MODEL TEST OF 1/5 SCALE MOVABLE BOX TYPE RF RESONATOR FOR THE RIKEN SSC

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Abstract

A resonator whose resonant frequency is varied from 17 to 45 MHz by the movable box in the resonator is designed for the RIKEN SSC. The transmission line approximation is used in the calculation. Based on the calculations, the 1/5 model resonator was constructed and the resonant frequencies, Q-values and radial distributions of RF electric field at the accelerating gap were measured.

1) Introduction

A new method to vary the resonant frequency is investigated. In Fig. 1, the new type resonator is shown. The resonant frequency is varied from 17 MHz to 45 MHz by moving the "movable box". The box does not make contact with the stem but contact only with the outer wall. The gap between the stem and box is 4 cm. This resonator has following merits:

1) The height is less than 3 m.
2) The distance which the box is moved is short (0.6 m).
3) The contact fingers are not at the location where the current density is maximum.

Figure 2 shows resonant frequencies and Q-values calculated by the transmission line approximation.

2) The 1/5 scale model resonator

To investigate the RF characteristics of this resonator, the 1/5 scale model resonator was constructed. The resonant frequency, Q-values and the radial distribution of RF electric field were measured. The resonant frequencies and Q-values measured are shown in Fig. 2 with the calculated values. The resonant frequencies measured are fairly well reproduced by the calculations. However, the Q-values measured are about 0.4 times of the calculated values. The poor agreement between the measured and calculated Q-values may be due to poor contact between the movable box and the outer wall,and the complex structure of this resonator.

Relative distributions of RF electric field along the dee edge of the model resonator were measured by perturbation method.[1] The distributions measured are shown in Fig. 3 , which are normalized at injection radius. The strength of the field at middle radius is 75 % of that at the injection radius for 45.9 MHz. This is not desirable for beam acceleration. In order to improve the distributions, the stems were reconstructed as shown in Fig. 1 (hatched). The electric field distributions after the reconstruction are shown in Fig. 3. The distributions are improved.

3) Conclusion

The dee voltages required for beam acceleration were calculated for several particles. The dee voltage as a function of RF frequency is shown in Fig. 4. The maximum output power of the amplifier for the resonator is to be 300 kW. The dee voltages generated by the amplifier are estimated using the Q-values measured and calculated. The results are shown in Fig. 4. The dee voltages estimated are sufficient for the beam acceleration.

Reference

1) L.C. Maier, Jr. and J.C. Slater: J. Appl. Phys., 23, 68 (1952)

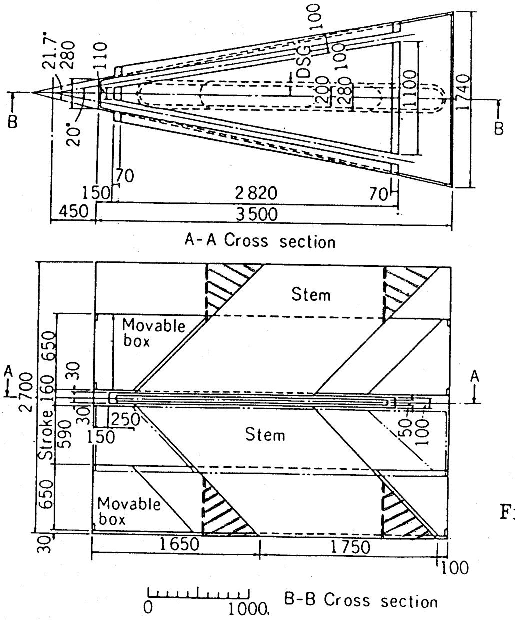

Fig. 1. Schematic view of the movable box type resonator.

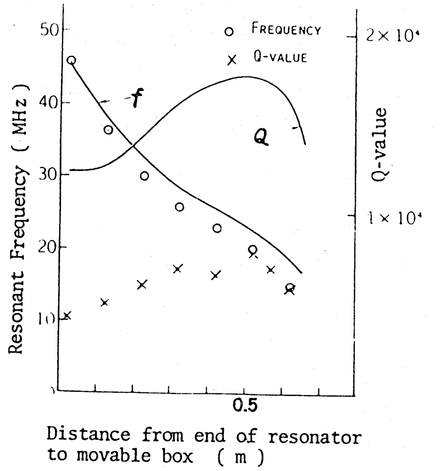

Fig. 2. Resonant frequencies (f) and Q-values measured and calculated by the transmission line approximation.

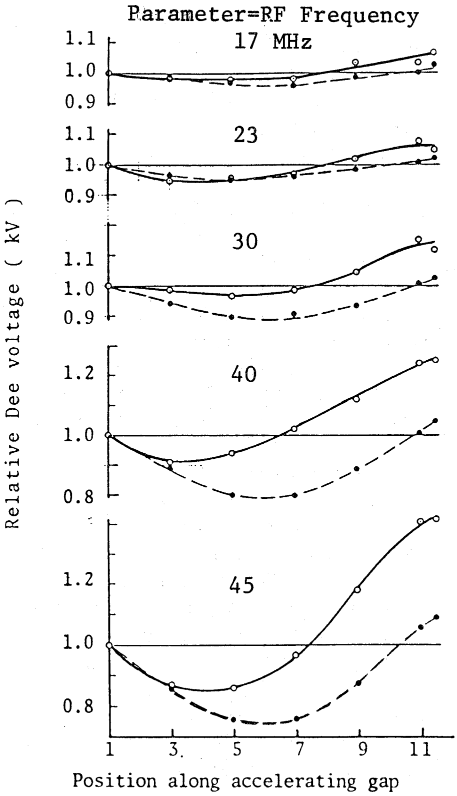

Fig.3. Relative distribution of RF electric field along the accelerating gap for the 1/5 model resonator. Solid lines show after the reconstruction.

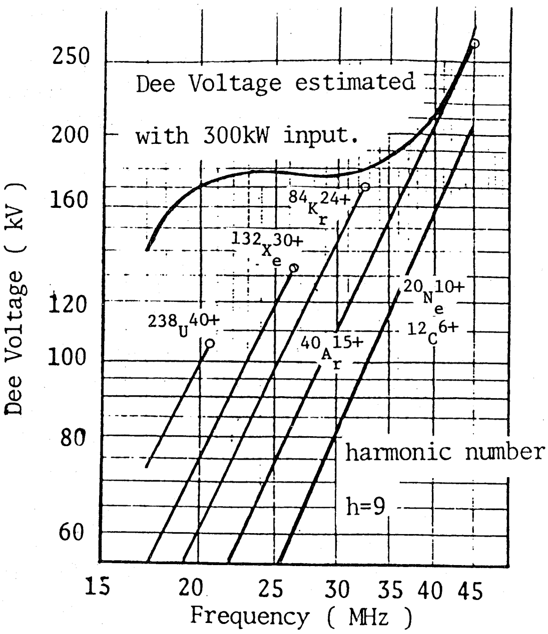

Fig.4. Dee voltage required for beam acceleration.