CENTRAL REGION OF THE INJECTOR CYCLOTRON

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Abstract

Central region of the injector cyclotron for the ring cyclotron project of the RCNP has been studied to accelerate axially injected beams. An electrostatic inflector and a small deflector are considered to accept proton beam with injection energy of 60 keV.

1. Introduction

A ring cyclotron project has been proposed at the RCNP, Osaka[1]. As the injector is important to decide the beam qualities we have compared several types of the injectors[2]. A compact cyclotron with an external ion source is a candidate in the first phase. The external ion source is useful to improve beam qualities and essential to accelerate a polarized beam.

The existing AVF cyclotron of the RCNP has also the polarized ion source and an axial injection system. Our experiments for the beam developments have shown that the phase slit at the central region is important to get a good time structure but insufficient to realize the single turn extraction, and that only a small emittance beam is able to go through the mirror electrode system. Our existing cyclotron and many other cyclotrons have the axial injection system with injection energy of about 10 keV while the TRIUMF cyclotron has a very large geometry and its injection energy is 300 keV. As high energy injection is preferable to get good quality beams, an injection proton energy of about 60 keV has been adopted for the injector cyclotron. For heavy ions injection voltage is proportional to B^2q/A, where B is magnetic field strength, q is the ion charge and A is the particle mass.

2. Central geometry

The RF electrode system of the injector cyclotron consists of double 60° dees and works in 2nd and higher harmonic acceleration mode to match the RF frequency of the ring cyclotron which is 20∿32 MHz. The peak value of the dee voltage is 50 kV. A system composed of a spiral inflector and a small deflector has been considered to accept relatively high energy injected beams. The small deflector is placed for correction of the beam centering. A vertical deflector system is also situated at the first turn radius. For the 60 keV proton, the field strength of the spiral inflector and the small horizontal deflector are 18 kV/cm and 16 kV/cm respectively and the magnetic field is 10 kG. Fig. 1. shows the central geometry and a beam orbit.

3. Model test

The injector cyclotron is commercially available but it is necessary to modify the central region. A small test magnet was designed to examine the central region of the injector. A field measuring system is now in preparation. Main characteristics of the injector is listed in Table 1.

References

1. I. Miura et al., Proc. 8th Int. Conf. on Cyclotrons & their Applications IEEE-NS-26 ♯2, 2074 (1979).
2. M. Inoue et al., Proc. 3rd Sym. on Accel. Sci. & Tech. p. 128 (1980).

Table 1

Main characteristics of the injector cyclotron

extraction radius	67.5 cm
magnet gap hill	13 cm
valley	28 cm
main coil power	150 kW
trim coil power	25 kW
magnet weight	110 tons
RF cavity	2 60° dees
RF frequency	20 32 MHz
maximum voltage	50 kV
harmonic	2. 3. 4
RF power	250 kW
Ion source	external 60 keV

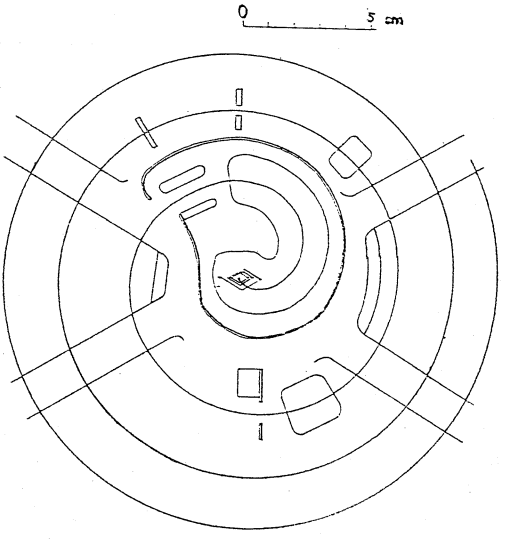

Fig. 1. Central region of the injector cyclotron