

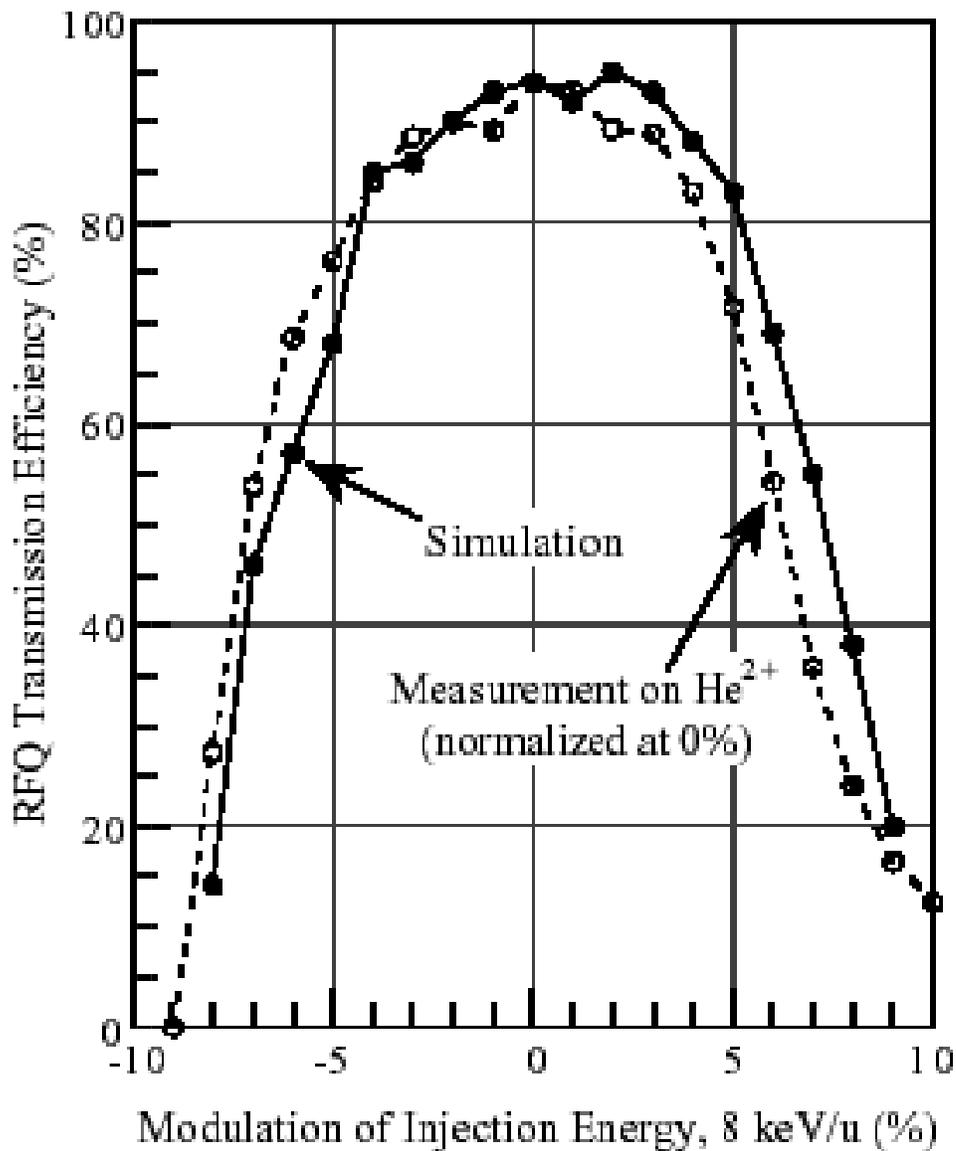
RPIA2002, KEK, Tsukuba, Oct. 29-31, 2002

***Longitudinal Beam Chopper
with MA Cores***

Akira Takagi

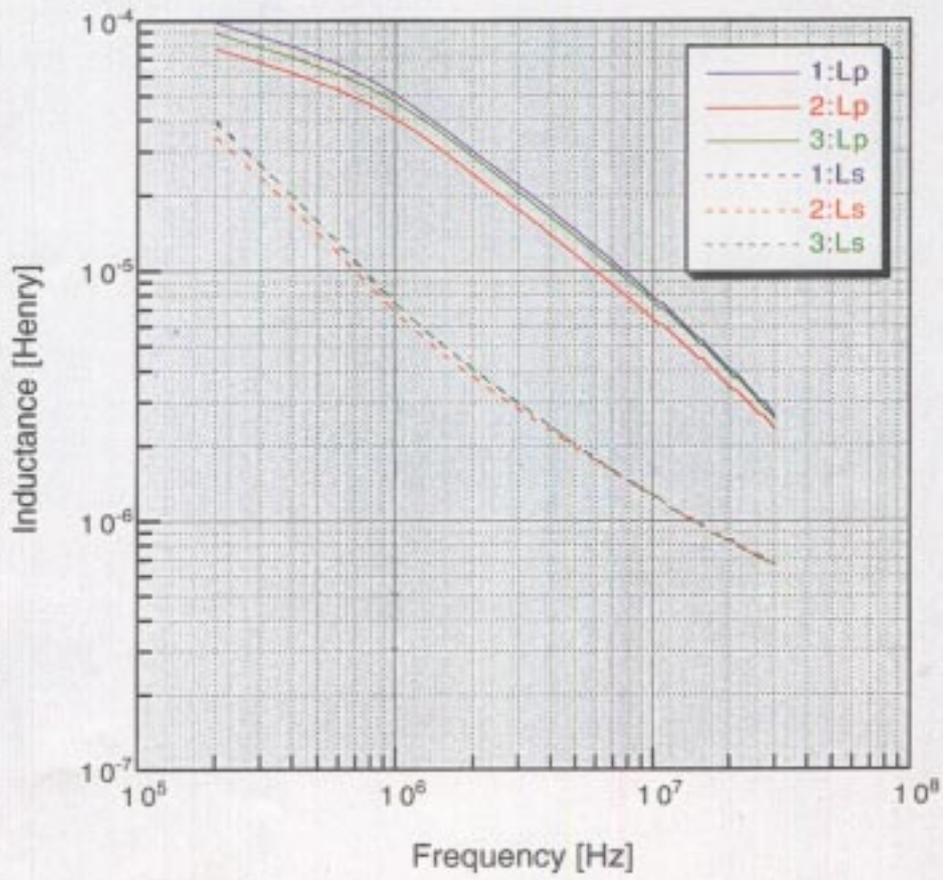
KEK



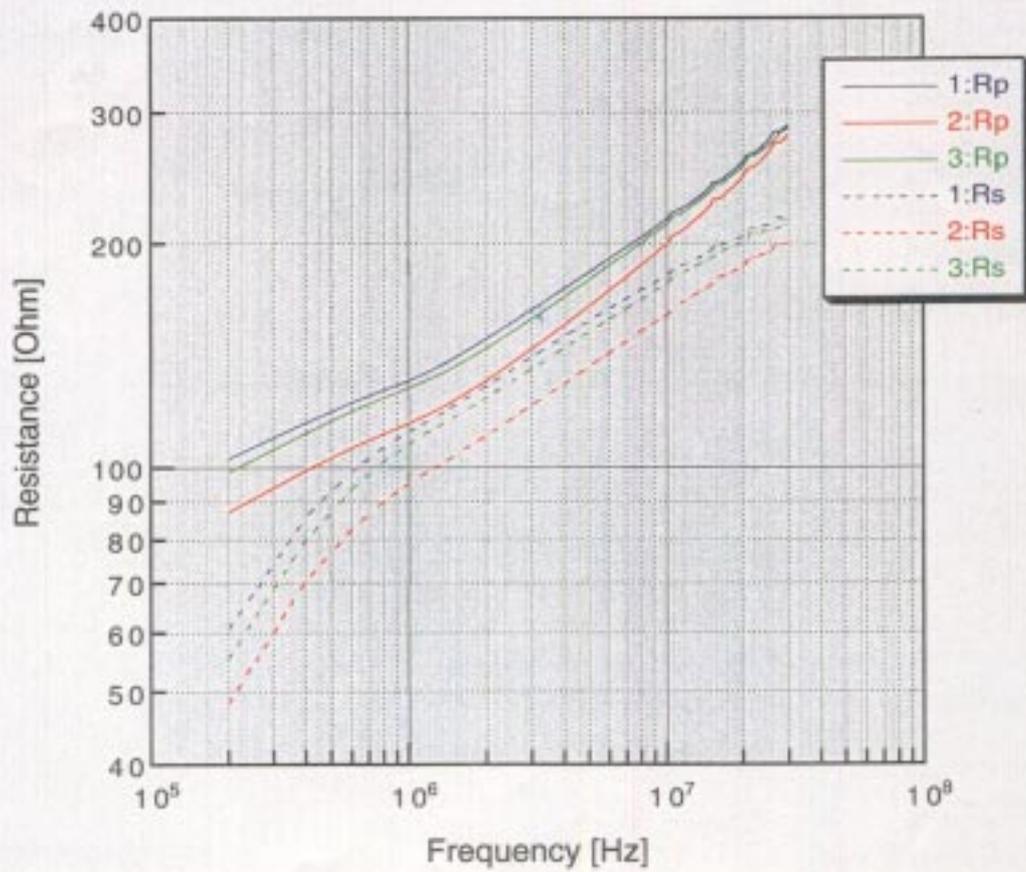


Simulated and measured RFQ transmission efficiency as a function of the injection energy modulation. Since the measured values contain a certain transport loss, they are normalized so that the measurement agrees with the simulation at the 0% modulation.

