CERN/EF/RF 80-1
3 March 1980

SOME COMPUTATIONAL RESULTS ON SPHERICAL ACCELERATING CAVITIES

E. Chiaveri, E. Haebel and H. Heinrichs(*)

In selecting the aperture diameter of superconduting TM_{011} mode cavities for multicell π mode structures a compromise between insensitivity of the field flatness against perturbations, low ratio of peak to accelerating field and high shunt impedance has to be found.

Whereas the first point requires a high dispersion step i.e. a big opening (only the aperture is used to couple the cells), the two others ask for a small one.

We have therefore used the LALA program to calculate for spherical cavities the above mentioned quantities in characterizing the dispersion step by

$$k = 2 \times (f_\pi - f_0)/(f_\pi + f_0)$$

f_π = π mode frequency

f_0 = 0 mode frequency.

These frequencies were found with half cell calculation in closing the aperture either by an ideal magnetic conductor ($H_t = 0$), which enforces the π mode field distribution, or by an ideal electric conductor ($E_t = 0$) to produce the 0 mode.

In table 1, 2 and 3 a summary of results for different thickness of disks is given.

(*) Visitor from the University Wuppertal, Wuppertal, Germany.

EC/mk

TABLE 1

LALA results for spherical cavities with round disk edge, disk thickness Th = 2.5 cm

2a(cm)	2b(cm)	f_π (MHz)	$\frac{\Delta f}{f}$(%)	Q	R/Q $\left(\frac{\Omega}{m}\right)$	R $\left(\frac{M\Omega}{m}\right)$	E_p/E_{acc}	H_p/E_{acc} (Oe/MV/m)	G(Ω)
10	51.56	499.88	.38	49,900	576	28.76	2.43	31.64	288.3
12	51.80	500.16	.75	49,810	527	26.25	2.62	33.08	287.9
14	52.20	499.61	1.27	50,150	496	24.90	2.80	34.06	289.7
16	52.60	500.13	2.0	50,550	443	22.41	3.15	36.08	292.2
18	53.16	499.85	2.88	50,810	417	21.2	3.22	37.10	293.6
20	53.80	499.82	4.0	51,630	367	18.93	3.58	39.60	298.3

TABLE 2

LALA results for spherical cavities with round disk edge, disk thickness Th = 5 cm

2a(cm)	2b(cm)	f_π (MHz)	$\frac{\Delta f}{f}$ (%)	Q	R/Q $\left(\frac{\Omega}{m}\right)$	R $\left(\frac{M\Omega}{m}\right)$	E_p/E_{acc}	H_p/E_{acc} (Oe/MV/m)	G(Ω)
12	51.6	499.93	0.408	47,550	542	25.77	2.18	33.68	274.8
14	51.95	499.90	0.77	47,870	506	24.27	2.22	34.82	276.6
16	52.4	499.98	1.3	48,290	456	22.03	2.35	36.65	279.1
18	52.92	499.97	2.0	48,550	423	20.56	2.39	37.96	280.6
20	53.56	500.04	2.92	48,900	378	18.48	2.51	40.11	282.6

