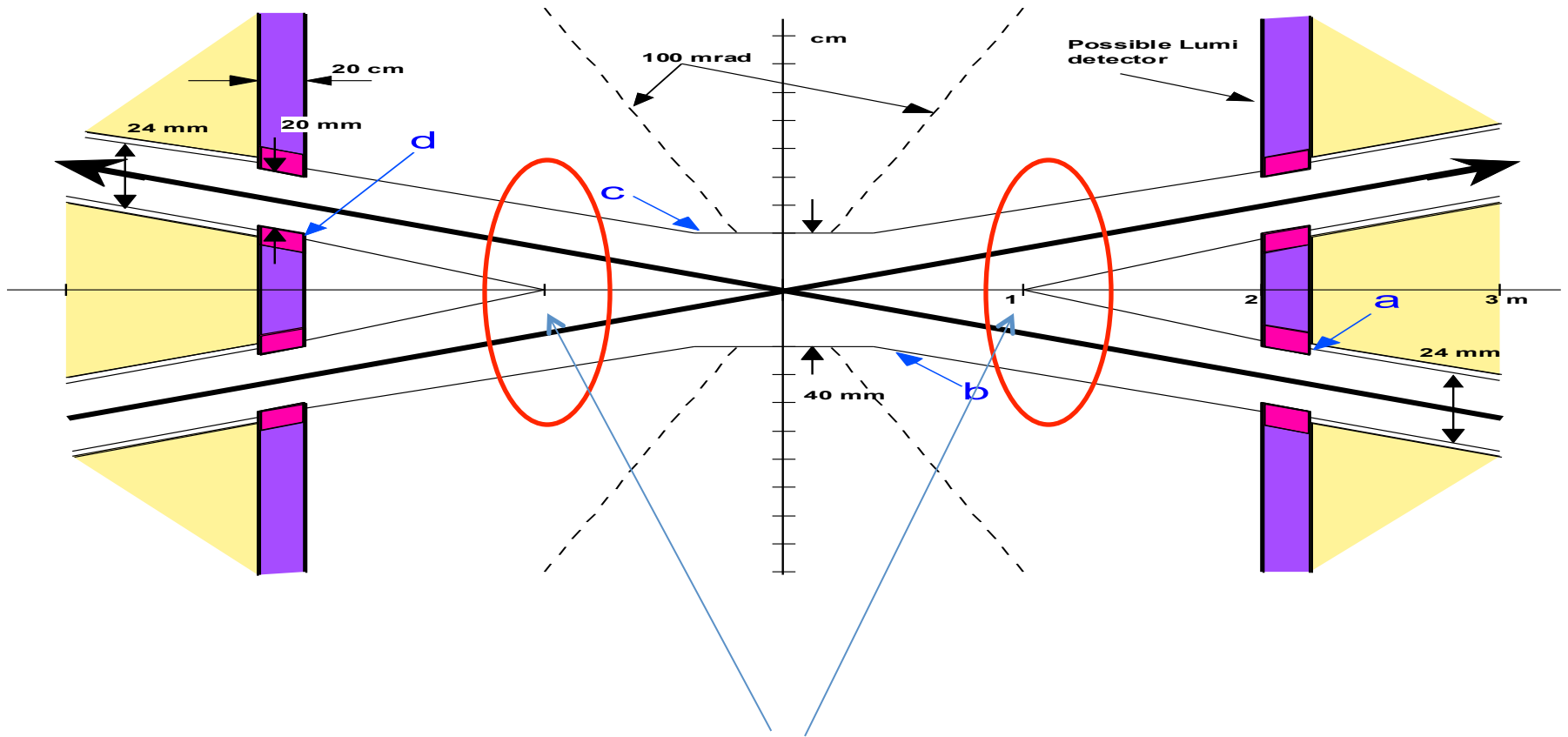

*FCC-ee IR Trapped modes Studies and
experience on PEP-II Absorbers*

