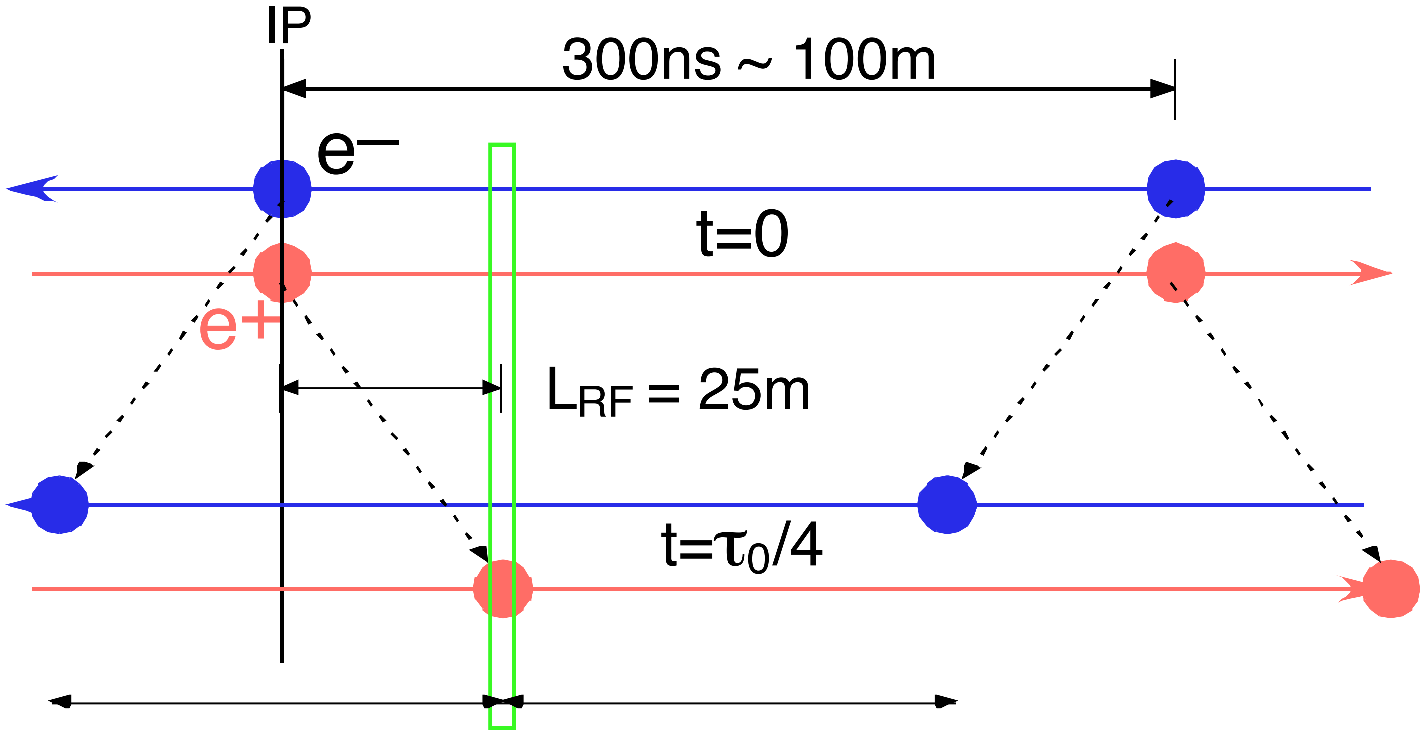
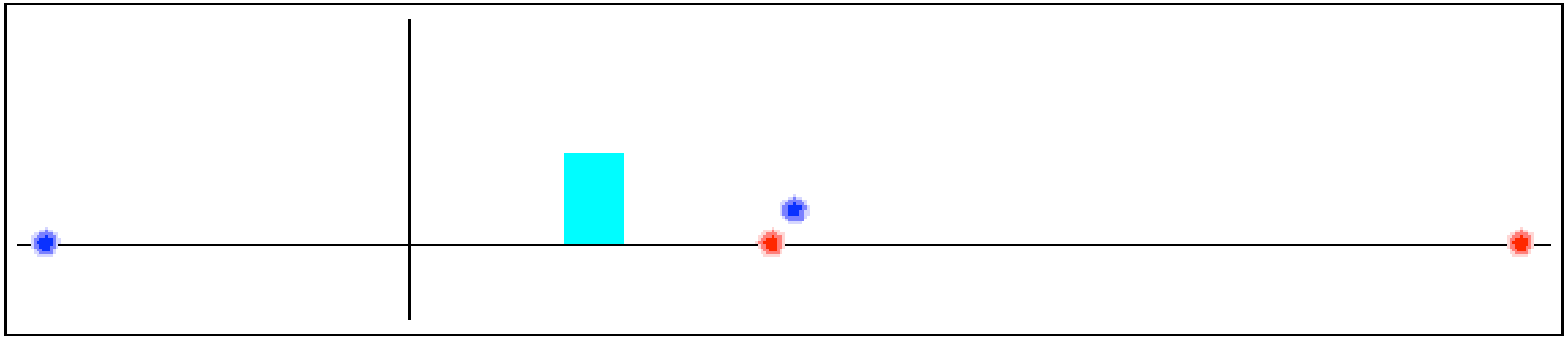
RF Kicker for Head-on-Collision

