T. Garvey / LAL – Orsay
CTF3 Review, October 2001.

- Gun Electronics
- High Voltage System
- Pre-bunching Cavities

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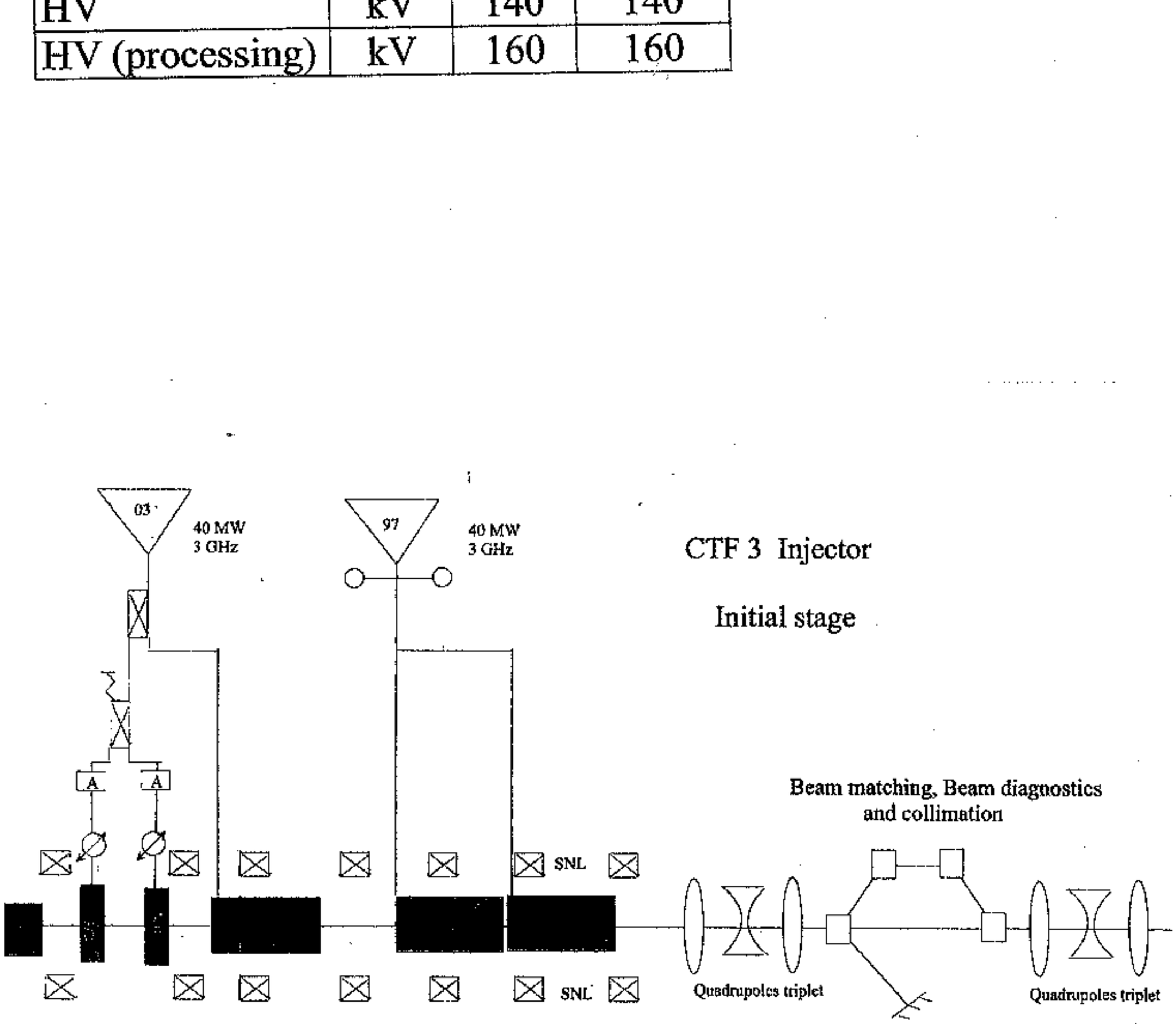
CTF3 GUN specification

	UNIT	OLD	NEW
Voltage stability	%	0.1	1
Current	A	9	6
Current flat-top	%	0.1	1 -> 0.1
HV	kV	140	140
HV (processing)	kV	160	160



