(WG422: Low emittance electron guns)

Proposal of a Photocathode Impulse-Gun and Followed by Impulse Accelerating Structures to Produce Low Emittance Electron Beam

Yoshitaka Kawashima

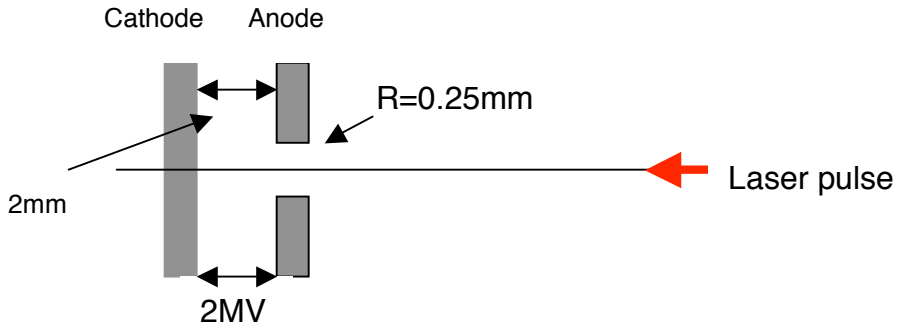
JASRI/SPring-8 Accelerator division
1-1-1 Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5198, JAPAN

1. Short review

(a) M.J. de Loos et al.,

"PRODU"CTION OF ULTRA-SHORT, HIGH CHARGE, LOW EMITTNCE ELECTRON BUNCHES USING A 1GV/M DC GUN"

(Proceedings of the 1999 Particle Accelerator Conference, New York (1999) pp.3266-3268.)



Merit: low emittance beam

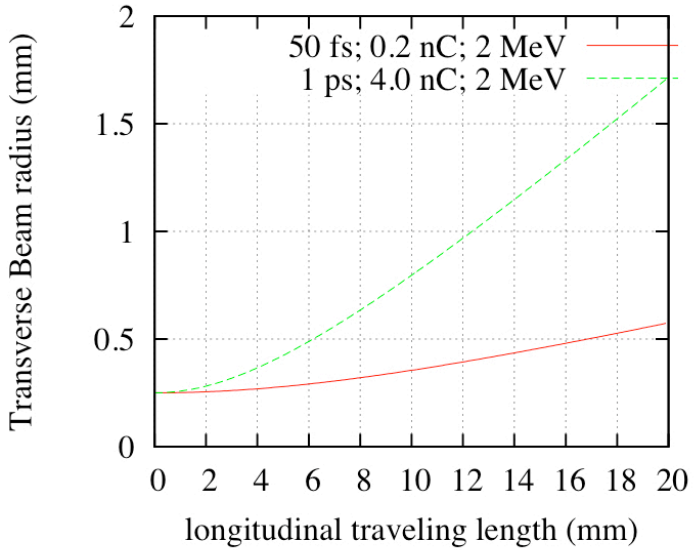
(b) F.B.Kiewiet et al., Proceedings of EPAC 2000,Vienna, Austria (2000) pp.1660.

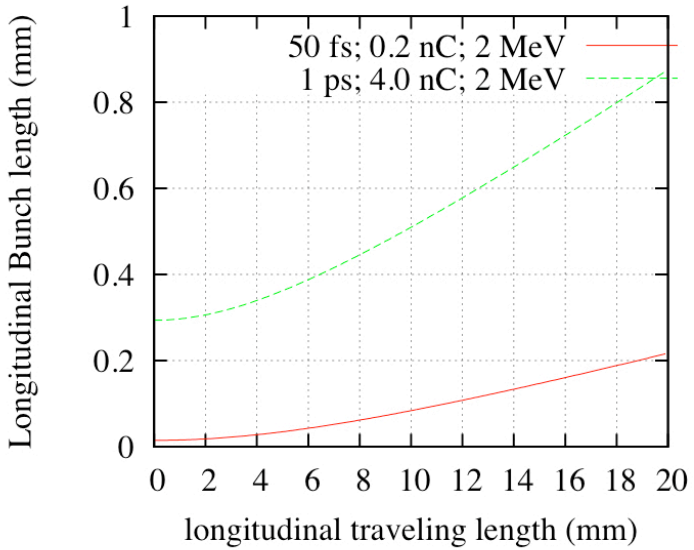
"A DC/RF GUN FOR GENERATING ULTRA-SHORT HIGH-BRIGHTNESS"

