INTERMEDIATE ENERGY PARTICLE ACCELERATOR COMPLEX

I. Miura, T. Yamazaki, A. Shimizu, M. Inoue, T. Saito,
K. Hosono, T. Itabashi and M. Kondo

Research Center for Nnclear Physics Osaka University

Abstract

A two rings separated-sector cyclotron system is being designed. This system is a variable energy and variable particle accelerator. A common acceleraton frequency (20-34 MHz) is used through the system. The construction period of the accelerator complex can be divided into three phases. On the phase 1, a injector cyclotron (K=60) and the first ring (N=4,K=250) will provide energies up to 190 MeV and 60 MeV/A for protons and light ions, respectively. The second ring (N=8,K=500) is added on the phase 2, and the energy range will be extended up to 550 MeV and 125 MeV/A for protons and light ions, respectively. Finally, a injector heavy ion linac (20MV+17MV) will increase the energies and intensities of the heavy ions. Uranium ions will be accelerated up to 14.5 MeV/A.

1. Introduction

The RCNP cyclotron facility was completed successfully and opened to all nuclear scientists in Japan. Many experimental studies are in full activity with protons, deuterons, α, ^{3}He, polarized protons and heavy ions. We are also planning to expand research activity for an open field above maximum energies of the RCNP cyclotron.

The field was considered in all its aspect, and many demands for new accelerator facilities are emphasized to study various kind of research field, on the Symposium for Studies of Future Plan at the Next Stage of RCNP[1]). This proposal for an Intermediate Energy Particle Accelerator Complex is being designed with the advice of the RCNP Resarch Program Committee.

This accelerator complex covers a wide energy range above the RCNP cyclotron and accelerates ions from proton through Uranium, with high intensity and good beam quality. Protons of 550 MeV are available for the Meson Factory.

The construction period can be divided into three phases, and everyphases can be constructed with moderate and minimum cost.

2. Main Accelerator (Poststripper Accelerator)

The main accelerator was divided into two separated-sector ring cyclotrons to keep away from the ν_z=1 resonance. The injection (extraction) radius of the first ring (N=4,K_{inj}=30,K=250,900ton) and one of the second ring(N=8,K=500, 1200ton) are 1.2 m(3.2 m) and 3.2 m(4.5 m),respectively. Plan view drawings of the two rings are shown in fig. 1.

Fig. 2 and 3 show the radial and axial focusing frequencies calculated with modified SPYRING code[2]) for the first and the second rings. Ions from proton through Uranium might be accelerated with out crossing the ν_z=1 resonance, except protons of ∿450 MeV.

Variable frequency H_{101} cavities are proposed for acceleration. A common and narrow acceleration frequency range (20-34MHz) is used through the accelerator complex. Fig. 4 shows acceleration harmonics on the two rings for various ions and energies. Acceleration voltages for the first and the second rings are 0.8MV/turn and 2MV/turn respectively.

