For starters

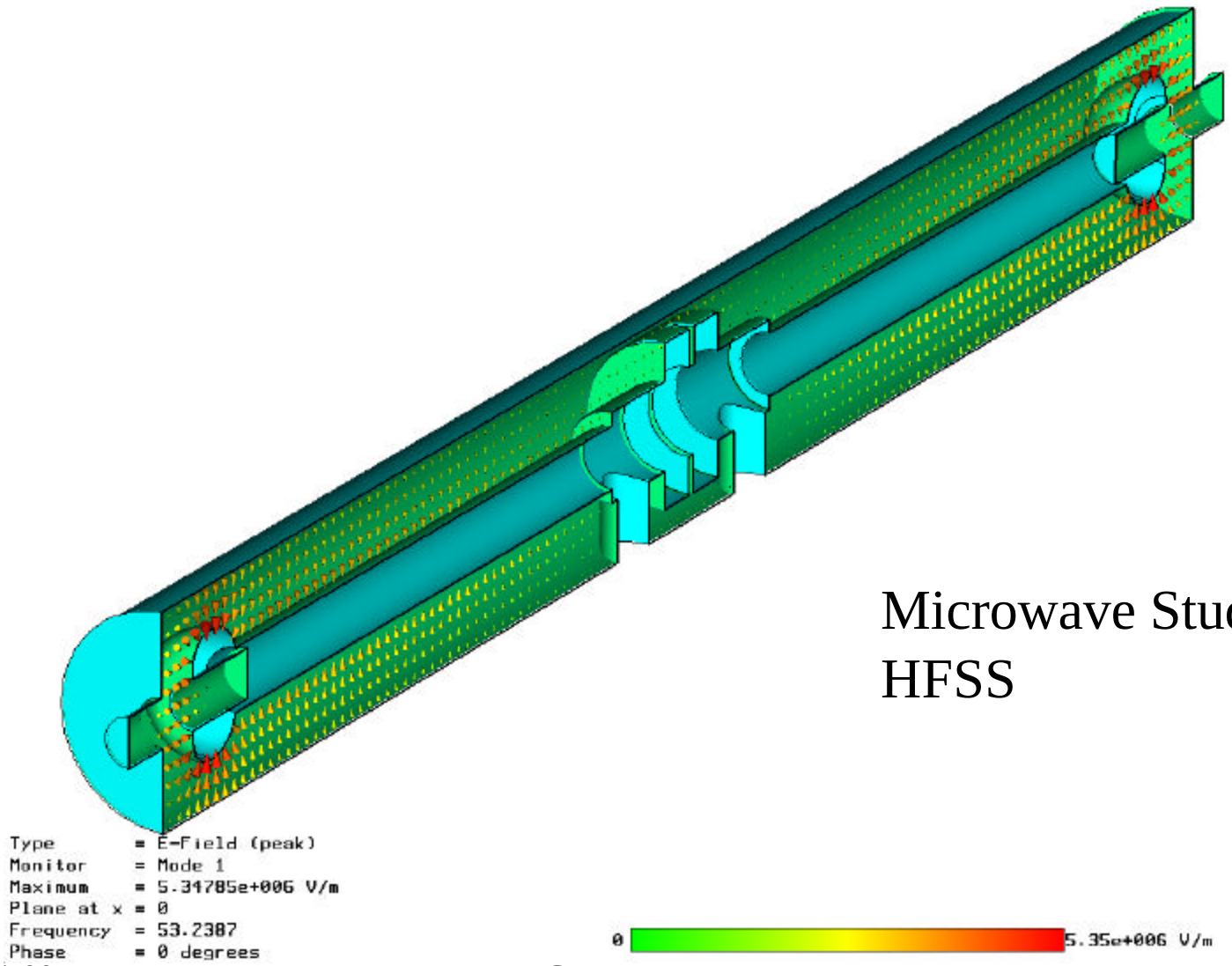
Low frequency RF noise
Modes in cavity
Beam harmonics, mode excitation
Transient beam loading

After some discussions (J.Steimel, D.Finley)

Mechanical resonances
Amplitude and phase modulation induced by beam
Modes of cavity+transmission line system
Measurements of test resonator

