CONCEPT OF ELECTRON SOURCE BASED ON PULSED PLASMA DISCHARGE

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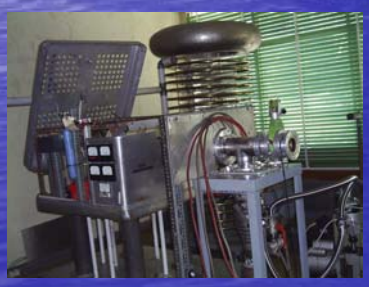

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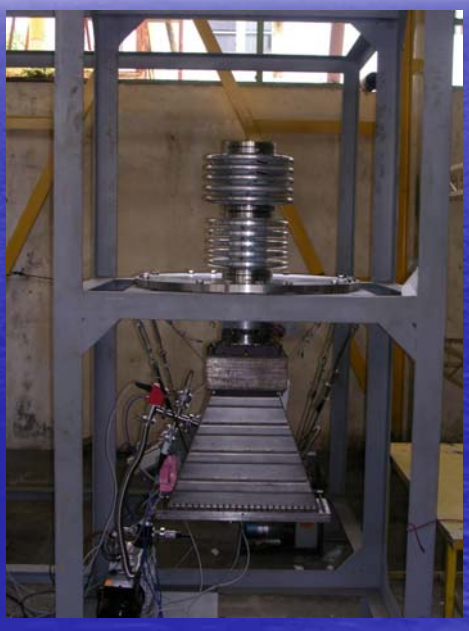
ELECTRON BEAM MACHINE



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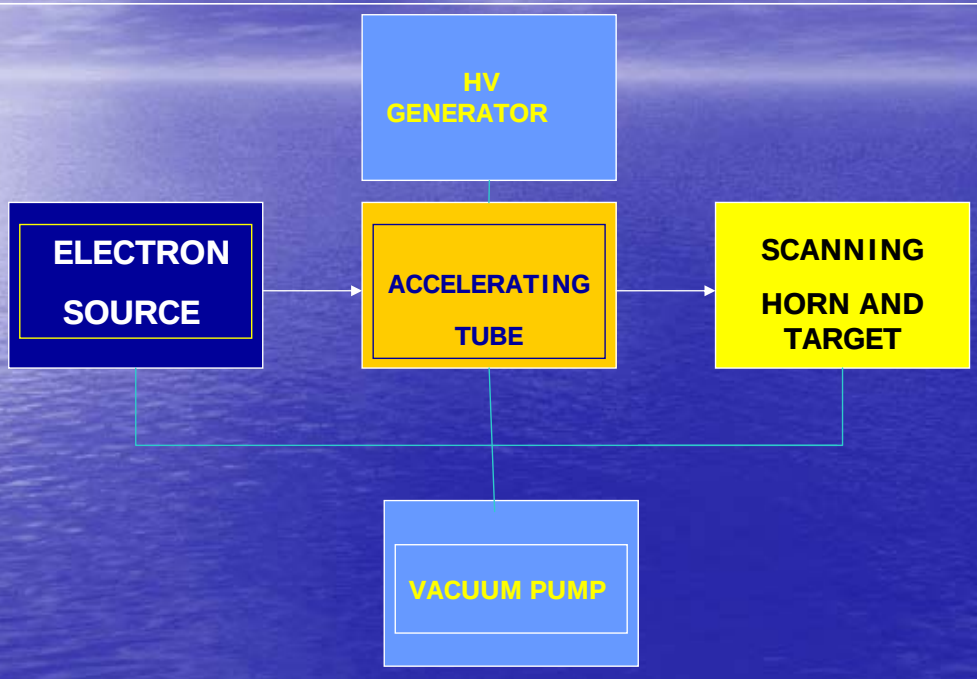
ELECTRON SOURCE

THIS ELECTRON SOURCE BASED ON FILAMENT :

- DEPENDS ON FILAMENT CURRENT, LIMITED
- OPERATED IN CONTINUOUS MODE.

EFFECT :
-CURRENT LIMITED
- LOW DOSE
-TAKES TIME
-HEATING ON TREATED MATERIAL
-HIGH COST

ELECTRON BEAM MACHINE : COMPONENTS



THE NEXT ELECTRON BEAM MACHINE

SOUTH EAST ASIAN COUNTRIES :

NATURAL RUBBER PRODUCERS

WHAT WE NEED :
1. HIGH CURENT, SO HIGH DOSE
2. WIDE AREA
3. PULSE MODE

WHO IS THE CANDIDATE ?
PLASMA ?