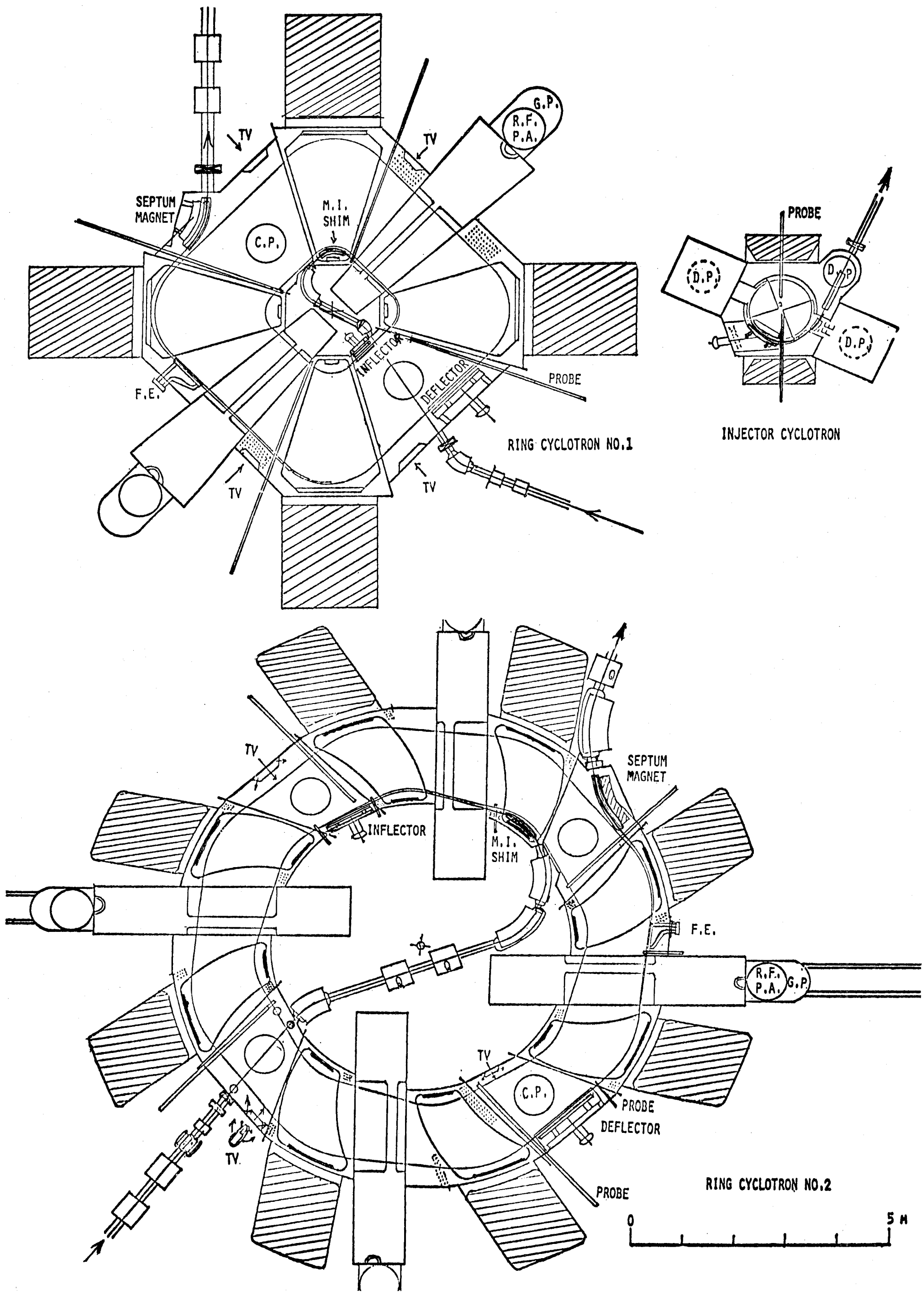

Fig. 1 Plan view drawing of the injector cyclotron (K=60), the first ring (N=4,K=250) and the second ring (N=8,K=500).

The turn separations on the injection (extraction) radii are 30mm (8mm) and 16mm (5mm) for the first and the second rings, respectively.

3. Injectors

This accelerator system has two injectors. A small isochronous cyclotron (K_f=25,K=60, 100ton,R_{ext}=0.6m) will be used for proton and light ion injections, with or with out a gas stripper.

The other injector is a wideroe type variable frequency (20-34MHz) heavy ion linac (0.5MV C.W.+20MV+17MV) followed by a gas or a foil stripper.

The distances between the last two inner drift tubes of the 20MV and the 17MV linac sections are 1/12 and 1/8 of the orbit length on the injection radius of the first ring.

4. System Perfomance

Fig. 5 shows expected maximum energies of this proposal on the phase 1, 2 and 3 with GANIL, OAK RIDGR, INDIANA and 25MV tandem.

Expected maximum intensities are 50pμA, 2pμA and 0.02pμA for protons, ^{12}C and ^{238}U.

5. References

1. RCNP-P-10 (1976)
RCNP-P-16 (1977)

2. M. M. Gordon NIM 83 (1970) 267

RCNP-P-16 (1977) 28

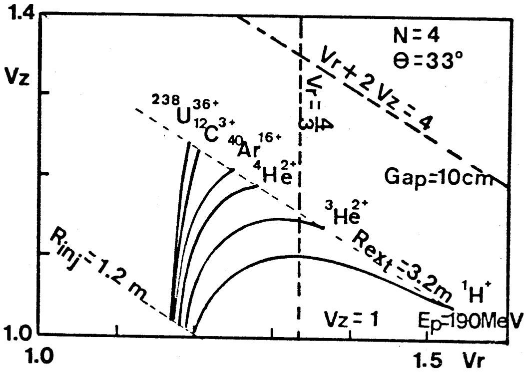

Fig. 2 The radial and axial focusing frequencies for the first ring calculated with the modified SPYRING code.

