On Tuning of 433 MHz Four-cavity H-resonator

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Abstract

Compact ion $H^{\pm}$ accelerator on the basis of four-cavity H-resonator [1,2](input and output energies are respectively 60 keV and 1.8 MeV) is designed and fabricated as prototype, which lets practically to develop the design, manufacturing and circuit solutions arising in construction of similar devices. The paper reports on the results of test assemblies and low power RF measurements of four-segment H-resonator.

1. INTRODUCTION

1.1 Resonator Characteristics

Volume of the H-resonator is formed with four segments (figure 1) and closed with end covers. Converging to axis cone electrodes have longitudinal sinusoidal modulation with increasing period and amplitude. Length of the electrodes is 1.5 m. Average radius is 3.5 mm.

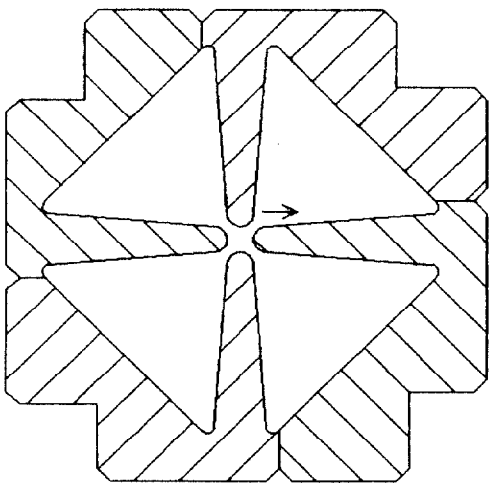

Figure 1. H-resonator cross-section.

Frequency of operation and frequencies of few higher order resonator modes are shown as functions of length of resonator in figure 2 (numerals 0 - 3 mean number of longitudinal variations of field of the modes; solid-line - quadrupole modes, dash-line - dipole modes). Frequencies of parasitic dipole modes without longitudinal variations are the nearest of frequency of operation mode and exceeding that by 6 MHz for 1.5 m length of electrodes. Particularly, frequencies of dipole modes are equal frequency of operation mode for 1.9 m length of electrodes.

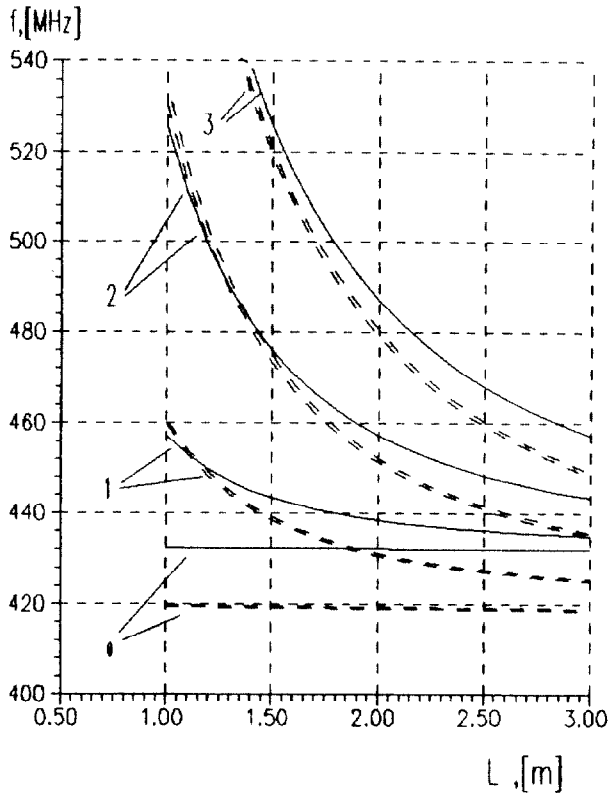

Figure 2. Frequencies of modes as functions of length of resonator.

1.2 Nowadays

By now a number of precision assemblies of accelerate structure (with low level RF measurements of accelerating mode and higher order modes) has been accomplished. The assemblies and measurements used an experience, which was obtained during tuning of early made same type resonator. Vacuum works are completed.

2. TEST ASSEMBLIES AND RF MEASUREMENTS

A number of precision assemblies of accelerate structure was made to get suitable field distribution.

Assembly of segments with accuracy worse then 70 - 100 μm initiates large frequency relocation of dipole and in less degree quadrupole modes (in the case there are positions of electrodes, when frequency of operation mode is practically unchanged, the effect is fixed if sum of four shortest distances between tips of electrodes is kept constant). In addition, the considerable redistribution of fields of the modes is present and making very difficult identification of the ones. For example, deflection of one electrode tip in direction shown with arrow in figure 1 at distance exceeded 30 μm from nominal position produces not only separation of degenerate (at nominal positions of electrodes, figure 3,a schematically reflects H_Z component of field in this case) dipole modes, but marked redistribution of field of the ones(figure 3,b).

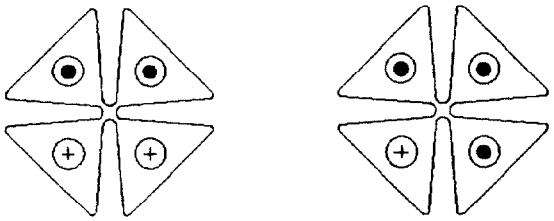

Figure 3. H_z component of dipole mode.

In figure 4 the frequency separation of dipole modes without longitudinal variations is plotted against deflection of center of radius of curvature of one electrode tip from nominal position in direction shown with arrow in figure 1.

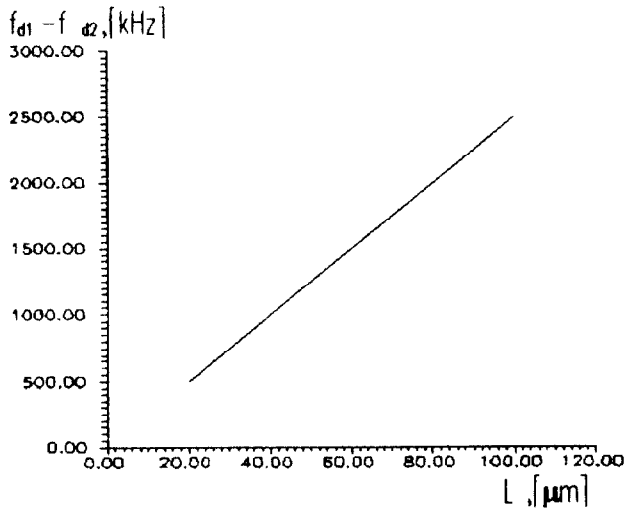

Figure 4. Frequency separation of dipole modes.

The grooves for indium gaskets are made at the junction of segments at RF-carent-conducting surfaces. The gaskets make assembly of segments more difficult and decrease accuracy of one from 20-30 μm to 50-60 μm. By now assembly with gaskets is developed.

3. REFERENCES

[1] A.A. Budtov at al., Linear Ion RF Accelerators for Analysis of Materials, Proc. of the XIII Conference on Accelerators of Charge Particles, JINR, Dubna, 13-15 October, 1992.

[2] A.A. Budtov at al., Accelerating Structure with Spatially Homogeneous Quadrupole Focusing, Proc. of the Seventh Conference on Applied Accelerators, NIIEFA, St. Petersburg, 16-18 June, 1992.