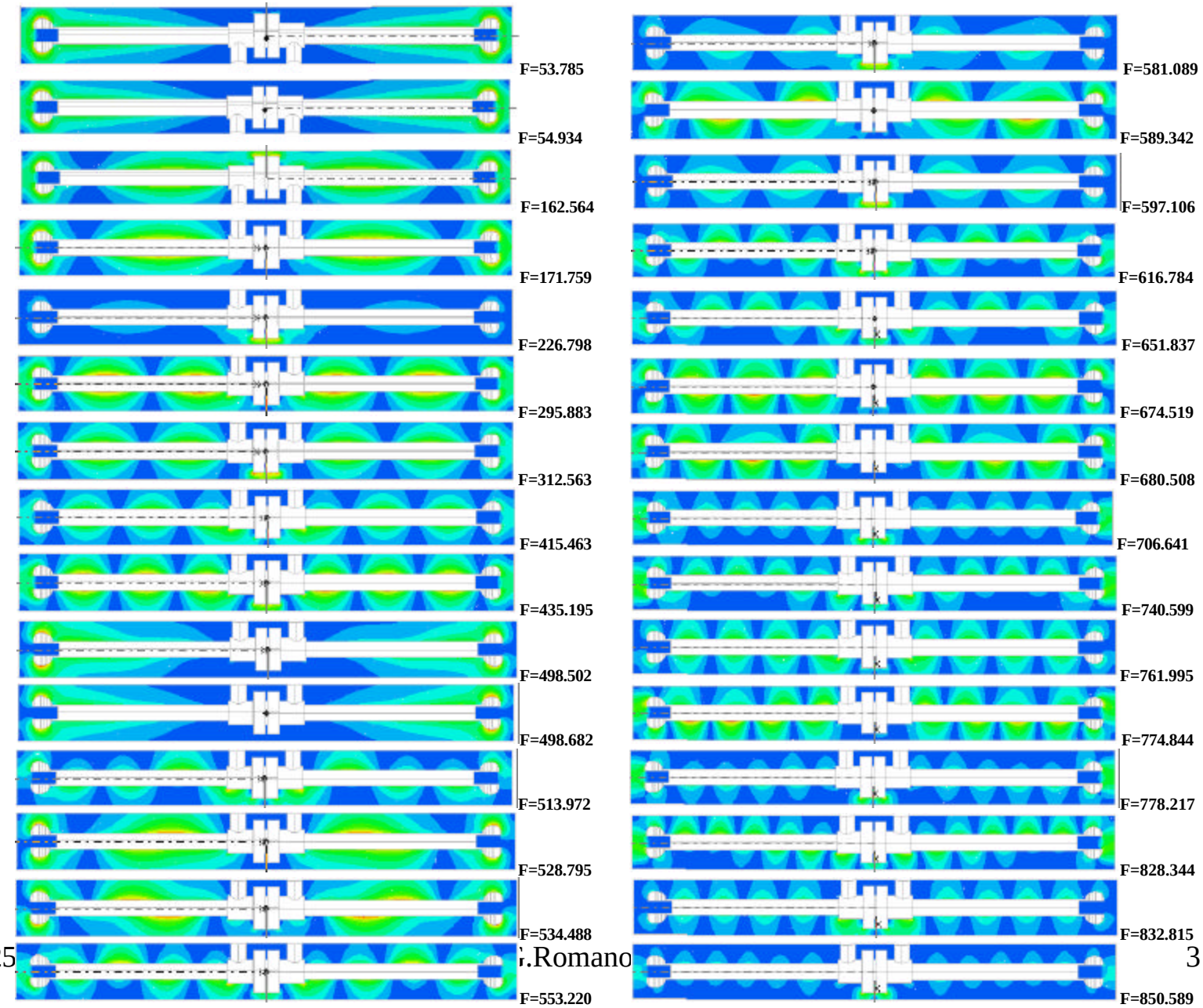
Timergali Khabiboulin, Ivan Gonin

Modes in Tevatron cavity



Microwave Studio
HFSS

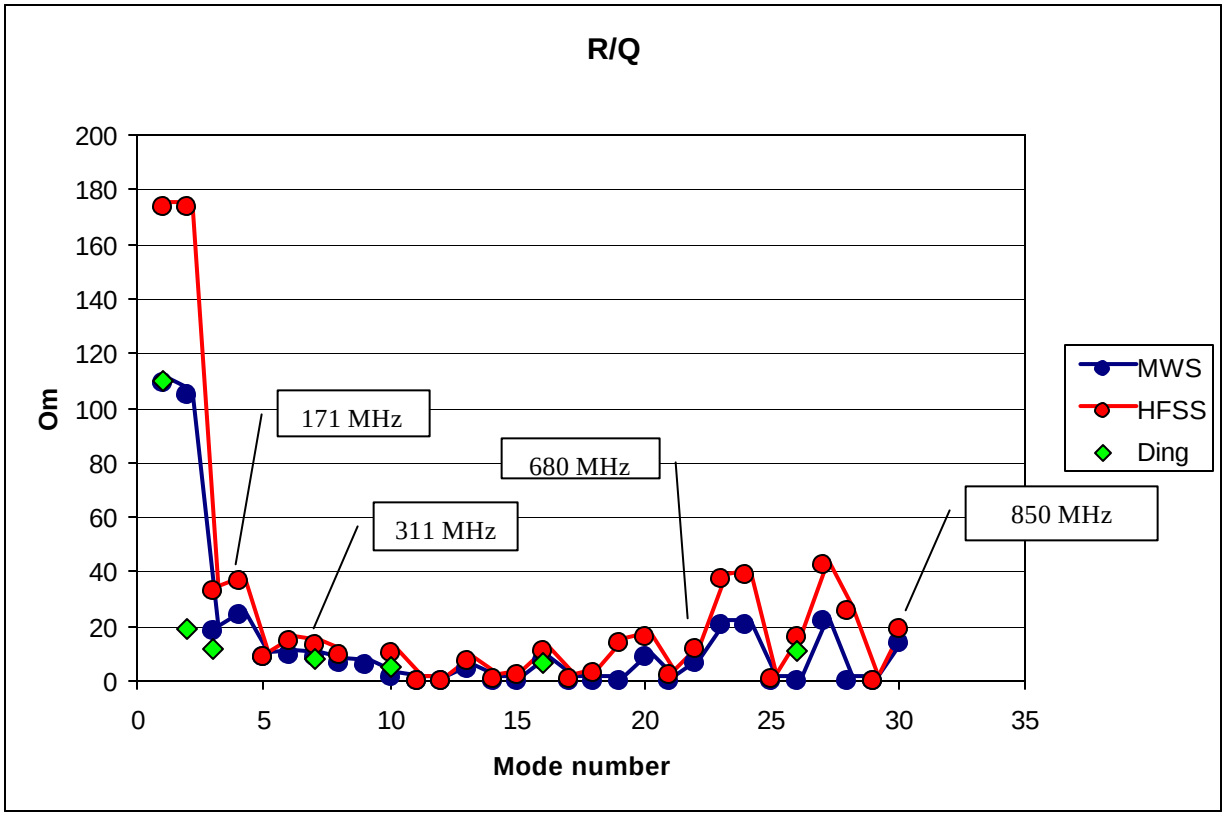
Modes in Tevatron cavity



Modes in Tevatron cavity

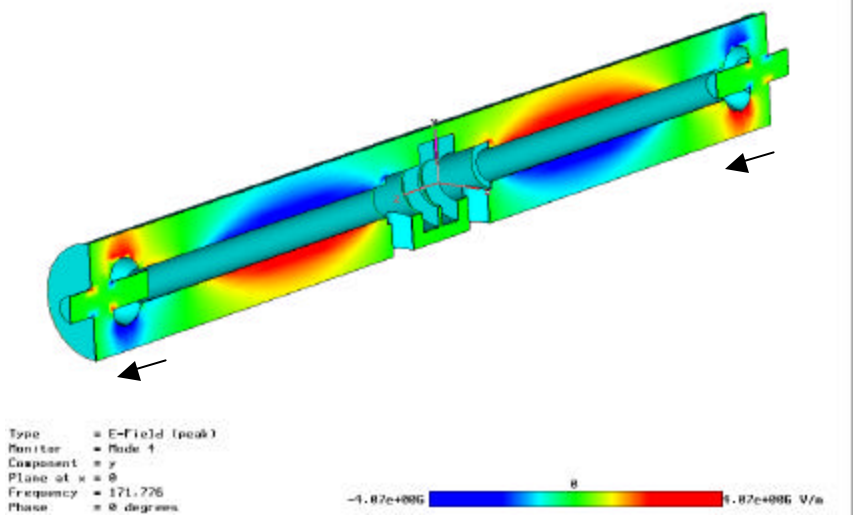
Tun	Ding		Calcs. Microwave Studio			Calcs. HFSS				
Freq	Freq	R/Q	Mode	Freq.	R/Q(app)	Freq.	R/Q			
53.104	53.114	109.6	1	53.21758	108.8	53.785	173.55			Dipole
54.512	56.51	18.81	2	54.86296	105	54.934	173.67			InPhase
148.765										
155	158.2325	11.68	3	154.6757	18.3	162.564	33.21		R/Q is estimated for two gaps	
170.18			4	171.7261	24.3	171.759	36.53		No transmission line	
186.782									No damping	
			5	205.0872	8.8	226.798	8.49			
242.325										
285.8										
			6	295.8508	9.4	295.883	14.92			
311.199	310.7	7.97	7	308.6703	8.9	312.563	13.11			
			8	415.3444	6.3	415.463	9.7			
421	424.25	1.28	9	429.8875	5.9					
437	439.77	5.23	10	459.3185	1.2	435.195	10.57			
			11	497.5451	0	498.502	0.12			
499	498.5	0	12	497.7791	0	498.682	0.027			
			13	513.3652	4.6	513.972	7.22			
			14	529.0405	0	528.795	0.53			
			15	533.5563	0	534.488	1.86			
	559.48	6.63	16	553.6592	7.3	553.22	11.24			
	583.39	0.1	17	588.6394	0	581.089	1.08			
	592.39	0.2	18	589.5254	0	589.342	2.78	597.106	0.57	
			19	615.5711	0	616.784	13.67			
			20	651.2659	8.9	651.837	15.78			
	664.7	0.35	21	673.018	0	674.519	1.94			
			22	678.1548	6.4	680.508	11.46			
			23	704.2662	20.4	706.641	37.18			
			24	739.9336	20.8	740.599	38.64			
			25	751.56	0	761.995	0.46			
	748.18	10.9	26	758.5034	0	774.844	16.08			
	768.03	2.47	27	776.819	22	778.217	42.82			
			28	782.7464	0	828.344	25.57			
			29	800.6884	0	832.8156	0.24			
			30	827.7942	13.7	850.589	19.2			