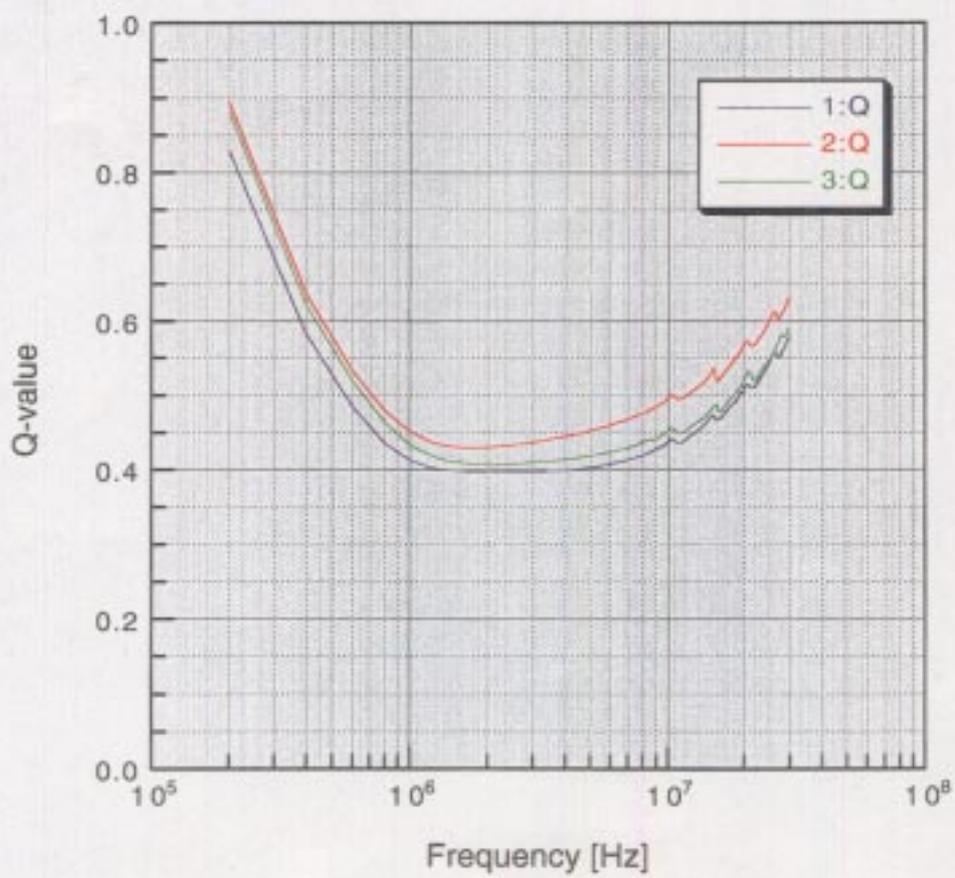
Chopper Core Inductance



Chopper Core Resistance



Chopper Core Q-value



FINEMET CORE

FT-3M

O.D. = 500mm

I.D. = 165mm

t = 25mm

3 Cores / Chopper Cavity

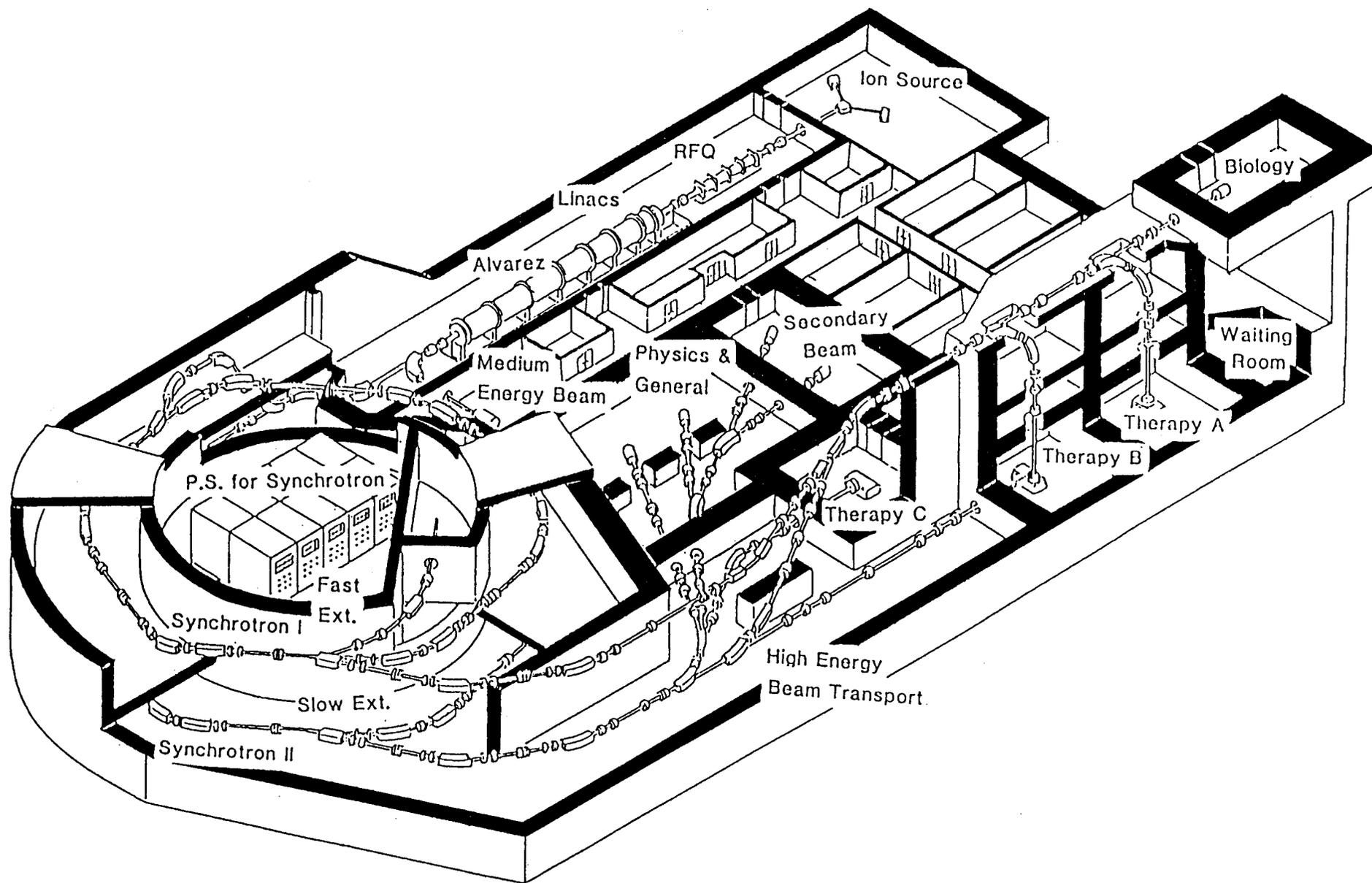
Freq = 1MHz

Ls ~ 7 microH Rs ~ 110 Ohm Q ~ 0.45

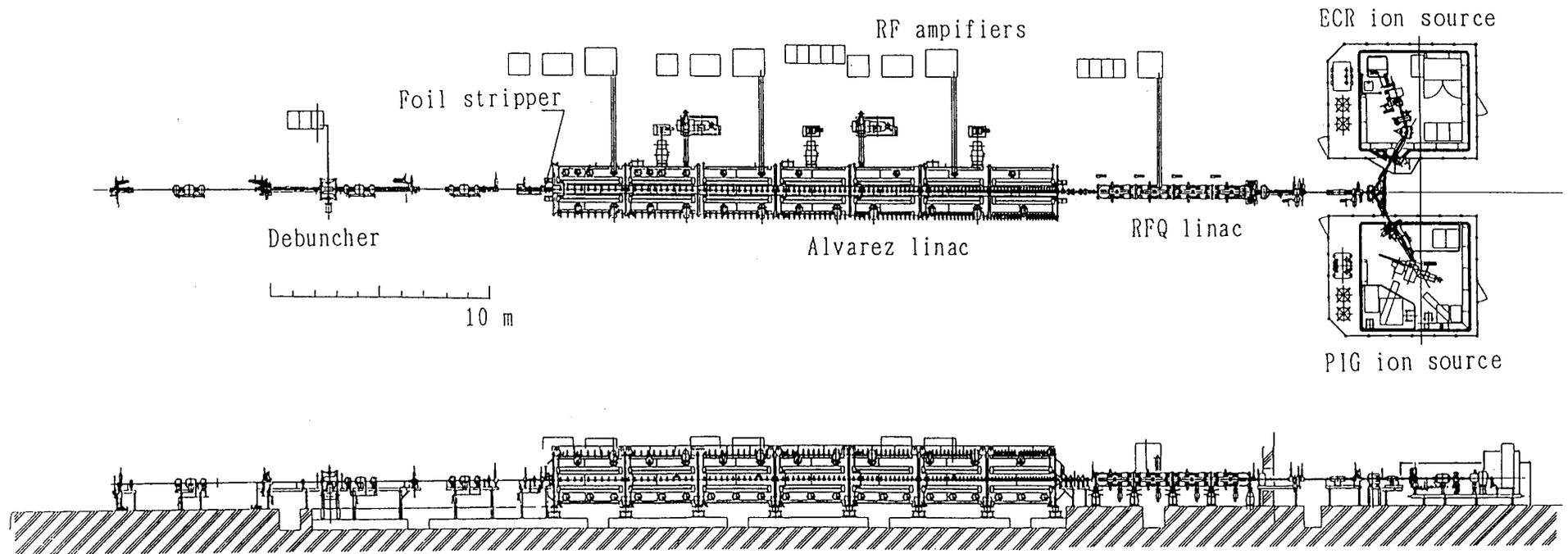
Lp ~50 microH Rp ~ 120 Ohm Q ~ 0.45

Lp = 160 microH / 3 Cores

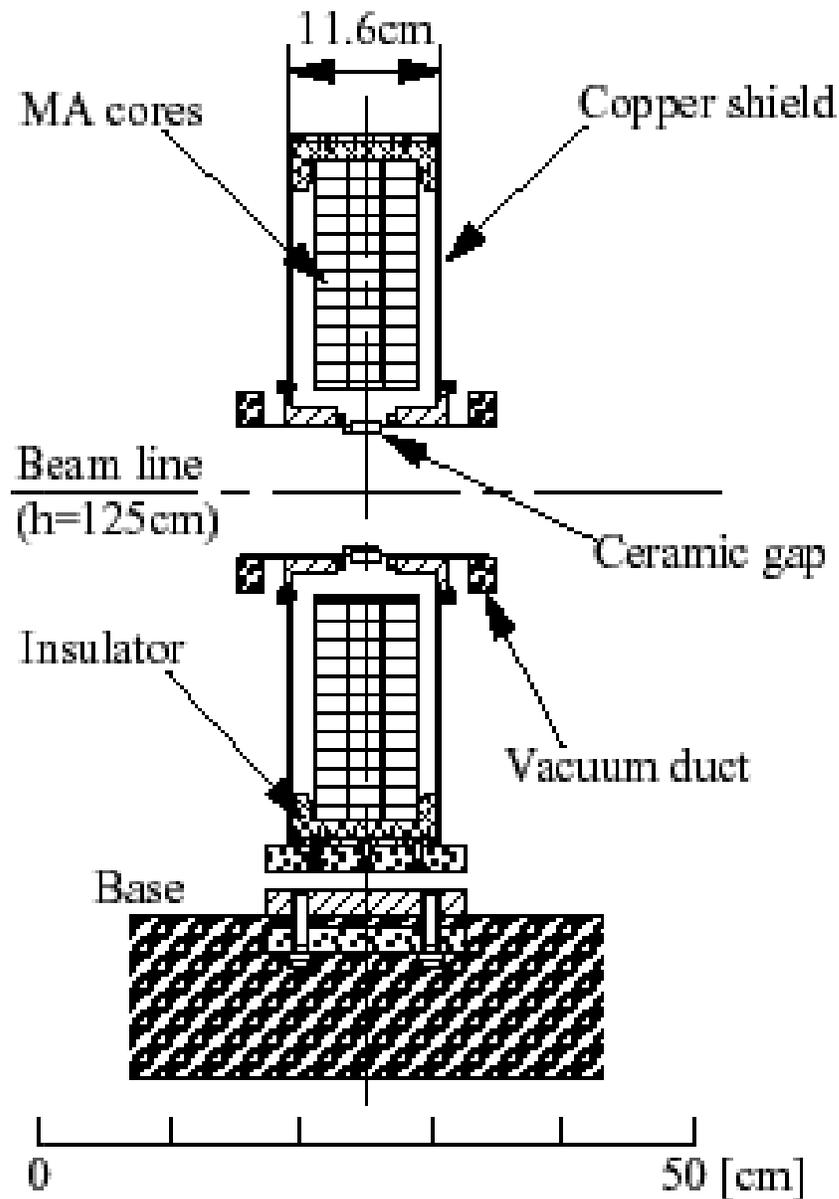
Rp = 360 Ohm / 3 Cores



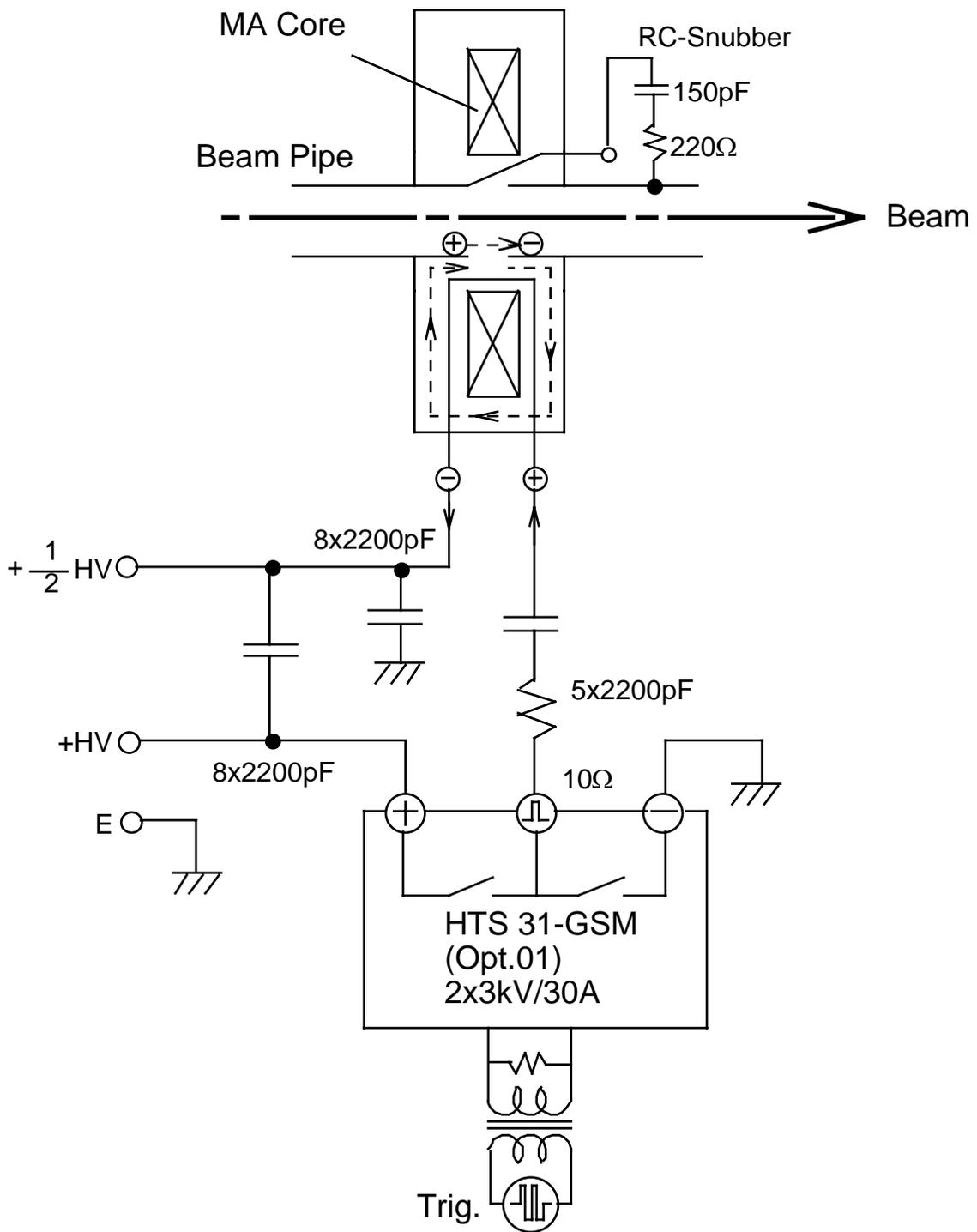
Bird's eye view of the HIMAC facility.

