

Quasi Traveling Wave Side Couple RF Gun for SuperKEKB

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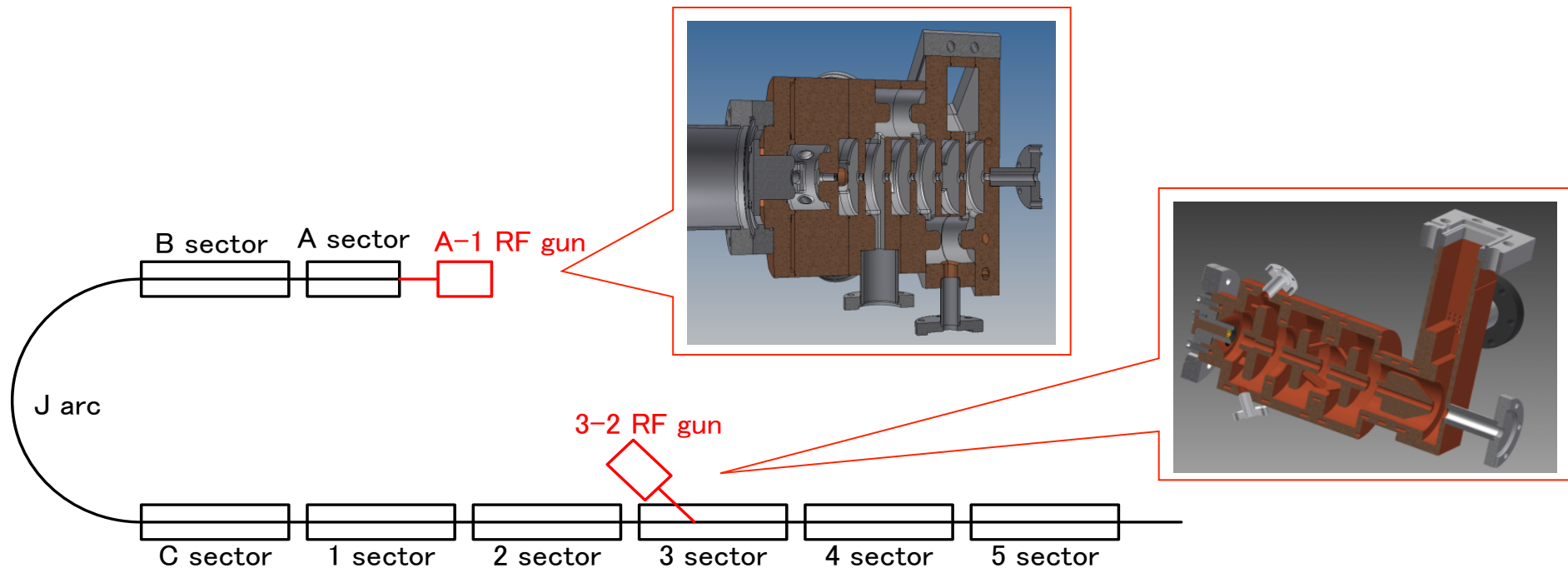
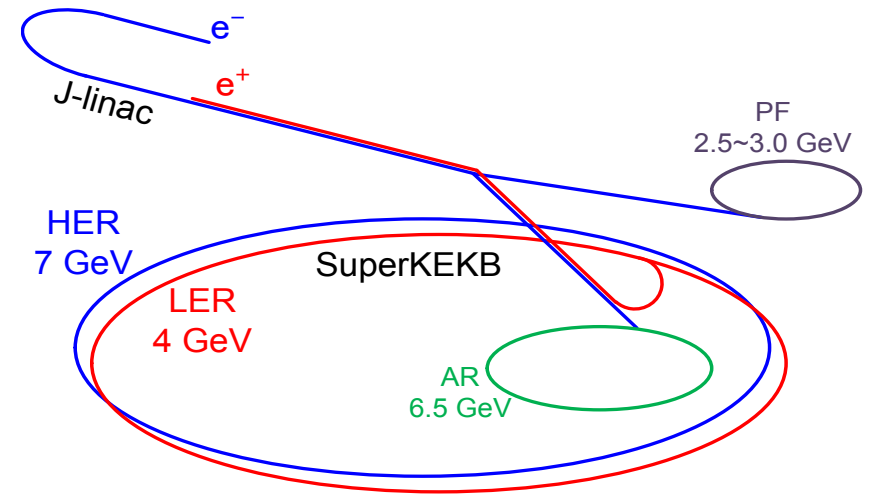
1-1 Oho, Tsukuba, Ibaraki Japan

Contents

- Introduction
- Disk and Washer(DAW) type RF gun
- Quasi-traveling wave RF gun
- Cavity calculation and design of Quasi-traveling wave RF gun
- Conclusion

SuperKEKB Upgrade and RF gun development

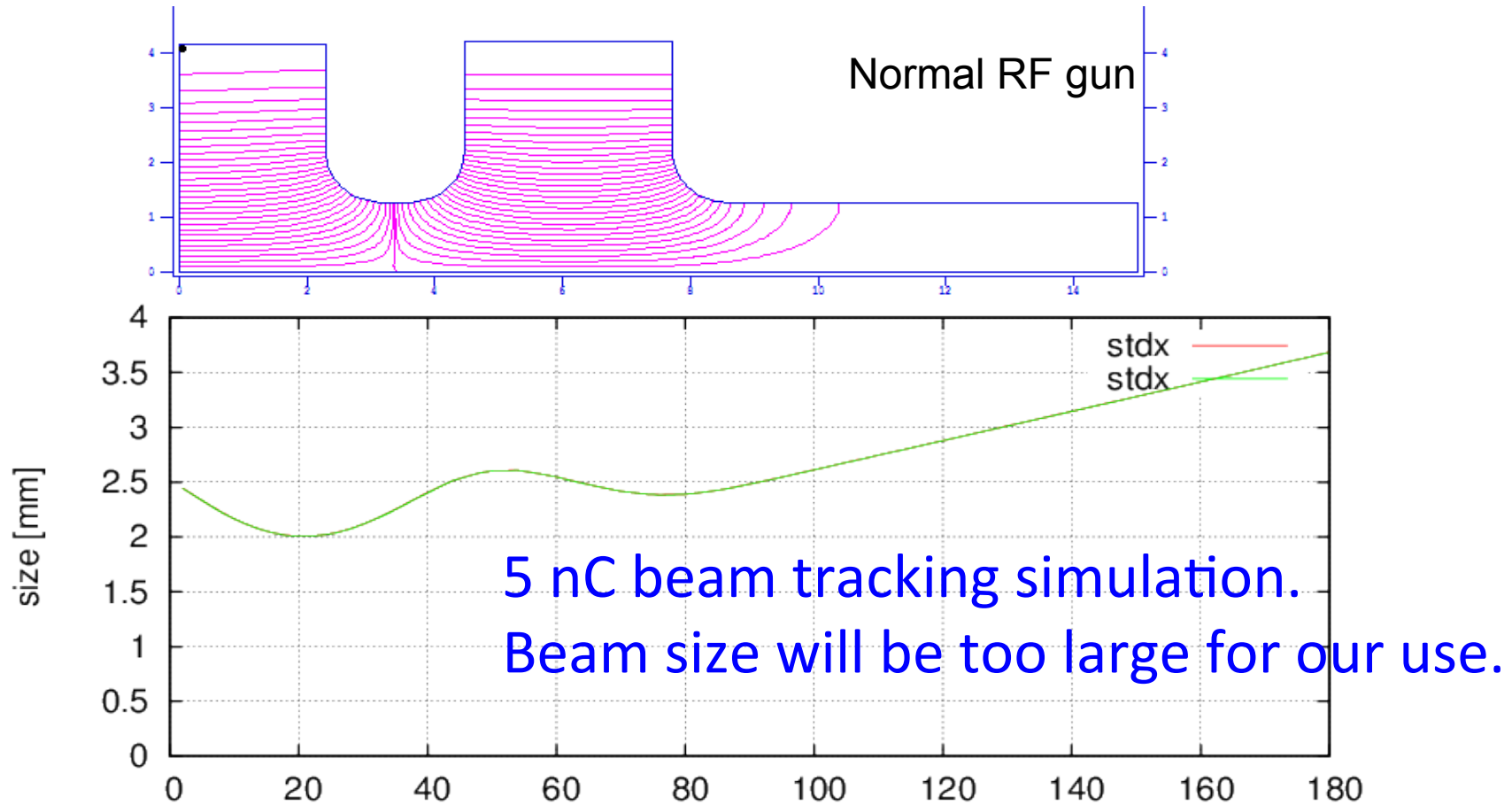
	KEKB obtained (e+ / e-)	SuperKEKB required (e+ / e-)
Energy	3.5 GeV / 8.0 GeV	4.0 GeV / 7.0 GeV
Charge	e- → e+ / e- 10 → 1.0 nC / 1.0 nC	e- → e+ / e- 10 → 4.0 nC / 5.0 nC
Emittance [mm-mrad]	2100 / 300	6 / 20



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Why we need advanced RF gun?