Modes in Tevatron cavity

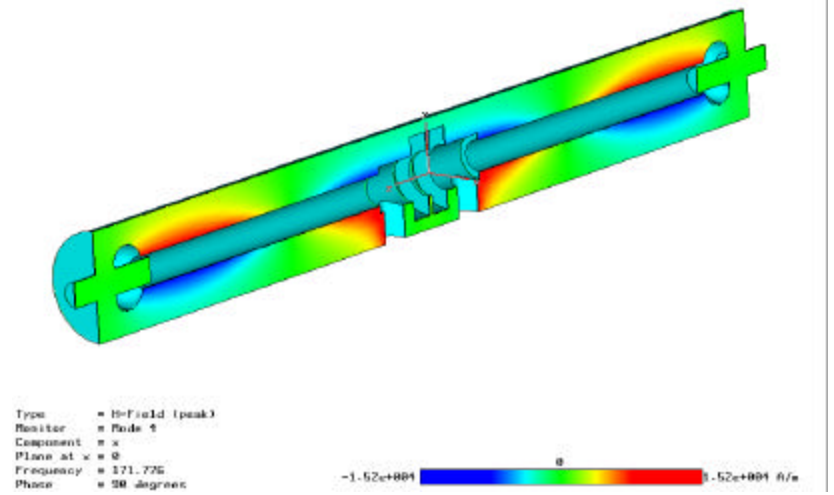


Modes in Tevatron cavity

E_y



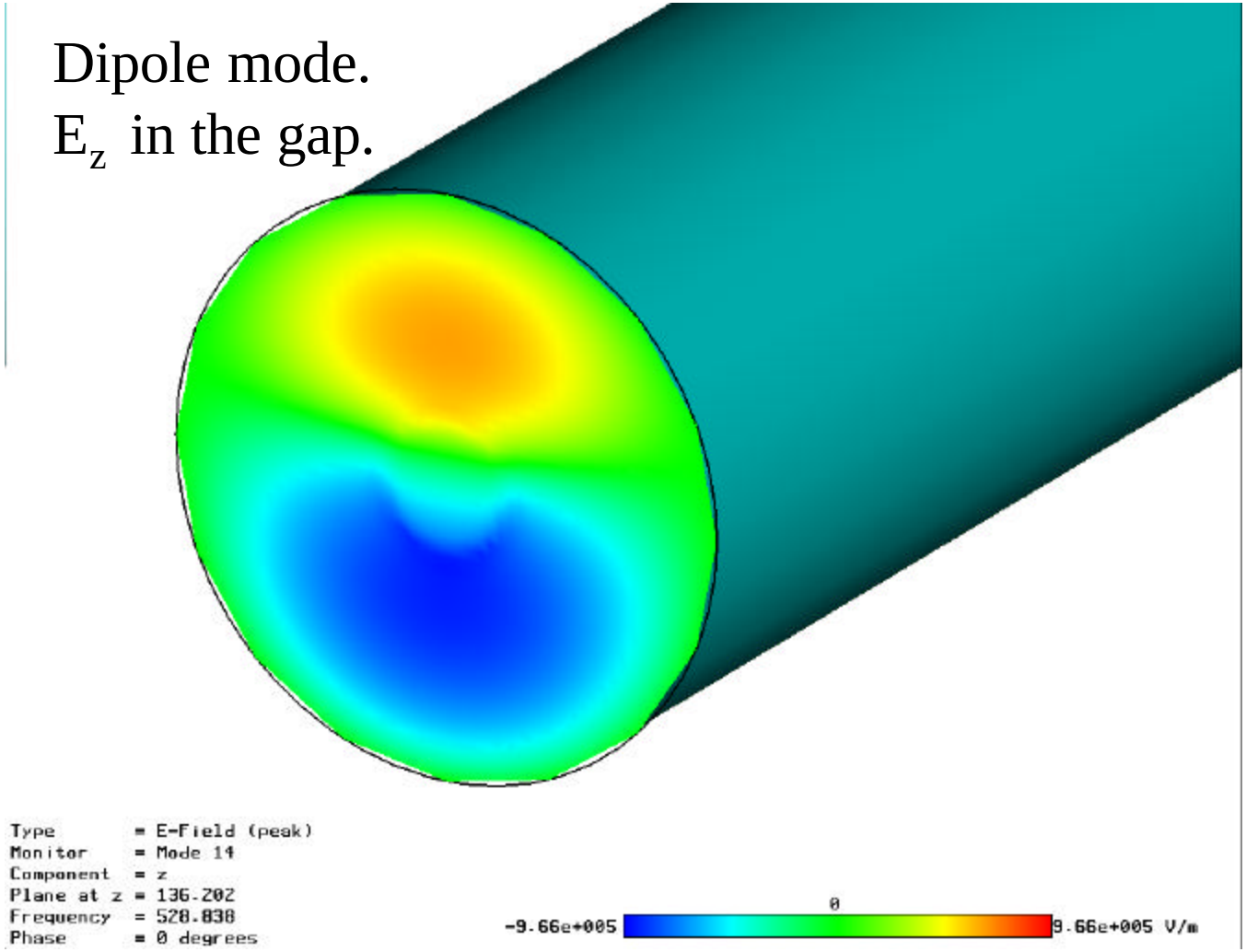
H_x



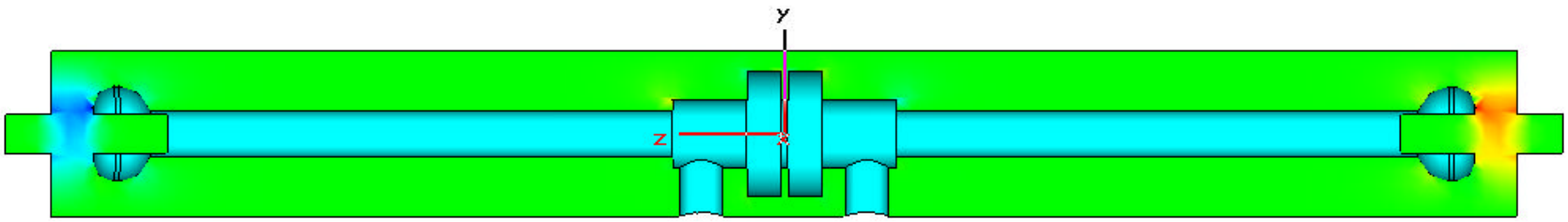
No coupling with transmission line

No coupling with antenna (?)