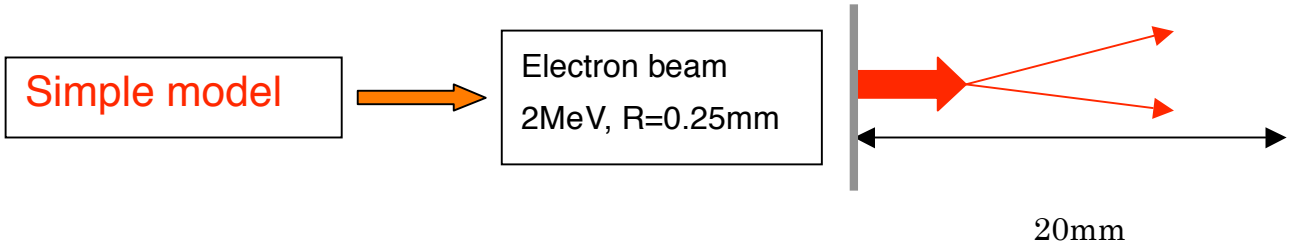
Combination of a DC gun and an RF cavity

2. Emittance growth due to space charge effect in drift space

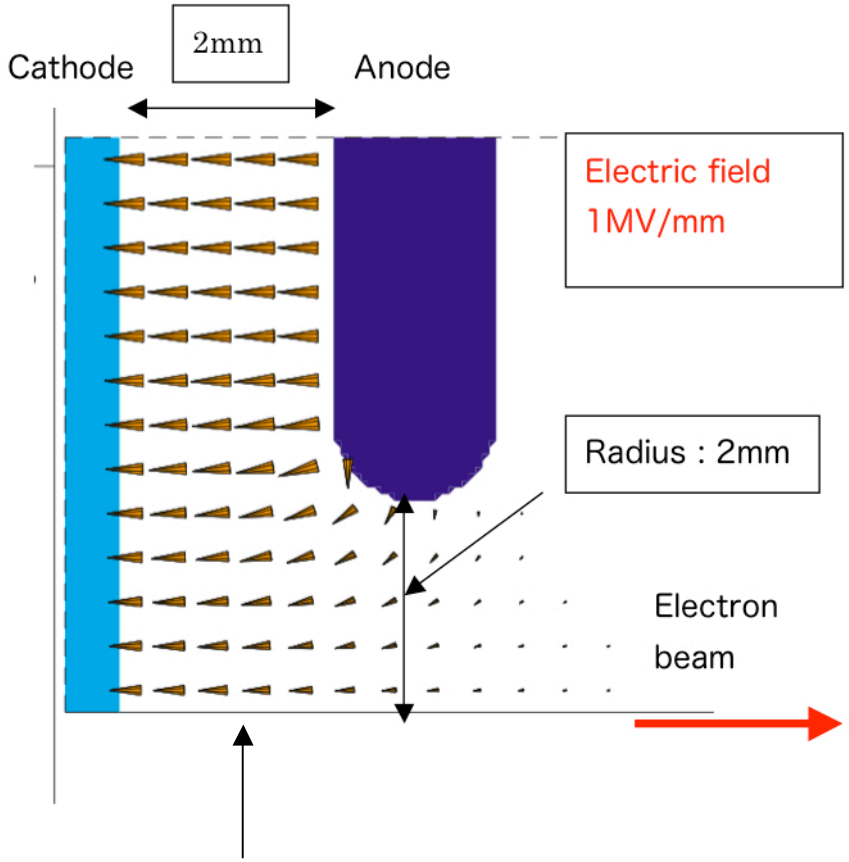
Space charge effect: analytical calculation results







Electric field map calculated by MAFIA



Basing on the de Loos et al. ‘s idea.

3. Impulse high voltage (HV) generator

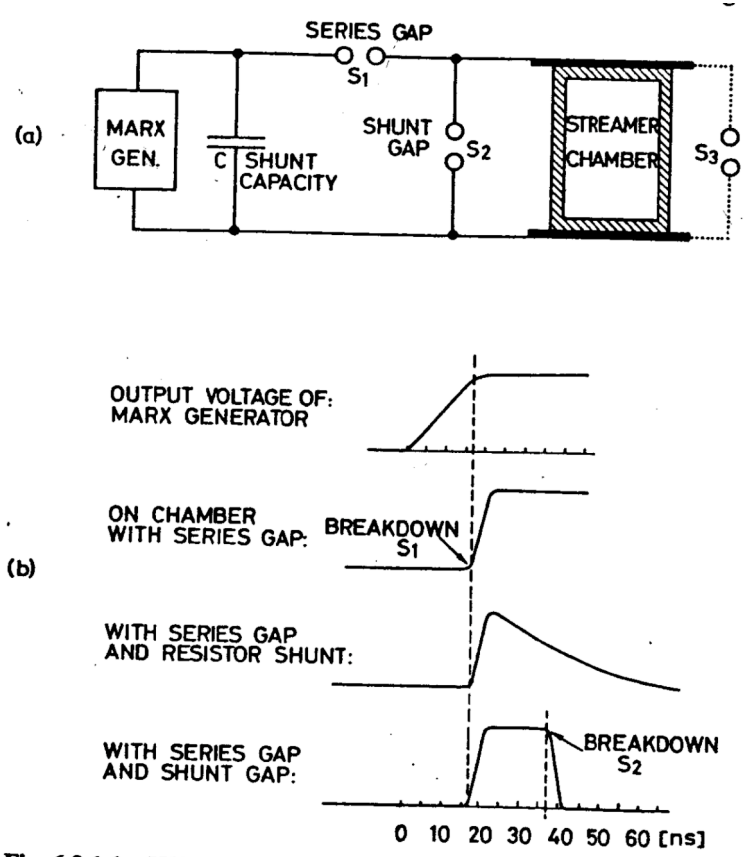


Fig. 6.2.1.1 HV pulse shaping with series and shunt spark gaps.