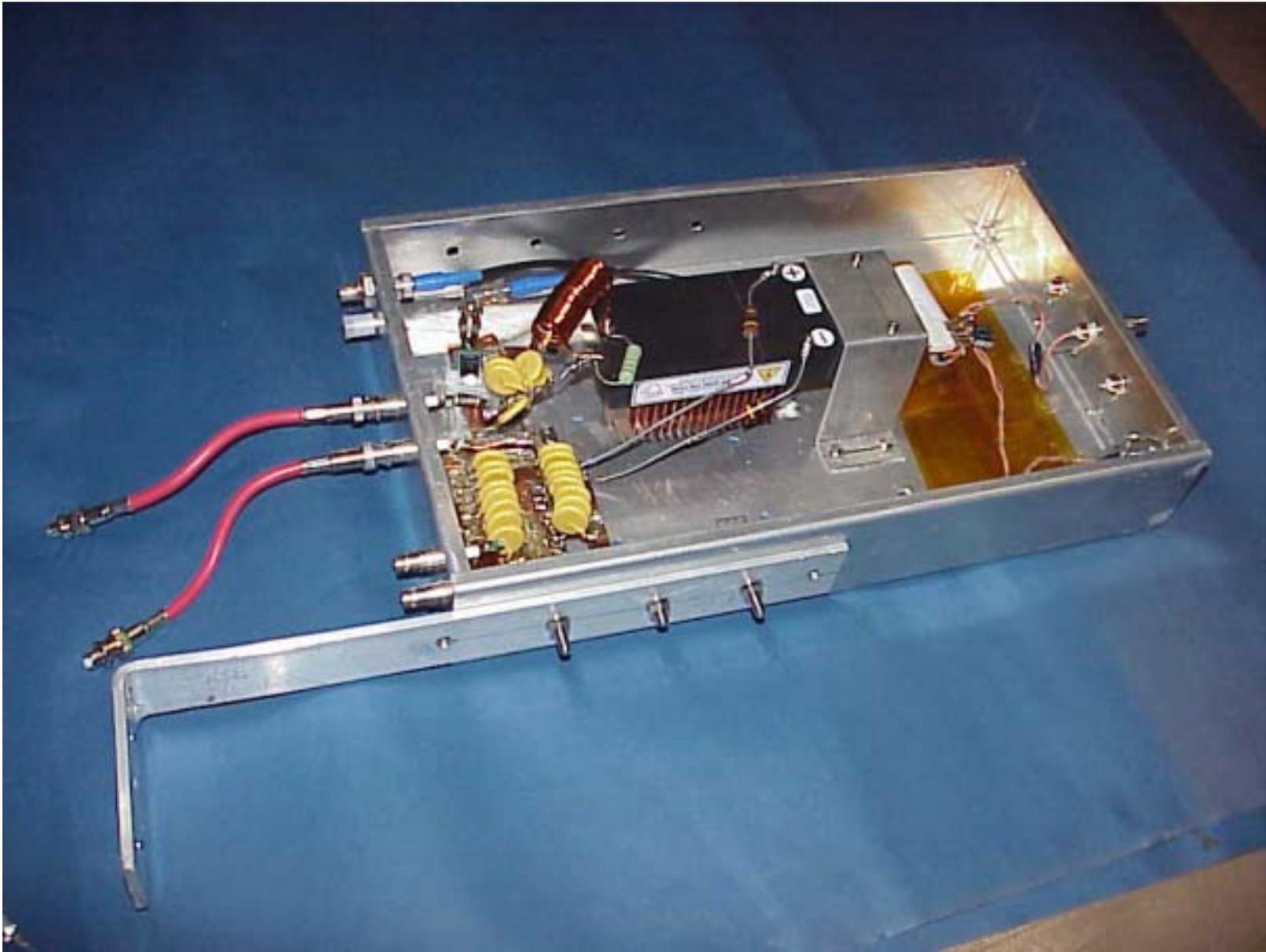


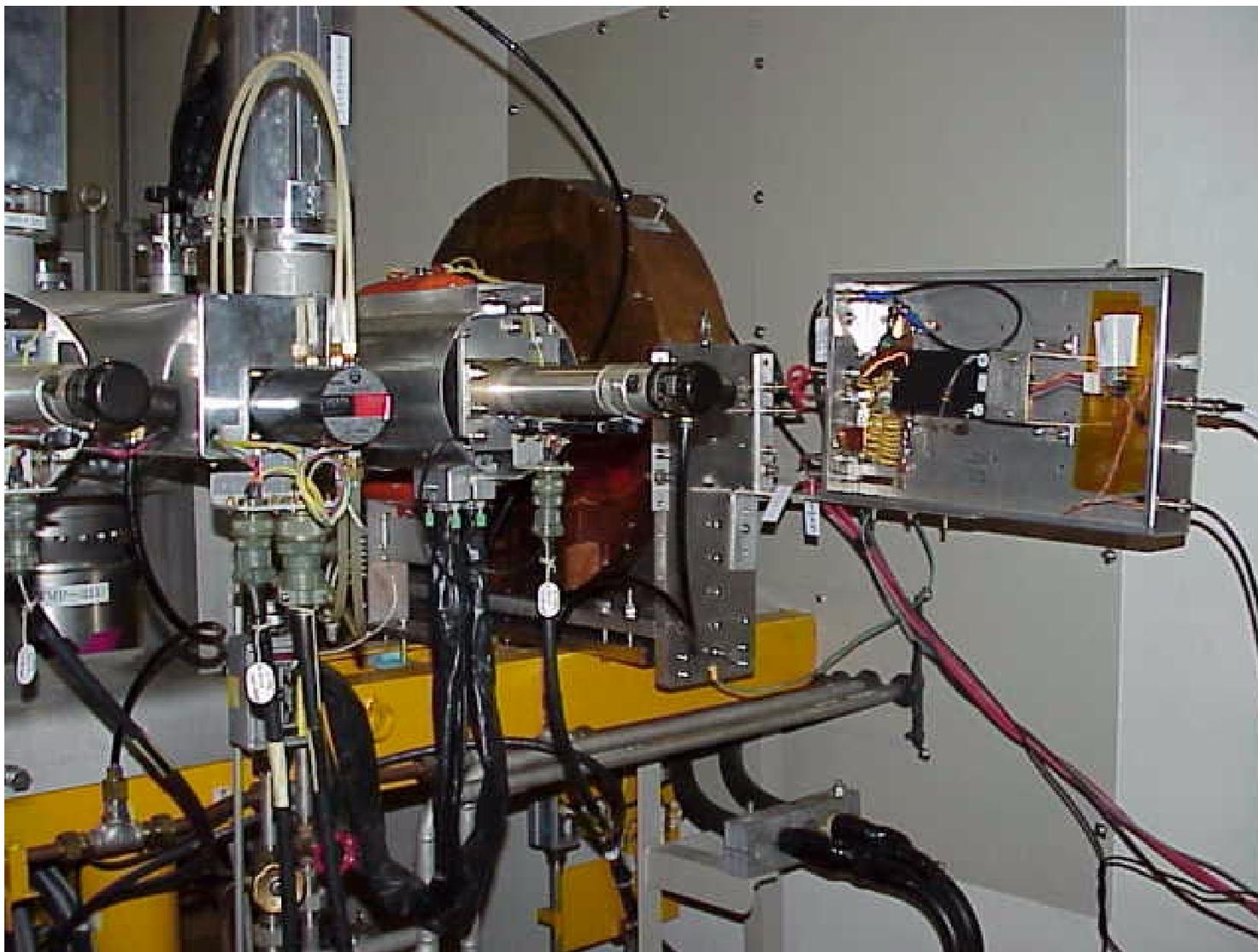
Layout of injector system.