Y. Iwashita
Accelerator Laboratory,
Advanced Research Center of Beam Science,
Institute for Chemical Research, Kyoto University,
Gokanosho, Uji, Kyoto 611-0011, JAPAN
iwashita@kyticr.kuicr.kyoto-u.ac.jp
http://wwwal.kuicr.kyoto-u.ac.jp

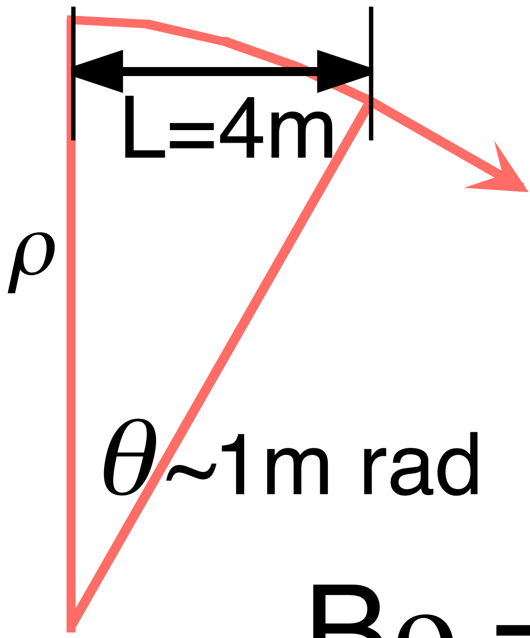
Time Structure of Beam



Out-bunch at the Center of In-bunch



Magnetic Field Strength



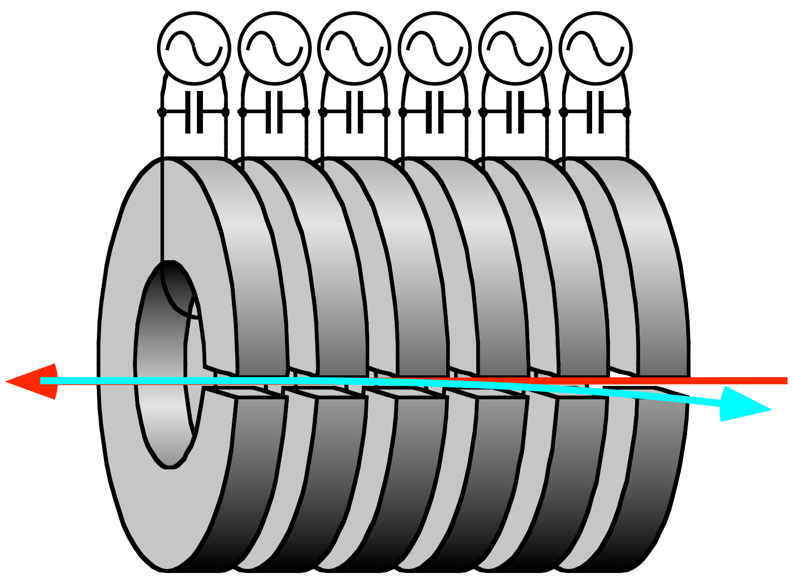
$B\rho$ = ~1 T.km @ 250GeV

ρ =L(4m)/θ(1mrad)=4km

B=0.25T

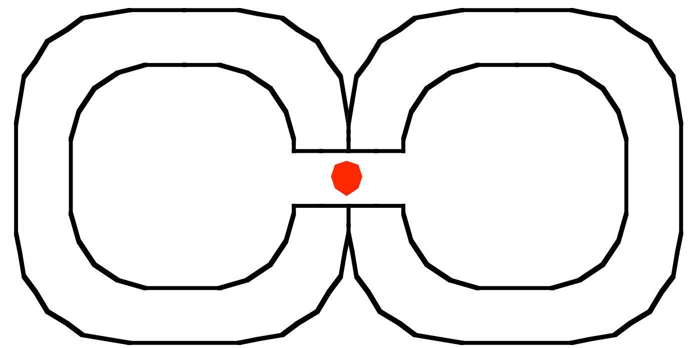
Sketch of a Kicker

DC+3MHz (+9MHz)