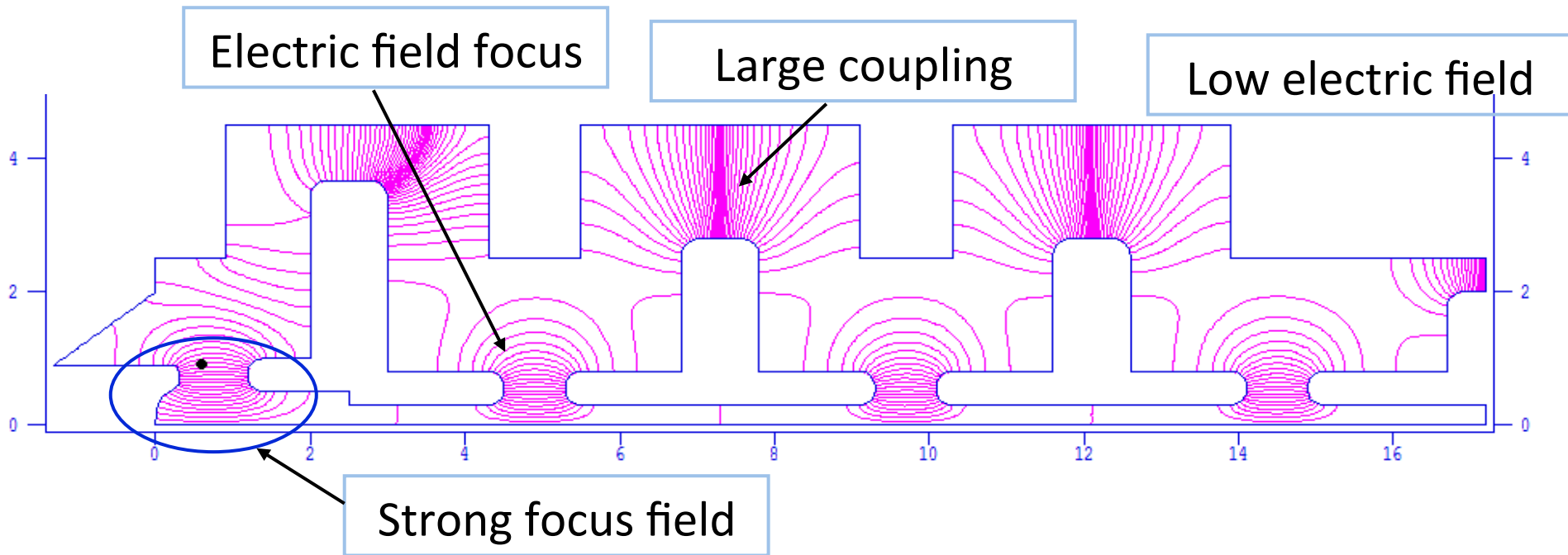
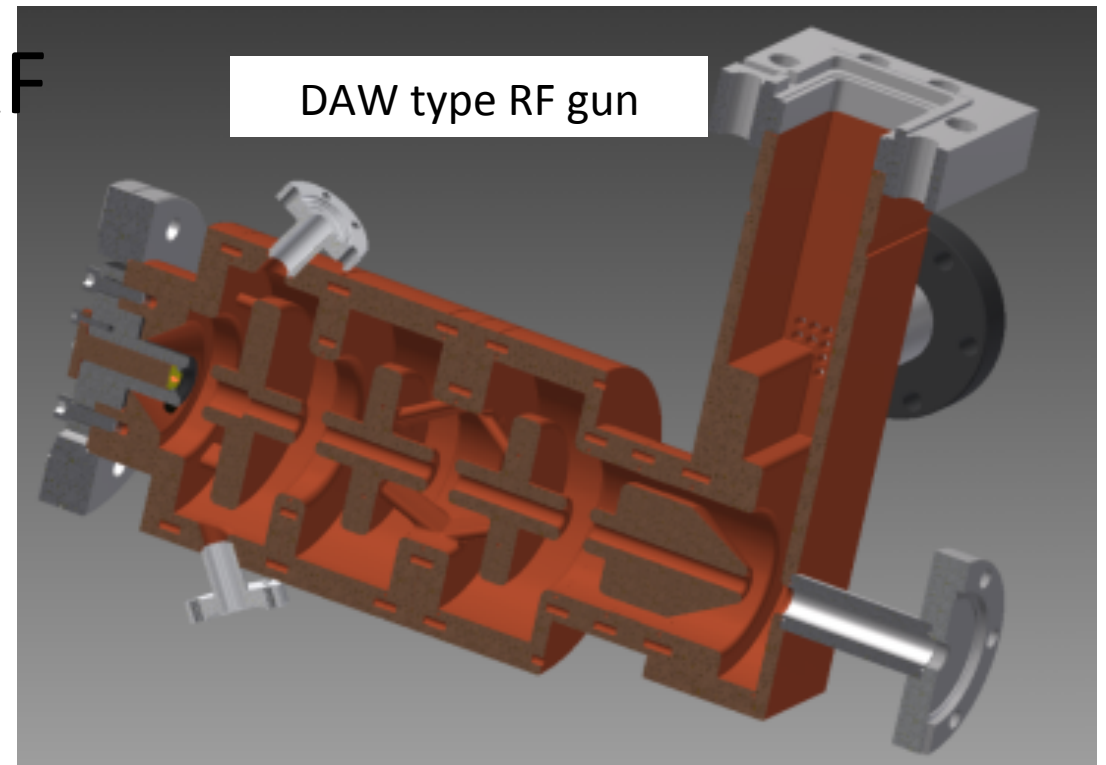


Normal RF gun does not have focusing E-field.
5 nC beam charge has much higher space charge.
We need advanced RF gun.

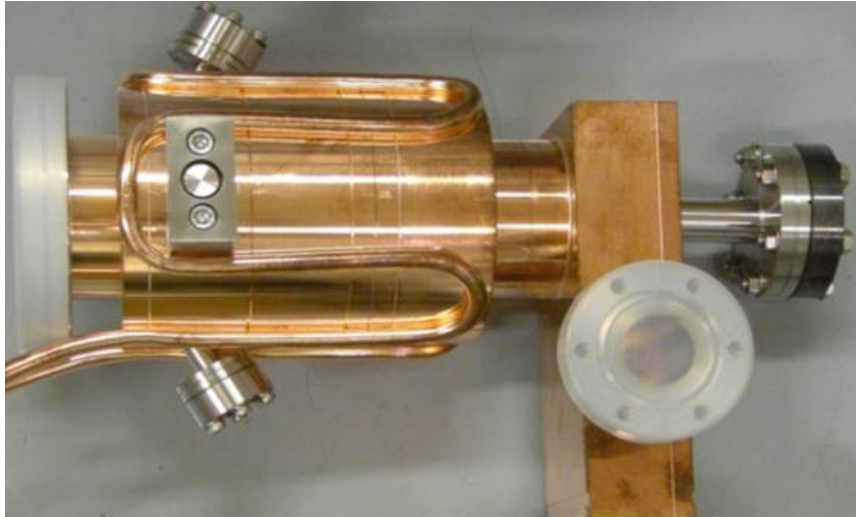
DAW (Disk and Washer) RF gun development