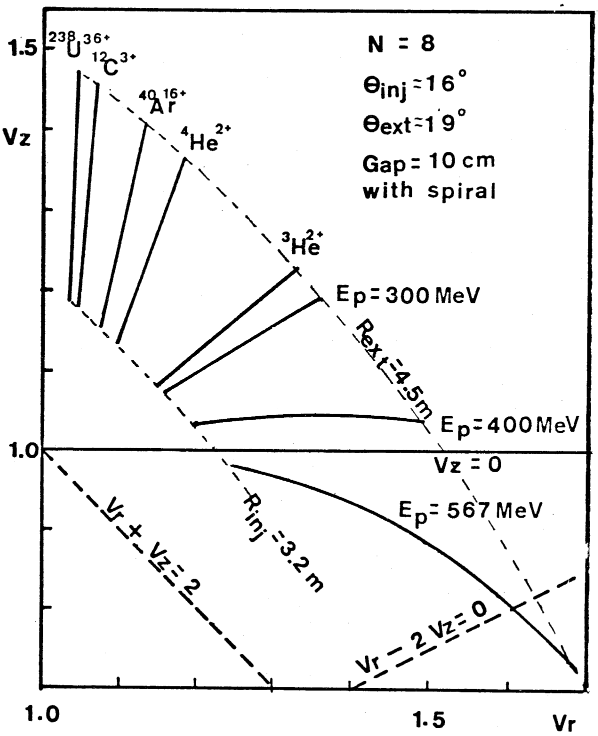

Fig. 3 The radial and axial focusing freqencies for the second ring calculated with the modified SPYRING code.

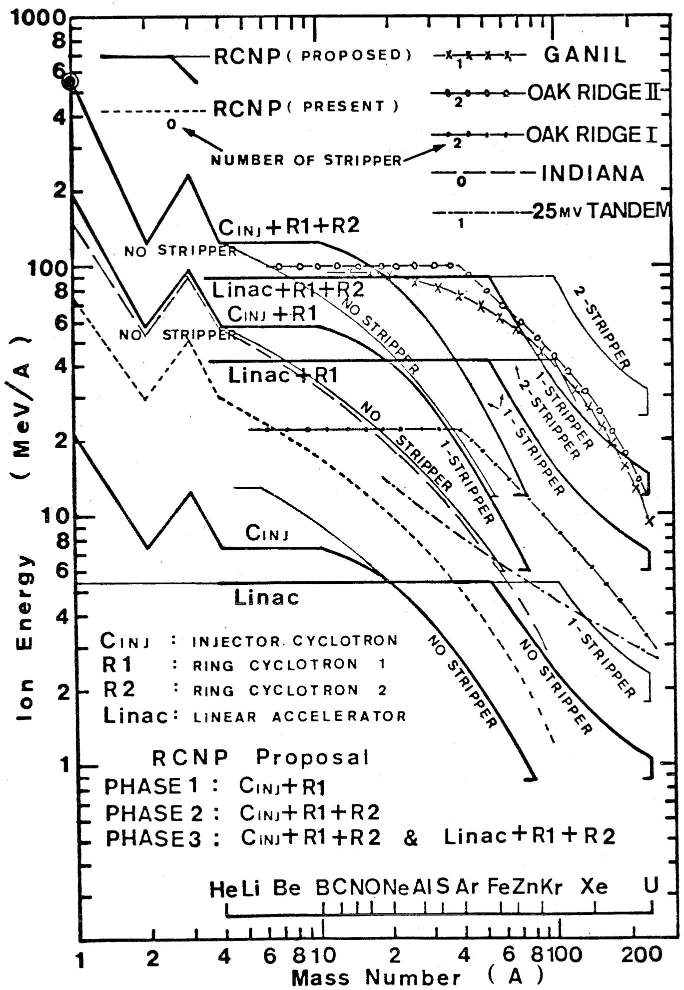

Fig. 5 Expected maximum energies

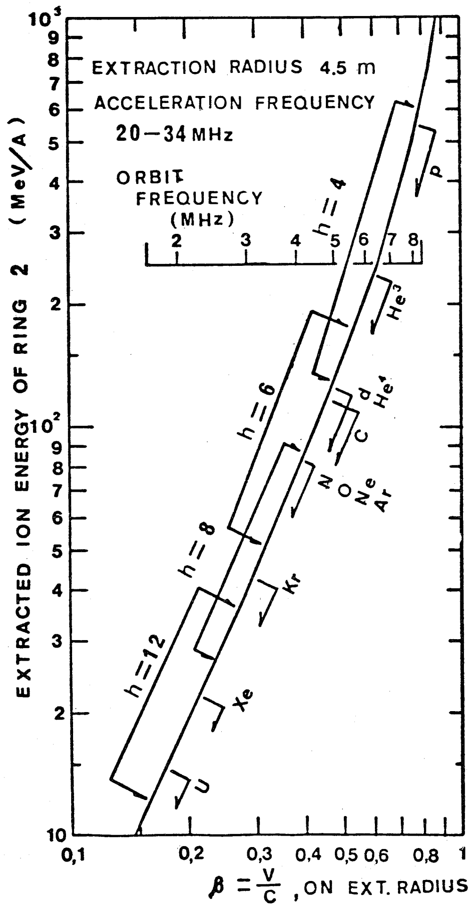

Fig. 4 Ion energy and acceleration harmonics, h, as a function of orbit frequency and $\beta=\frac{v}{c}$, on extraction radius of the second ring.