Chikovani and Roinishvili et al.

Reference (Famous textbook)

P. Rice-Evans

"Spark, Streamer, Proportional and Drift Chambers"

Richelien Co.

Goal:

To generate high voltage:

HV= 2MV, time width = 1 or 2ns.

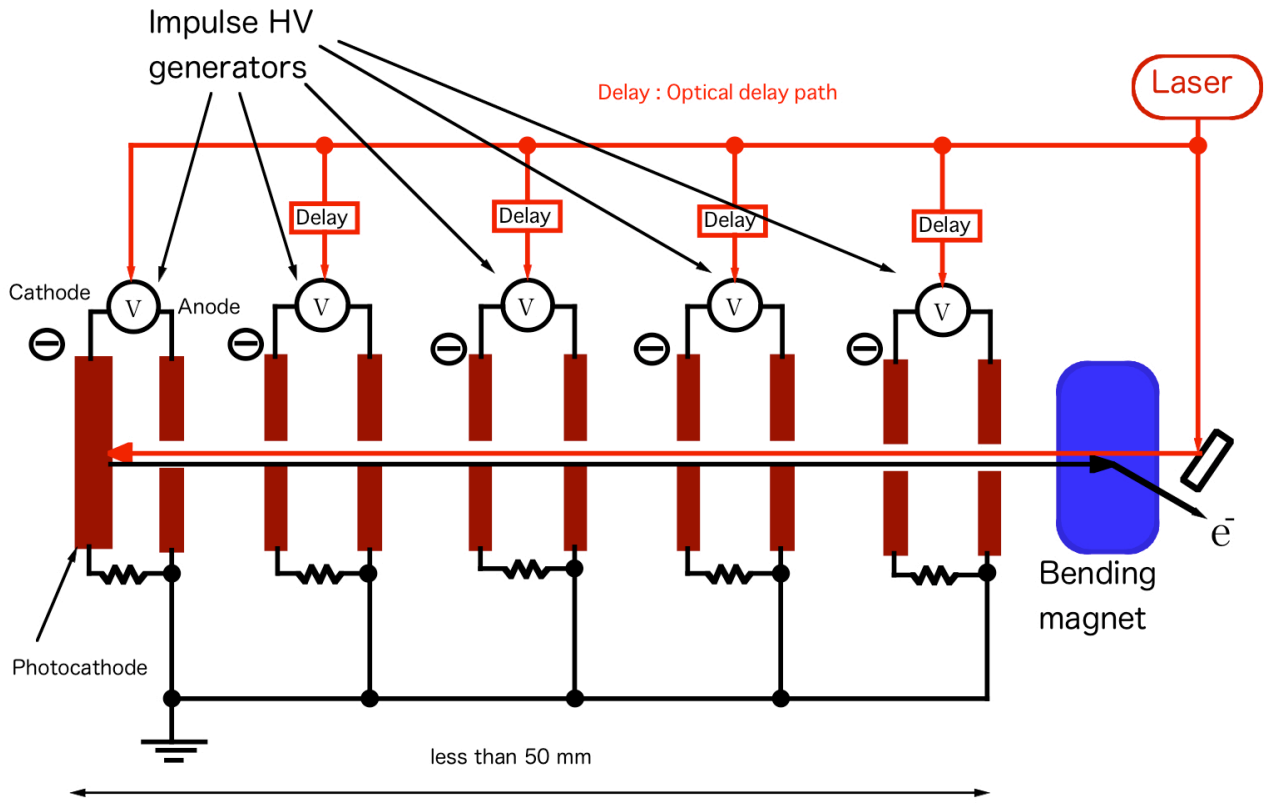
We may say that the technology of the impulse HV generator has been established in particle physics field.

S.B.Brussaard and D.Vyuga,

Plasma Science, IEEE transactions on Vol.32 (2004) 1993-1997.

4. A method to raise the beam energy and keep the low emittance

Schematic view



5. Summary

In order to obtain low emittance beam for FEL ;

Combinaiton of (1) + (2) is the best solution at present.

(1) photocathode impulse-gun

(2) followed by impulse accelerating structures

We should concentrate on the development of the impulse HV generator.