f_{RF} = 2.99855 GHz for all RF structures

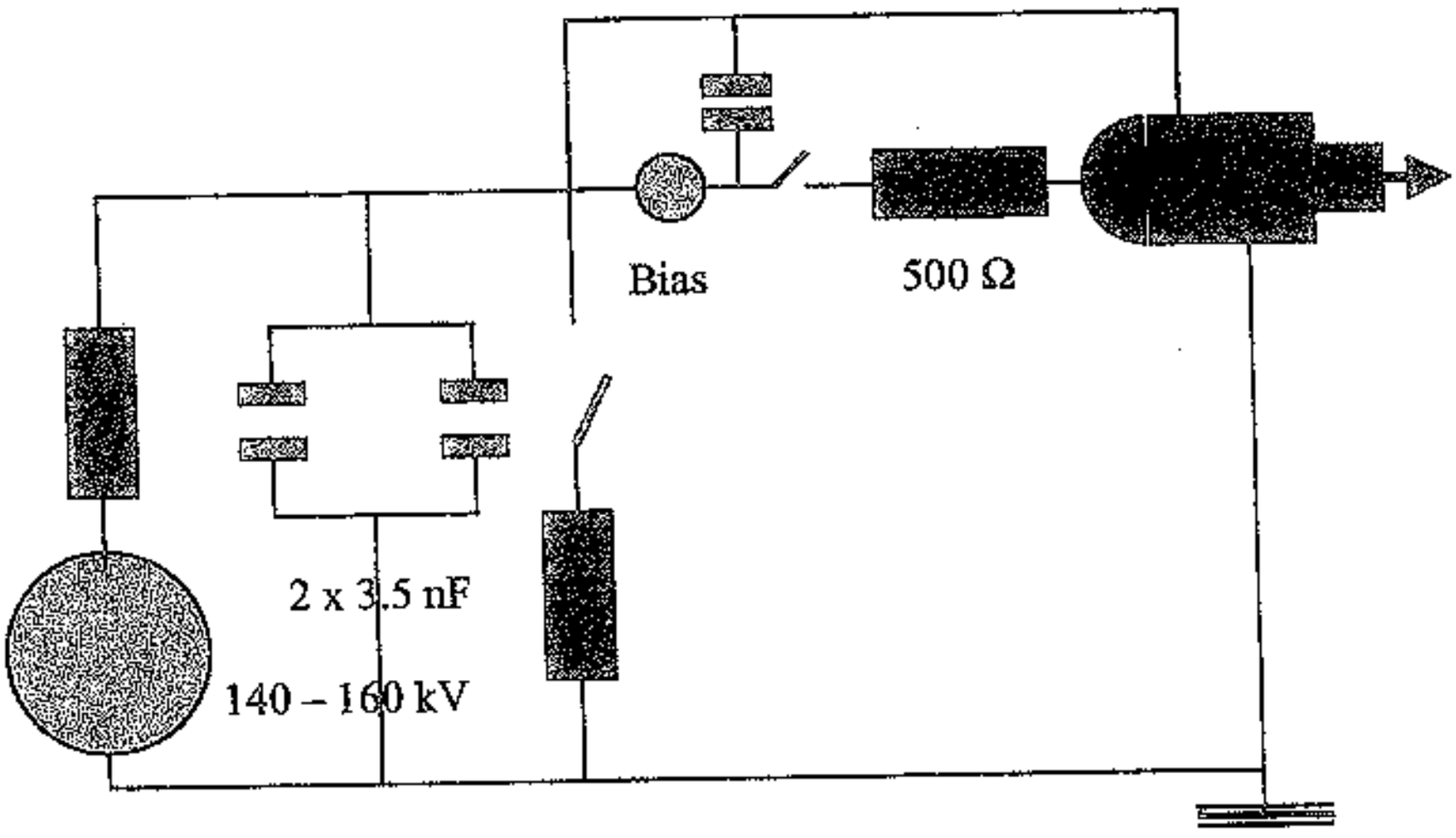
PB1, PB2 = Pre-bunchers

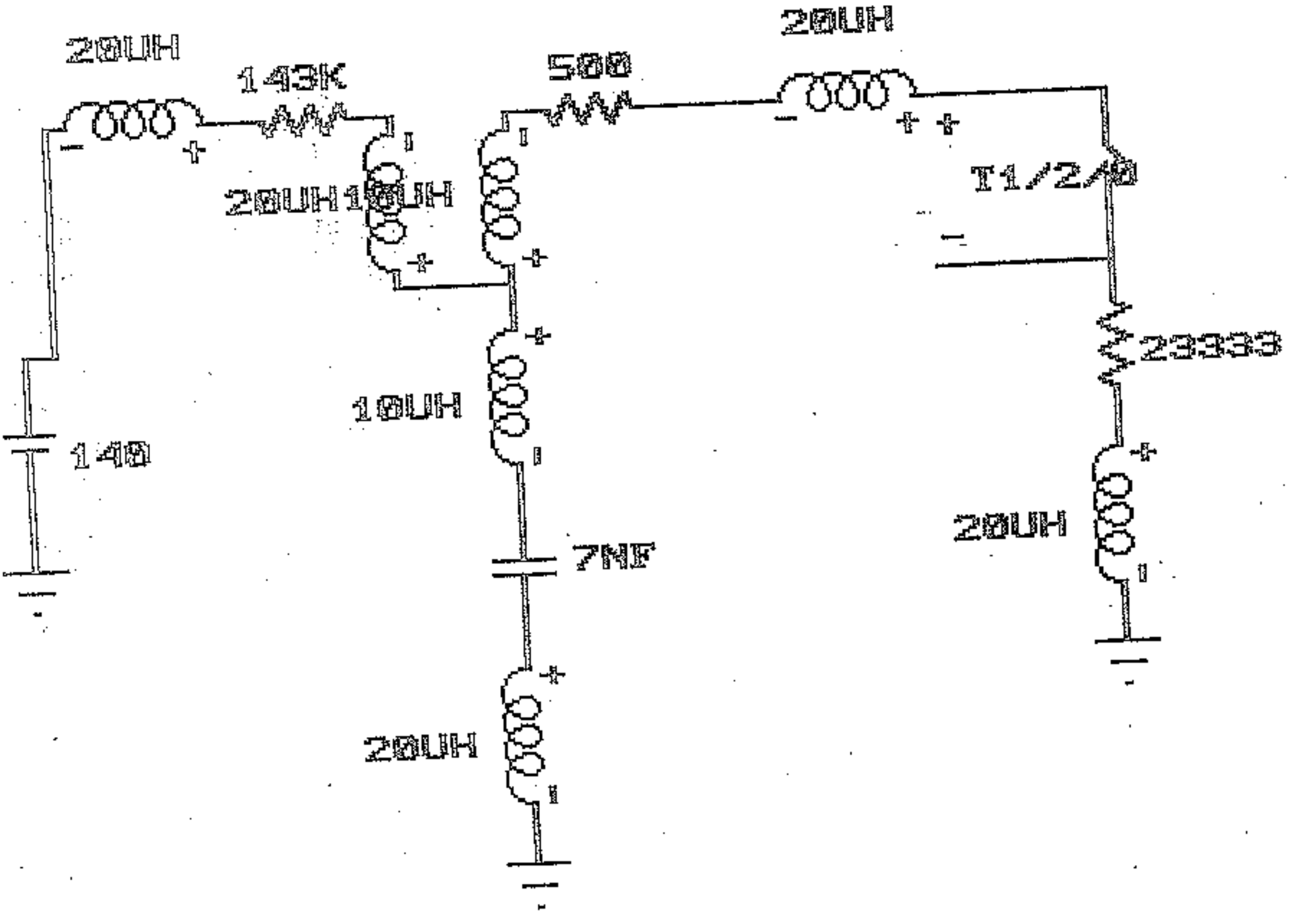
B1 = Bunching system (TW structure)