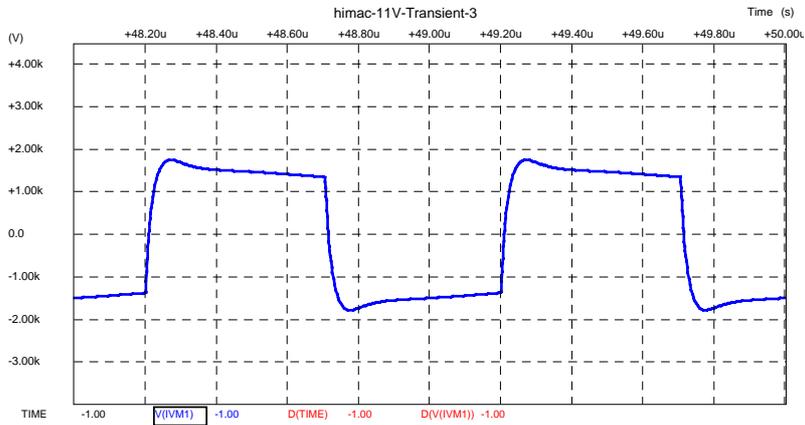
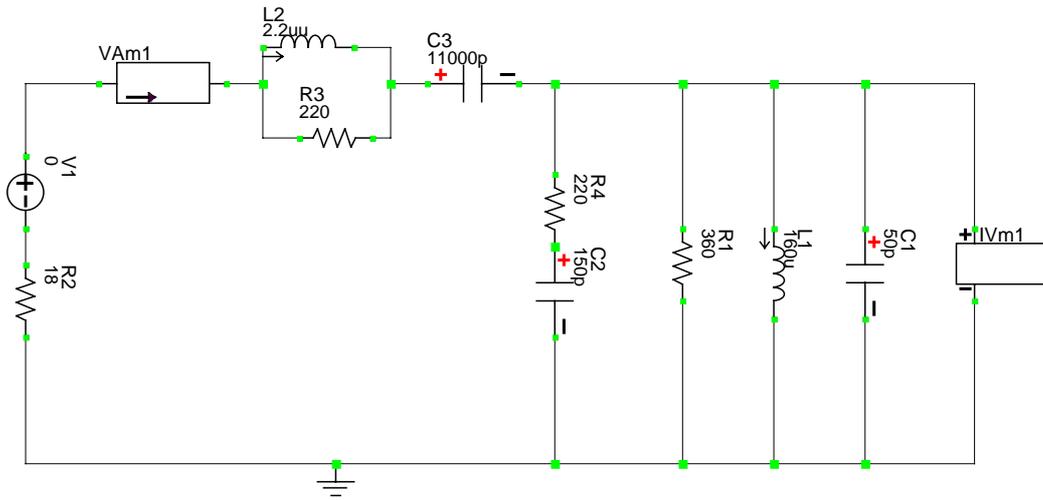


Side view of the chopper. Three magnetic-alloy cores with 504mm \varnothing_{out} x 158mm \varnothing_{in} x 25mm thickness are used. An one-turn coil is wound around the cores.

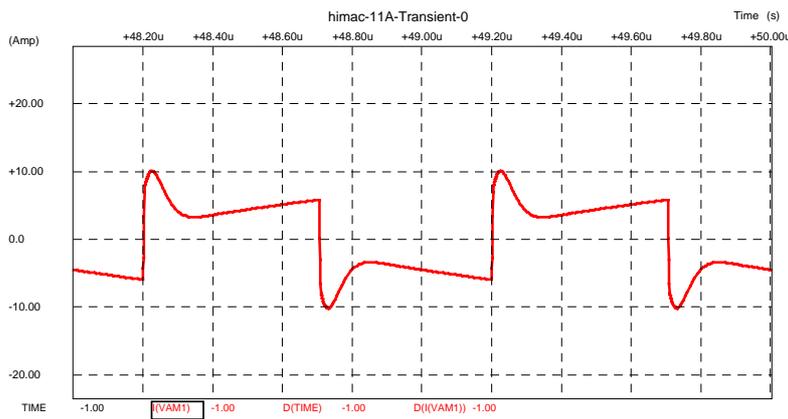






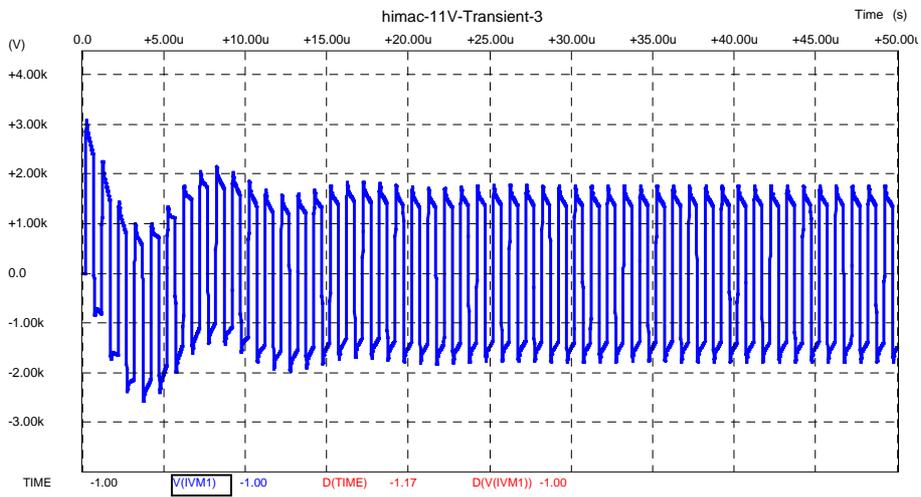
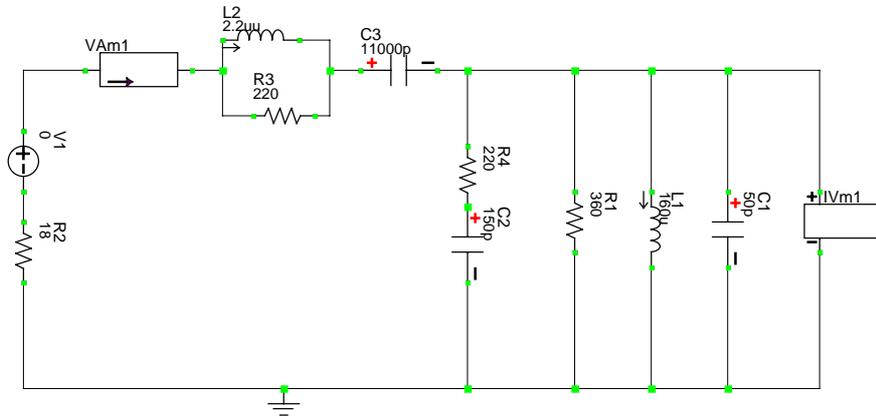