Alexander Novokhatski

FCC-ee MDI meeting #5

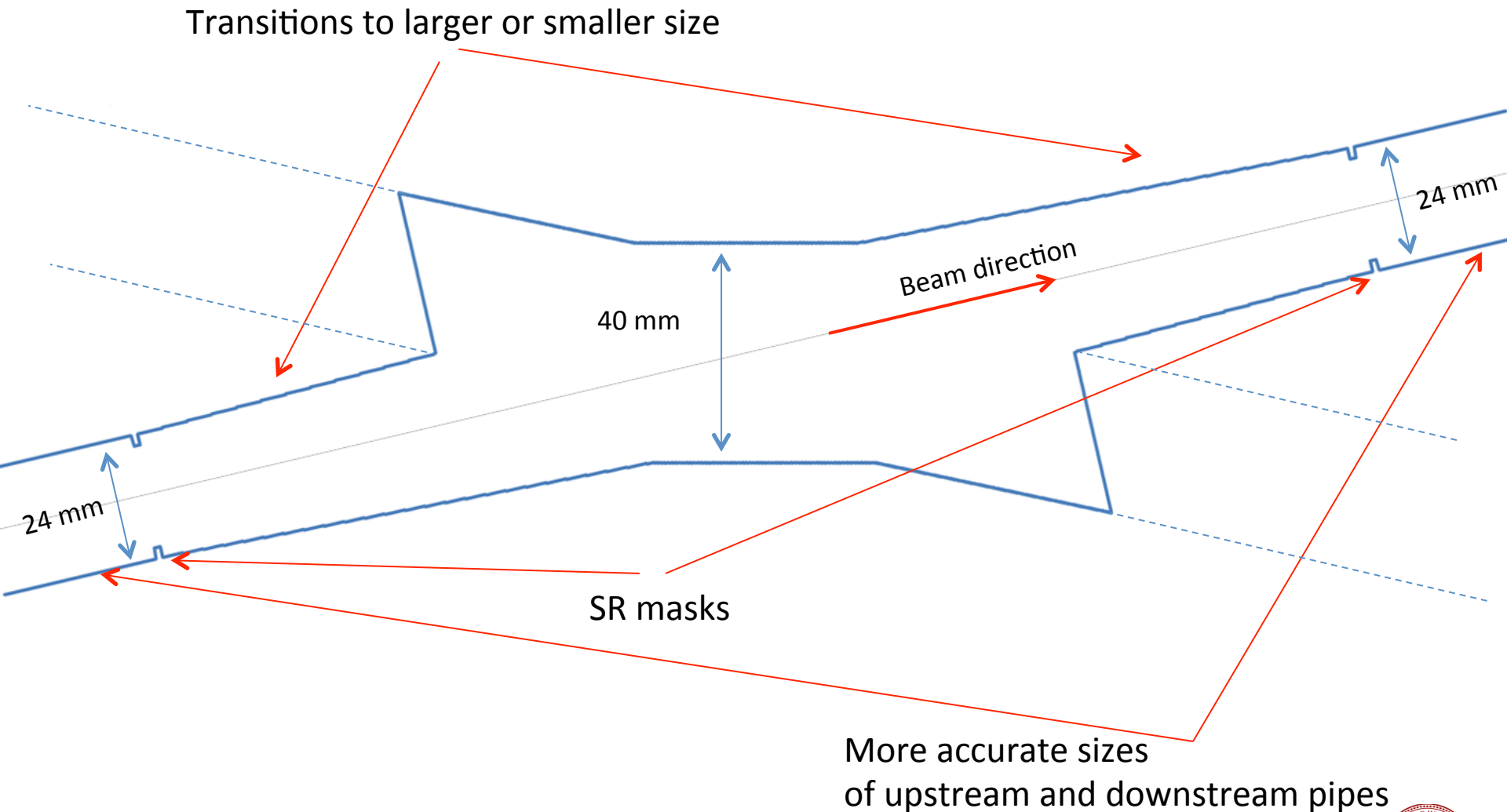
July 18, 2016

FCC ee IR.