Beam tracking simulation result

Emittance	6 mm-mrad
Size (σ)	1.2 mm
Bunch length	8 psec
Energy	3.2 MeV



DAW (Disk and Washer) RF gun



RF gun



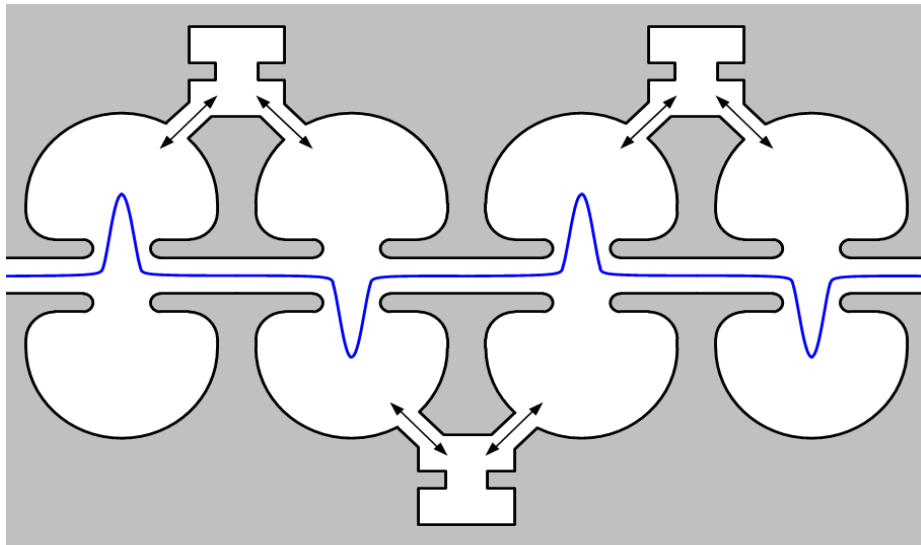
RF gun beam line

We already installed RF gun into KEK linac beam line and tested.

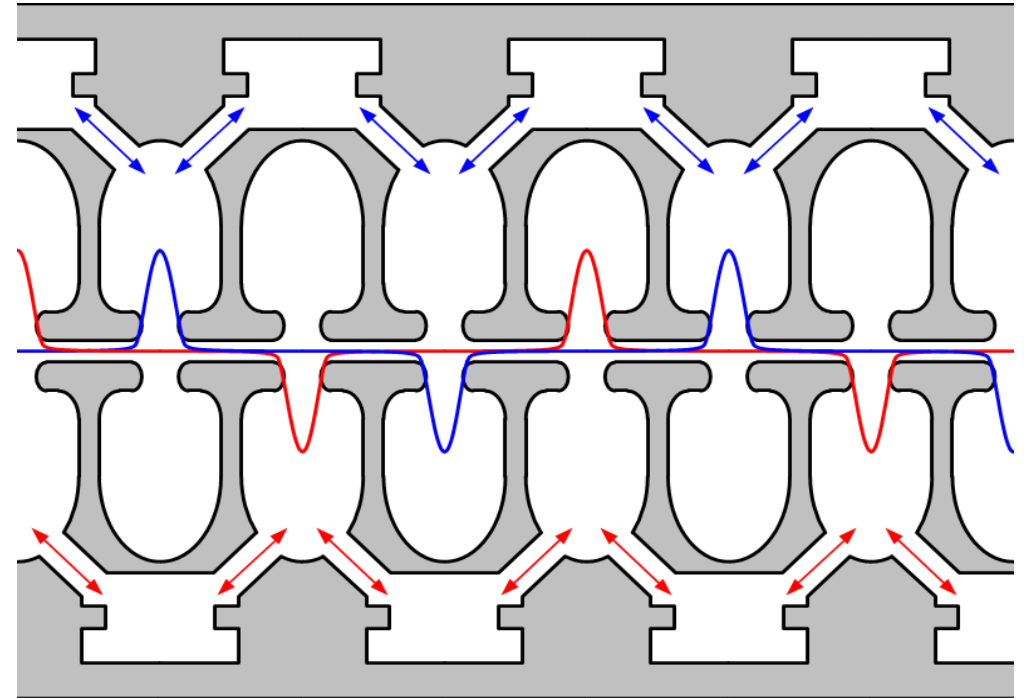
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Structure of the quasi traveling wave cavity