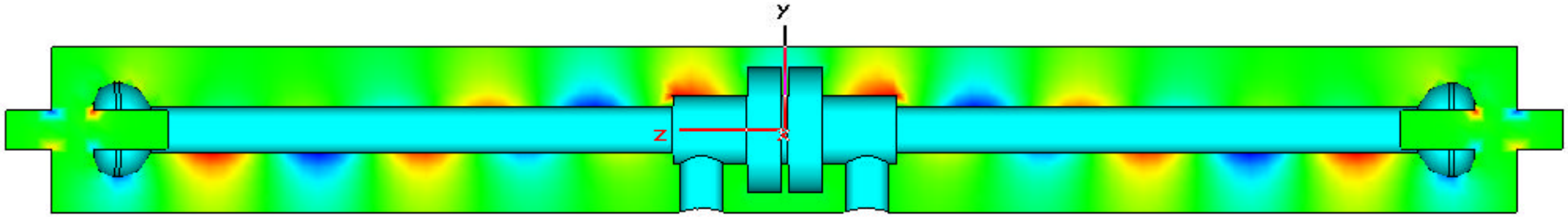
Modes in Tevatron cavity



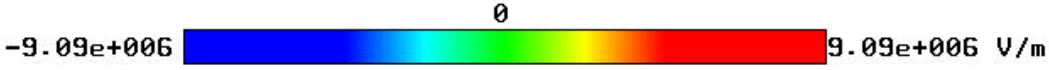
Modes in Tevatron cavity



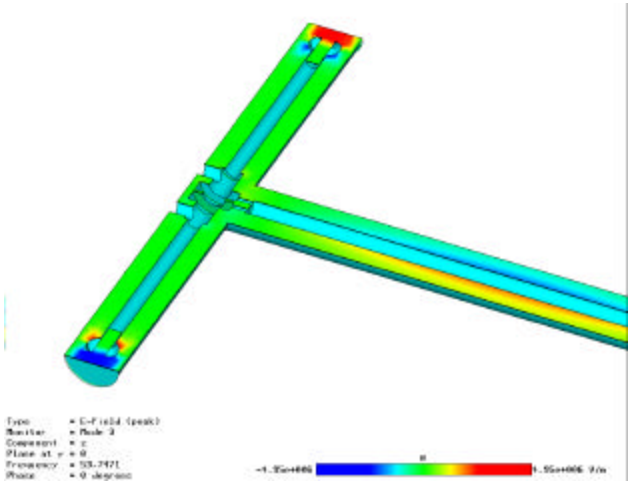
Type = E-Field (peak)
Monitor = Mode 30
Component = z
Plane at x = 0
Frequency = 828.604
Phase = 0 degrees

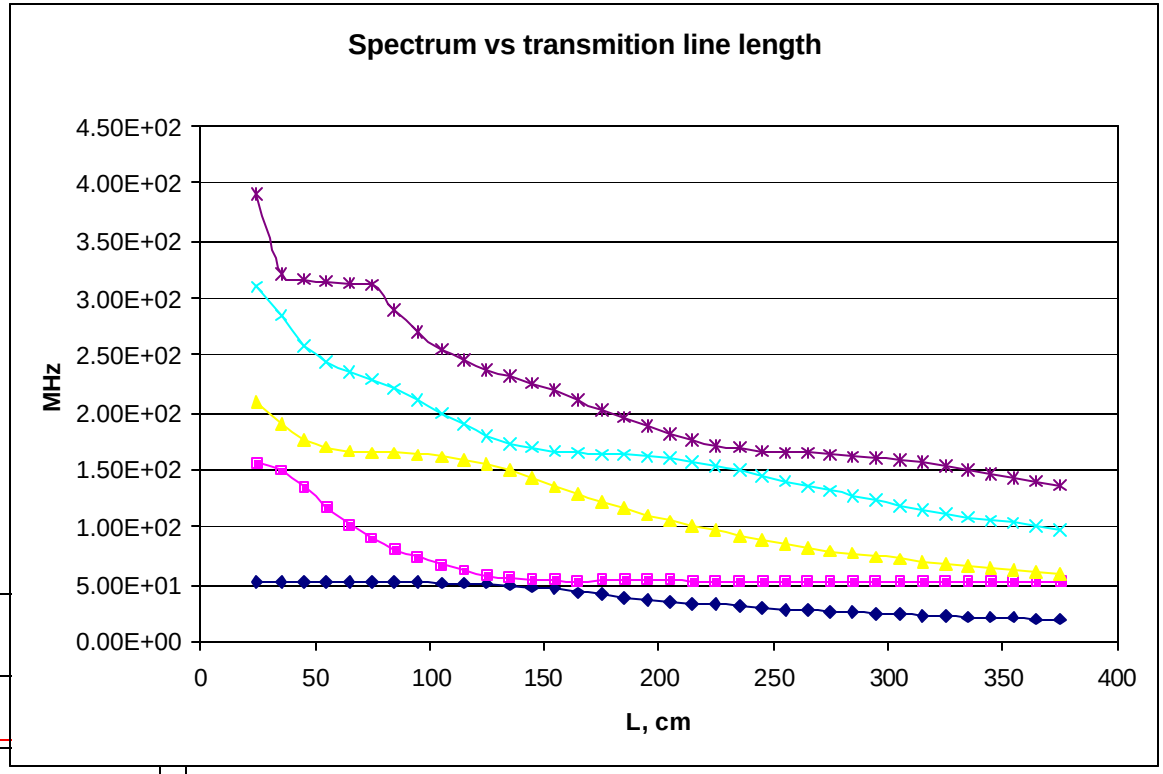


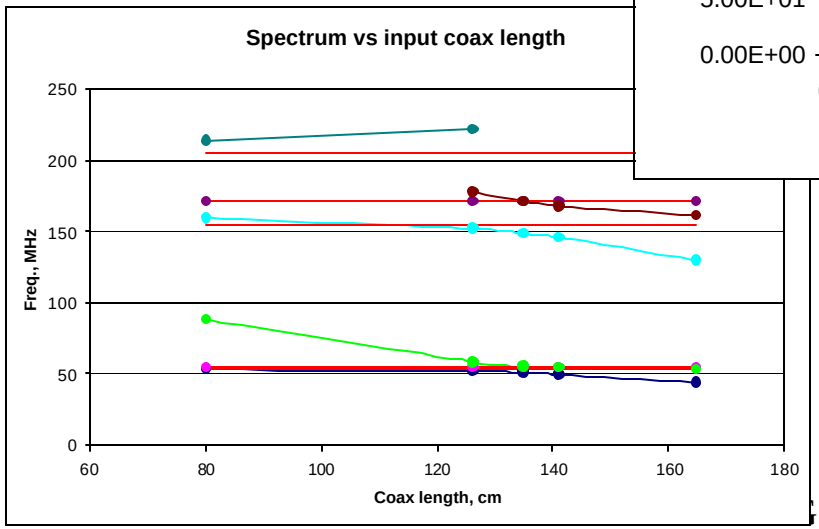
Type = E-Field (peak)
Monitor = Mode 30
Component = y
Plane at x = 0
Frequency = 828.604
Phase = 0 degrees