Voltage

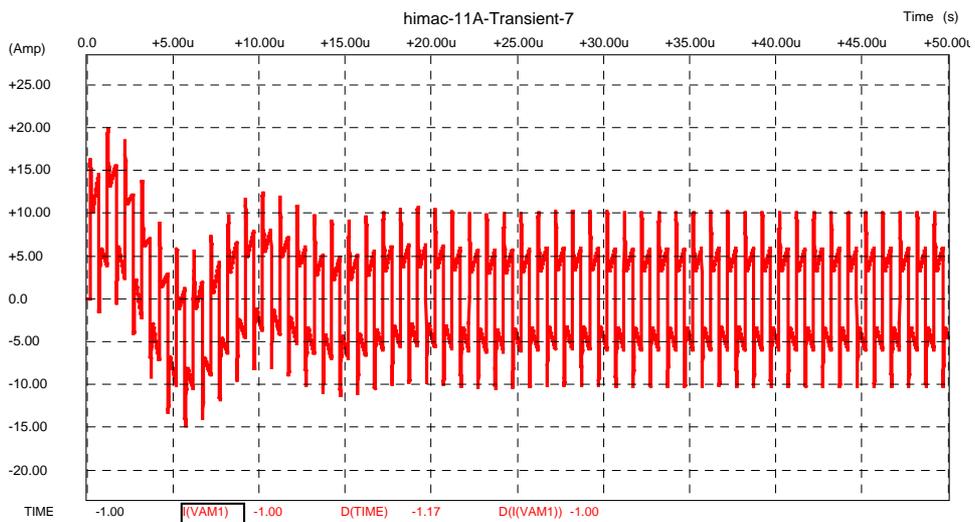


Current

With DC-Cut

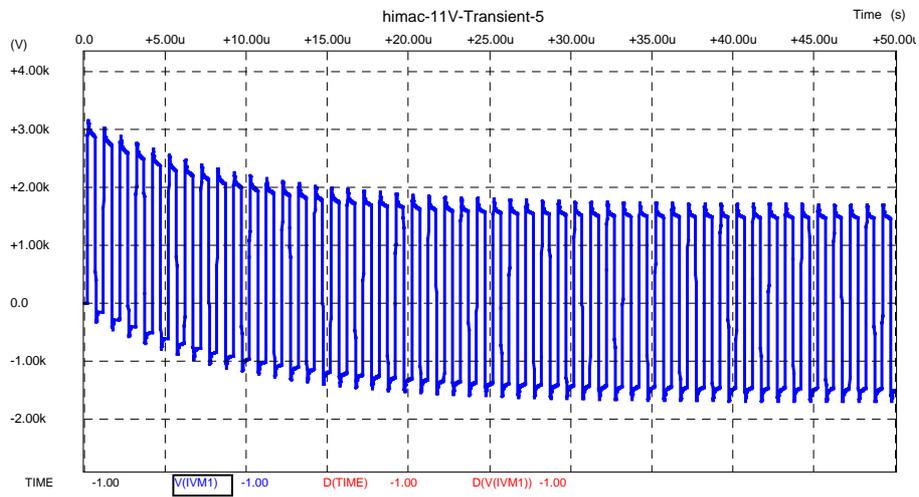
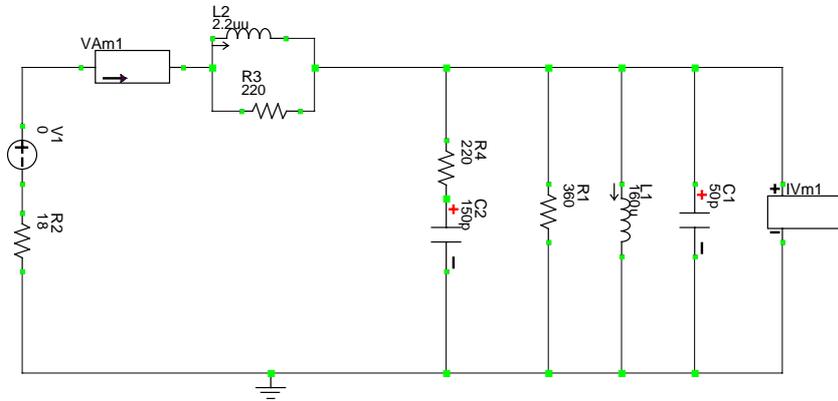


