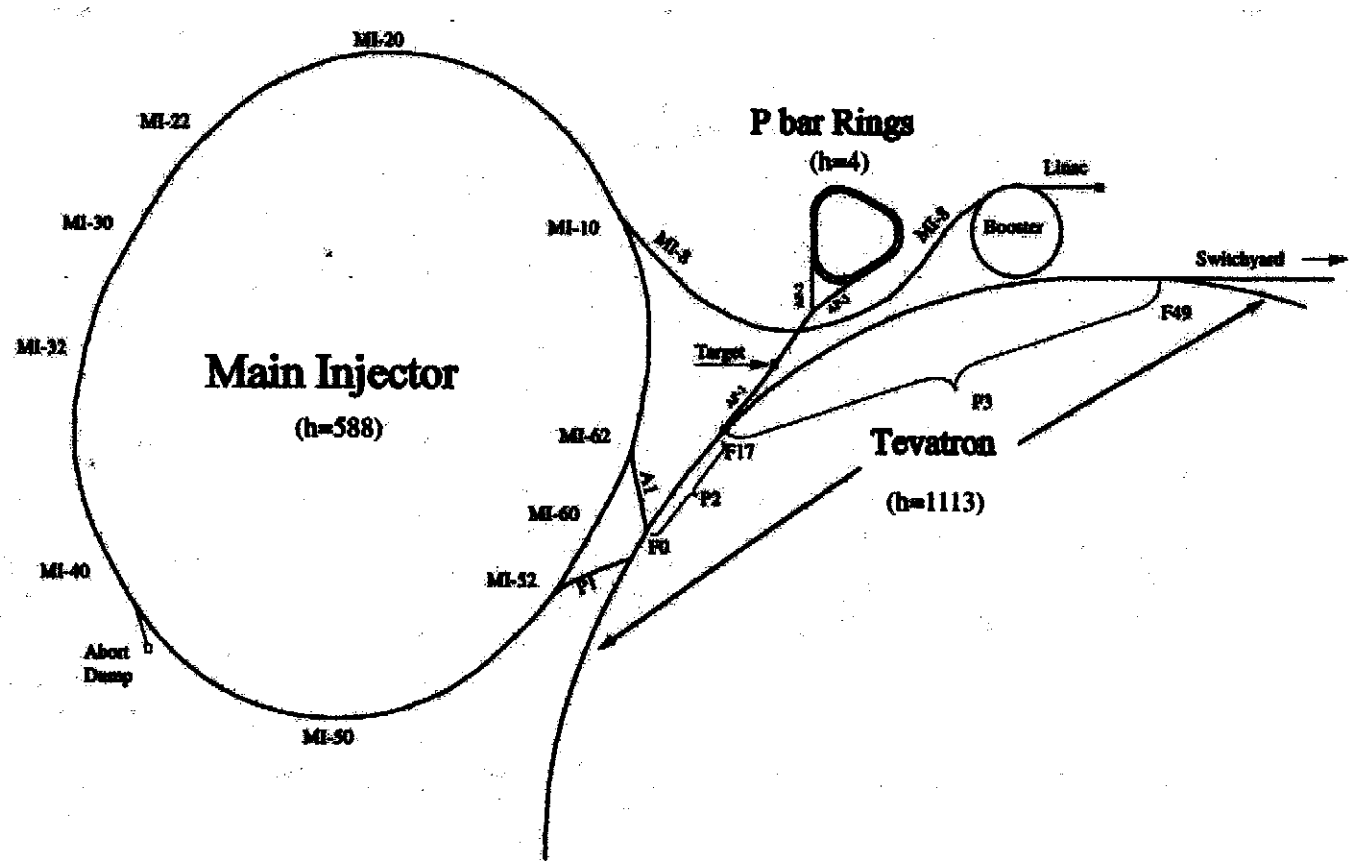
Slip Stacking

April 09 02

Kiyomi Koba
Fermilab

