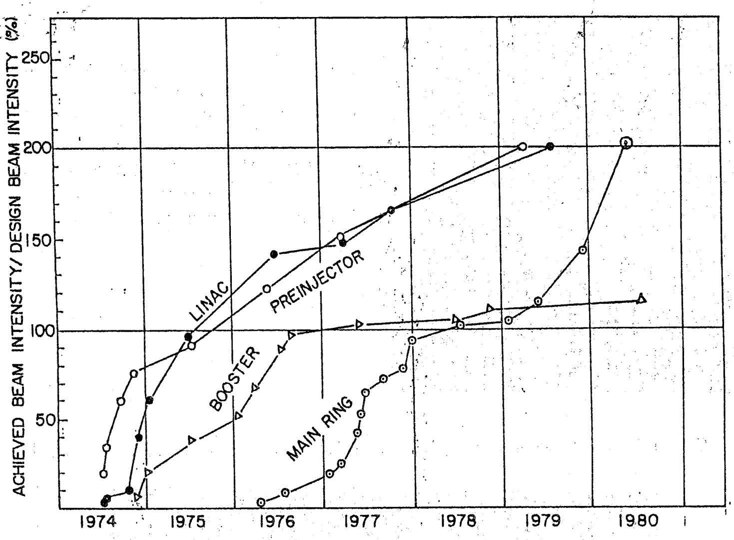
Charge Exchange Injection and Polarized Beam Acceleration Project

Conversion of the injection scheme in the booster synchrotron is under consideration from the present multi-turn injection to charge-exchange injection with H^- ion beam. By this scheme, the ordinary proton beam intensity will be not only increased, but acceleration of polarized proton beam will also come into practice. The developement of H^- ion source[2] and the design of the injection system of the booster synchrotron are in progress. From the measurements of beam life time of the proton beam in the multi-traverse at a 120μg/cm^2 carbon foil stripper, it is possible to inject H^- ion beam of 150 turns into the booster. This means that the circulating beam current in the booster after the injection process is estimated to be about 1.5A with 15mA H^- injected ion beam, while the present circulating current is about 0.4A in the multi-turn injection scheme. The H^- ion source in a test stand is now delivering 15mA H^- ion beam of 150μsec in time duration. Fig. 5 shows a current waveform of H^- ion beam.

Feasibility of the acceleration of polarized proton beam in KEK synchrotron is being reexamined by careful studies of resonant depolarization and developing a new type of polarized H^- ion source. In order to realize a polarized beam intensity of 4 x 10^9 protons per pulse in the booster synchrotron, which corresponds to 1mA circulating beam current at injection, the polarized ion source is required to deliver more than 10μA polarized beam with 100 turns injection. The new polarized ion source is based on the transfer of the electron spin of alkali atom to neuclear spin in sodium vapour. In a preliminary experiment, the polarized H^- ion beam current of about 3μA has been obtained. The polarization of the beam was estimated to be 30-40%[3]. There are so many problems to be resolved in order to overcome the resonant depolarizations during the acceleration, especially in the main ring synchrotron. However, the recent studies on the resonant depolarization in detail[4] show the possibility to accelerate a polarized beam up to the maximum energy of the main ring synchrotron in combination with slow and fast passage at the resonances.

References

(1) KEK Internal 80-2; A. Araki, A. Ando, and E. Takasaki
(2) Proc. 4th Symp. on Ion Source and Ion Application Technology, 1980 (Tokyo); A. Takagi, K. Ito, Y. Mori, and S. Fukumoto
(3) Proc. 4th Symp. on Ion Source and Ion Application Technology, 1980 (Tokyo); Y. Mori, K. Ito, A. Takagi, C. Kubota, and S. Fukumoto
(4) Accelerator Study Note ASN-187; S. Hiramatsu and K. Muto