L=4m

Variant



Double C-type

Better shielding

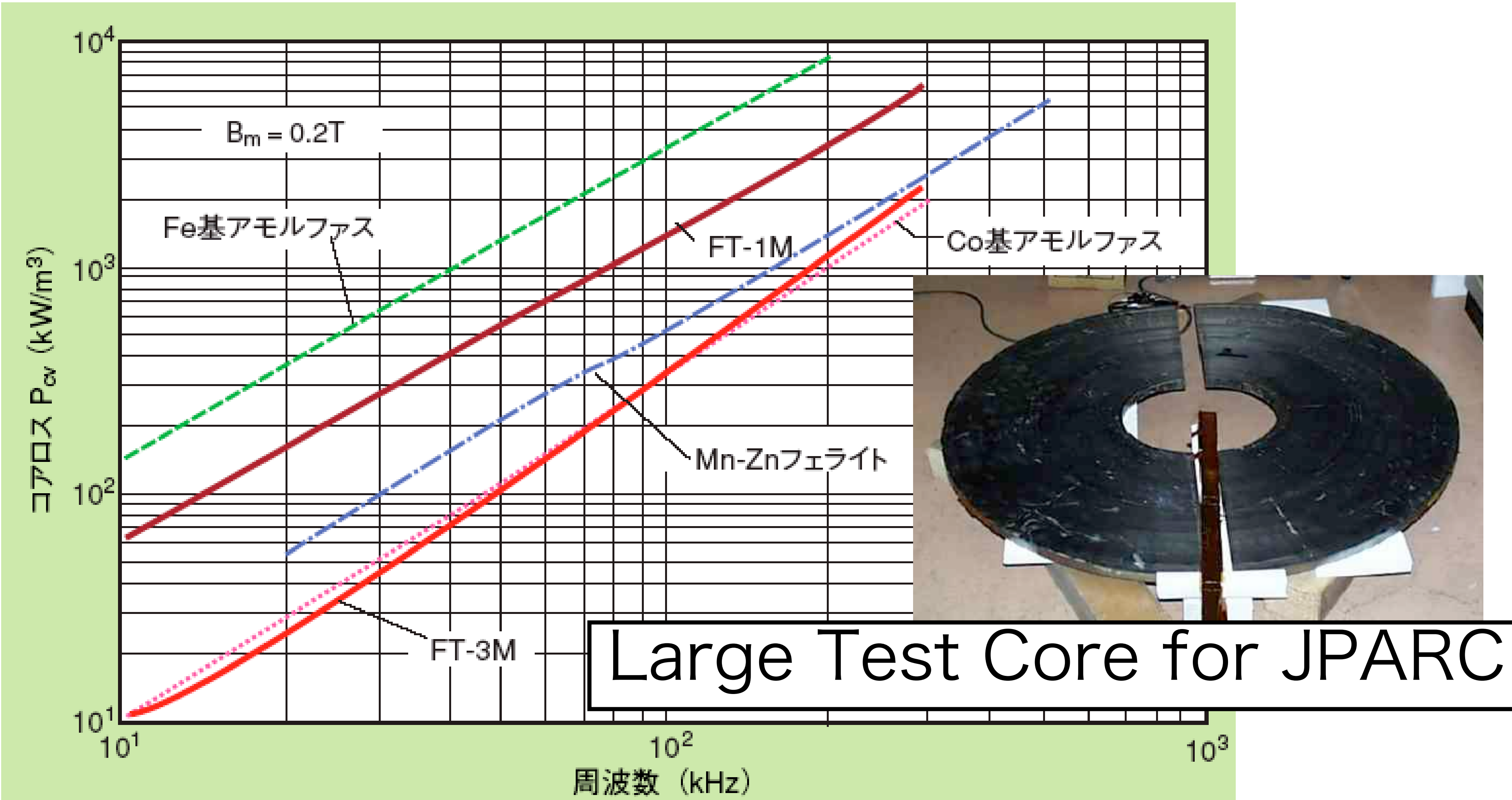
Step at center?