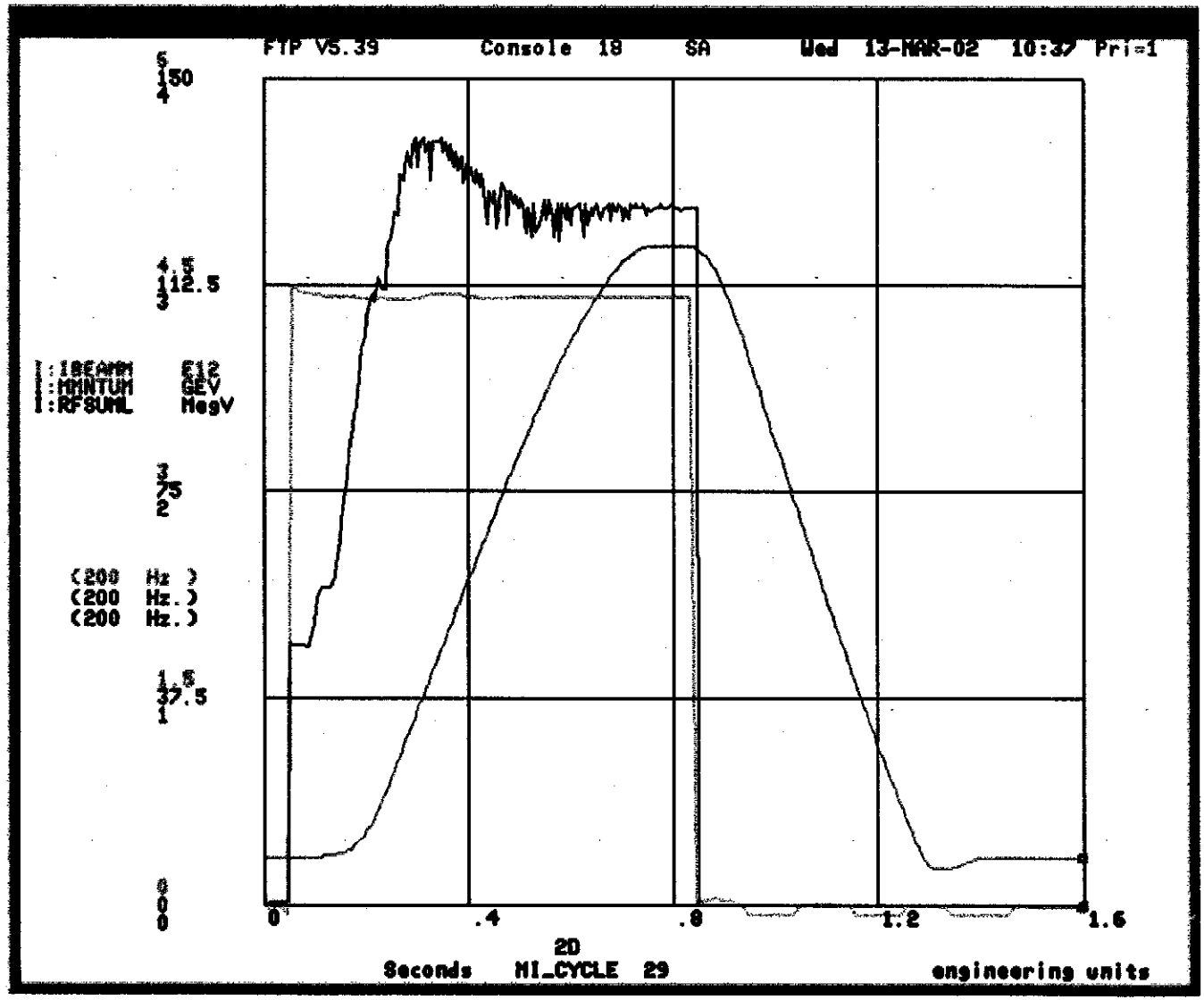


Antiproton production cycle

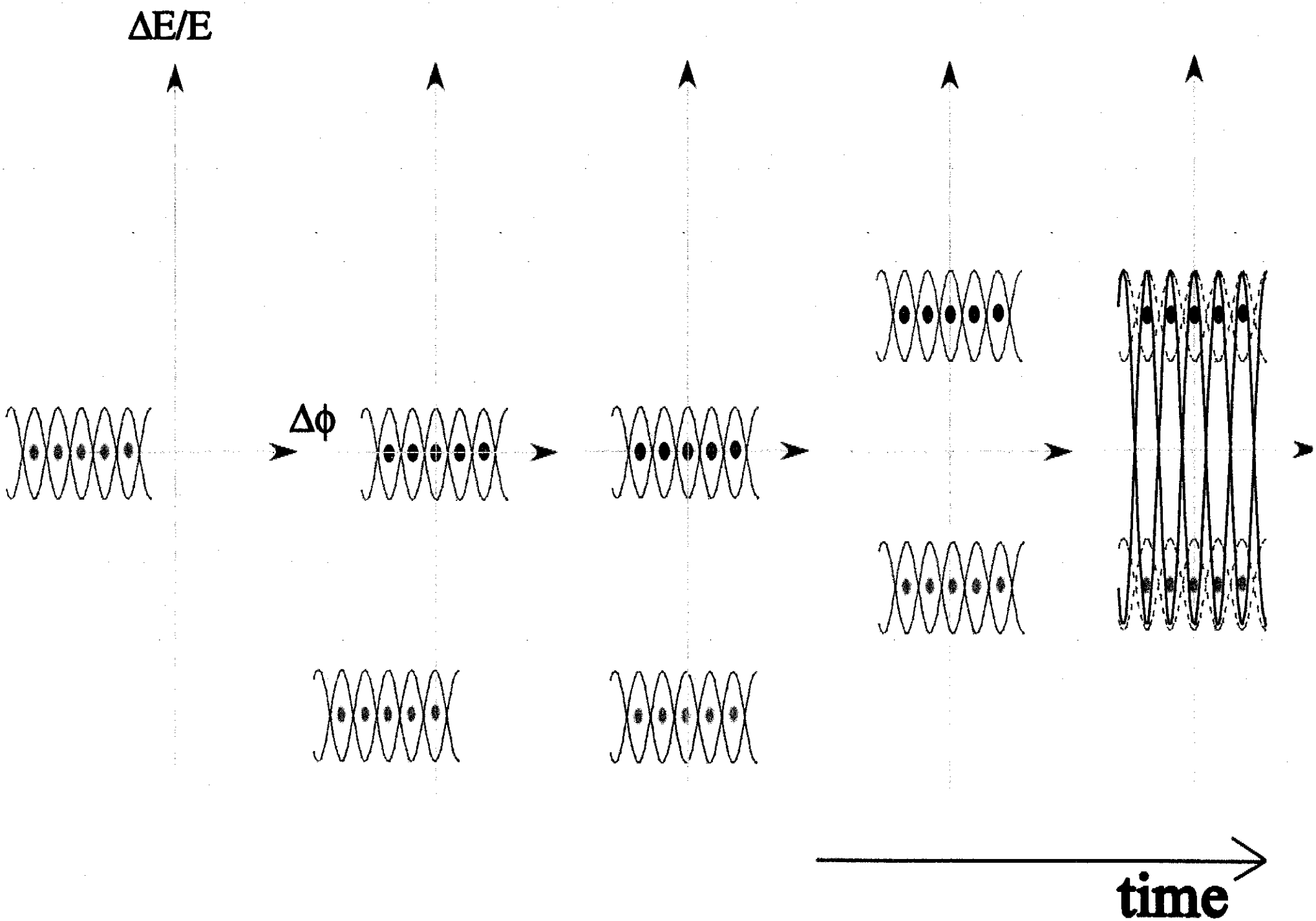
84 bunches