DESIGN	INTENSITY
PREINJECTOR	200 MA
LINAC	100 MA
BOOSTER	6×10^{11} PPP
MAIN RING	2×10^{12} PPP

Fig. 1. Evolution of output beam intensity of KEK PS

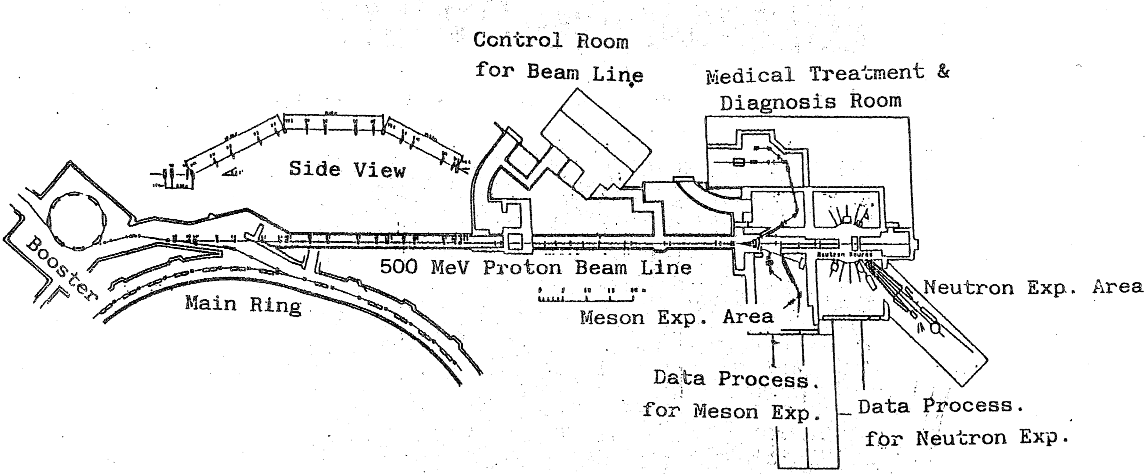
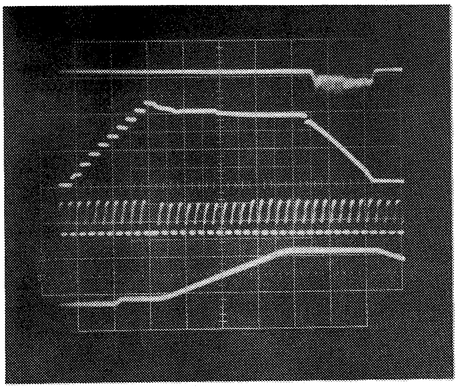


Fig. 2. Layout of Booster Synchrotron Utilization Facility



1st trace: Output of a loss-monitor in Main Ring
2nd trace: Circulating beam intensity in Main Ring
3rd trace: Circulating beam current in Booster
4th trace: Magnetic field of Main Ring

Fig. 3 Circulating beams of M.R synchrotron and Booster synchrotron

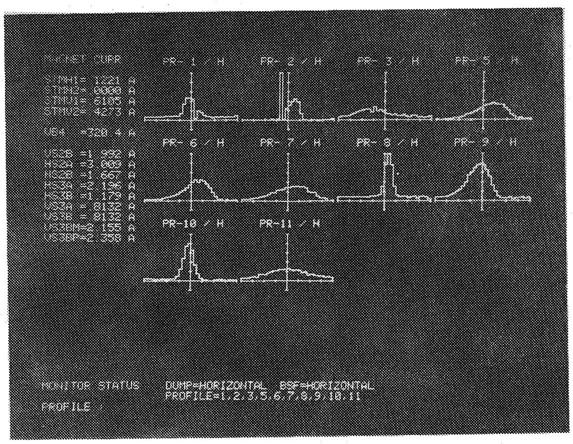


Fig. 4 Horizontal beam profiles on the BSF beam line

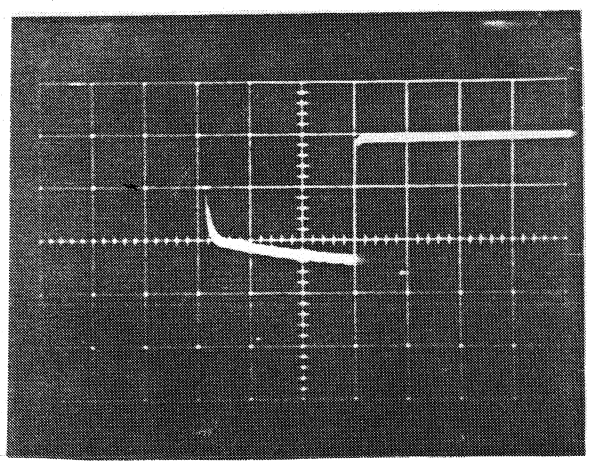


Fig. 5 Current waveform of H^- ion beam (5mA/div, 50μsec/div)