PROPERTIES OF THE DISK-AND-WASHER CAVITY

S. Inagaki, T. Higo, K. Takata and H. Nakanishi

National Laboratory for High Energy Physics
Oho-machi, Tsukuba-gun, Ibaraki-ken, 305, Japan

The disk and washer (DAW) structure would possibly be superior to any other structures like the alternating periodic structure or the side coupled structure in the effective shunt impedance and the coupling constant in the high beta region. However, the field distribution of this cavity is so violated by the washer support that the expected value of the shunt impedance or quality value can hardly be obtained. Our model cavity experiments at 500 MHz showed that an effective shunt impedance of 40.0 Mohm/m or 35.8 Mohm/m is obtained by a single radial stem or two longitudinal stem scheme, while the calculated value by SUPERFISH is 44.8 Mohm/m. We expect an overall impedance to be higher than 35 Mohm/m for a 12-cell cavity for the TRISTAN accumulator ring[1]. This geometry is referred as Type A afterwards.

Further it is revealed that in the Type A cavity, the TM_{11} passband crosses the accelerating mode[1,2,3]. The Brillouin diagram of the above cavity is shown in Fig. 3(a). $TM_{01\pi}$ resonance is crossed by TE_{31} and TM_{11} dispersion curves, each of which splits into two modes with the transverse field either parallel or perpendicular to the stem. In our 12-cell cavity, the model cavity measurement shows that the nearest TM_{11} mode will exist 3.7 MHz higher than the accelerating mode. LANL[4] managed to make a stopband at the operating frequency by the biperiodic four-T stem structure. We propose as an alternative way the geometry Type B which has a considerably small disk diameter. It has a calculated effective shunt impedance of 34.6 Mohm/m, which is still higher than any other structures. The electric field of the accelerating mode, coupling mode, zero mode and 2π mode are shown in Fig. 2. The bandwidth of TM_{01} mode is as wide as Type A. The coupling cavity is so much isolated from the accelerating cavity that it rather looks like the annular coupled structure. The electric field is concentrated between the washer rim and the disk. Therefore, the effect of the radial stem is expected to be small and the bandwidth of parasitic modes to be narrow compared to Type A.

Figure 3(b) shows the dispersion of Type B cavity. Both TM_{11} and TE_{31} passband are moved above the accelerating mode. The modes with small cell-to-cell phase shift are moved upward because these frequencies are mainly determined by the disk radius. Those with large phase shift remain almost unaffected. The bandwidth of TE_{11}, TE_{21}, TM_{11} and TE_{31} modes becomes narrower than those of Type A as expected.

The study of the third cavity with the intermediate dimension (Type C) is in progress.

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References

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Table I Three Types of the DAW Cavity

Type	A	B	C
Rc(cm)	45.45	33.36	40.0
Rd(cm)	40.25	25.0	33.0
Td(cm)	7.2	10.0	9.25
G(cm)	10.25	10.51	10.85
Rw(cm)	24.45	25.0	25.0
Tw(cm)	0.95	1.0	1.0
Tr(cm)	0.95	2.5	1.0
Rh(cm)	5.0	5.0	5.0
L(cm)	15.0	15.0	15.0
T	0.765	0.759	0.754
Z(Mohm/m)	76.49	60.07	72.55
ZT^2(Mohm/m)	44.76	34.59	41.19

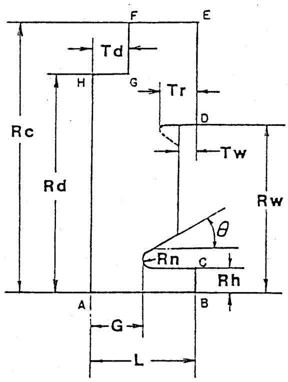

Fig. 1 Geometrical Notation of a Half-cell DAW Cavity.

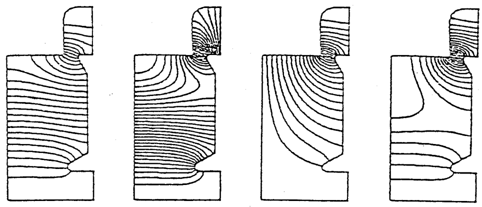

Fig. 2 Electric Field of Type B Cavity. 0-mode, π-accelerating Mode, π-Coupling Mode and 2π-mode (L-R).

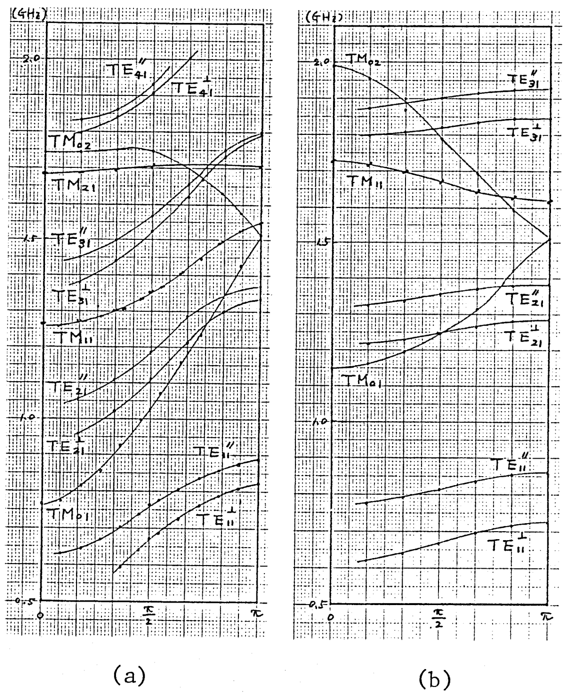

Fig. 3 Dispersion Curves of (a) Type A and (b) Type B Cavity.