VOLTAGE

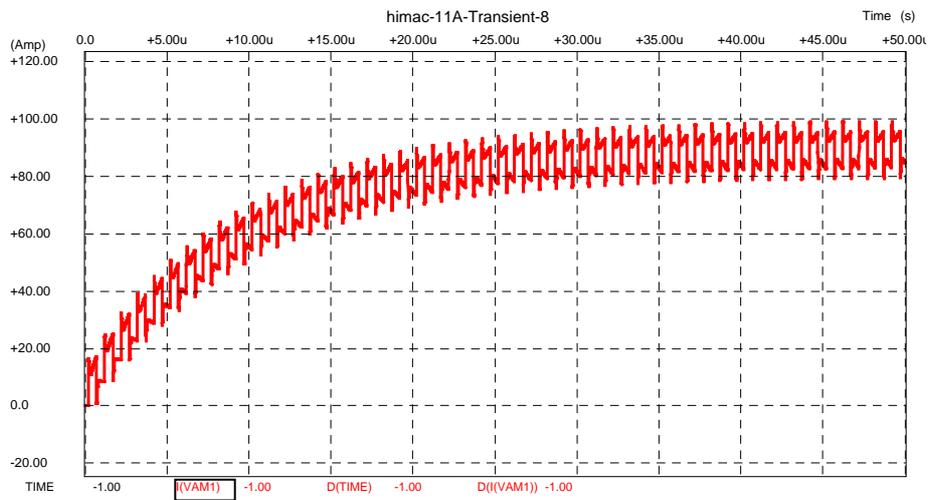


CURRENT

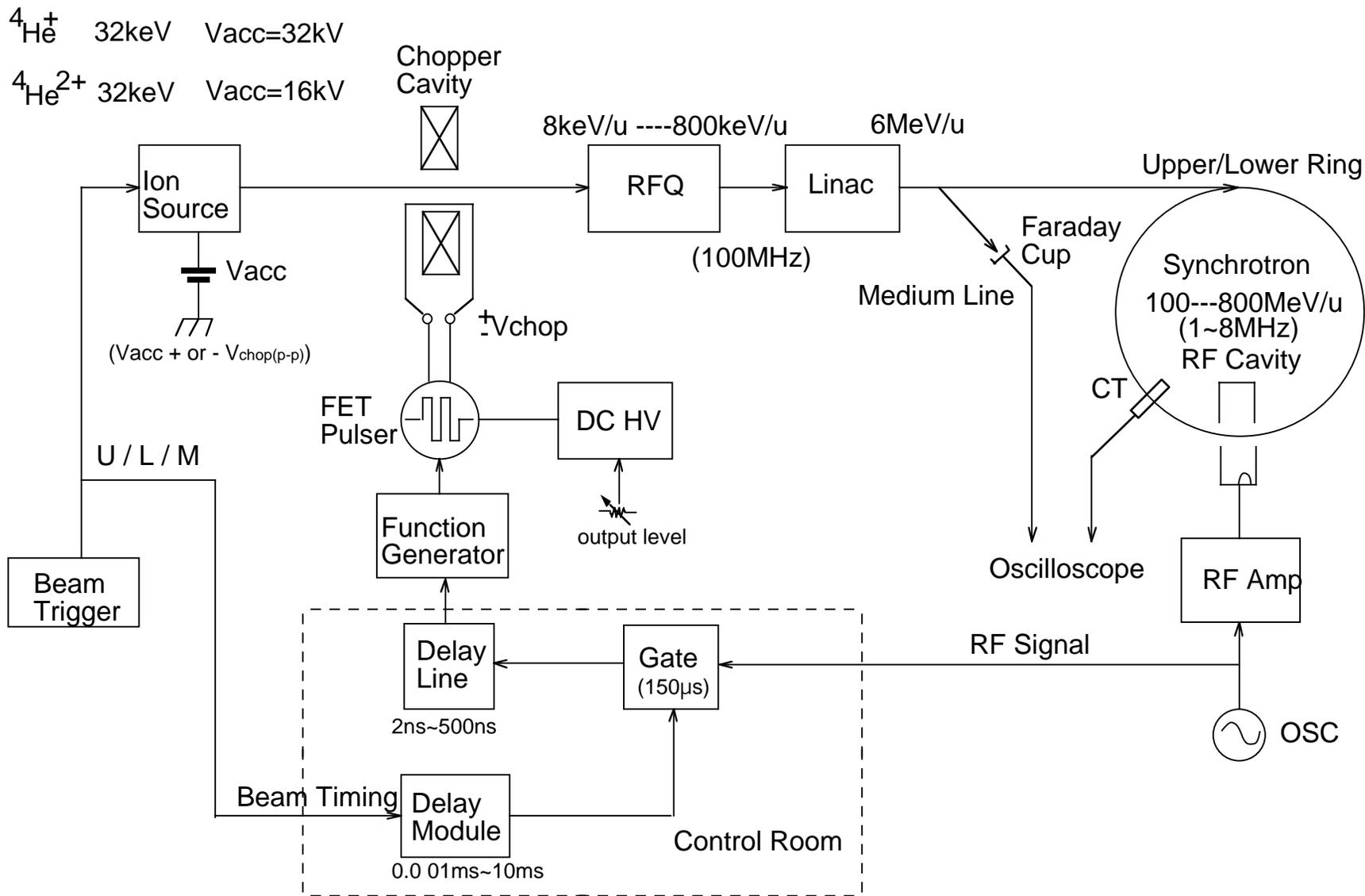
Without DC-Cut

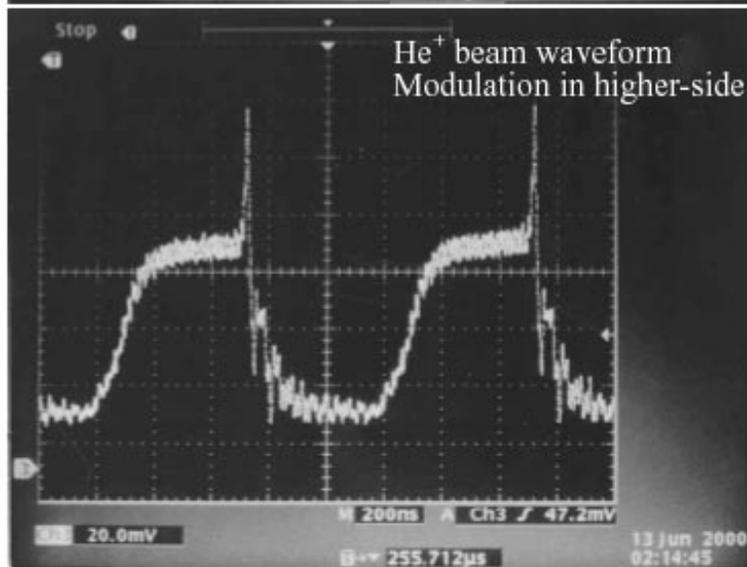
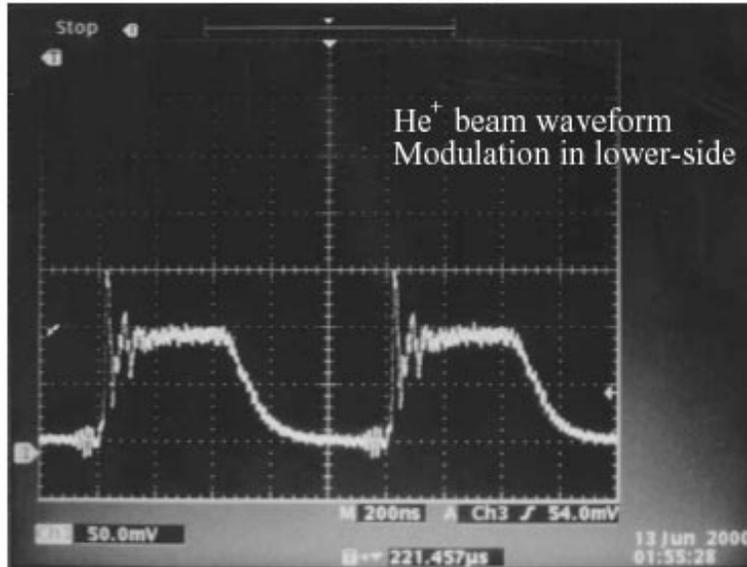