Stored Energy W ~ 125[J] @0.25T

x3MHz/Q(~100?)/(4m/3cm) ~ 35kWpk

(x133 units –> 4.5MWpk in total)

Magnetic Alloy (Finemet)



Large Test Core for JPARC

Q <1 for non-cut core

Q~10 for cut core @a few mm gap

Table 2. Electrical Characteristics of FINEMET® FT-1H Core

	ΔB (T)	Core loss(J/m^3) *
FINEMET® FT-1H	1.76	1000
Fe-based Amorphous	2.04	1800
Ni-Zn Ferrite	0.65	160

*Pulse width=0.5 μ sec

High B, low core loss

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FT-3L

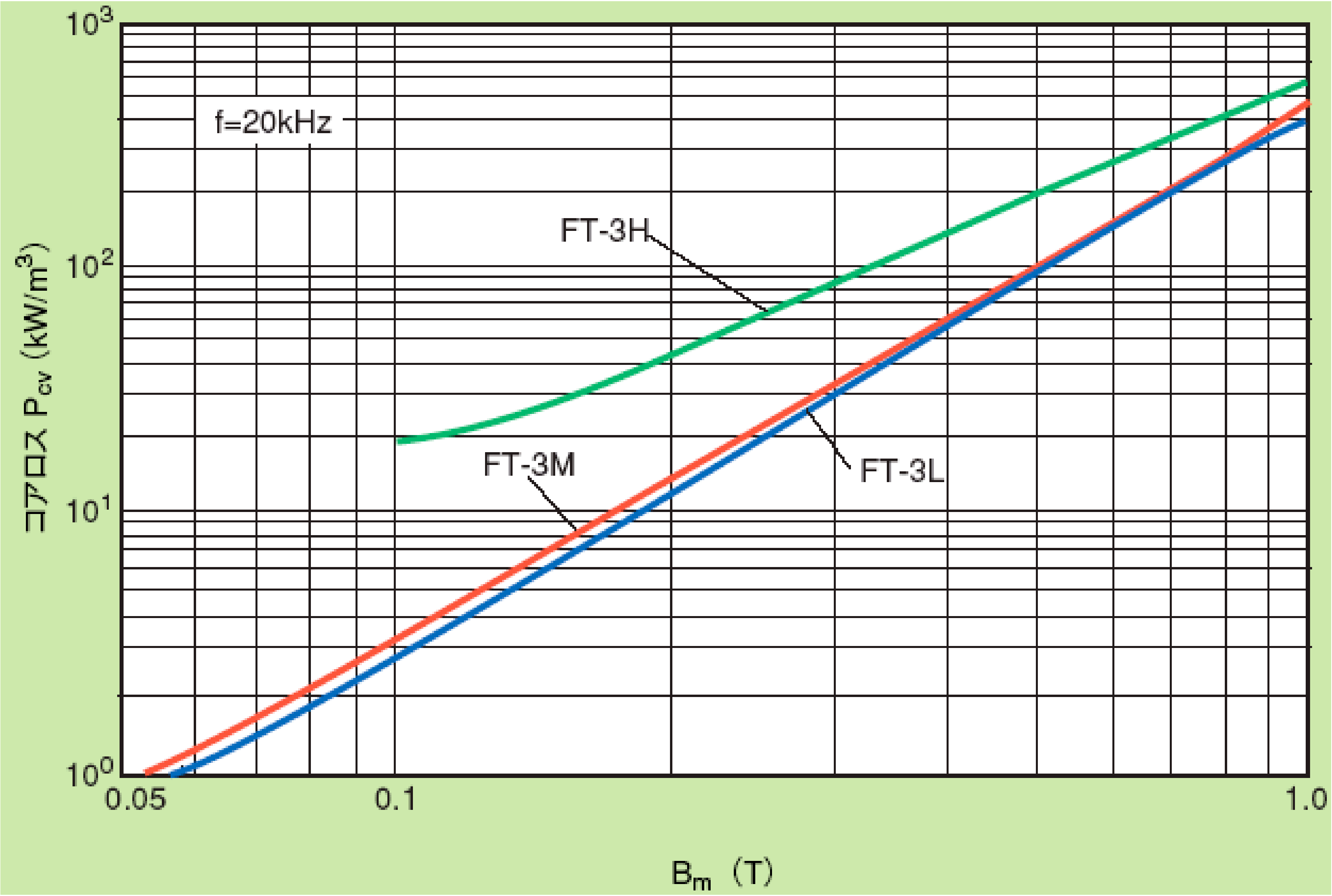
【ファインメット®と従来材の磁気特性（ノーカット・トロイダルコア）】

材料	板厚 (μm)	B_s (T)	B_r/B_s (%)	H_c (A/m)	$\mu_{r(1kHz)}$ ($\times10^3$)	$\mu_{r(100kHz)}$ ($\times10^3$)	P_{cv} (kW/m^3)	λ_s ($\times10^{-6}$)	T_c (℃)
ファインメット® FT-1H	18	1.35	90	0.8	5.0	1.5	950	＋2.3	～570
ファインメット® FT-1M		1.35	60	1.3	70.0	15.0	350		