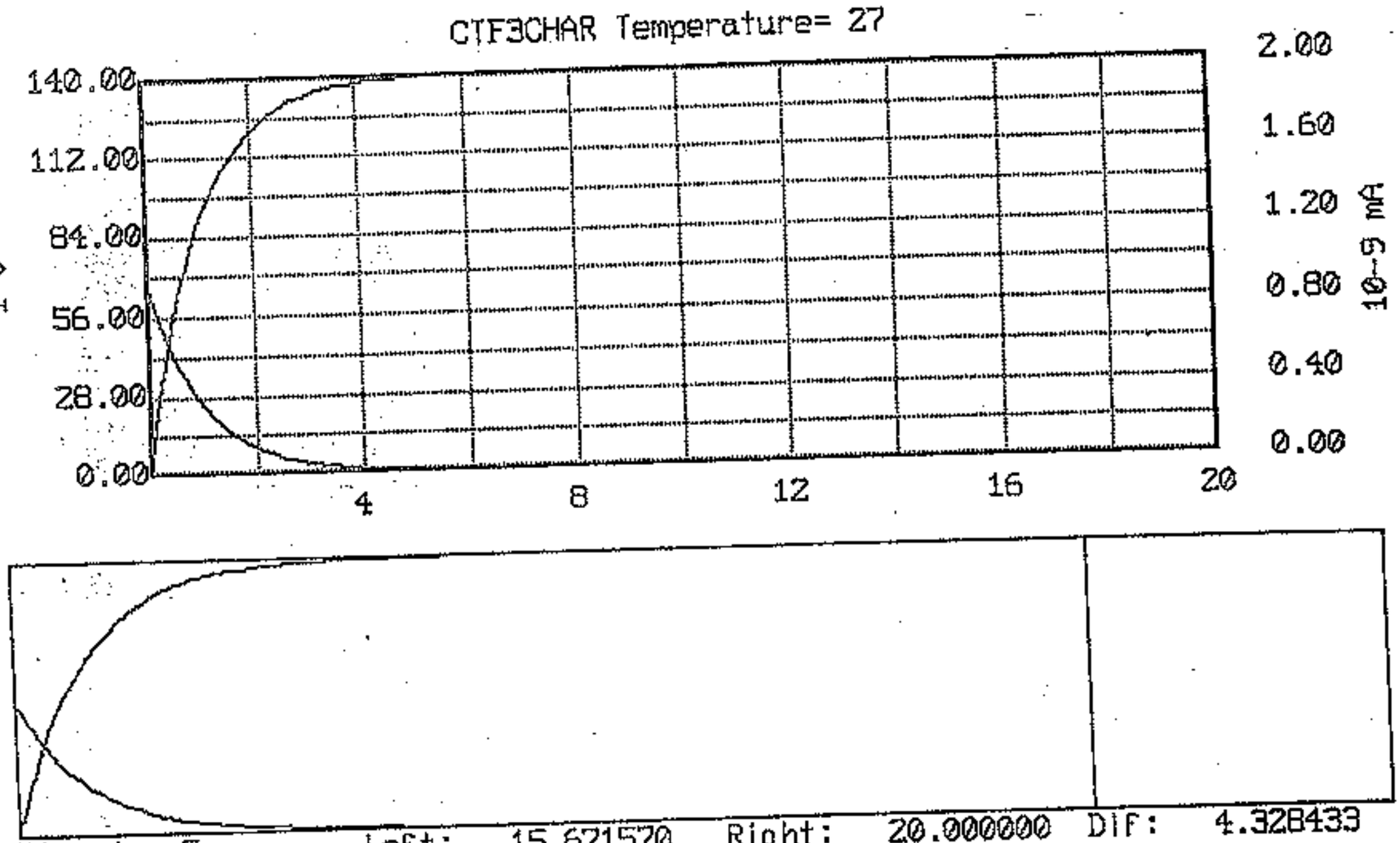
S1, S2 = Accelerating system (TW, 1.3 m , 9.2 MV/m)

SNL = Solenoids

Schematic layout of CTF3 gun







Short-circuit protection

With the new parameters:

$I = 6\ A \Rightarrow Q \sim 10\ \mu C \quad \Delta V/V = 1\% \Rightarrow C = Q/\Delta V = 7nF$

Stored energy = 70 J

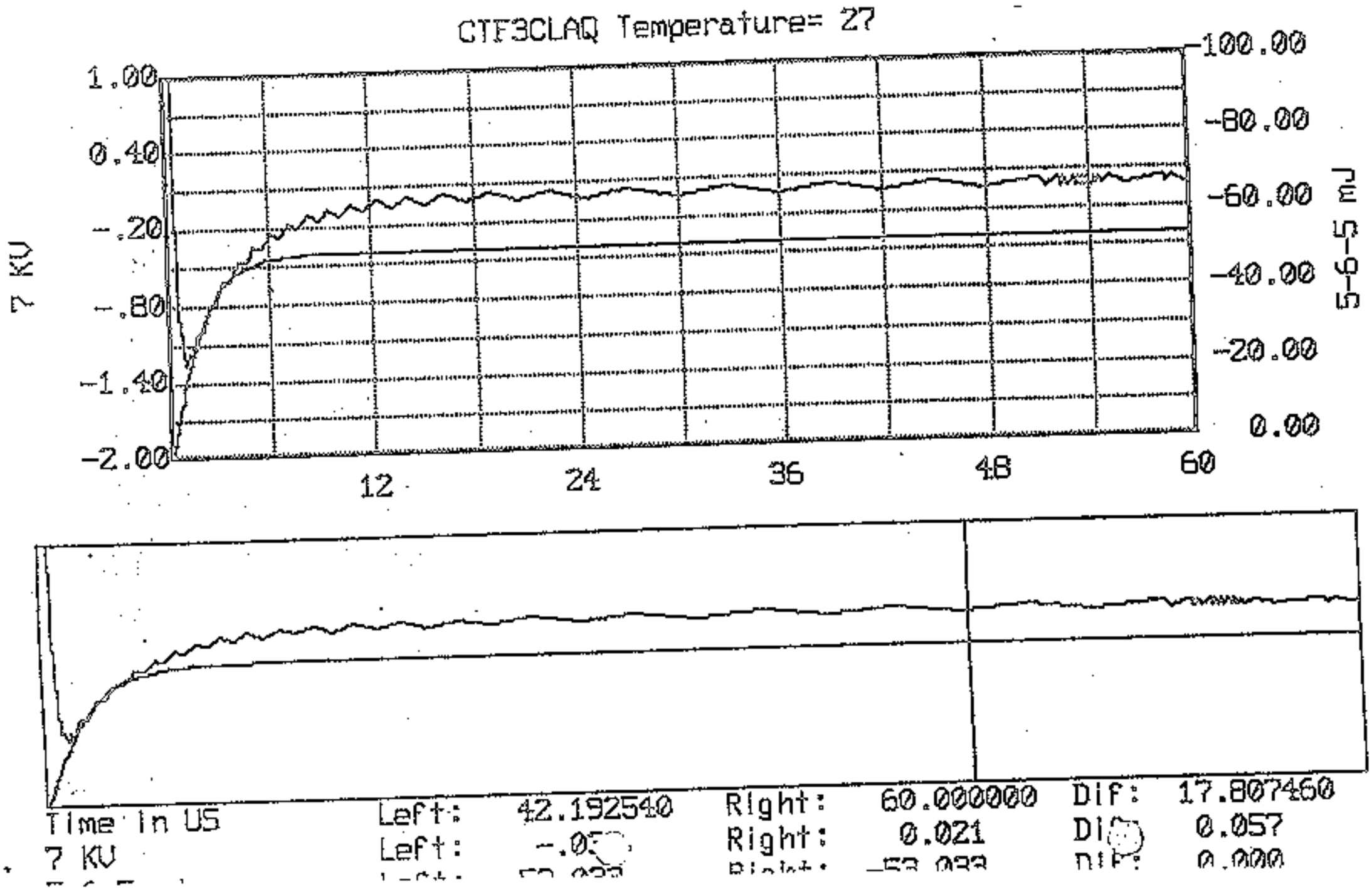
Hypothesis:

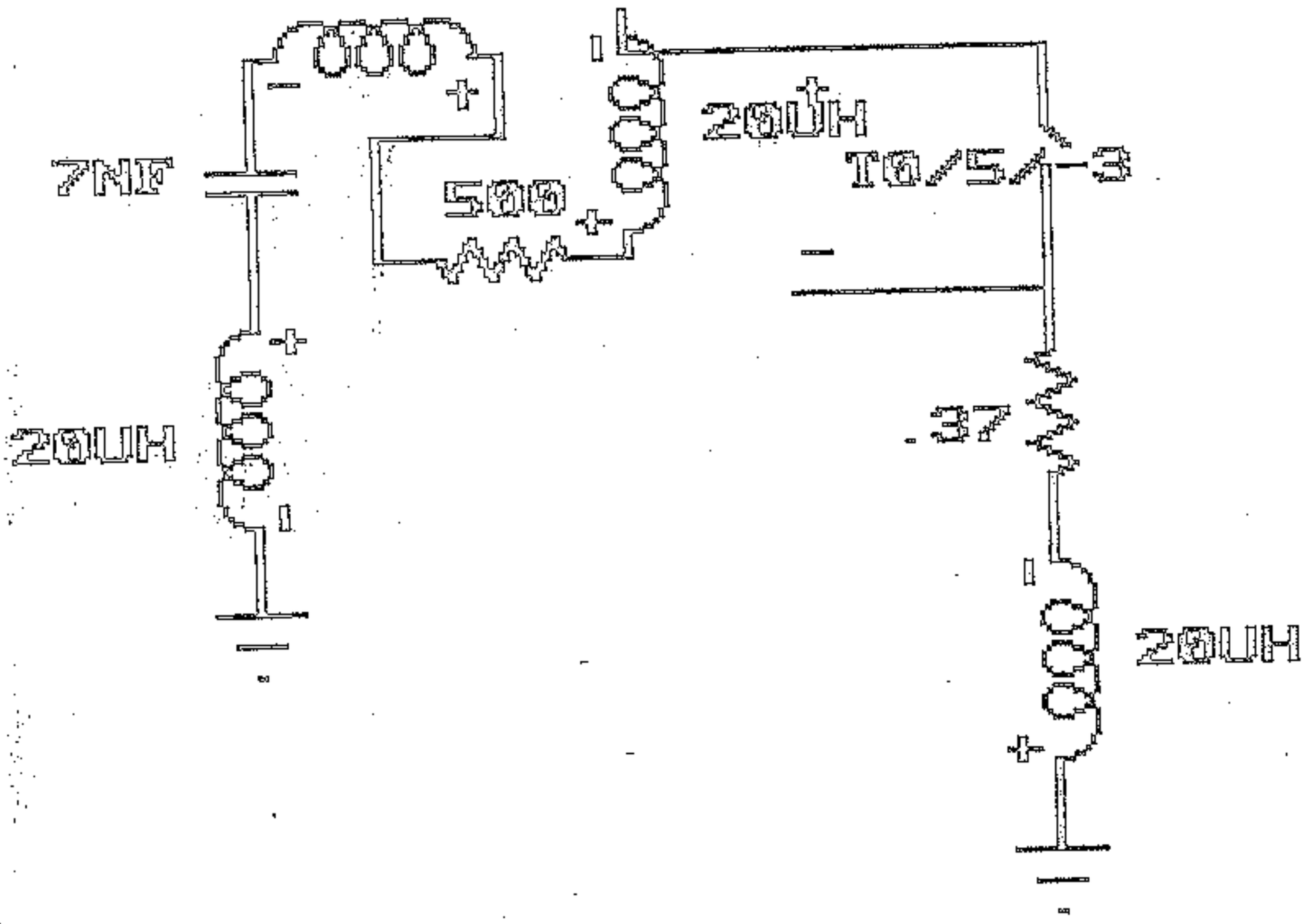
Vacuum $1x10^{-9}$ Torr, Arc potential 50-100 V