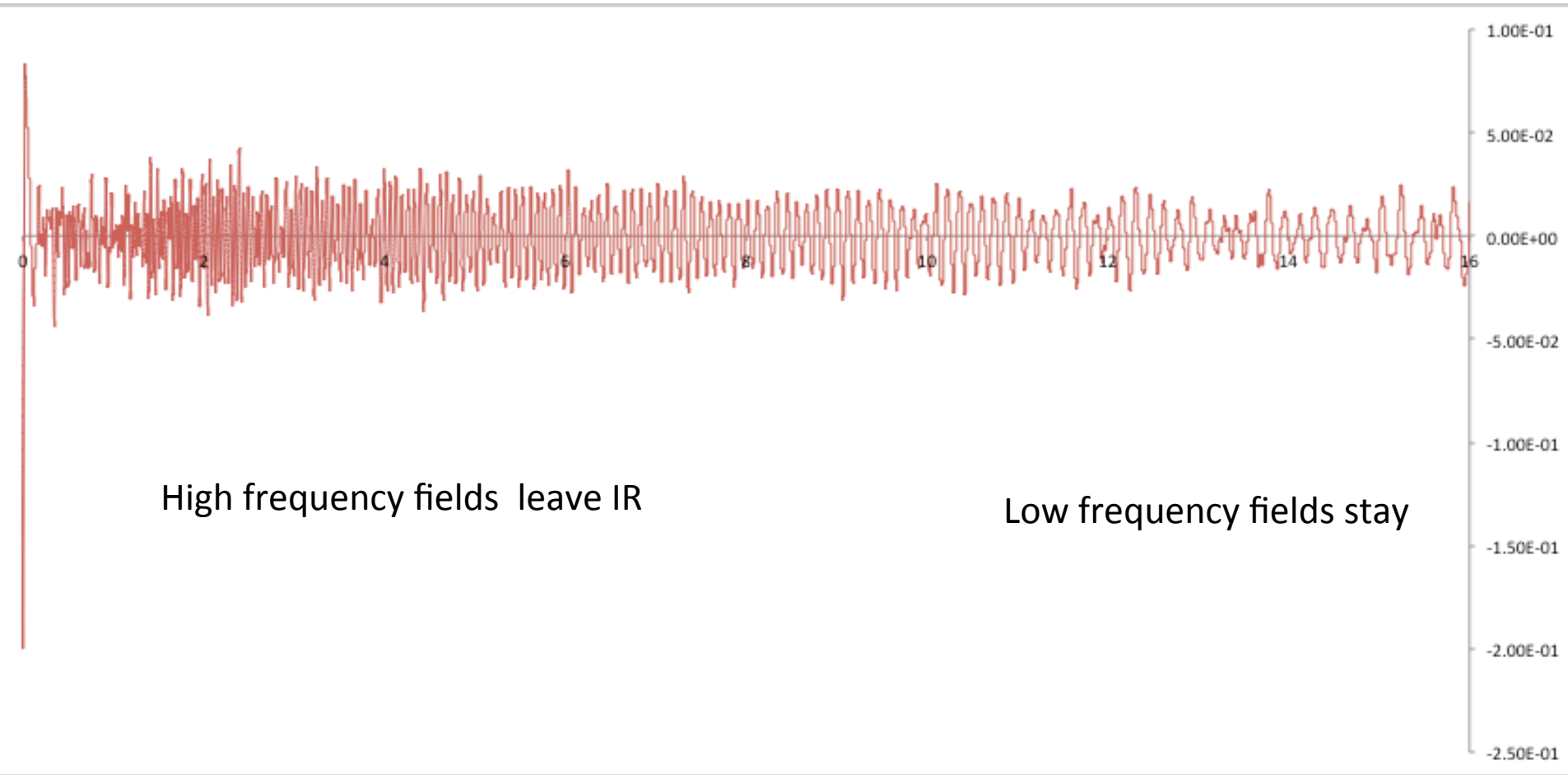


Regions where HOMs can be trapped

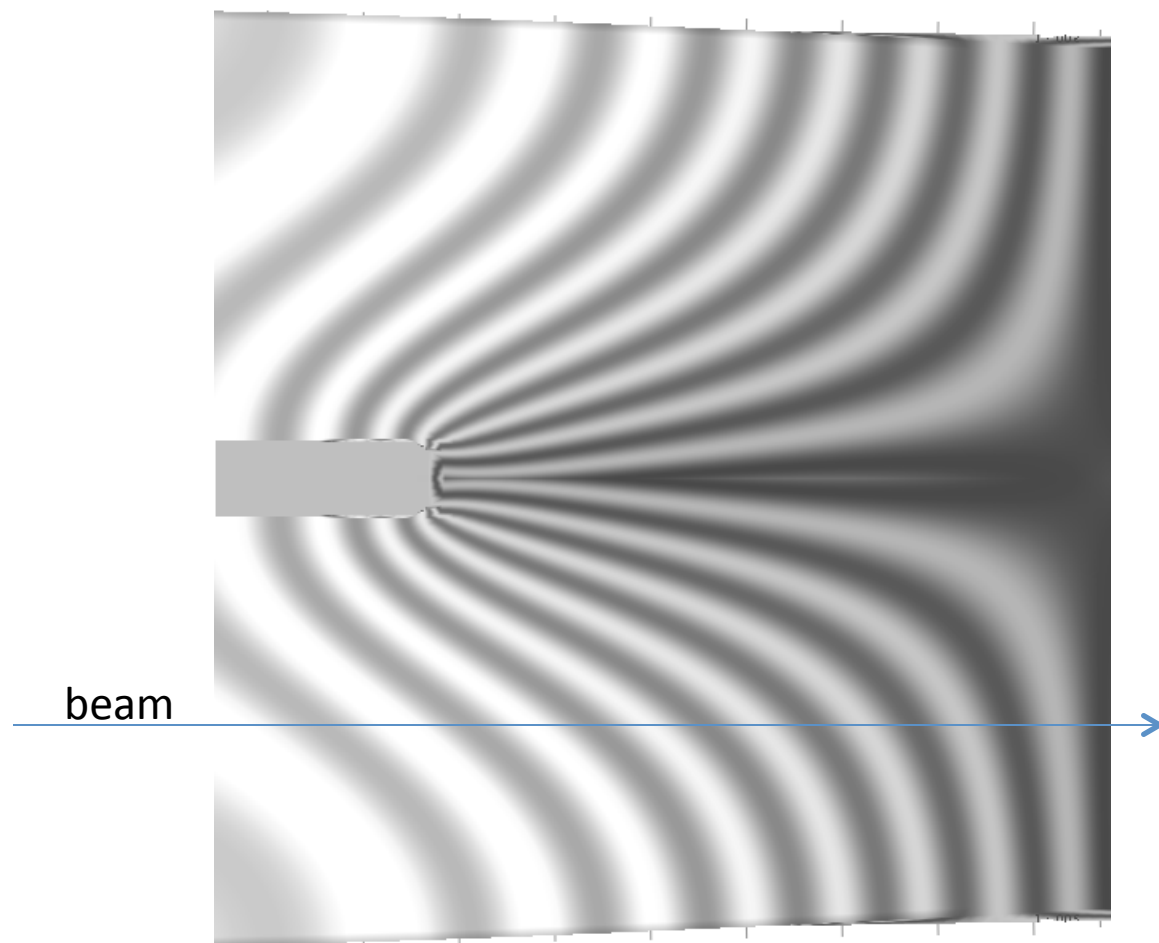
A more detailed model of IR



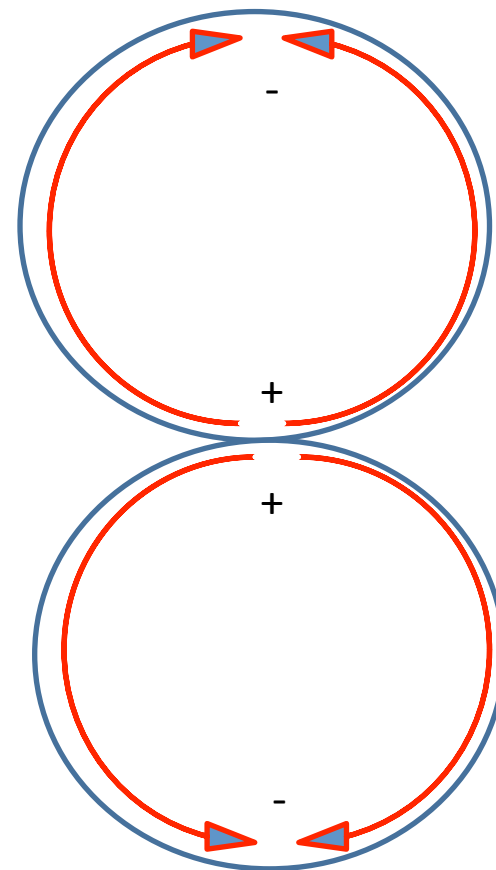
Wake potential



A trapped mode (5 GHz) in the place where incoming tubes are connected in IR