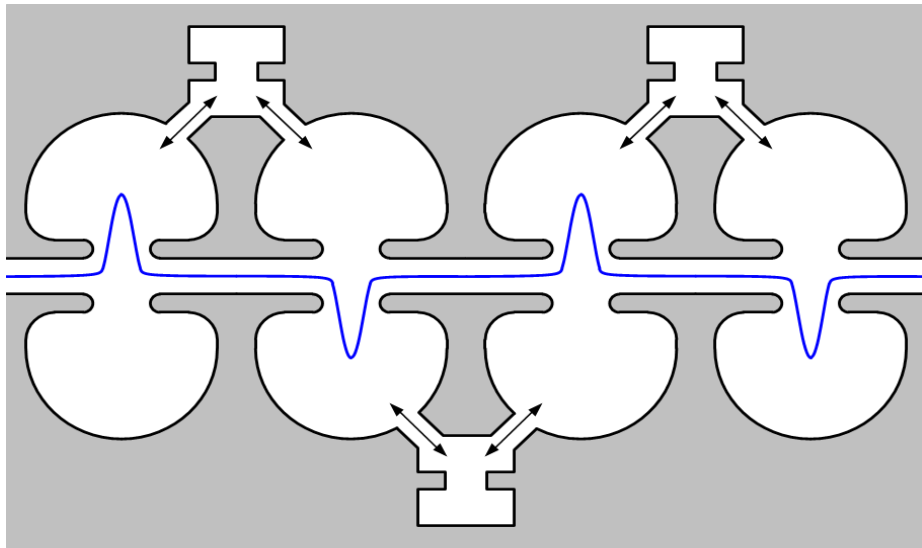
Normal side coupled cavities



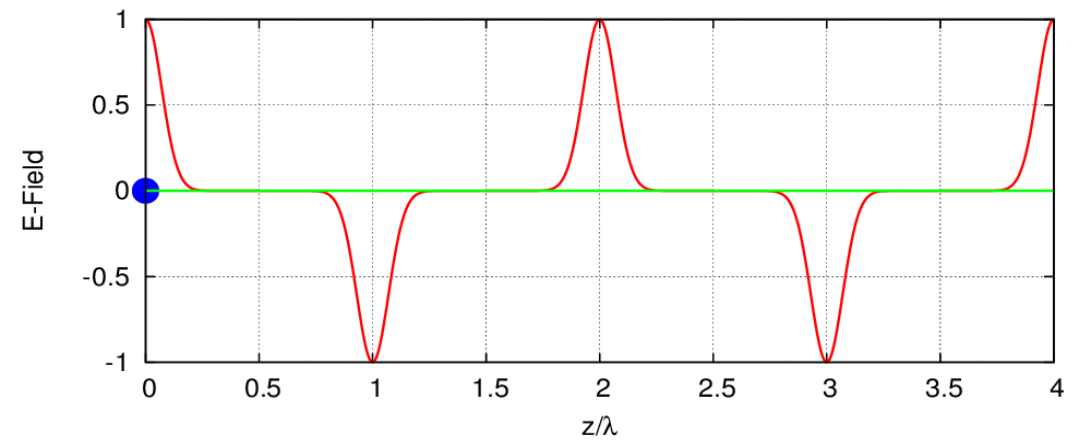
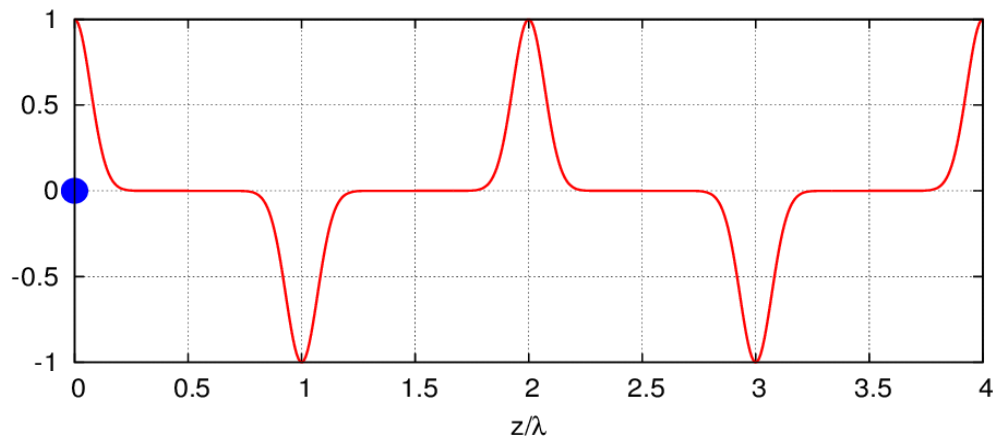
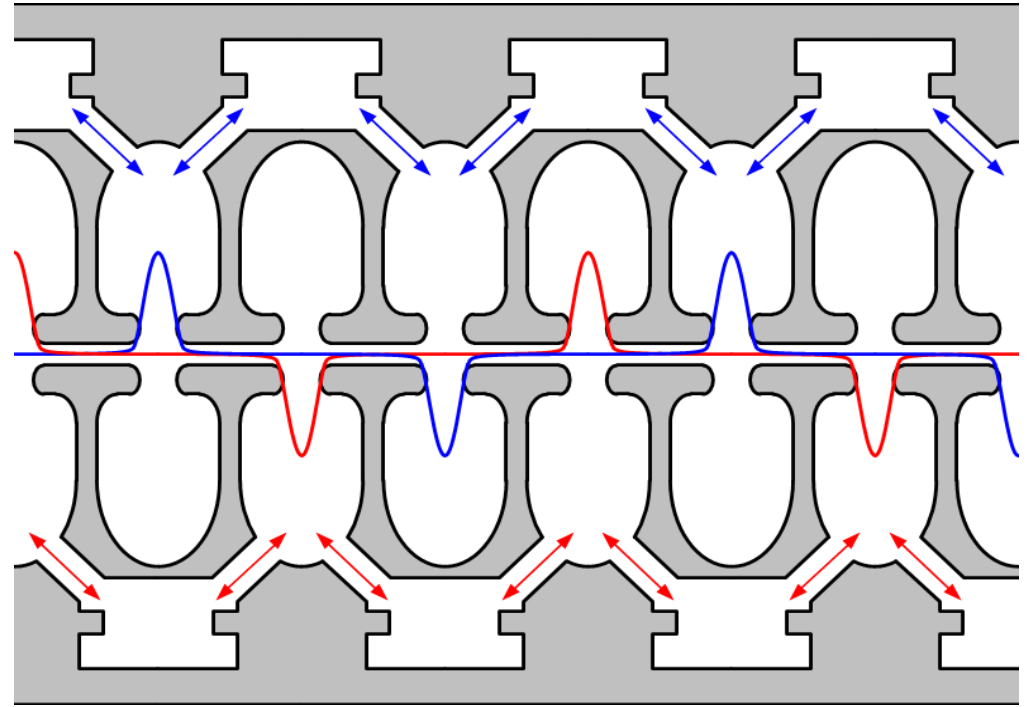
Quasi traveling wave side coupled cavities

The close nose makes focus field. Our DAW RF gun is using this focus field. Side coupled cavity also can be made the close nose. But, long drift space is problem. One solution is to use tow standing wave cavity.

Normal side coupled cavities

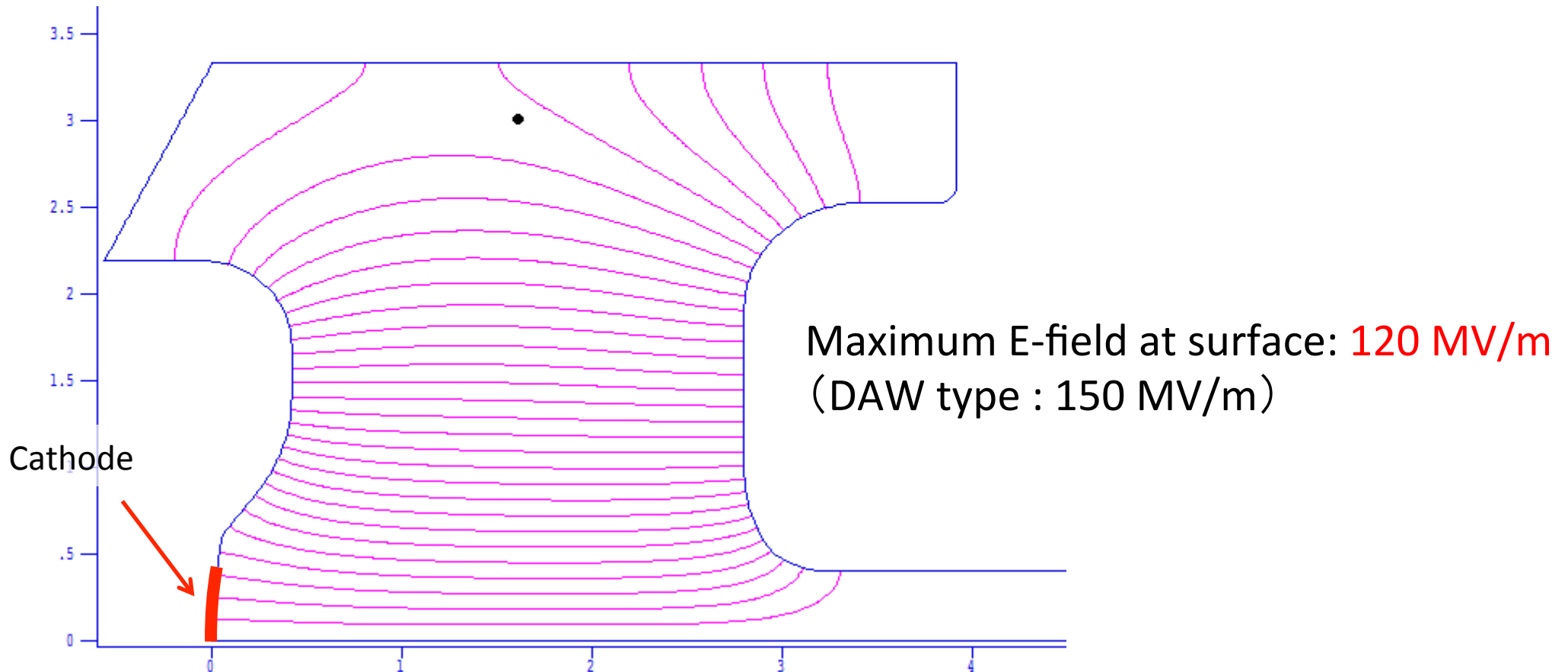


Quasi traveling wave side coupled cavities



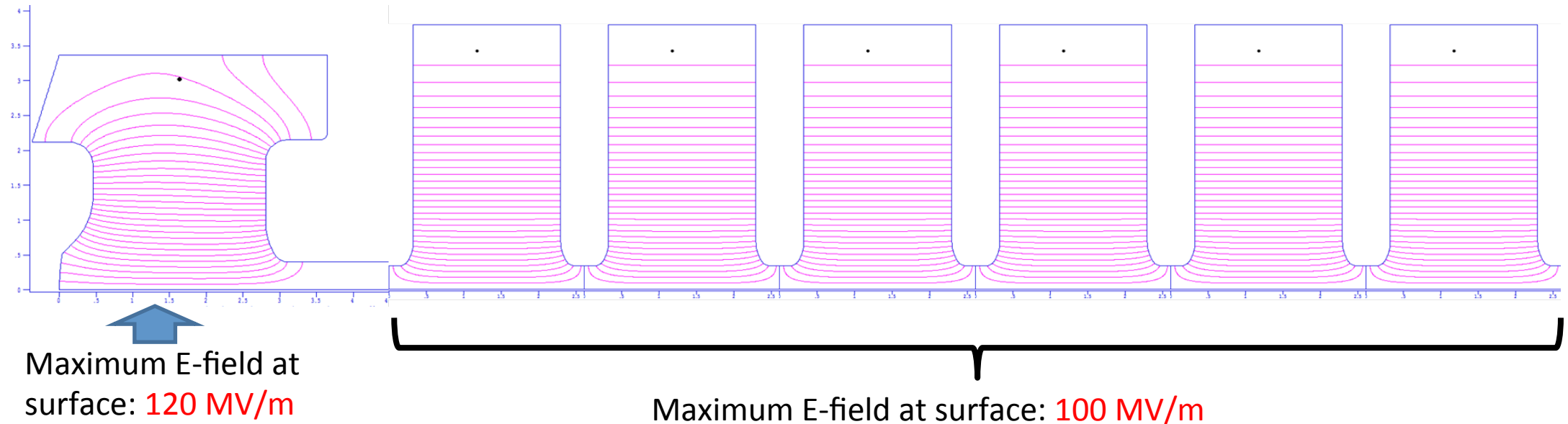
1st Cavity Design (cathode cell)

Finally, we gat optimum cavity shape.