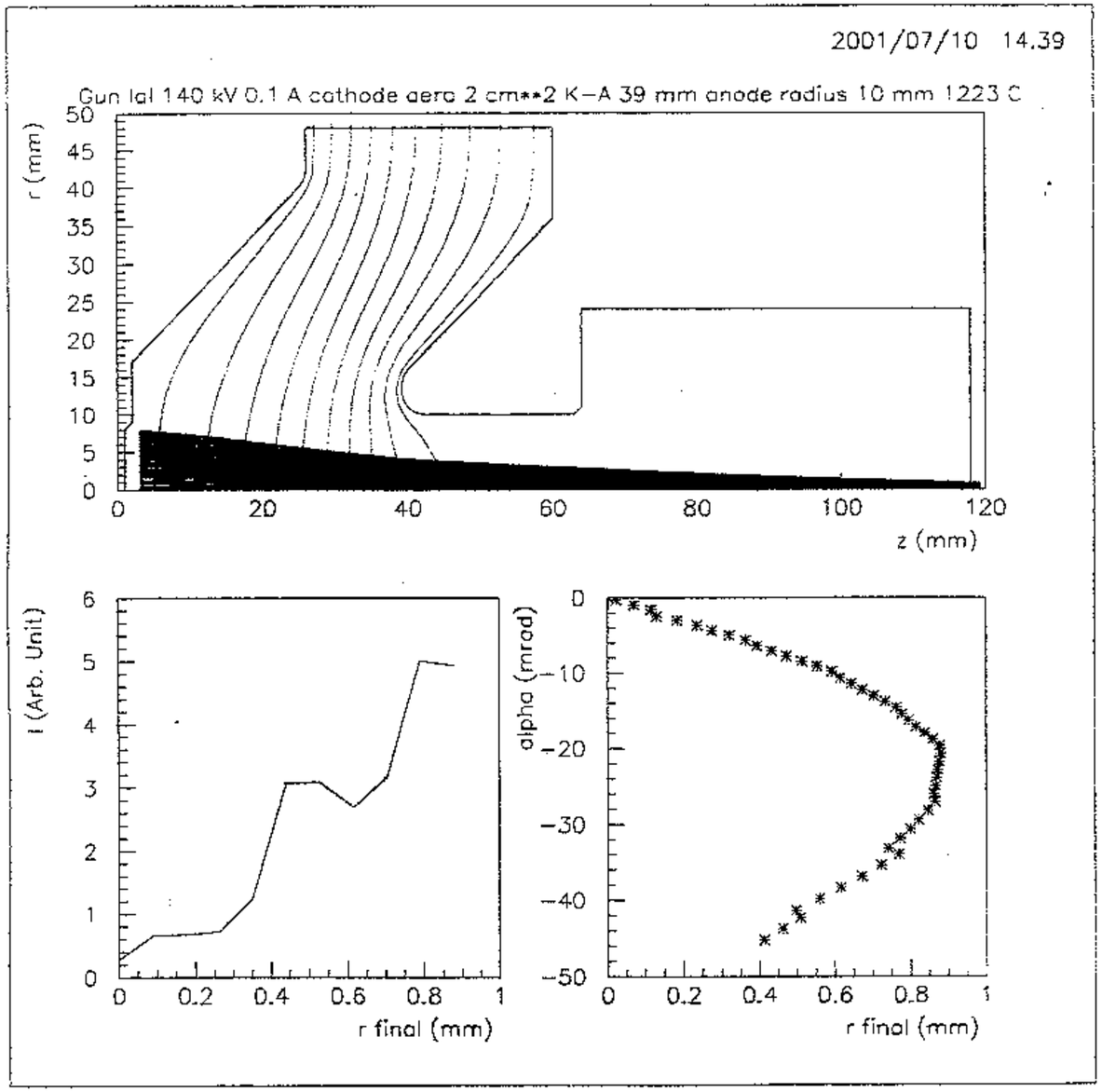
With a 500 Ω resistor

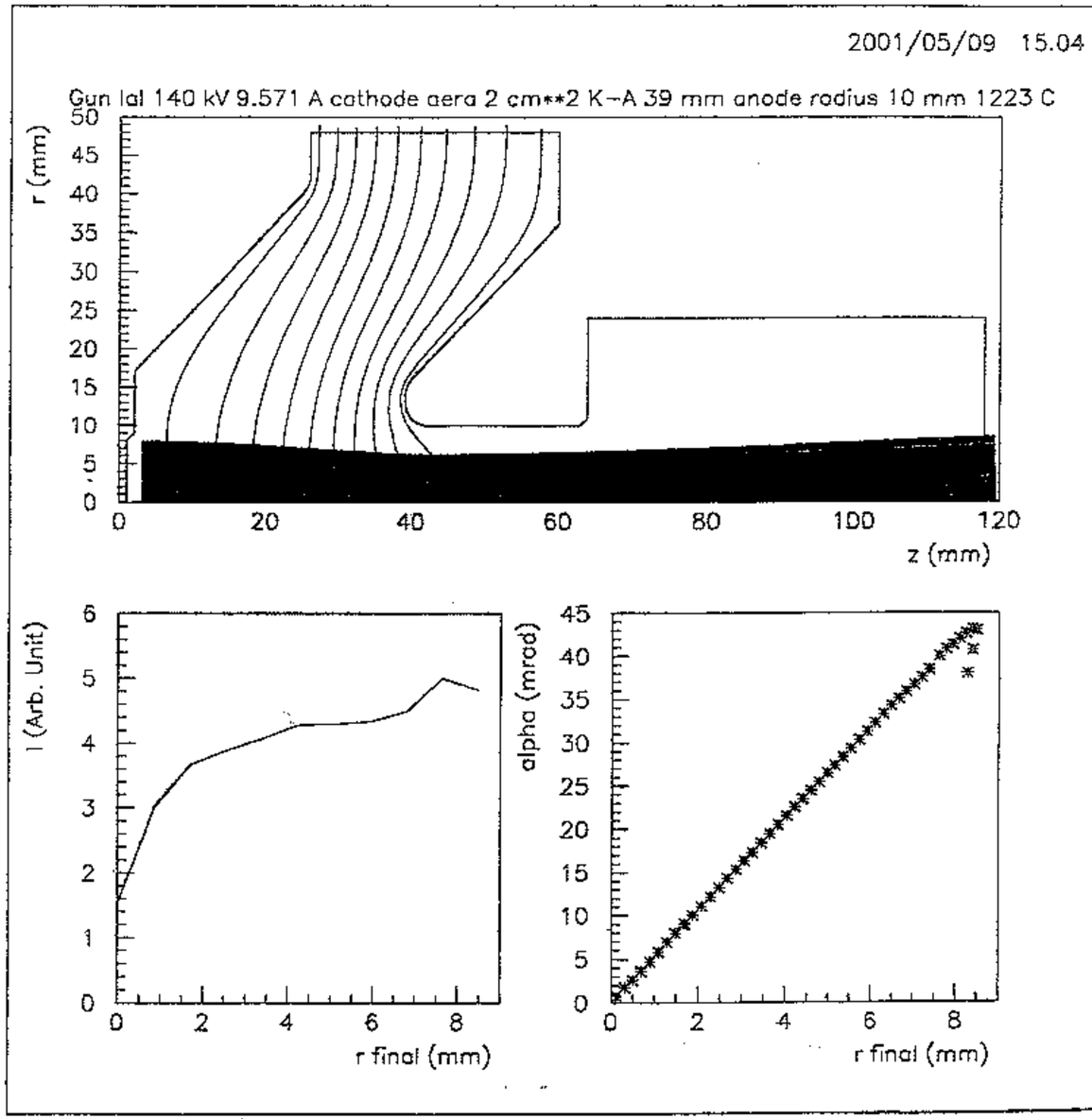
$I_{peak} = 280\ A$ (100 A for CLIO)