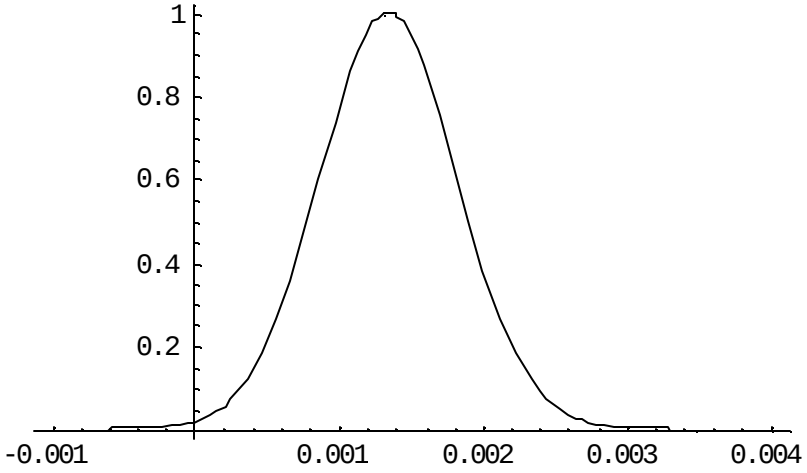
Modes in Tevatron cavity

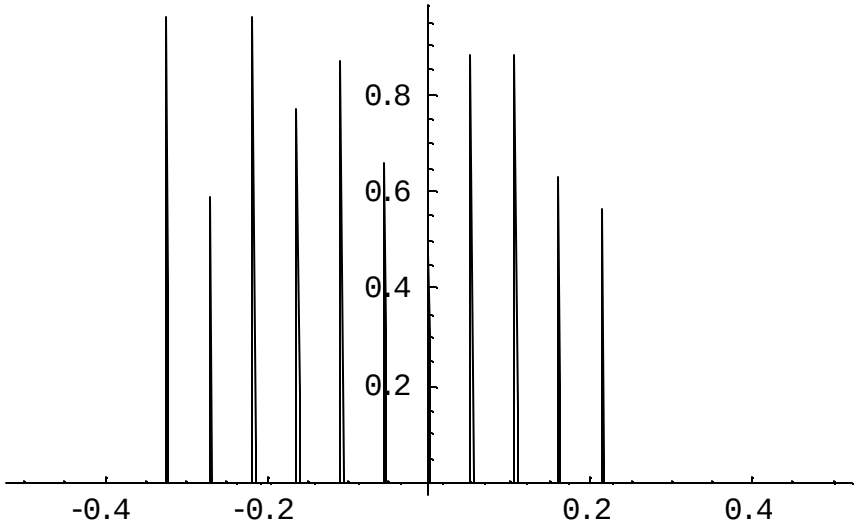




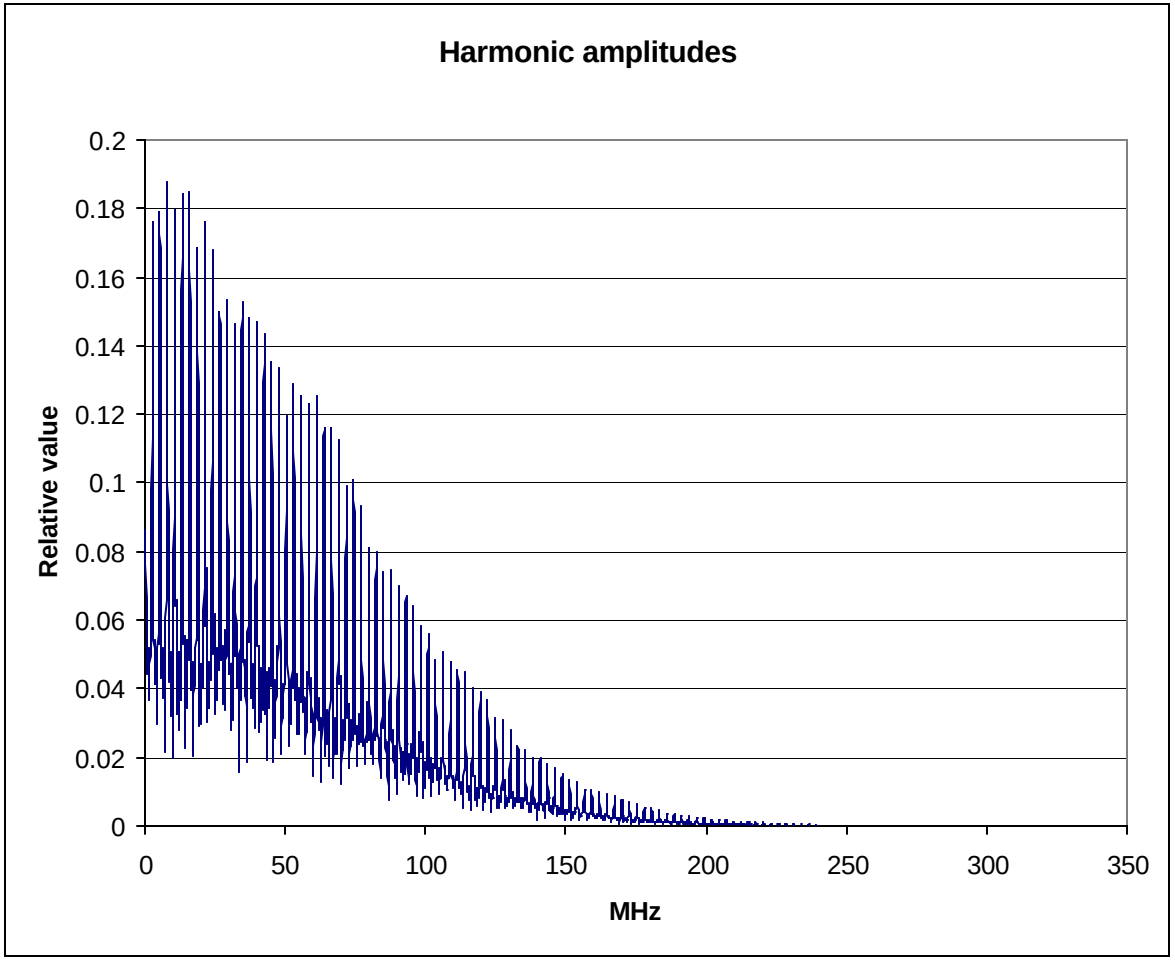


Beam harmonics

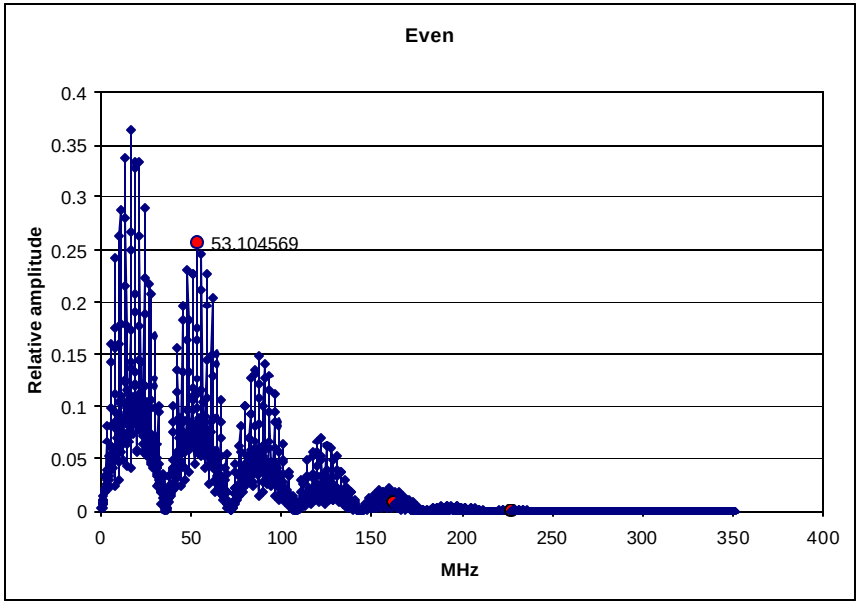


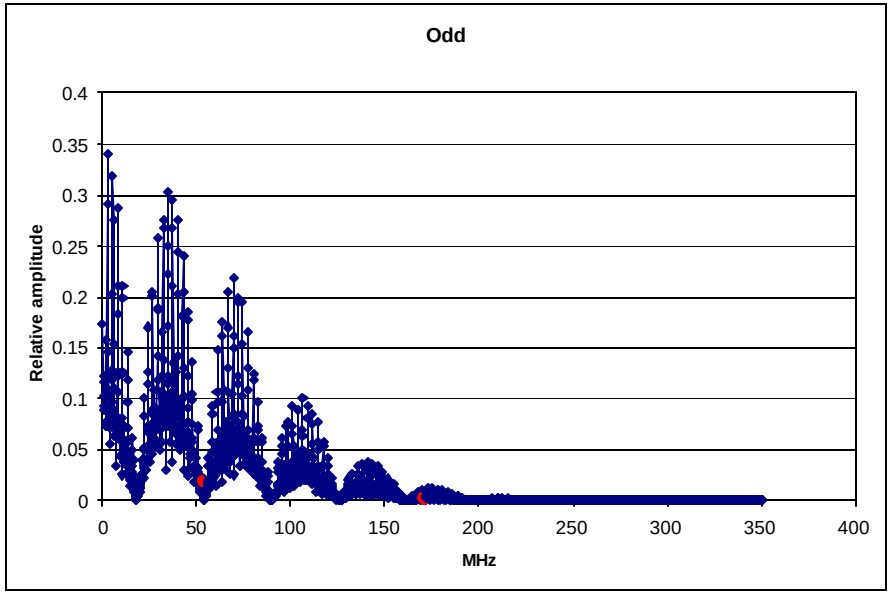