TABLE 3

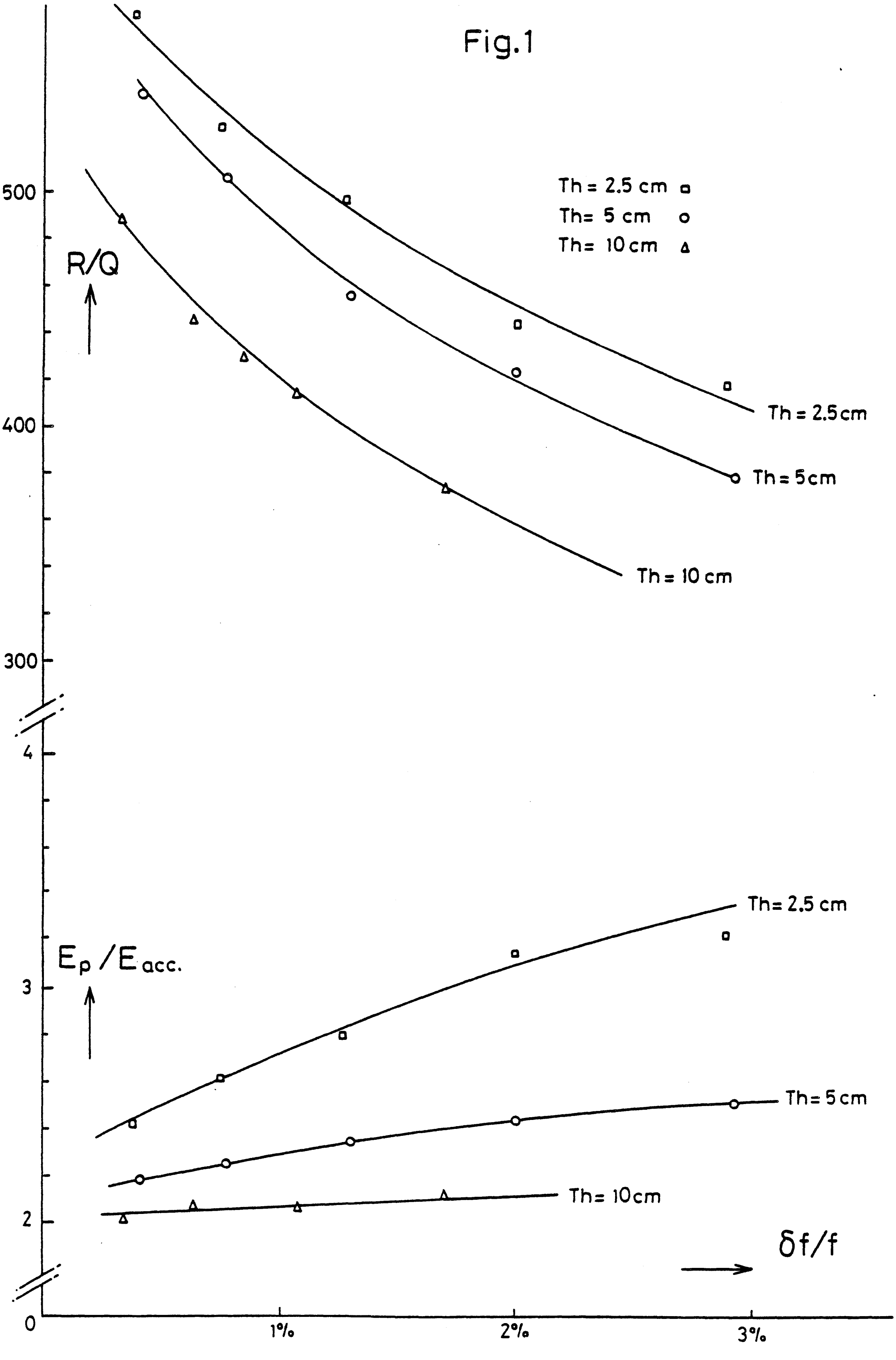
LALA results for spherical cavities with round disk edge, disk thickness Th = 10 cm

2a(cm)	2b(cm)	f_π(MHz)	$\frac{\Delta f}{f}$ (%)	Q	R/Q $\left(\frac{\Omega}{m}\right)$	R $\left(\frac{M\Omega}{m}\right)$	E_p/E_{acc}	H_p/E_{acc} (Oe/MV/m)	G(Ω)
14	51.9	499.82	0.33	41,940	488	20.48	2.02	39.95	242.3
16	52.4	499.99	0.62	42,776	446	19.1	2.06	41.40	247.2
17	52.7	499.85	0.83	42,220	430	18.16	2.06	41.98	244.
18	53.0	499.9	1.07	43,060	414	17.85	2.06	42.54	248.8
20	53.68	499.8	1.70	43,306	373	16.17	2.11	44.34	250.2

FIGURE CAPTIONS

Fig. 1 Shunt impedance Z and field enhancement factor E_p/E_{acc} as function of the relative dispersion step height $k = \delta f/f$.

Fig. 2 One quadrant of TM_{011} cavity.



Th = 2.5 cm
Th= 5 cm
Th= 10 cm
R/Q
500
400
300
Th = 2.5cm
Th = 5cm
Th = 10 cm
4
3
2
0
Ep / Eacc.
Th= 2.5 cm
Th= 5 cm
Th= 10cm
δf/f
1%
2%
3%

Fig.1

Fig. 2