Whole cavities design

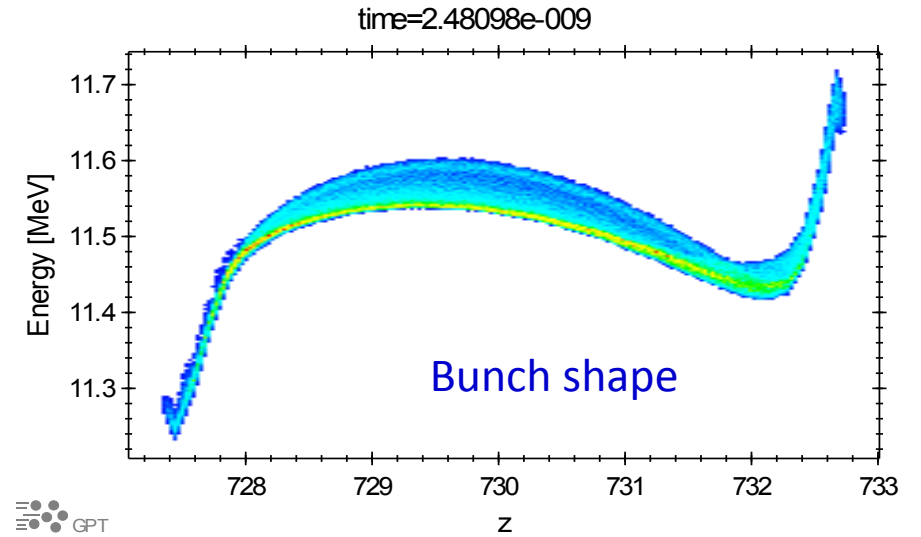
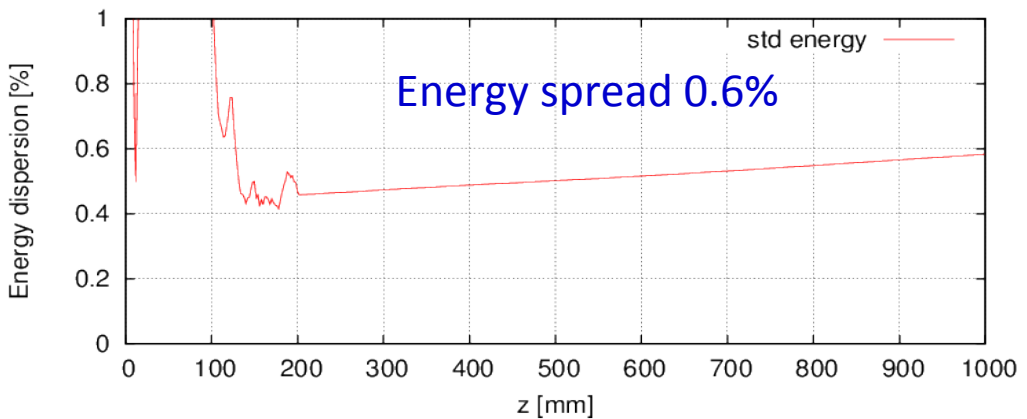
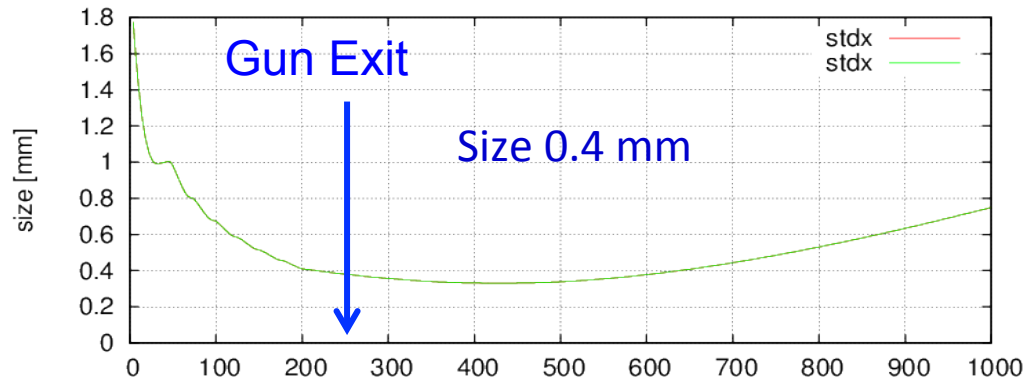
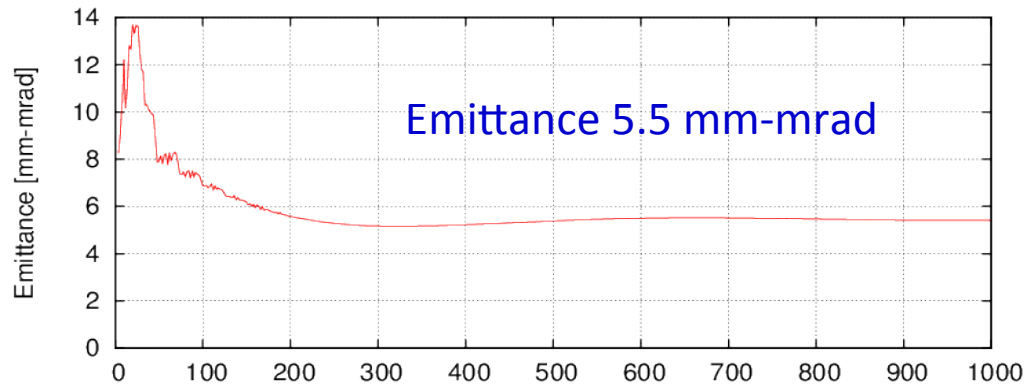
This RF gun has total of seven acceleration cavities. These are divided into two standing wave structure of 3 and 4 side coupled cavities respectively.