ファインメット® FT-3H	18	1.23	89	0.6	30.0	5.0	600	≃0	～570
ファインメット® FT-3M		1.23	50	2.5	70.0	15.0	300		
ファインメット® FT-3L		1.23	5	0.6	50.0	16.0	250		
Fe基アモルファス	25	1.56	83	2.4	5.0	5.0	2200	＋27	415
Co基アモルファス高透磁率材	18	0.55	5	0.3	115.0	18.0	280	≃0	180
Co基アモルファス高角形比材	18	0.60	85	0.3	30.0	10.0	460	≃0	210
3%Siケイ素鋼	50	1.90	85	6.0	2.7	0.8	8400	-0.8	750
6.5%Siケイ素鋼	50	1.30	63	45.0	1.2	0.8	5800	-0.1	700
50%Niパーマロイ	25	1.50	95	12.0	—	—	3400	＋25	500
80%Niパーマロイ高透磁率材	25	0.74	55	0.5	50.0	5.0	1000	≃0	460
80%Niパーマロイ高角形比材	25	0.74	80	2.4	—	—	1200	≃0	460
Mn-Znフェライト高透磁率材	—	0.44	23	8.0	5.3	5.3	1200	-0.6	＞150
Mn-Znフェライト低損失材	—	0.49	29	12.0	2.4	2.4	680	-0.6	＞200

注1）B_s、B_r/B_s、H_c：直流磁気特性（H_m=800A/m, 25℃）、$\mu_{r(1kHz)}$：比透磁率（1kHz, H_m=0.05A/m, 25℃）、$\mu_{r(100kHz)}$：比透磁率（100kHz, H_m=0.05A/m, 25℃）、P_{cv}：コアロス（100kHz, B_m=0.2T, 25℃）、λ_s：飽和磁歪定数、T_c：キュリー温度
注2）上記特性は、当社での測定による