$W_{Gun} < 0.1\ J$

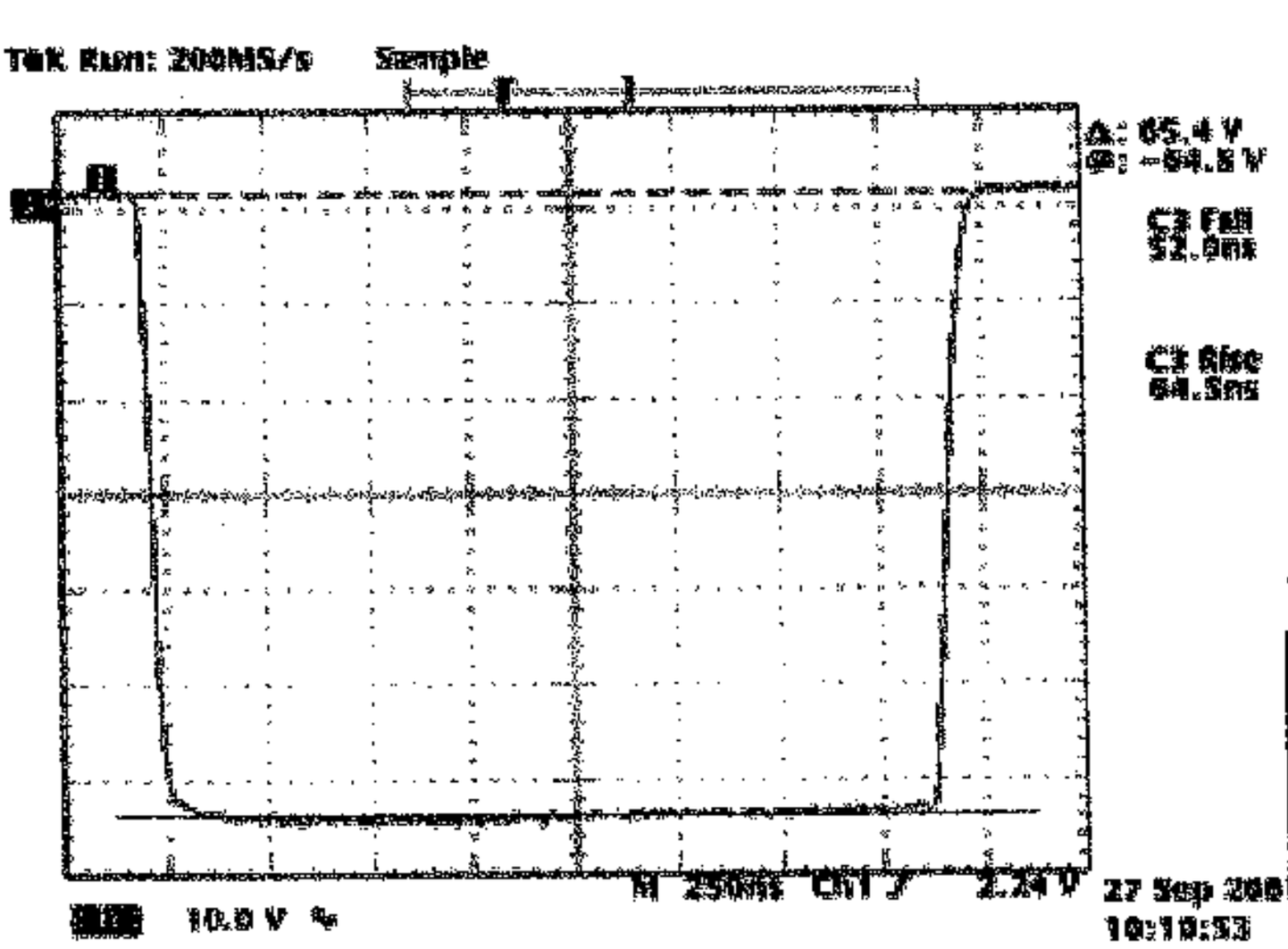

CTF3CLAQ Temperature= 27
1.00
0.40
-.20
-.80
-1.40
-2.00
7 KV
12
24
36
48
60
100.00
-80.00
-60.00
-40.00
-20.00
0.00
5-6-5 mJ
Time In US
7 KV
Left: 42.192540
Left: -.05
Right: 60.000000
Right: 0.021
Dif: 17.807460
Dif: 0.057


7NF
500
20UH
T6/5
37
20UH
20UH

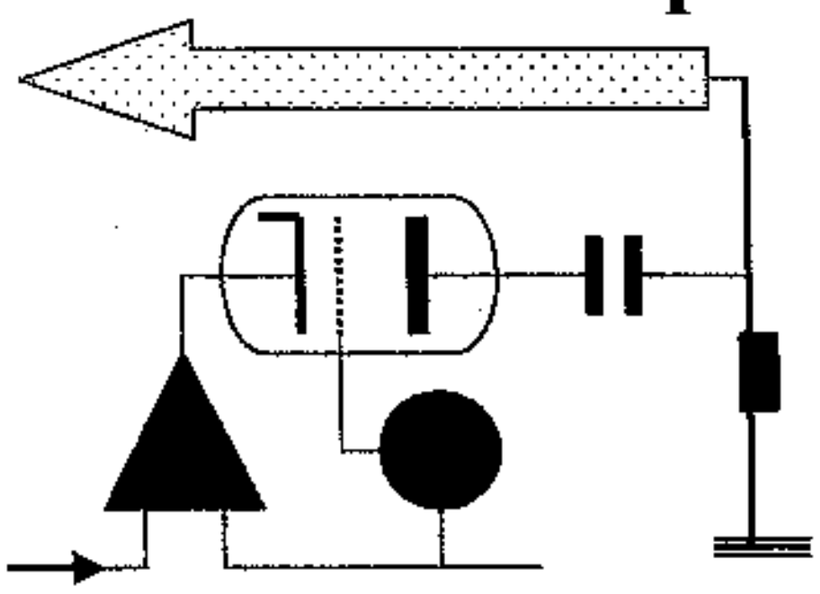

2001/07/10 14.39
Gun Ial 140 kV 0.1 A cathode aera 2 cm**2 K-A 39 mm anode radius 10 mm 1223 C
r (mm)
z (mm)
I (Arb. Unit)
r final (mm)
alpha (mrad)
r final (mm)


2001/05/09 15.04
Gun Ial 140 kV 9.571 A cathode aera 2 cm**2 K-A 39 mm anode radius 10 mm 1223 C
r (mm)
z (mm)
I (Arb. Unit)
r final (mm)
alpha (mrad)
r final (mm)