Emittance: 5.5 mm-mrad @ 5 nC

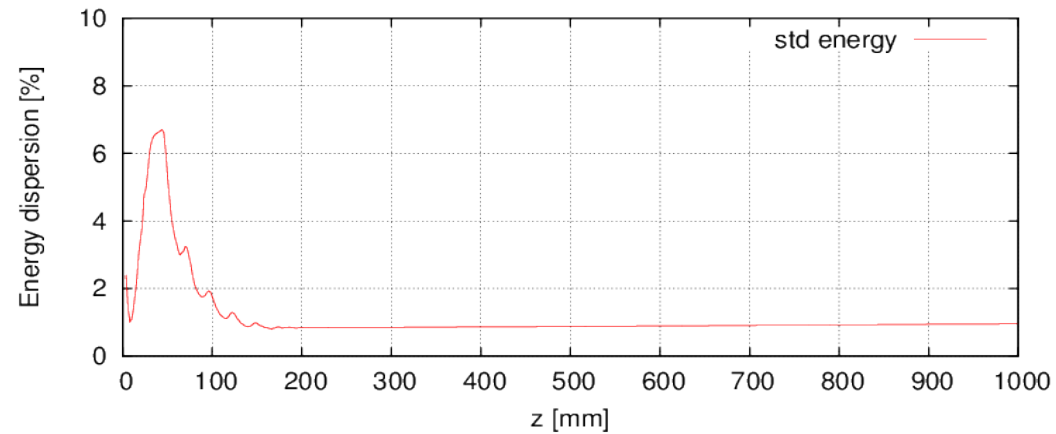
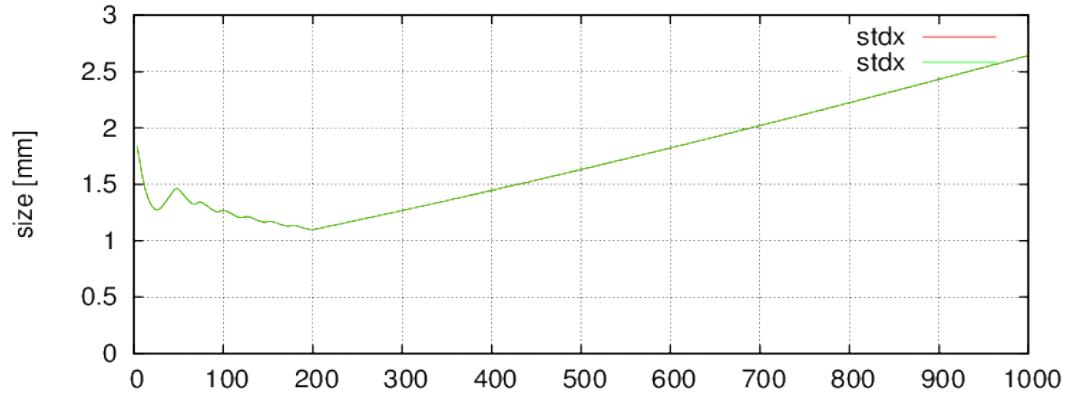
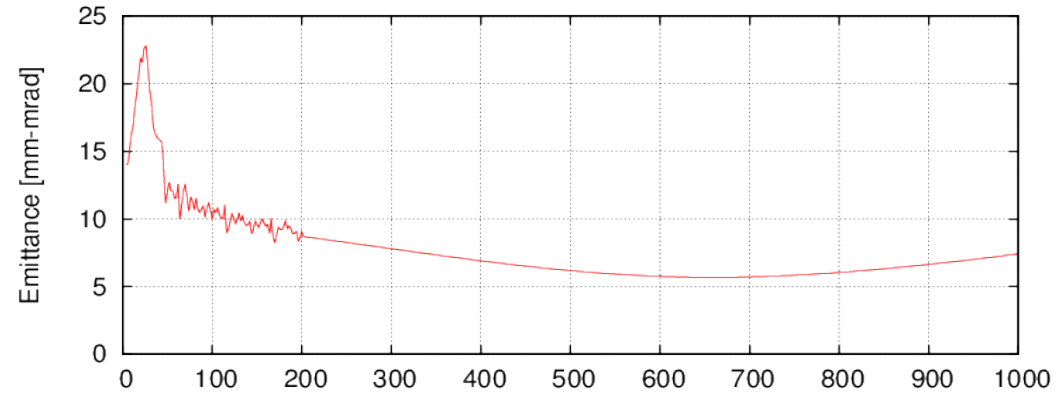
This RF gun can generate 10 nC beam

Beam tracking simulation result (5 nC)



5 nC 11.5 MeV parallel beam

Beam tracking simulation result (10 nC)



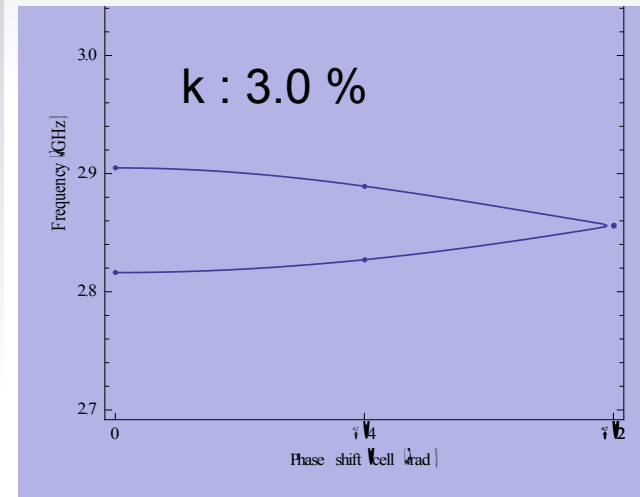
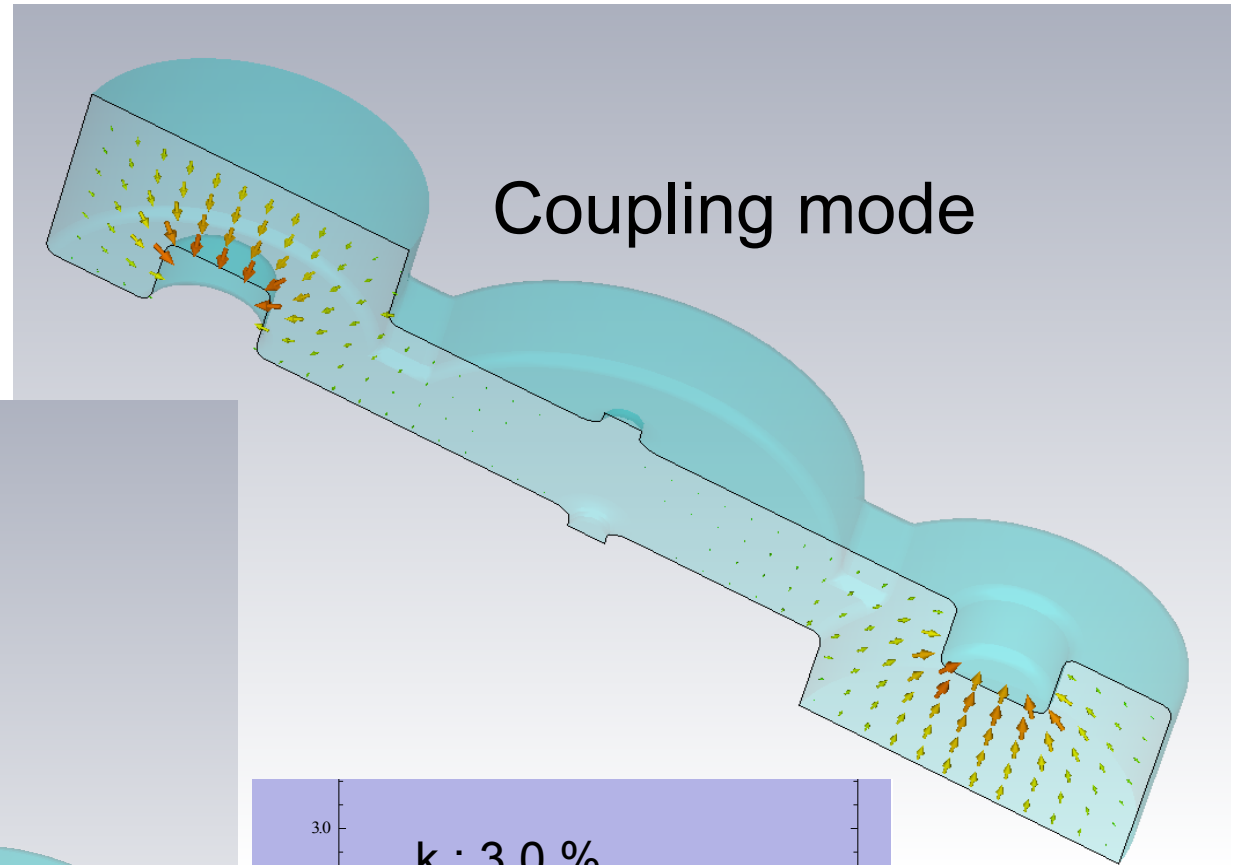
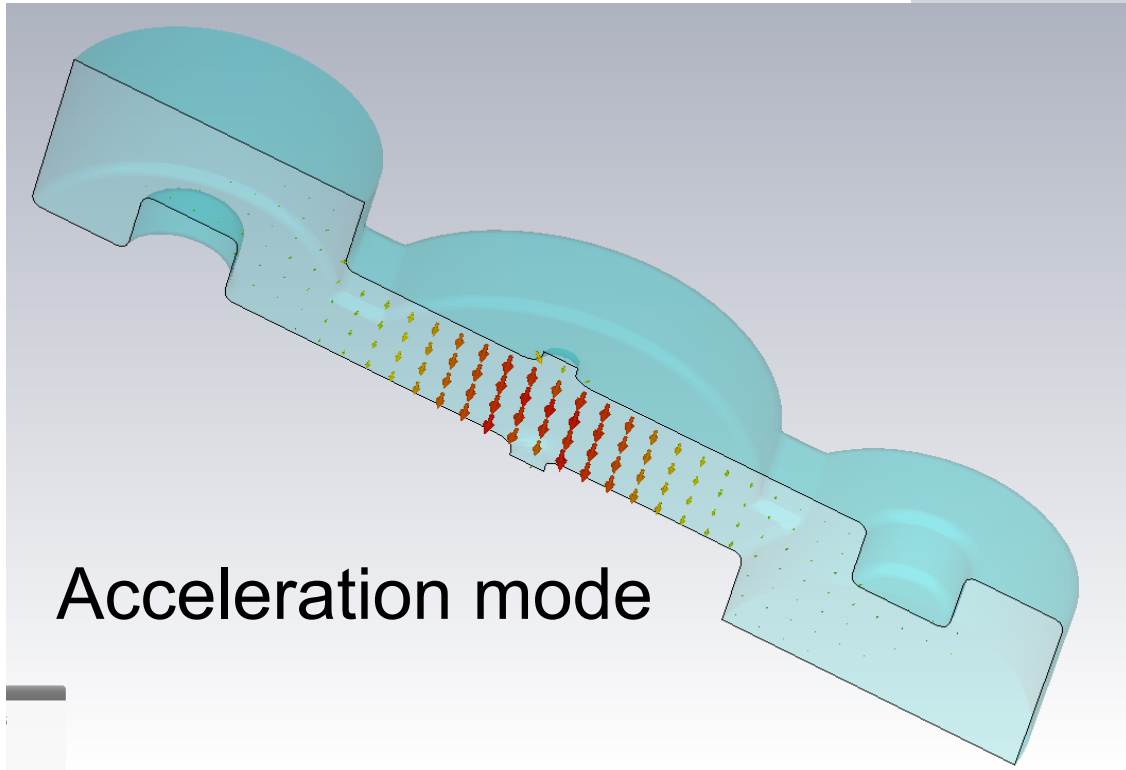
This RF gun can generate 10 nC beam.