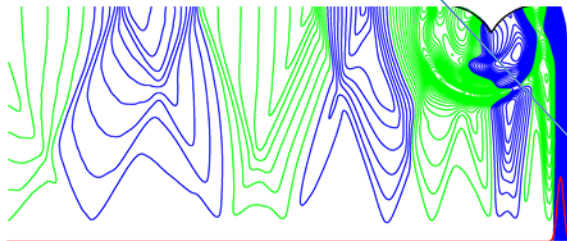
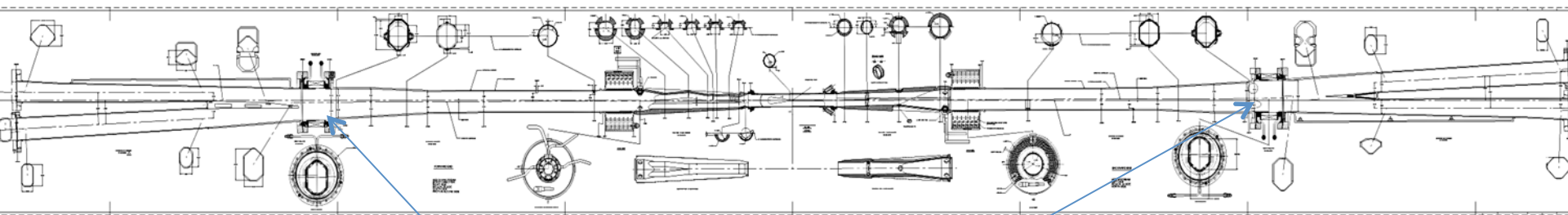
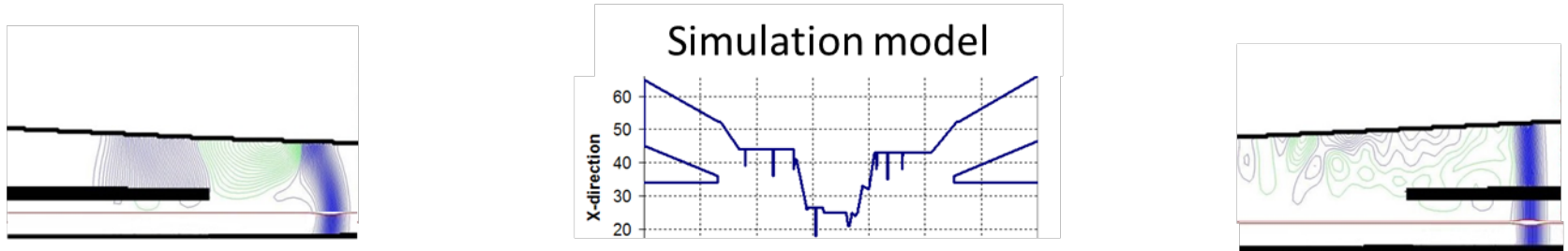
Electric force lines



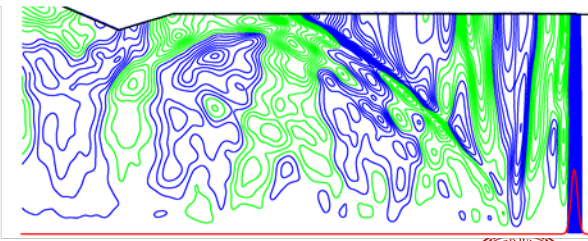
Surface currents have also longitudinal slope

PEP-II IR

- Wake field and HOMs calculations and measurement for the PEP-II rings including interaction region.
 - *A. Novokhatski, J. Seeman, M. Sullivan, “Analysis of the wake field effects in the PEP-II storage rings with extremely high currents”, NIM A 735 (2014)*