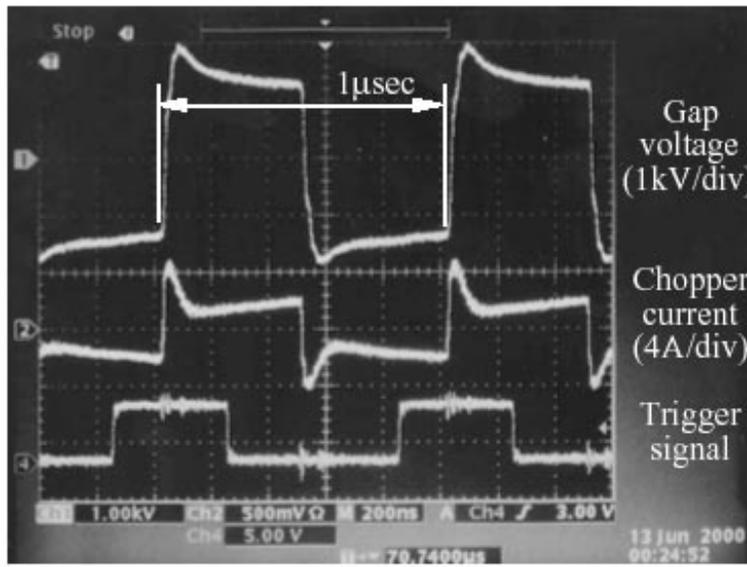


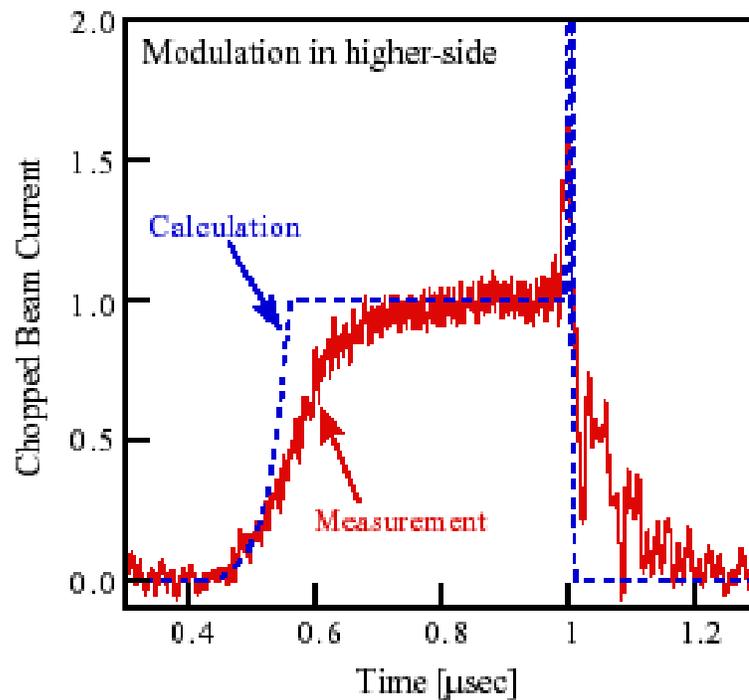
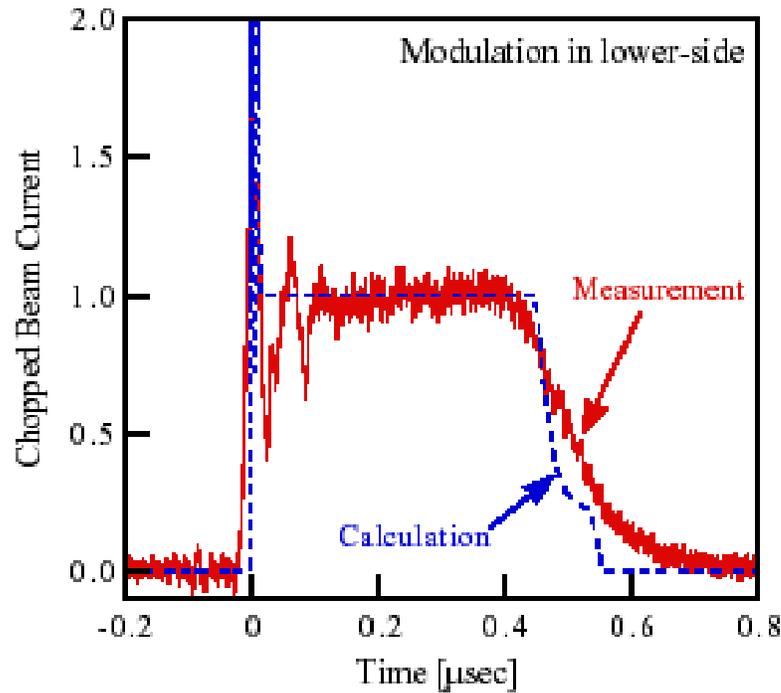
VOLTAGE



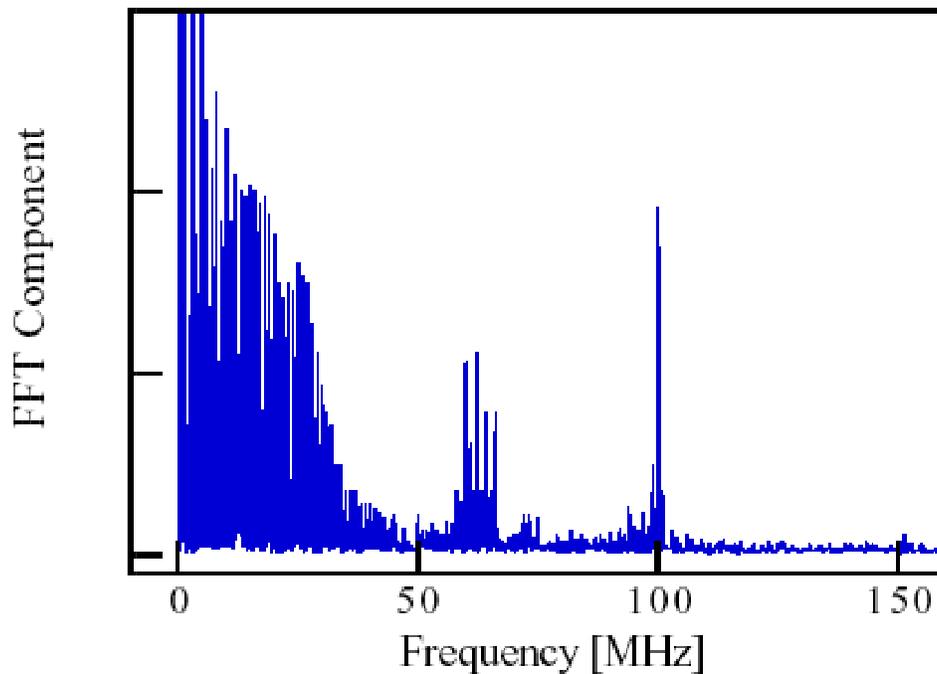
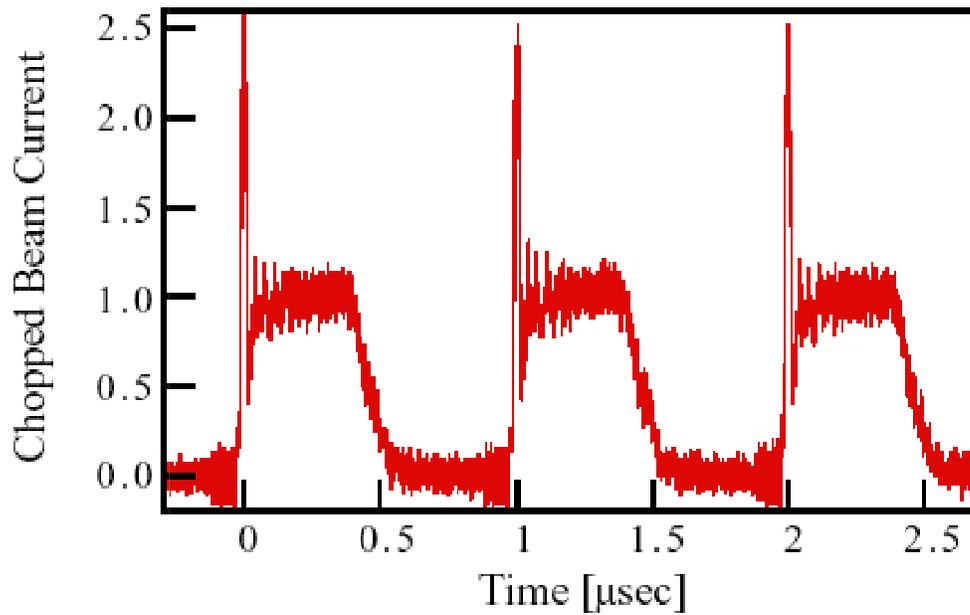
CURRENT