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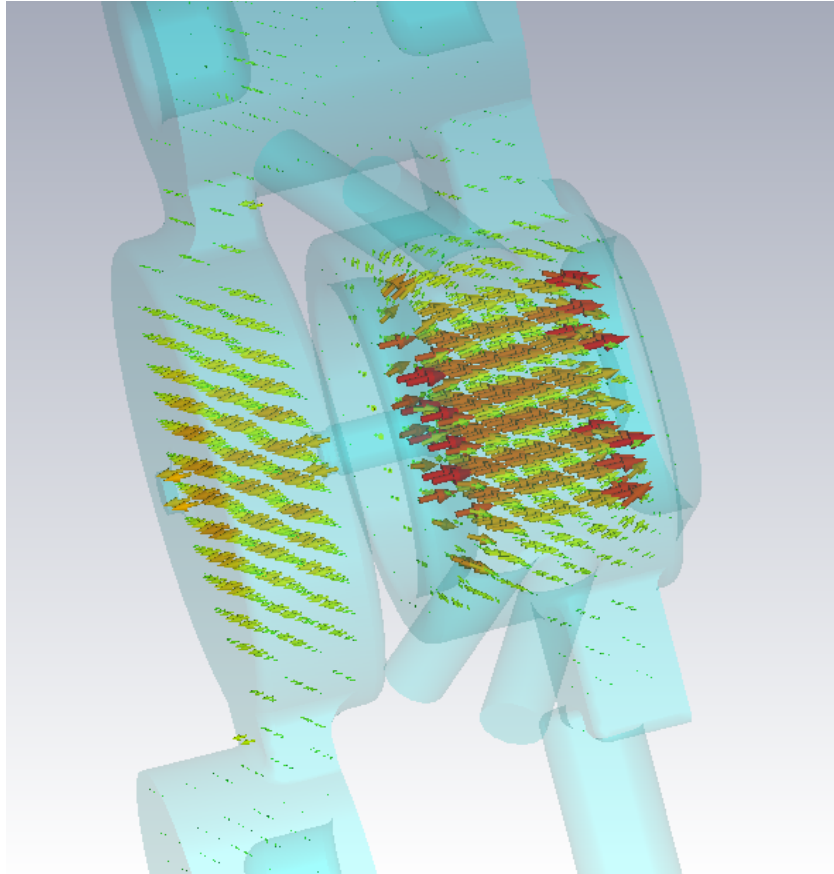
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3D cavity calculation