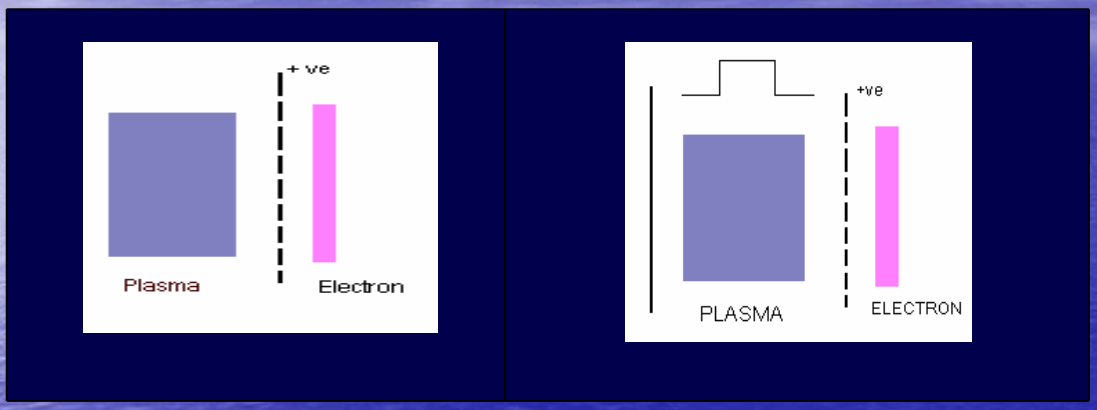
WHY PLASMA ?

PLASMA :

- RICH OF ELECTRON AND ION
- COULD BE OPERATED IN PULSE MODE
- CONTROLLED BY ELECTROSTATIC POTENTIAL OR MAGNET.
- GIVES ION DUE TO –VE POTENTIAL
- GIVES ELECTRON DUE TO +VE POTENTIAL

THE LAST PROPERTY IS THE BASIS OF ELECTRON SOURCE BASED ON PLASMA.

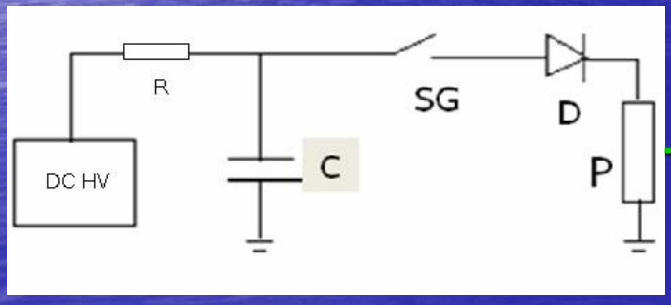
TWO TYPE OF ESBP

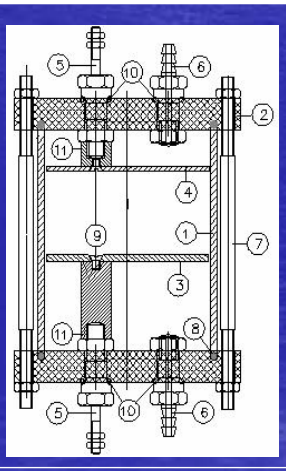


(a)	(b)
-Needs two generator, first one produces plasma, the scond attracts electron	- Needs only 1 generator - has two function, produces plasma and attracts electron

ADVANTAGE AND DISADVANTAGE

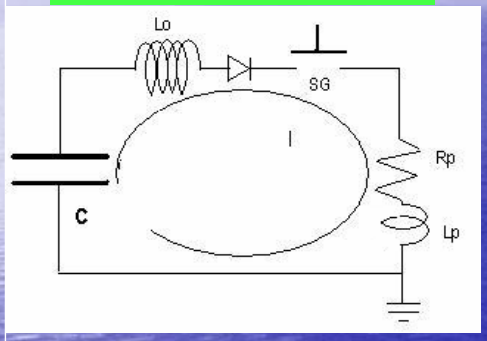
-IT WORKS INDEPENDENTLY -SOPHISTICATED -NEEDS SYNCHRONISATION -BEAMS MORE STABLE	-SIMPLE IN CONSTRUCTION -SIMPLE IN OPERATING -ENERGY LOST IS HIGH





CIRCUIT ANALYSIS

EQUIVALENT CIRCUIT



CIRCUIT EQUATION

$$V_0 = L_0 \frac{dI}{dt} + IR_p + IR_D + \frac{\int Idt}{C} + L_p \frac{dI}{dt}$$

NORMALIZED CIRCUIT EQUATION

$$1 - (1+\beta)\frac{d\imath}{d\tau} - \imath(\alpha + \alpha_D) - \int \imath d\tau = 0$$

NORMALIZATION FACTOR

$$\imath = \frac{I}{I_0}, I_0 = \frac{V_0}{\sqrt{\frac{L_0}{C}}}$$

$$\tau = \frac{t}{t_0}, t_0 = \sqrt{L_0 C}, \alpha = \frac{R}{\sqrt{\frac{L_0}{C}}}, \beta = \frac{L_p}{L_0}, \alpha_D = \frac{R_D}{Z}$$

