

HOMs extraction structure design for HEPS 166.6MHz cavities



X. Hao, Z. Li, F. Meng, P. Zhang, X. Zhang

Institute of High Energy Physics (IHEP), Chinese Academy of Sciences (CAS), Beijing, China



Abstract

Higher order modes (HOMs) may affect beam stability and refrigeration requirements of superconducting cavity such as the 166.6MHz superconducting(SC) cavity, which is studied at IHEP.

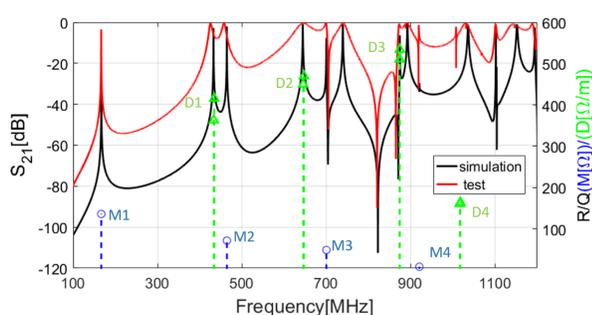
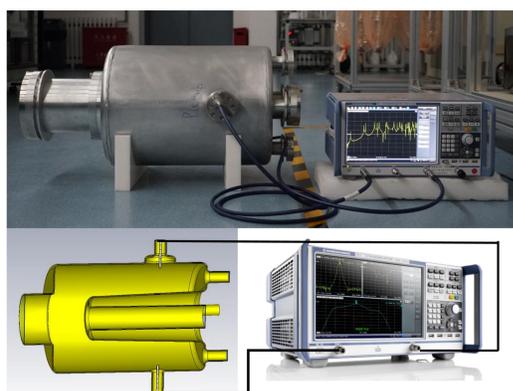
Under certain conditions beam-induced HOMs can accumulate sufficient energy to destabilize the beam or quench the SC cavities. In order to limit these effects, we consider the use of coaxial HOM couplers on the cut-off tubes of the SC cavity.

However, HOMs cannot be effectively extracted by HOM couplers. Therefore, it is necessary to design a HOMs extraction structure to introduce the dangerous modes from the cavity into the bundle tube, which are designed to couple to potentially dangerous modes while sufficiently rejecting the fundamental mode.

The HOMs extraction structure consists of an enlarged tube, a coaxial structure, and the petal. The extraction of the dangerous modes and the suppression of the fundamental mode are realized by the petal structure and the coaxial structure.

In order to verify the designs, a rapid prototype for the favored structure was fabricated and characterized on a low-power test-stand.

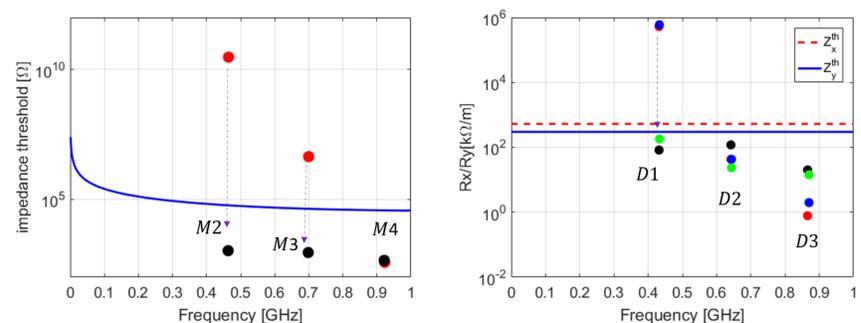
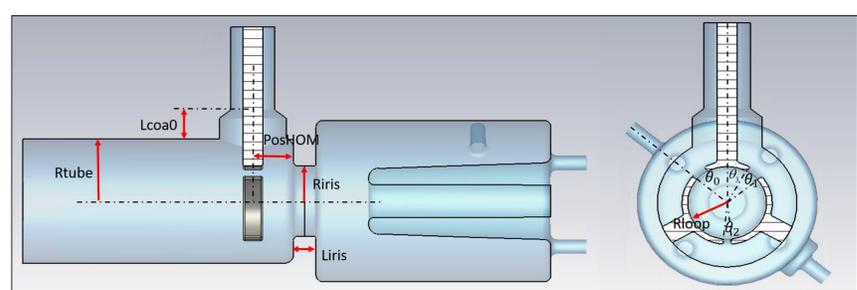
1. The HOMs and their DAMPING REQUIREMENTS



Mode	Freq. [MHz]	R/Q [Ω]	$Z_{ }^{th}$ [Ω]	Q_{ext}^{th}
M1	166.6	136		$1.0E+09$
M2	464.5	71.8	$8.5E+04$	$1.3E+03$
M3	700.3	49.1	$5.6E+04$	$1.5E+03$
M4	920.8	8.4	$4.3E+04$	$1.1E+04$

Mode	Freq. [MHz]	R/Q [Ω/m]	$Z_{x,y}^{th}$ [Ω/m]	Q_{ext}^{th}
D1x	433.3	363	$5.3E+05$	$2.9E+03$
D1y	434.4	416	$3.0E+05$	$1.4E+03$
D2x	645.3	450	$5.3E+05$	$2.4E+03$
D2y	647.1	470	$3.0E+05$	$1.3E+03$
D3x	873.9	511	$5.3E+05$	$2.1E+03$
D3y	874.4	534	$3.0E+05$	$1.1E+03$

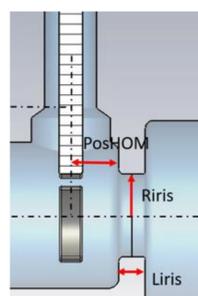
2. (simulation) HOMs extraction structure



Mode	Freq. [MHz]	R/Q [Ω]	Q_{ext}
M1	166.8	136	$2.6E+05$
M2	463.5	88	1052
M3	698.6	33.5	892
M4	921.7	4.5	446

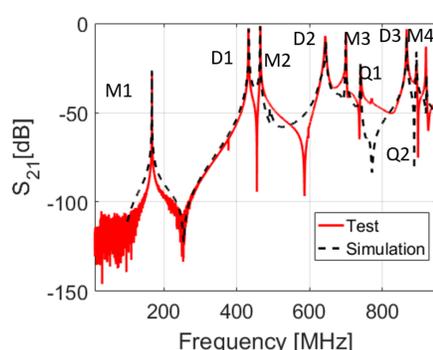
Mode	Freq. [MHz]	R/Q [Ω/m]	Q_{ext}
D1.1	431.9	210	786
D1.2	432.9	449	806
D2.1	642.3	525	456
D2.2	647.3	307	153
D3.1	867.3	142	284
D3.2	869.9	124	232

3. (Test) HOMs extraction structure



• posHOM: 90 → 100mm

• Liris: 15 → 30mm



Mode	freq. [MHz]	Q_{ext}		Q_{load}	
		Sim.	Test	Sim.	Test
M1	166.7	$8.73E+05$	$7.38E+05$	$1.21E+04$	$1.04E+04$
M2	464.0	$3.70E+03$	$5.31E+03$	$3.17E+03$	$4.14E+03$
M3	698.6	$1.00E+04$	$3.10E+04$	$2.26E+03$	$3.49E+03$
M4	920.7	$4.81E+03$	$1.10E+04$	$1.14E+03$	$2.64E+03$
D1	433.1	$1.20E+03$	$4.11E+03$	$1.14E+03$	$3.46E+03$
D2	644.3	$2.63E+03$	$7.57E+03$	$4.63E+02$	$5.00E+02$
D3	866.1	$1.95E+03$	$2.66E+03$	$1.13E+03$	$1.89E+03$