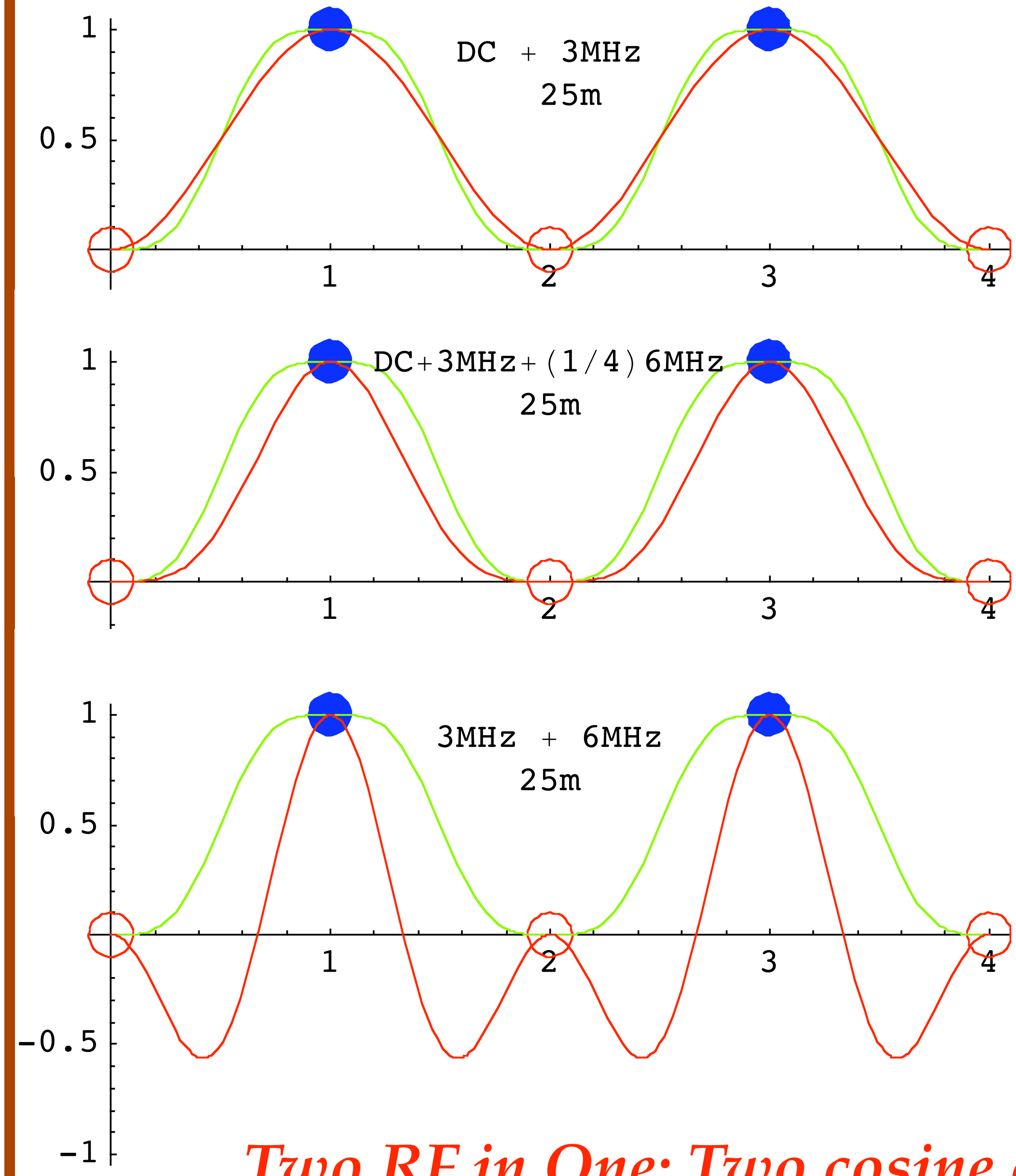
High B, low core loss, high Tc

Core Loss



FT-3L is the best option here.

