NEXT ACCELERATOR AT SENDAI

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I Introduction

The Tohoku 300 MeV electron linear accelerator facility, after 4 years of the construction, completed the machine and experimental equipments in the beginning of 1967. Since then they have been in operation successfully more than ten years carrying out various subjects which cover nuclear physics, neutron diffraction by TOF, radiation chemistry, and so on. The users of various branches came to perform experiments from inside and outside of the university. Many visitors from abroad also came our laboratory to do their works. The machine run has been divided into nuclear physics 55%, radiation chemistry 20%, neutron for condensed matter 20%, and others 5%.

In the plan of the next accelerator the status of the present subjects and facility must be taken into account. For example, high power pulsed beam is needed for the neutron group. The next accelerator described here must satisfy many user's criteria.

II The next accelerator for nuclear physics

First of all we discussed an accelerator required for the study of nuclear physics. So far electro and photonuclear excitations have been carried out observing scattered electrons or decayed particles only. In order to improve them further the study should be extended by a coincidence experiments which becomes feasible with 100% duty cycle beam on the target. Measurements may be considered as follows;

1) emitted particles in coincidence with a scattered electron.
2) measurements of the energy and angular correlation of two or more emitted particles.
3) monoenergetic photon with tagged Bremsstrahlung.

The present subjects that are multipole giant resonances, (γ,p), (γ,α), (γ,π) and so on improve significantly with these methods. In addition, the next machine aims to investigate phenomena such as the exchange current, isobar in nucleus, short range correlation and so on which need higher energy to explore. Then, it would be adquate to choose machine parameters which are 1 GeV, 100 μA and 100% DC.

III High duty cycle machine

In order to obtain 100% DC electron beam, there are possible candidates as follow;

1) a conventional CW linac with recirculation
2) a multistage microtron
3) a supperconducting linac with recirculation
4) a supperconducting multistage microtron
5) a conventional pulsed linac with beam stretcher

We mention briefly the present status of these types. NBS has a plan to build type (1) to obtain both pulsed (66 MeV, 10 nsec) and CW 225 MeV beams. The pulsed beam is produced from a CW 40 m linac and the 225 MeV beam is obtained by recirculation. As to (2) the first two stages of the cascade microtron (14, 100, and 820 MeV) have been started at Mainz. Candidates (3) and (4) which aim medium energies (100-300 MeV) are now going successfully at Stanford and Illinois. The design study for type (5) has been made at Saclay and Saskatchewan. A sotrage ring for 100 MeV has also been studied at Lund.

Our facility needs both pulsed and DC beams. The candidate (5) seems to be uniquely determined from the present situation.

IV Linac and beam stretcher

In order to suppress the cost of the construction, maintenance and operation we aim that a linac must be simple as far as possible. The next linac has 25 units in which each consists of a drift tube of 3 m, a klystron of RF duty cycle of 10^{-3}, a modulator of a compact size and so on. An accleration of 45 MeV and 200 ma peak current is available per unit within the present technology. 1 GeV, 100 μA average current, 1 μsec, and 500 pps are seem to be conservative.

The design study of a beam stretcher is going on by Dr. M. Sugawara, which may be seen in Fig. 1. A ring structure of about 60 m circumference into which the 1 μsec pulse is injected in a 5-turn process. The intensity of the stored beam is 1 A. It is then spilled out slowly through a resonant extraction lasting 2 msec. This way of the extraction is employed because it has been successfully achieved on many circular machine.

We expect this project will start within 4 years.

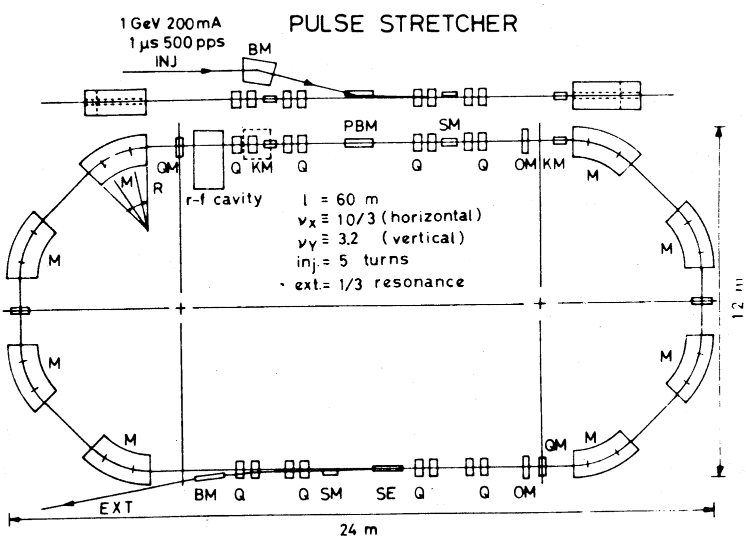

Fig. 1 Pulse stretcher for the beam of 100-1000 MeV