Preliminary tests



Triode output

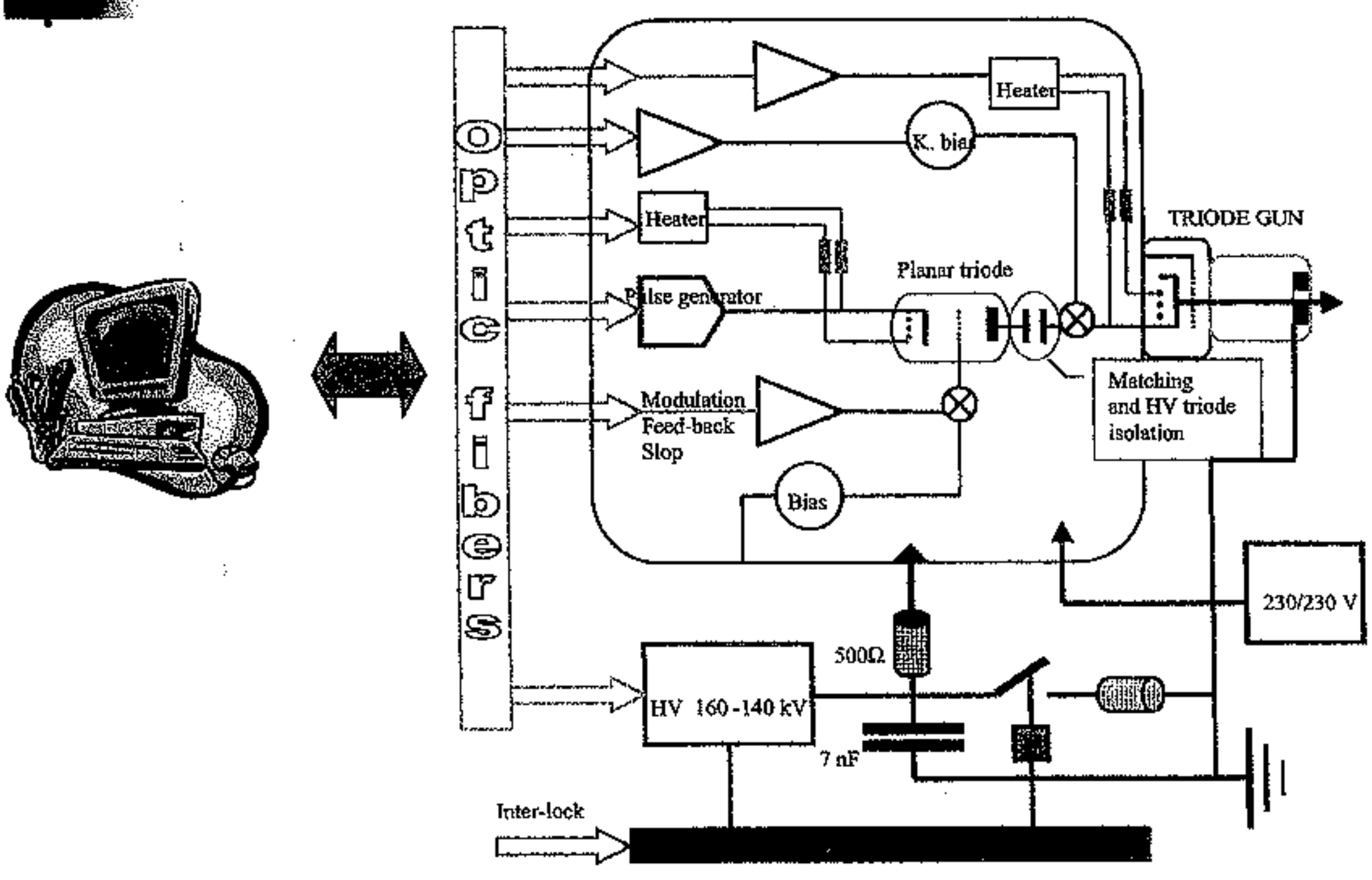


$R = 70\ \Omega$ BW < 20 MHz

$C = 2.2\mu F$ Probe 1/11

I = 10.3 A

Electronic synoptic



Prebunchers for the CTF3 injector

- First prebuncher : normal simple design
- Second prebuncher : beamloading compensation

First prebuncher

In copper, coupled with a waveguide, modelised with superfish and HFSS

Cut-off with a large diameter = 34 mm

⇓

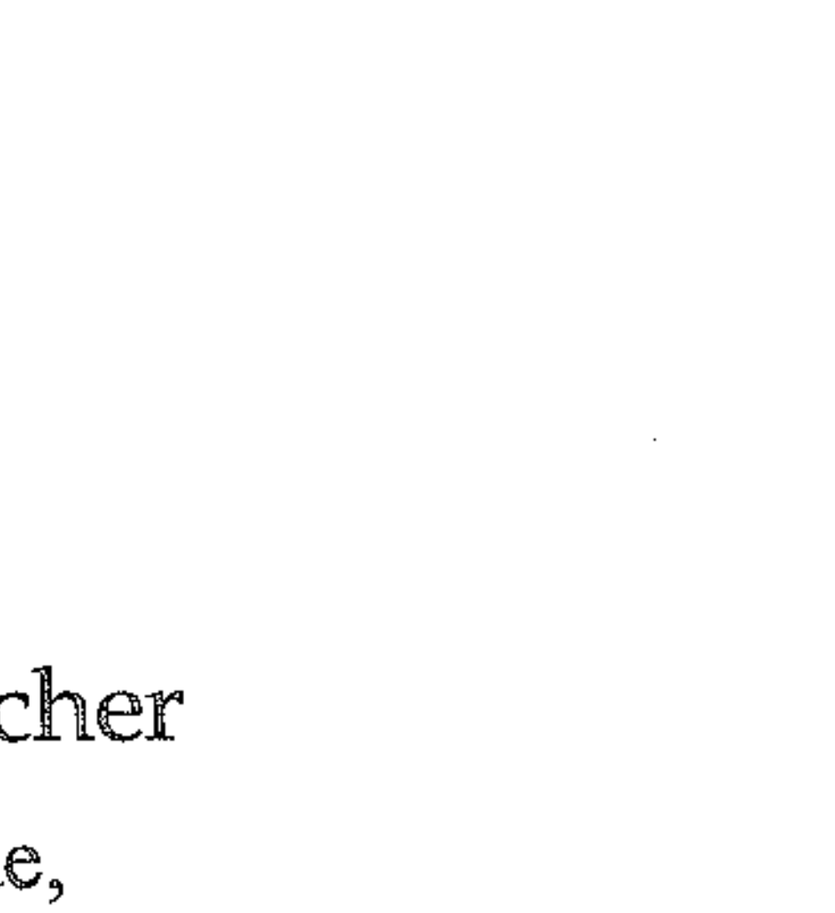
Long range electric field

⇓

Longer cut-off = 90 mm
Transit Time Factor = 0.4 (140 keV)

$Q = 10\,670$ $R_s = 1.02\ M\Omega$

Cavity dimensions : $R_c = 41.6$ mm
$h_c = 18$ mm



For a better magnetic field symmetry, cut-off axis shifted by 0.7 mm

Second prebuncher

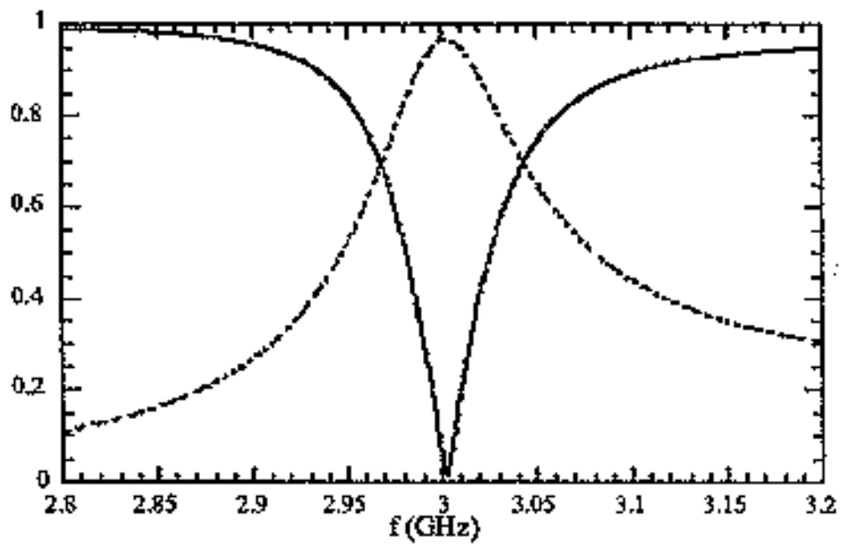
Beamloading $V_{ind} = \frac{R_s T^2 I_{harm}}{(1+\beta)}$