Beam harmonics



Beam harmonics

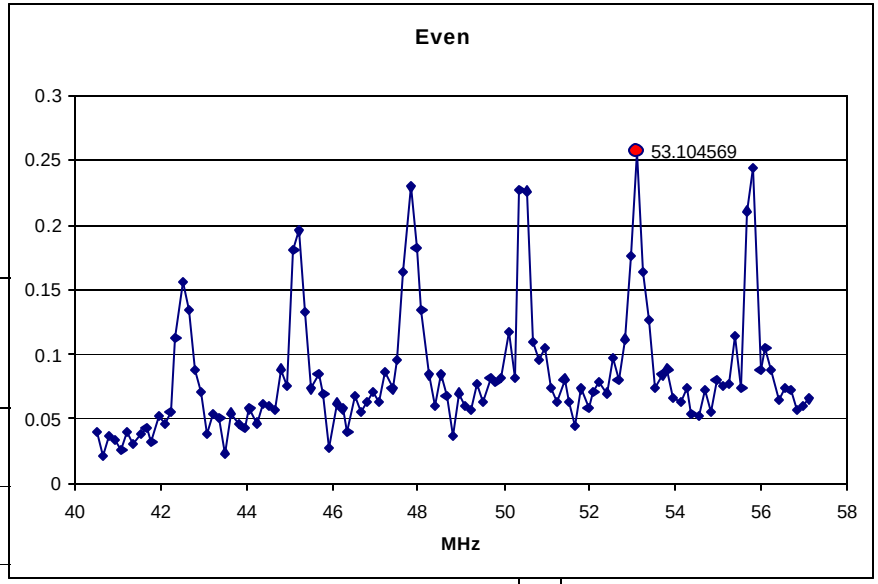


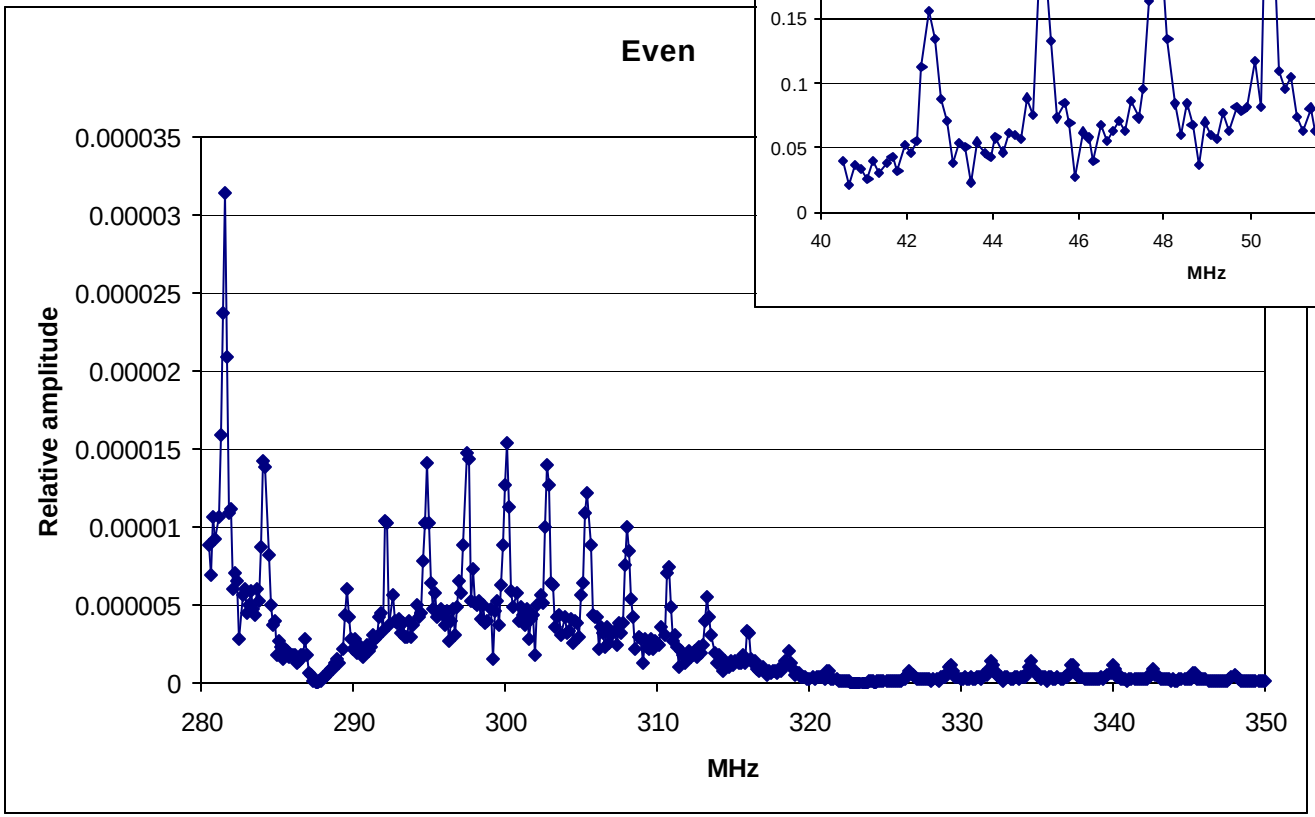


Beam harmonics

cavity	MHz
1	311.09
2	311.139
3	310.852
4	310.802
5	310.663
6	310.997
7	310.945
8	311.282

