RF CAVITY FOR IPCR SSC

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The rf cavity for IPCR SSC is required to satisfy following conditions[1]:

(1) The frequency range is from 17 to 45 MHz for the synchronous operation with the injector linac.
(2) The maximum energy gain is 1 MeV/turn for proton.
(3) The radial length of the accelerating gap should be longer than 2.6 m corresponding to the injection and extraction radii of 0.81 m and 3.26 m at valleys respectively.
(4) The two cavities are located at opposite valley spaces between four 50° sector magnets.

In order to fulfil the above conditions, three types of cavities are investigated, that is, a single gap type, a $\lambda/4$ type with single vertical stem, and a $\lambda/2$ type with two vertical stems in opposite sides. The first one has a simple structure and high Q value, but, in our case, spatial restriction near the central region of SSC makes this impossible to be put in use. The second one has following problems;

(1) Vertical electric field may be induced at the accelerating gap and may, further, leak in the Dee.
(2) At the accelerating gap, the electric field has different strength above and below the median plane.
(3) Undesirable modes of oscillations may be excited because of large radial Dee length and elongated Dee aperture.

In spite of these problems, this type has some advantages compared with the half wavelength type in that this has small size and simple structure and pumping load is light. A $\lambda/4$ half scale model cavity was constructed and the field strength distribution was measured by a perturbation method. It was found that this cavity had a large rf electric field even inside the Dee, and had different field strength above and below the median plane at the accelerating gap. These fatal drawbacks made us give up the idea of using this type of cavity. Therefore, we have to employ the third one as the only one that could satisfy the conditions.

At first, $\lambda/2$ cavity with rounded triangle stems was investigated using half scale model, and it was found that this cavity satisfied the desired conditions. To make the cavity better, calculations based on the distributed constant circuit theory were done for three types of stems, the cross sections of which were circular, rounded triangle, and racetrack, according to the following guidelines:

(1) The power loss in cavity should be as little as possible.
(2) The cavity size or length should be as small as possible.
(3) The cavity should have neither parasitic nor undesirable modes of oscillations in this frequency range.
(4) Maximum current density at the short end should be less than 50 A/cm.
(5) Simple structure and easy handling

The current density at short end becomes high for the cylindrical stem to get a sufficient voltage. Racetrack stem was found to be most favourable. Figure 1 shows the schematic views of this cavity. Figure 2 shows the results of calculations.

In conclusion, the calculations show that the half wavelength cavity with double vertical stems satisfies the desired conditions and guides. A half scale model cavity is under construction to be investigated more in details.

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REFERENCE

1. Proceedings of the 8th Int. Conf. on Cyclotron and their Applications, INDIANA, 1978, p2070 and p 2000.

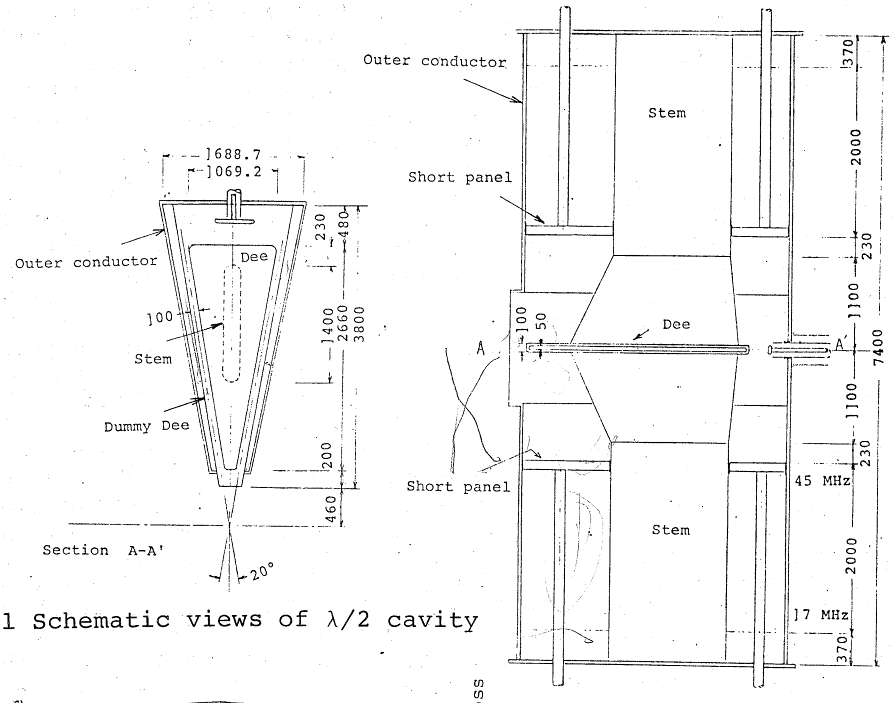

Fig.1 Schematic views of λ/2 cavity

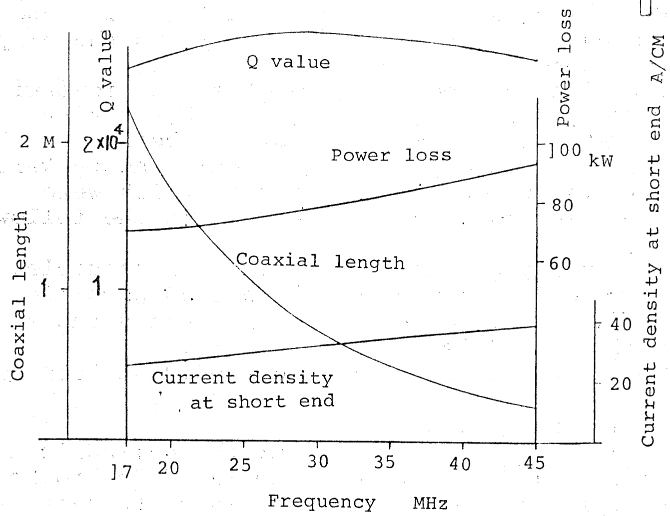

Fig.2 Calculated Q value, power loss, Coaxial length, and current density at short end versus frequencies