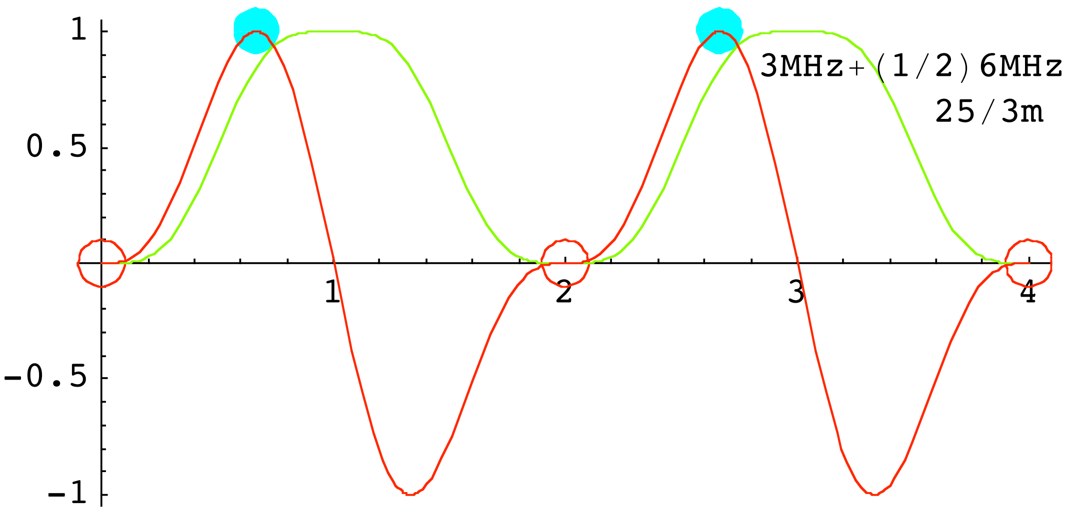
Waveforms-1

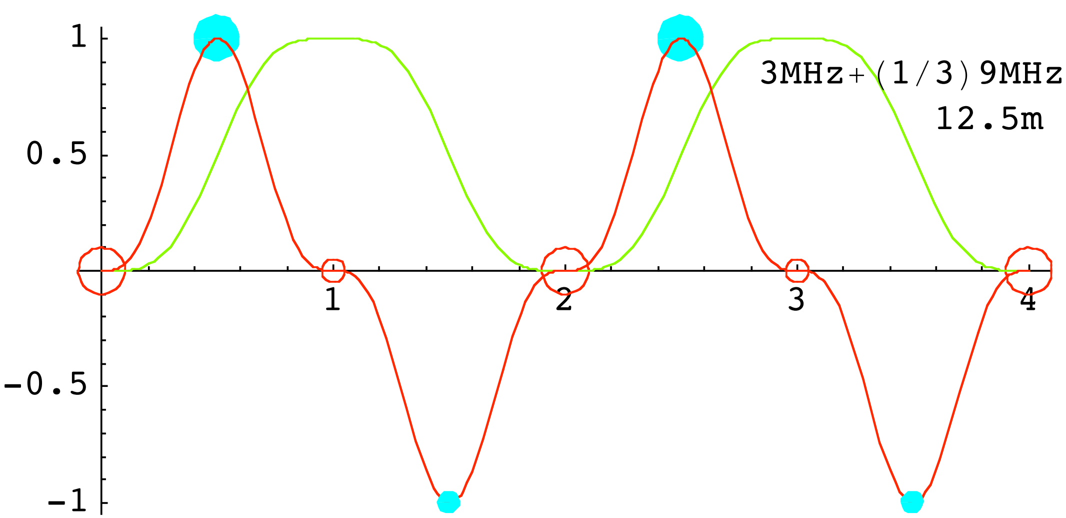


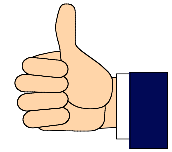
Single RF	needs DC
Wide Base	needs DC Two RF in One
No DC	Narrow Base Two RF in One

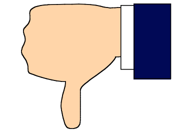
Two RF in One: Two cosine components superposition

Waveforms-2





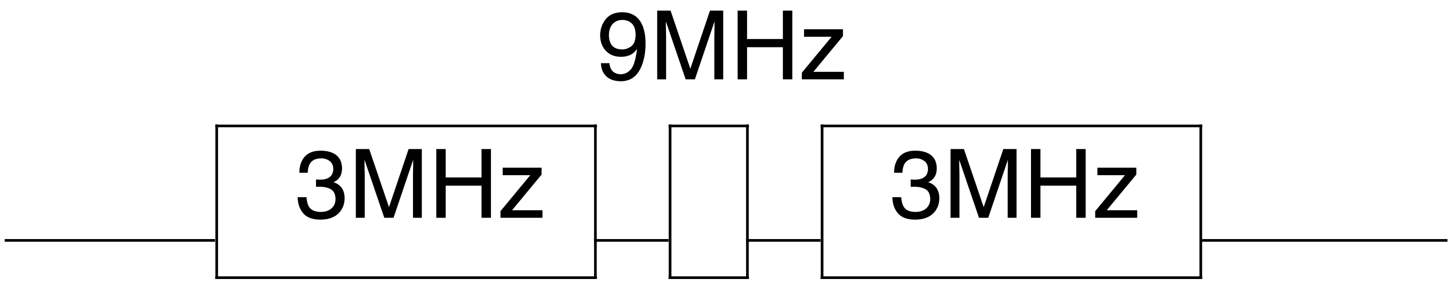




No DC Separate RF	Short L_{RF} Two RF
No DC Separate RF 6MHz too (if 2 sides OK)	Short L_{RF} Two RF

Separate RF: Each component for each separate kicker

Combination



- Separate two RF system for the latter two options.
- Phase slip for in-bunch can be compensated by phasing.
  —> less perturbation

Comments

- MA has been used for RF accelerating cavity to generate high voltage($V=\dot{\Phi}=\dot{B}S$). –> Not for generation of B. (R&D!)
- Estimated RF power: ~4.5MWpk, 23kWave. (.25Tx4m, 1m rad) 35kW x (133 cores, 133 Amp's)
- Upgradable to 1TeV(6MHz) — Two sets?
- Easier than Crab-cavity

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