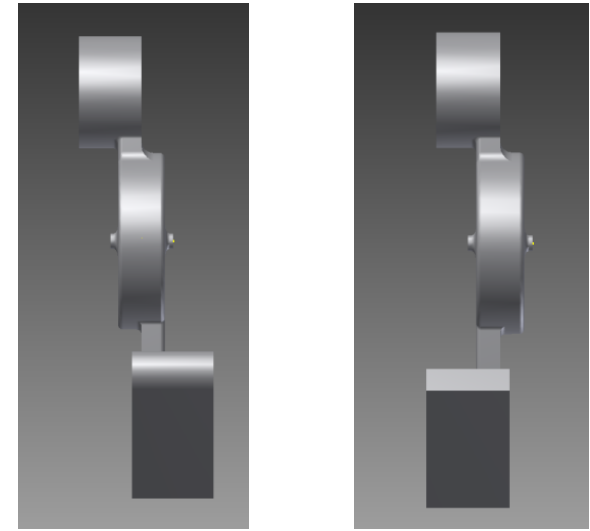
Regular cell



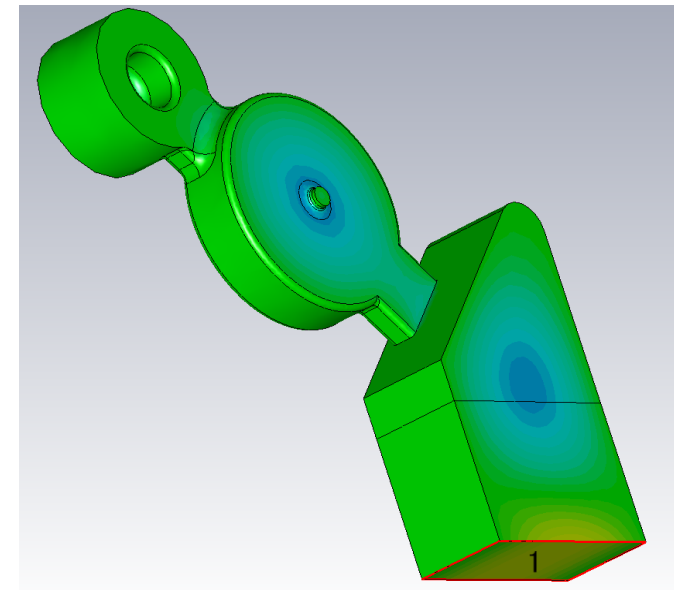
3D cavity calculation



1st cavity calculation

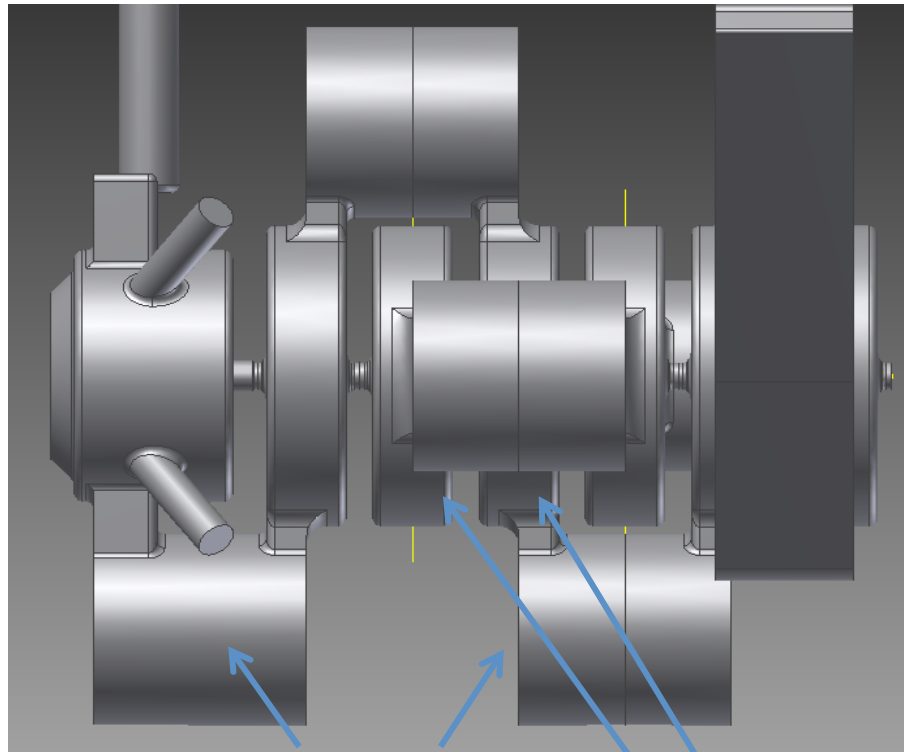


2 types coupler



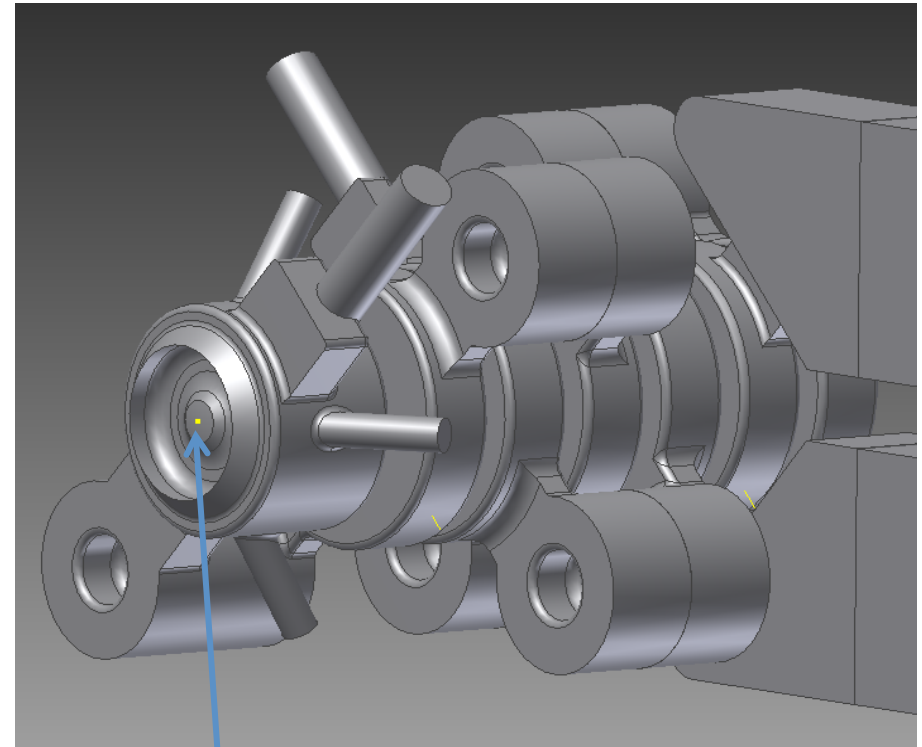
Coupler calculation

Whole cavity shape



coupling cavities

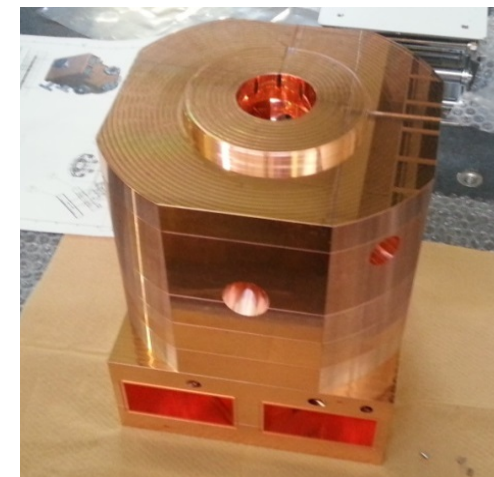
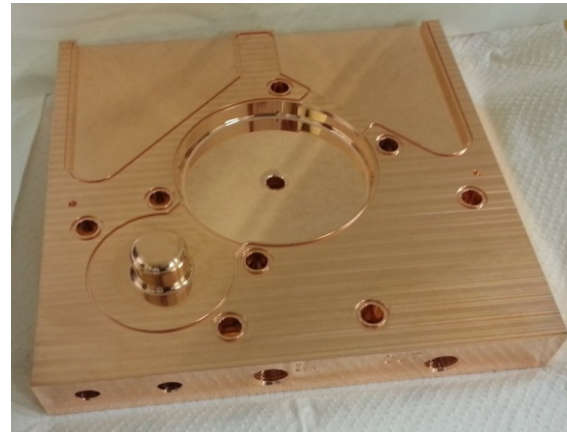
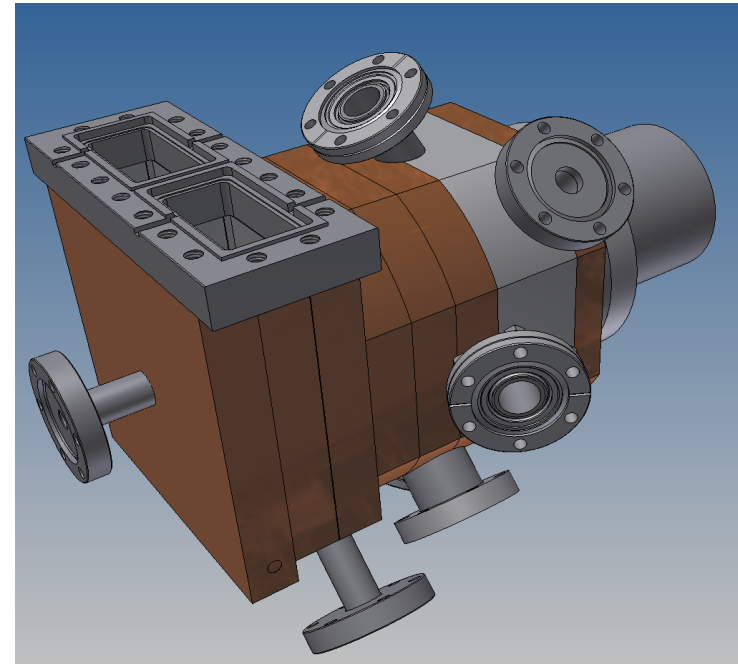
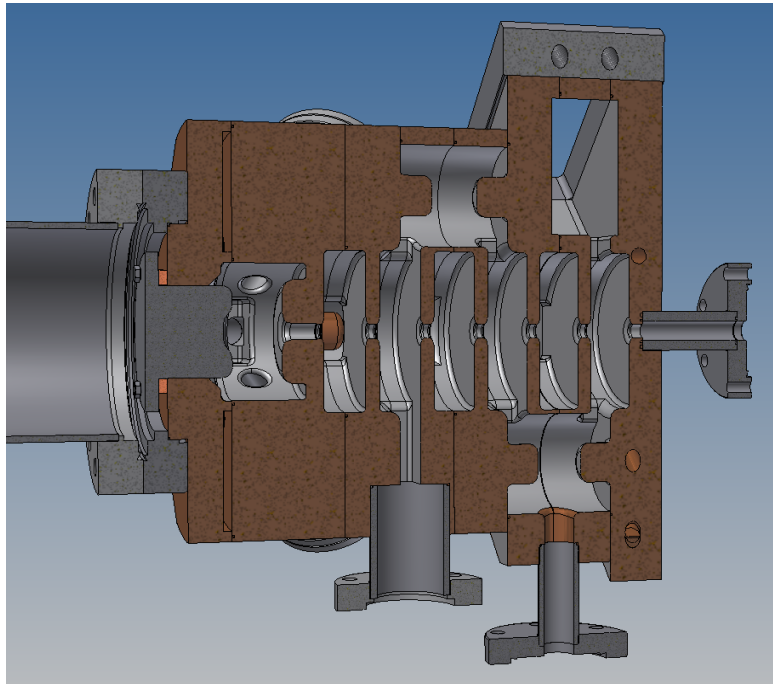
accelerating
cavity



cathode

Cavity shape

Mechanical design and manufacturing



Conclusion

- We are developing a photo cathode S-band RF gun for SuperKEKB.
- DAW type RF gun generated 4.8 nC. We confirmed electric field focus in the cavities.
- However DAW type RF gun is not enough to our SuperKEKB operation.
- A new quasi-traveling wave RF gun have developed. It is suitable for the high charge low emittance beam generation.
- The quasi-traveling wave RF gun will be tested soon.