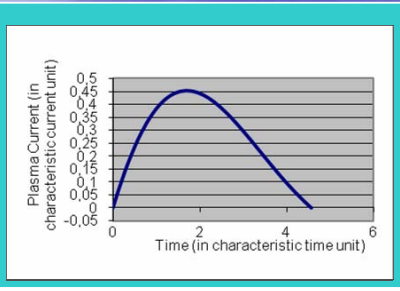
LIMIT CONDITIONS

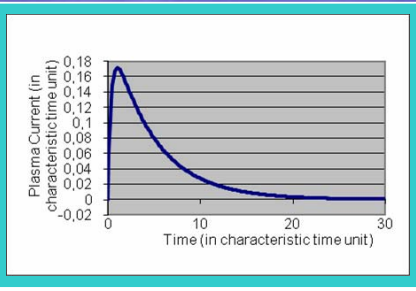
$$\frac{d\imath}{d\tau} = \frac{1}{(1+\beta)}, \int \imath d\tau = 0$$

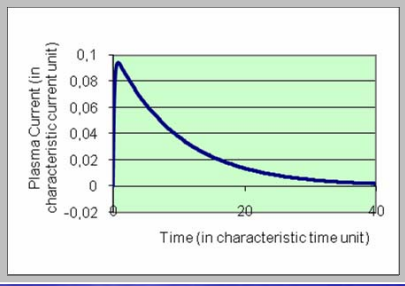
At $\tau = 0$, $\imath = 0$

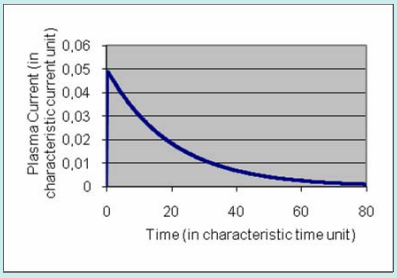
RESULTS AND DISCUSSION

Plasma current as function of time for R_D =1, 5, 10, 20

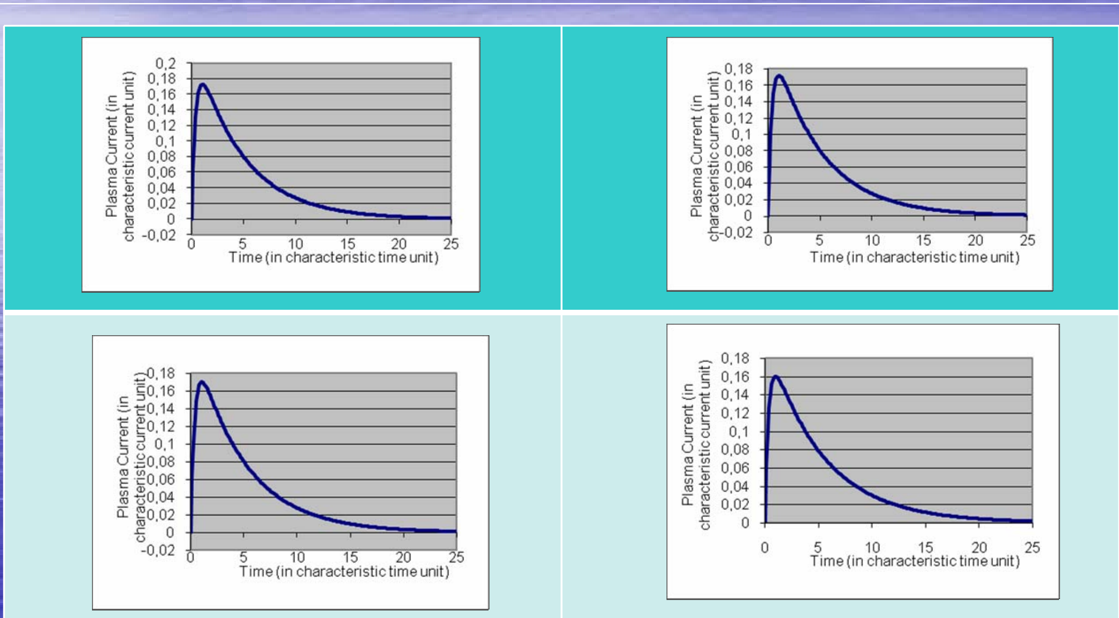








Plasma current as function of time for R_P =0.001,0.05,0.1, 0.5



DISCUSSION

For bigger R_D, the rise time of plasma current will be faster, their decaying time is slower and peak current is smaller. These data will be important in designing such machine. From this figure, in order to get high current, it is recommended that R_D should be 3-5 time higher than characteristic impedance Z. For higher R_D, it seems that the electron sources will be inefficient, because its plasma current is too low.

DISCUSSION

It seems that for higher R_P, the plasma current will be decreased, decaying time will be longer, and rise time will be slower. So, it is resumed that for R_P is smaller will increase the plasma current.

The computational result shown above has not drawn the actual machine yet, but it is useful as basic understanding in designing the machine

CONCLUSIONS

It has been shown basic principle of electron source based on pulsed plasma discharge. Using simple equation, it is shown that by varying some parameters like diode resistance and plasma resistance, some plasma characteristics like plasma current, rise time, and decaying time will be understood. Higher plasma current will impact in achieving higher electron beam current in electron source based on pulsed plasma discharge.

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