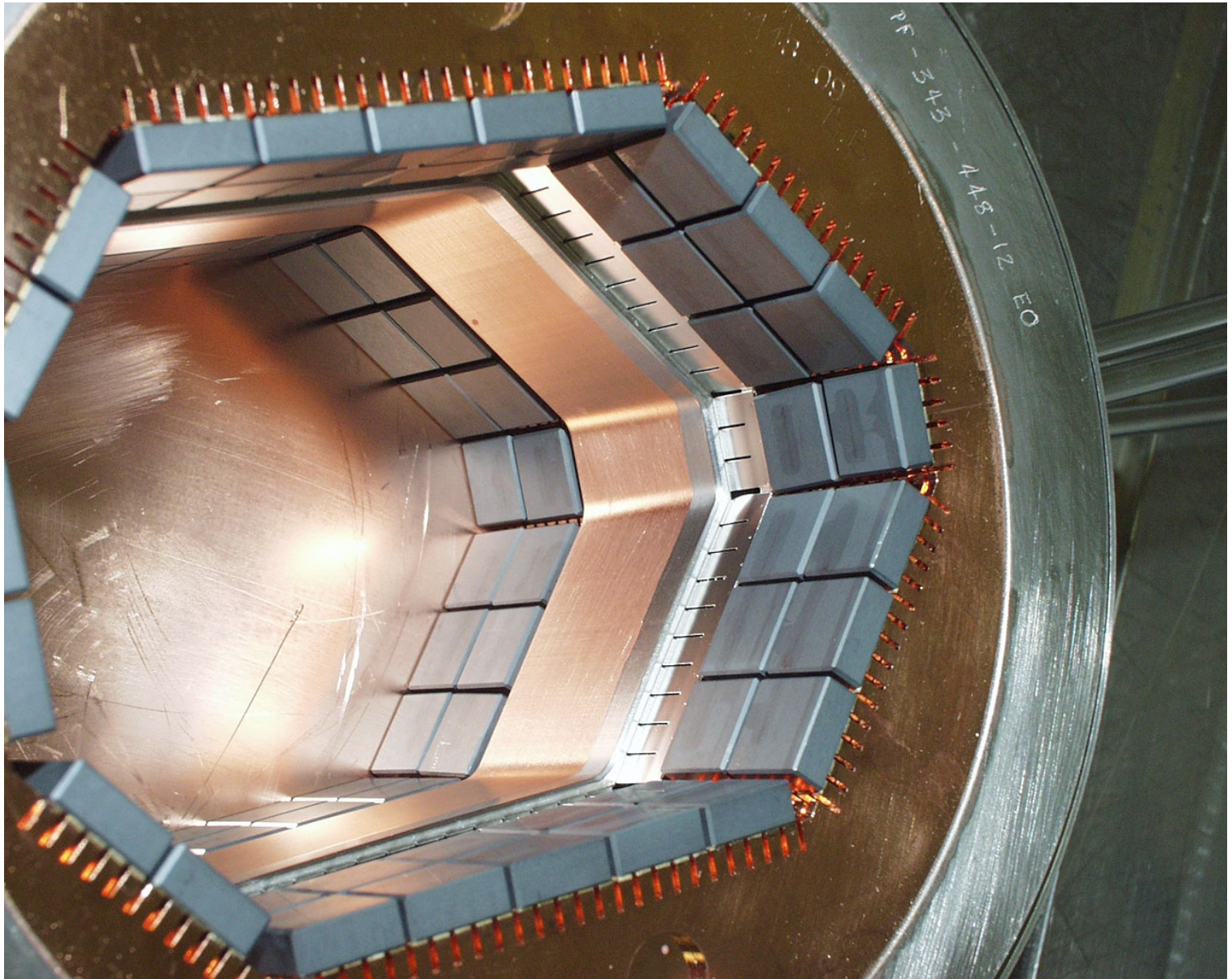
Parameters	PEP-II	PEP-II more c
Bunch length [mm] =	11.3	11.3
Loss factor [V/pC] =	0.327	0.327
LER current [A]	2.6	3
HER current [A]	1.7	1.9
Bunch spacing [nsec]	4.2	4.2
Power loss (pulse) [kW]	13.26	17.33



1/3 of the power is due to the the absorbing ceramic tiles being open to the beam (Cherenkov radiation)



Inside Q2



Properties of Ceradyne's Advanced Technical Ceramics for Microwave Applications

3169 Redhill Avenue • Costa Mesa, CA 92626
 Phone: 714-549-0421 • Fax: 714-549-5787
 email: sales@ceradyne.com
 internet: www.ceradyne.com