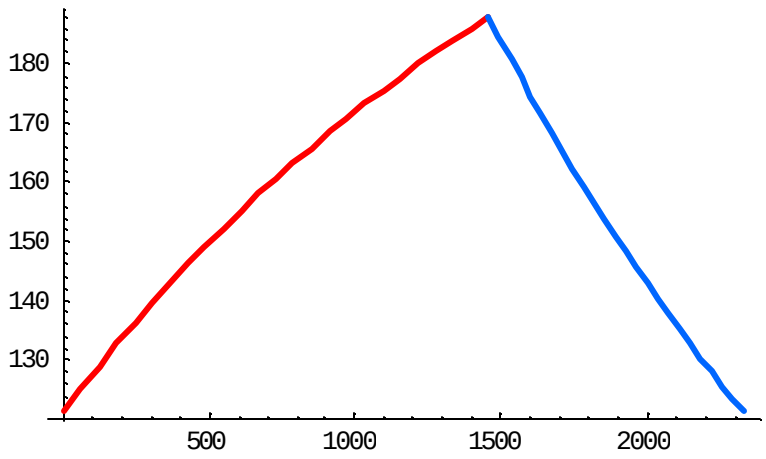
Measurements





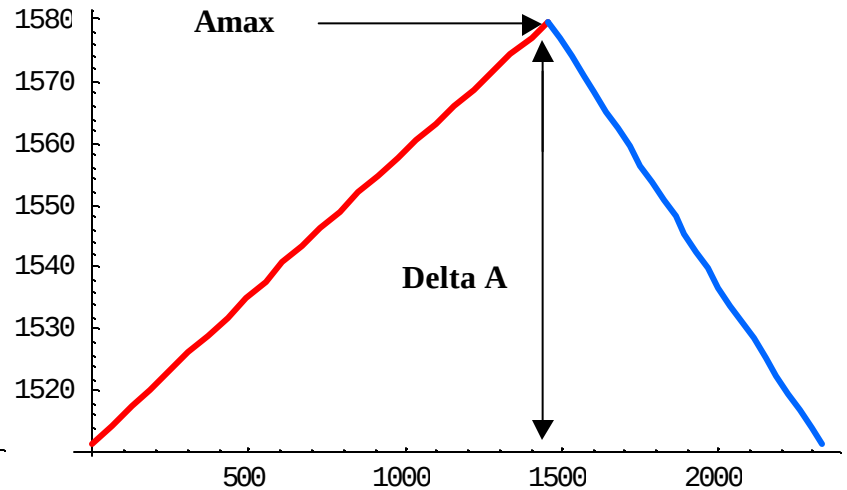
Transient beam loading

143.139 kHz



Number of RF periods

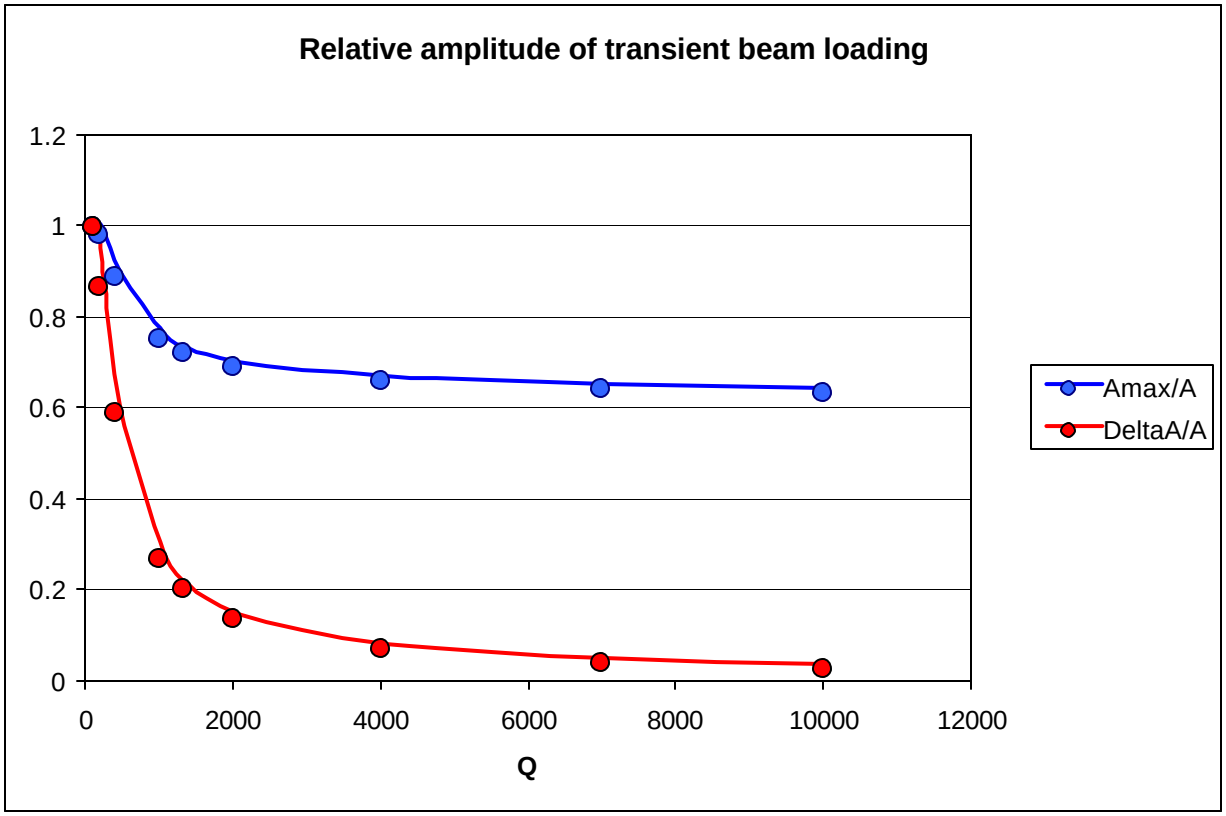
Q = 1,000



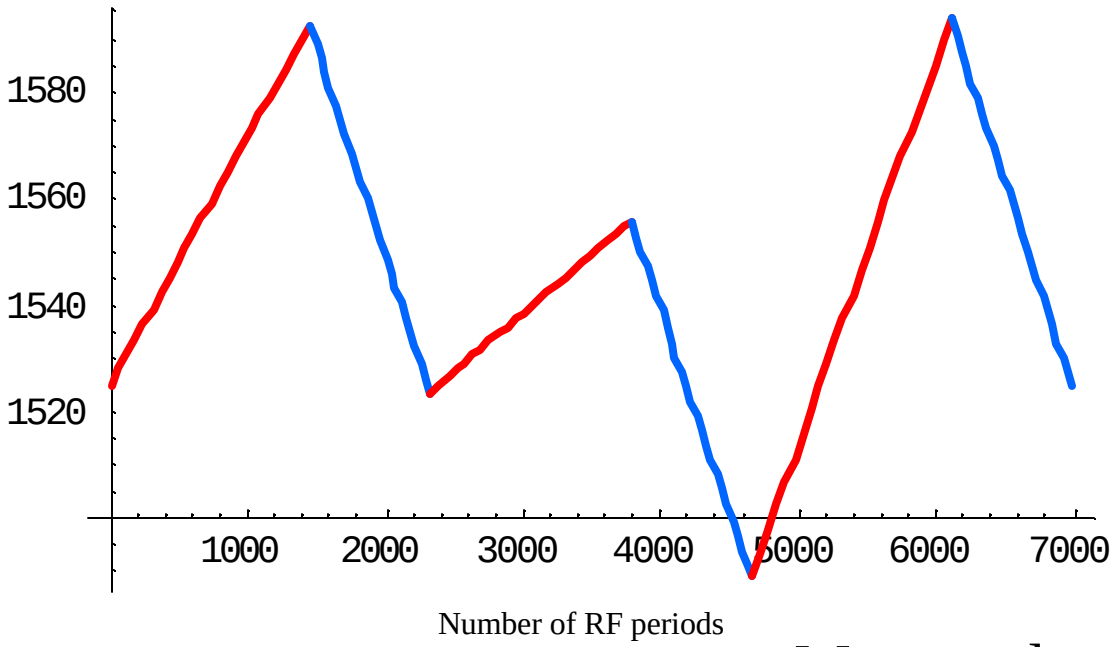
Number of RF periods

Q = 10,000

Transient beam loading



Transient beam loading
(three trains of different intensity)