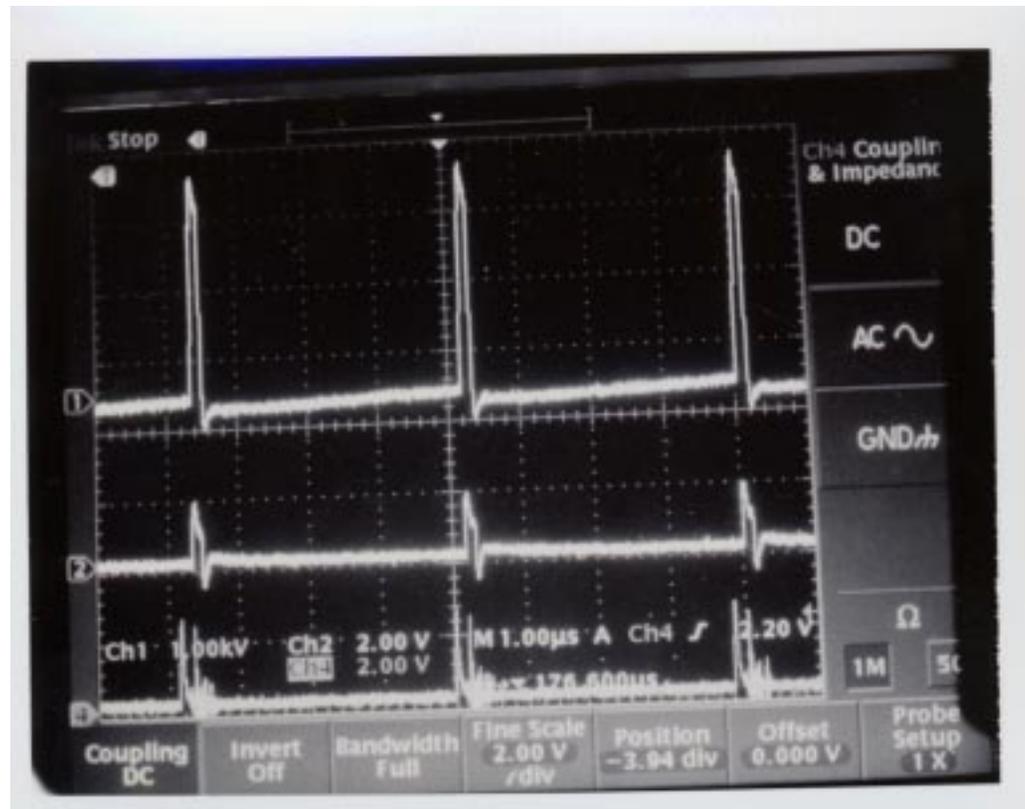




Measured and calculated results of chopped beam currents. When the chopping is done with the lower-side modulation, the spike appears at the front edge of the pulse (top), and with the higher-side modulation, at the rear edge (bottom). These spikes are caused with the bunching of beams due to the finite rise and fall speed of the chopper voltage. Numerical calculation was carried out, with a simplified assumption of a sinusoidal voltage rise- and fall-time of 50nsec (broken lines).



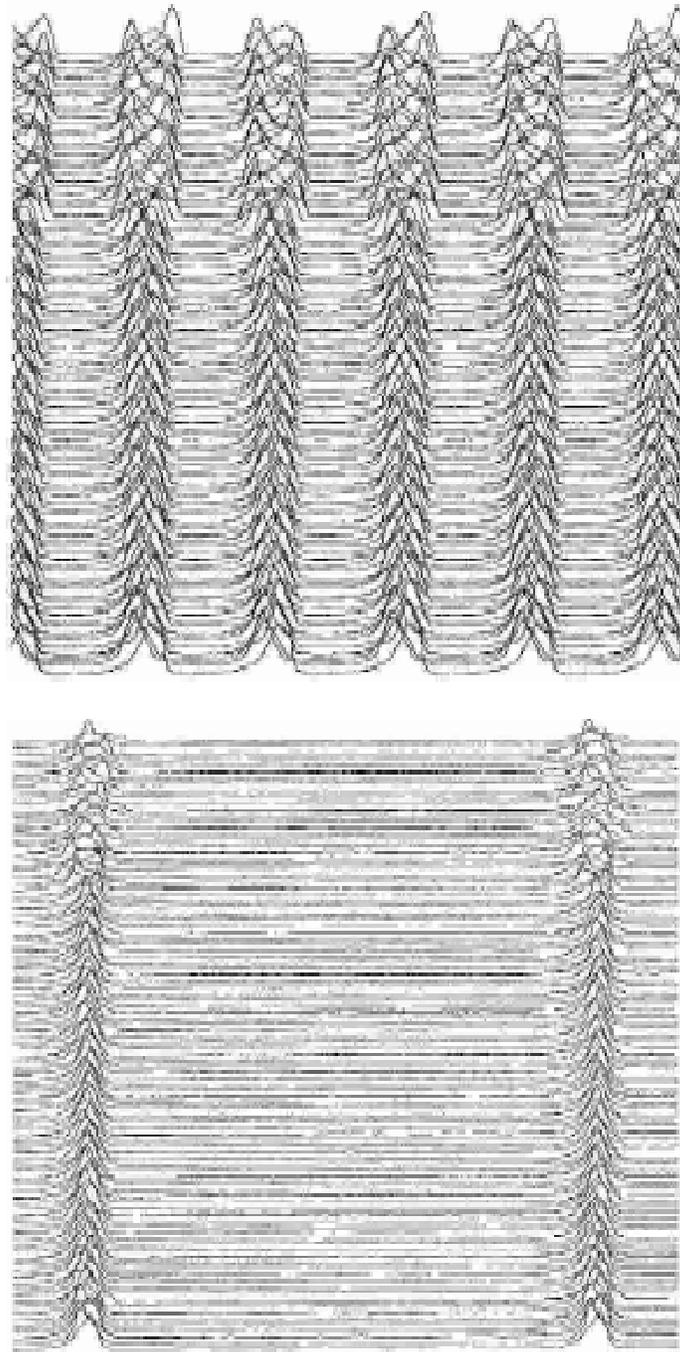
Fourier-transformed beam spectrum (top) with its original waveform (bottom) in the case of the lower-side modulation. The chopping frequency is 1 MHz and the duty factor is 50%.



Short & single bunch injection : ~150ns

U: linac beam, M: chopper pulse, L: drive trigger

1microsec/div.



Captured beam profiles observed at the HIMAC main-ring. Prior to the injection, the beams are chopped to make short bunches of 150nsec width. In the top figure, the beam is injected into 4 buckets of the main-ring. In the bottom figure, the same short bunches are injected with a harmonic number of 1. In both cases, the beams start growing in the longitudinal direction after ~30msec from the injection.