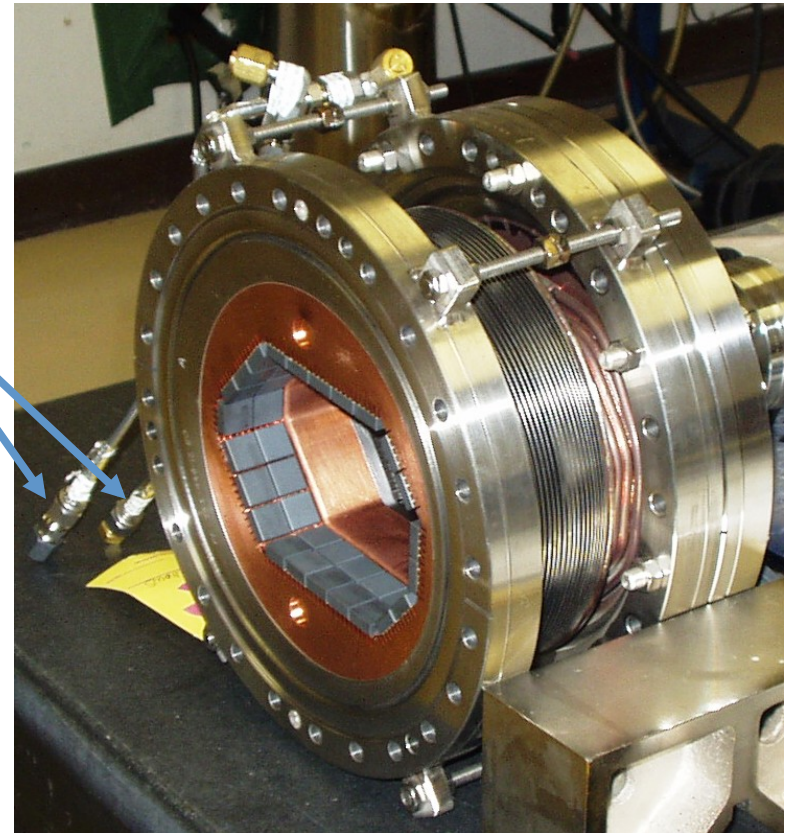
Property	Ceramic Composition									
	Al ₂ O ₃ -SiC	MgO-SiC		AlN-SiC		AlN-Composite		BeO-SiC**	AlN	BeO**
GRADE	Ceralloy® 7712	Ceralloy® 6703	Ceralloy® 6705	Ceralloy® 13740	Ceralloy® 13740Y*	Ceralloy® 137 CA*	Ceralloy® 137 CB*	Ceralloy® 2710	Ceralloy® 1370C*	
Composition	Al ₂ O ₃ +60%SiC	MgO+2%SiC	MgO+5%SiC	AlN+40%SiC	AlN+40%SiC	AlN Composite	AlN Composite	BeO+40%SiC	AlN	BeO-99.5%
Tailored Compositions Available	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	N/A	
Processing Route	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	Hot Pressing	
Density (g/cc)	3.36	3.50	3.48	3.19	3.19	2.99	2.99	3.02	3.26	
Outgassing	No	No	No	No	No	No	No	No	No	No
Thermal Conductivity (W/m·K) (RT)		30	30	30	53	85	95-105	130	160-200	250
Dielectric Constant										
@ 1.0 GHz				22	30	28	40	33	8-9	7.0
@ 8.0 GHz	130	11.2	12.8	15	22	18	30	24		
@10.0 GHz	83	11.1	12.7	15	21	18	28	23		
@12.0 GHz	69	10.9	12.6							
Loss Tangent										
@ 1.0 GHz				0.11	0.11	0.20	0.15	0.05		
@ 8.0 GHz	0.40	0.02	0.03	0.30	0.30	0.20	0.30	0.25		
@10.0 GHz	0.57	0.02	0.03	0.28	0.28	0.20	0.30	0.25		
@12.0 GHz	0.53	0.02	0.03							
Thermal Expansion Coefficient x10⁻⁶/°C; (RT-1000°C)		15.4	14.8	5.1	5.1	5.0	5.0	7.0	4.3	8.3
Flexural Strength (MPa)	530	200	200	300	300				260	175
Key Features						Dielectric Loss Independent of Temperature (to 3°K)	Higher Thermal Conductivity than Ceralloy® 2710 @ Temps. >150° C. Close Match in Electrical Properties	Former Industry Standard for Terminations, etc.	Higher Thermal Conductivity than BeO @ High Temperatures	Higher Thermal Conductivity @ RT
Applications	Slot Mode Absorbers	Absorbers, Buttons	Absorbers, Buttons	Replacement for Ceralloy® 2710 BeO-SiC, Terminations, Sever Wedges, Load Pellets, Absorbers	Replacement for Ceralloy® 2710 BeO-SiC, Terminations, Sever Wedges, Load Pellets, Absorbers	Terminations, Sever Wedges, Load Pellets, Absorbers, Cryogenic Environment Applications	Replacement for Ceralloy® 2710 BeO-SiC, Terminations, Sever Wedges, Load Pellets, Absorbers	Terminations, Sever Wedges, Load Pellets, Absorbers	Replacement for 99.5 BeO, Collector Rods, Helix Support Rods, Windows	Collector Rods, Helix Support Rods, Windows

NOTE: Properties are typical and should not be considered as specifications.