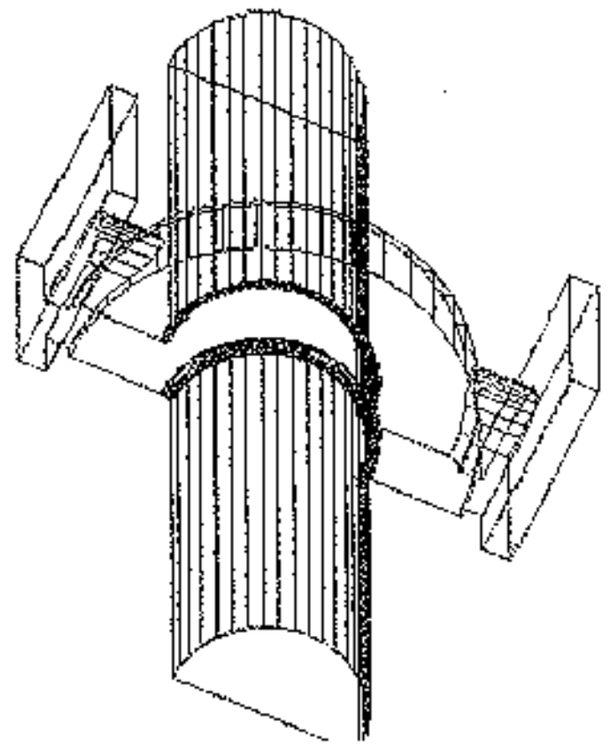
Two cases :

If bunch length is long , FWHM ≈ 8.33 mm

Same as the first but in **stainless steel** $\Rightarrow V_{ind} = 7.4$ kV

If bunch length shorter ⇒ one needs an external load and overcoupling





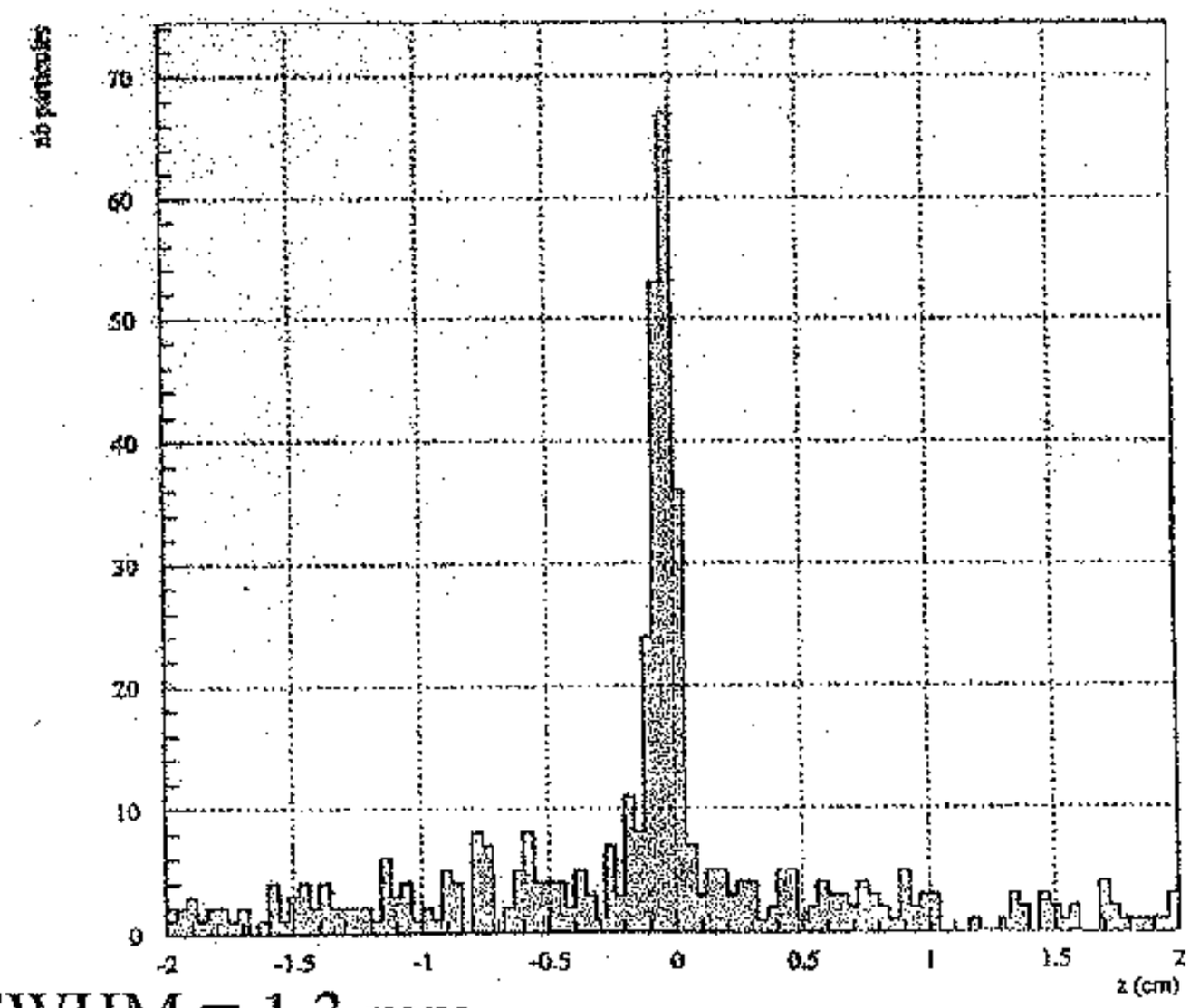
Few simulations with PARMELA

- Very simple calculations, just to see the bunching
- Assuming PB1 is situated where SHB1 will be

V = 60 kV
Using field given by Superfish

E=140 keV

1000 part.
No space charge



Z = 92.3 cm, FWHM = 1.3 mm