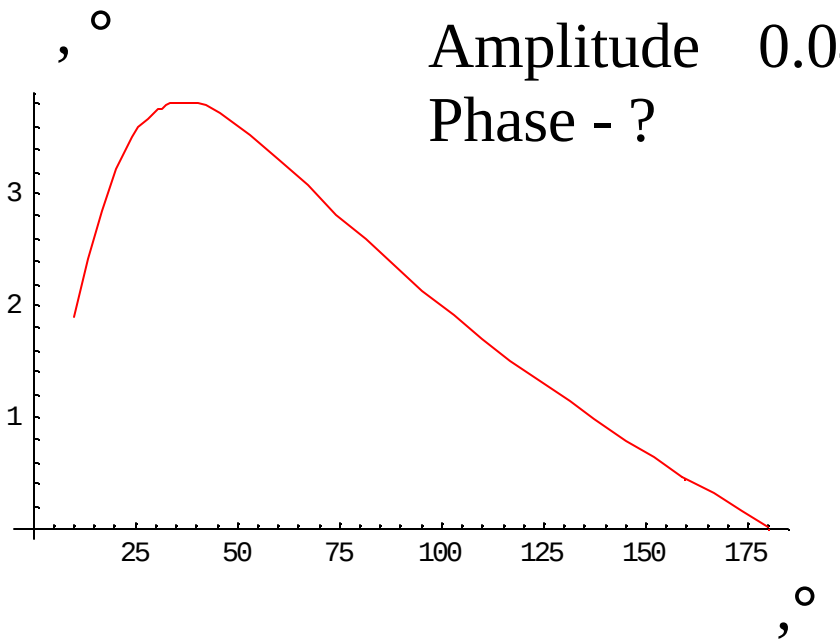
47.7 kHz
95.4 kHz
143.139 kHz

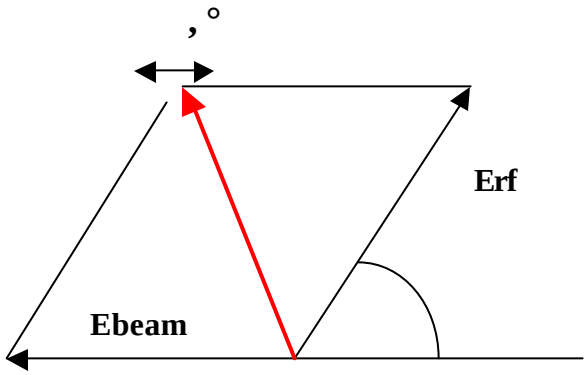
Q = 10,000; A1 = 0.2; A2 = 0.25; A3 = 0.3

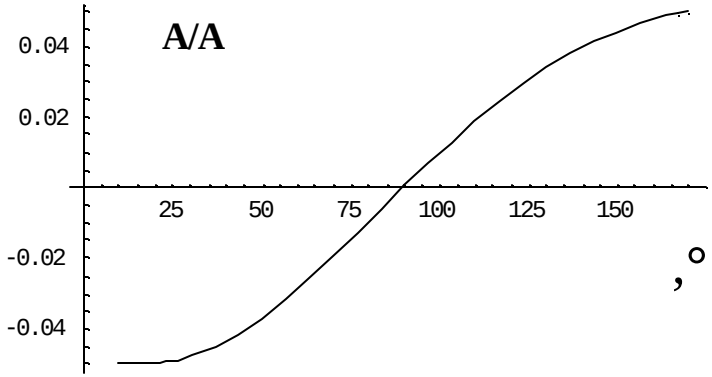
Measured modulation:
Amplitude 0.04%
Phase - ?

Transient beam loading

Measured modulation:
Amplitude 0.04%
Phase - ?



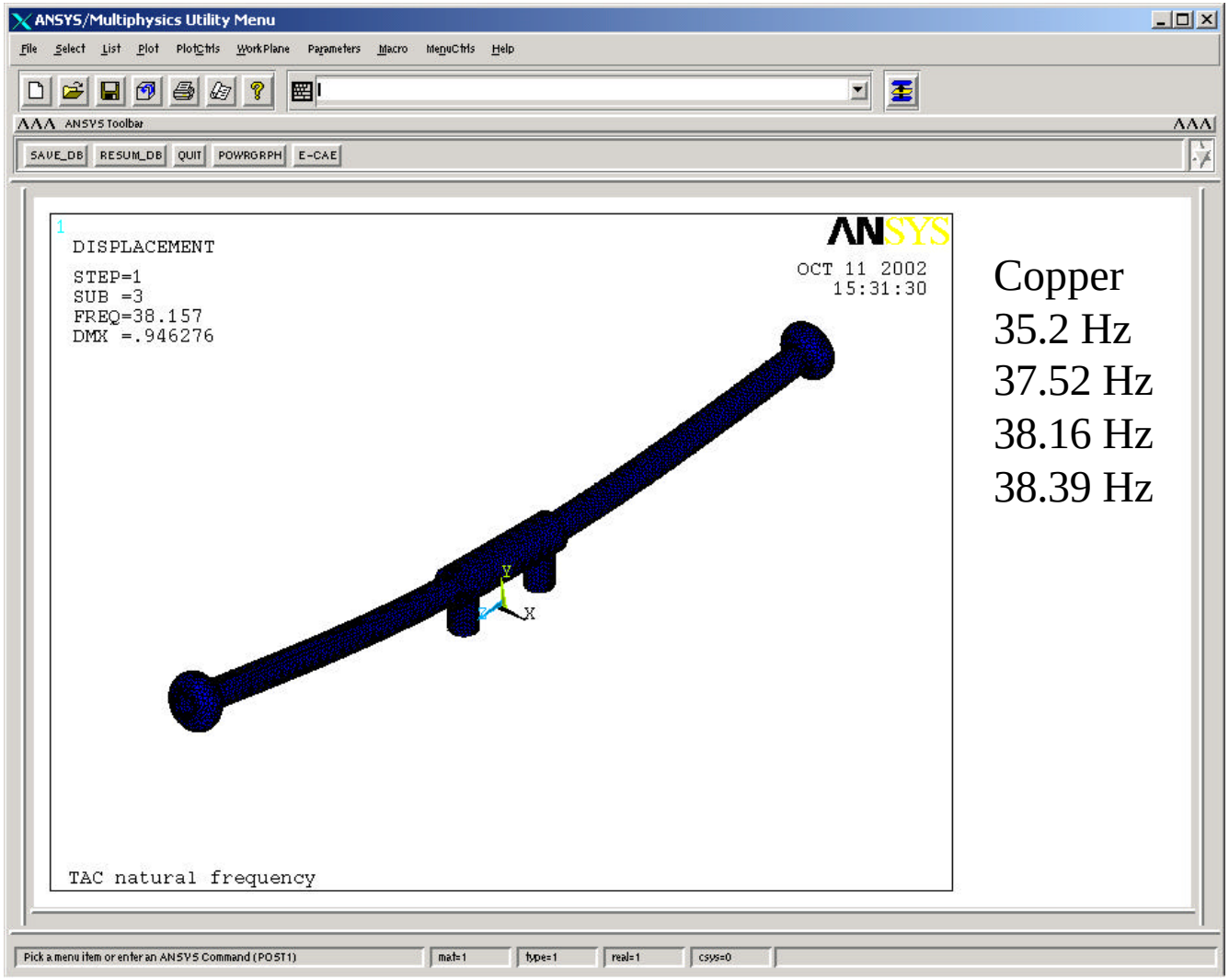




$E_{beam} = 0.5\ E_{rf}$

Mechanical resonances

Steel
48.88 Hz
52.1 Hz
52.99 Hz
53.30 Hz



Copper
35.2 Hz
37.52 Hz
38.16 Hz
38.39 Hz

No water inside