* Patent Pending ** BeO and BeO-SiC ceramics are no longer manufactured by Ceradyne. Data is included for reference only.

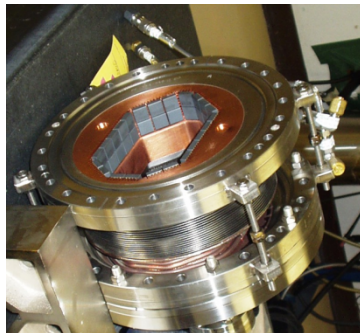
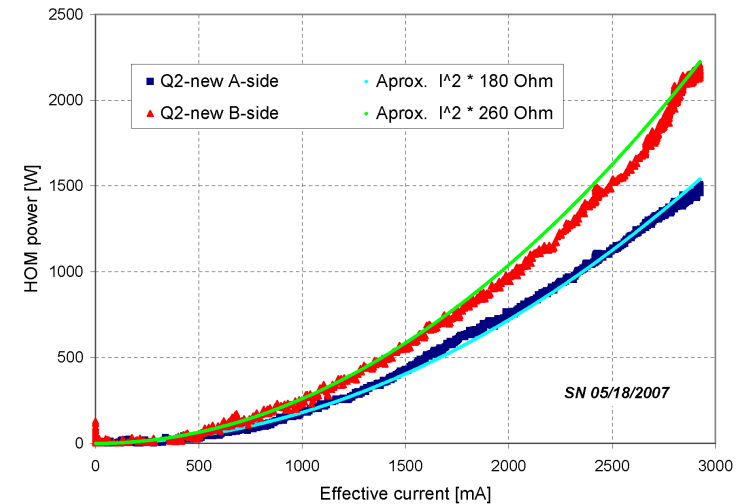
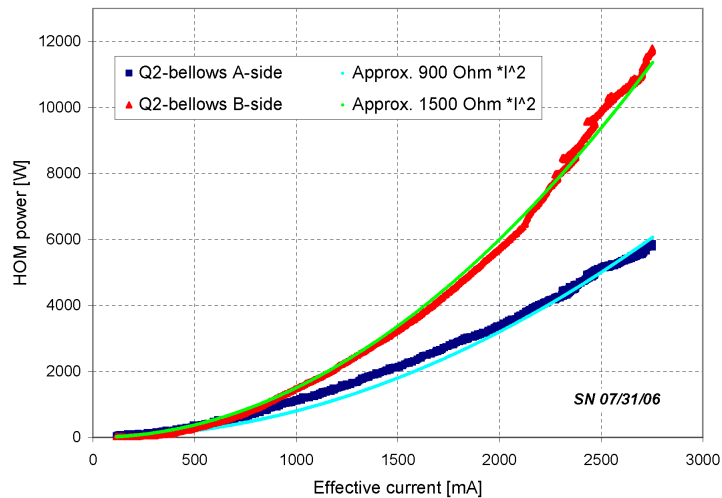
Measurement of absorbed HOM power in Q2-bellows

$$P_{[W]} = 146.2 * Q_{[g/m]} * \Delta T_{[F^{\circ}]}$$

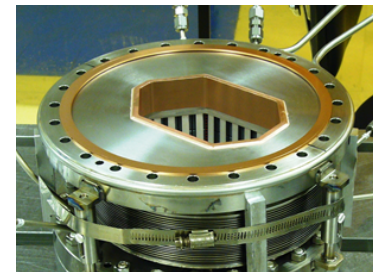


HOMs absorbers in IR

A. Novokhatski, S. DeBarger, S. Ecklund, N. Kurita, J. Seeman, M. Sullivan, S. Weathersby, U. Wienands, , “ A NEW Q2-BELLOWS ABSORBER FOR THE PEP-II SLAC B-FACTOR” , Proc. of PAC'07 (2007)



Open to the beam
ceramic tiles were
shielded



Components