Booster ——— **Main Injector** ⟶ **AP line Target**

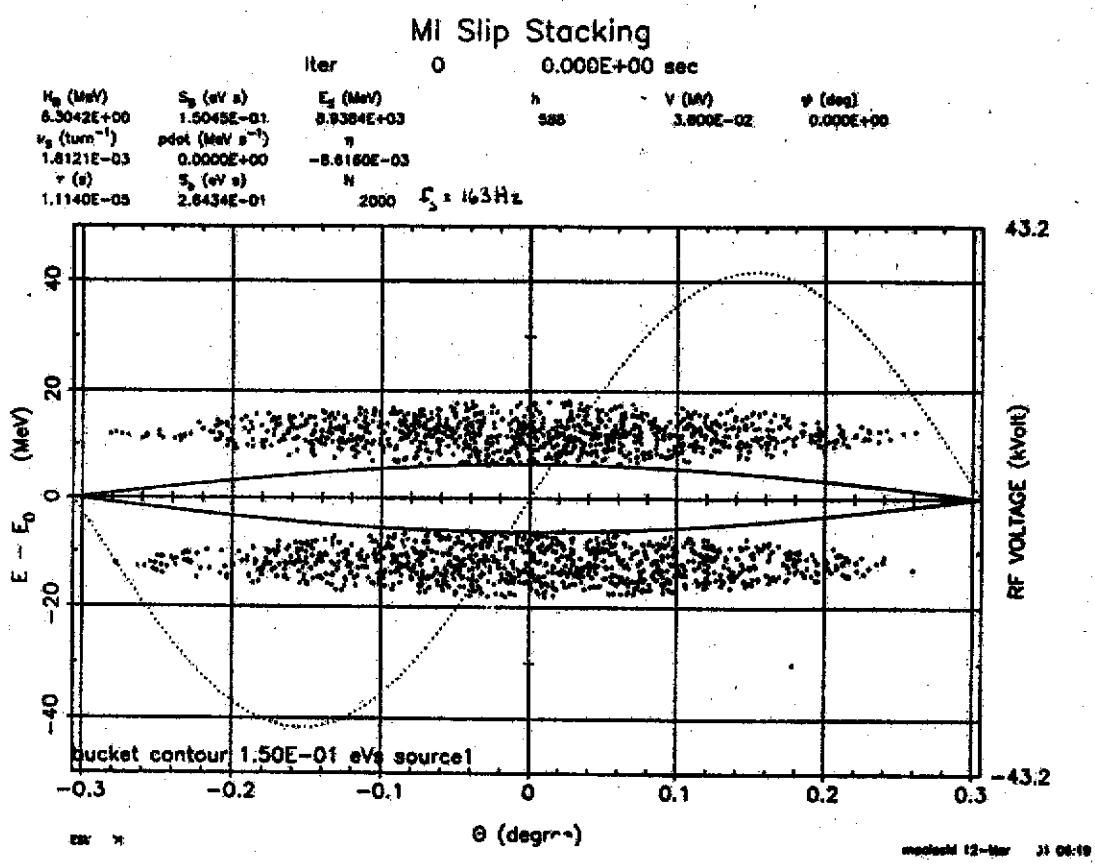
8GeV **120GeV**



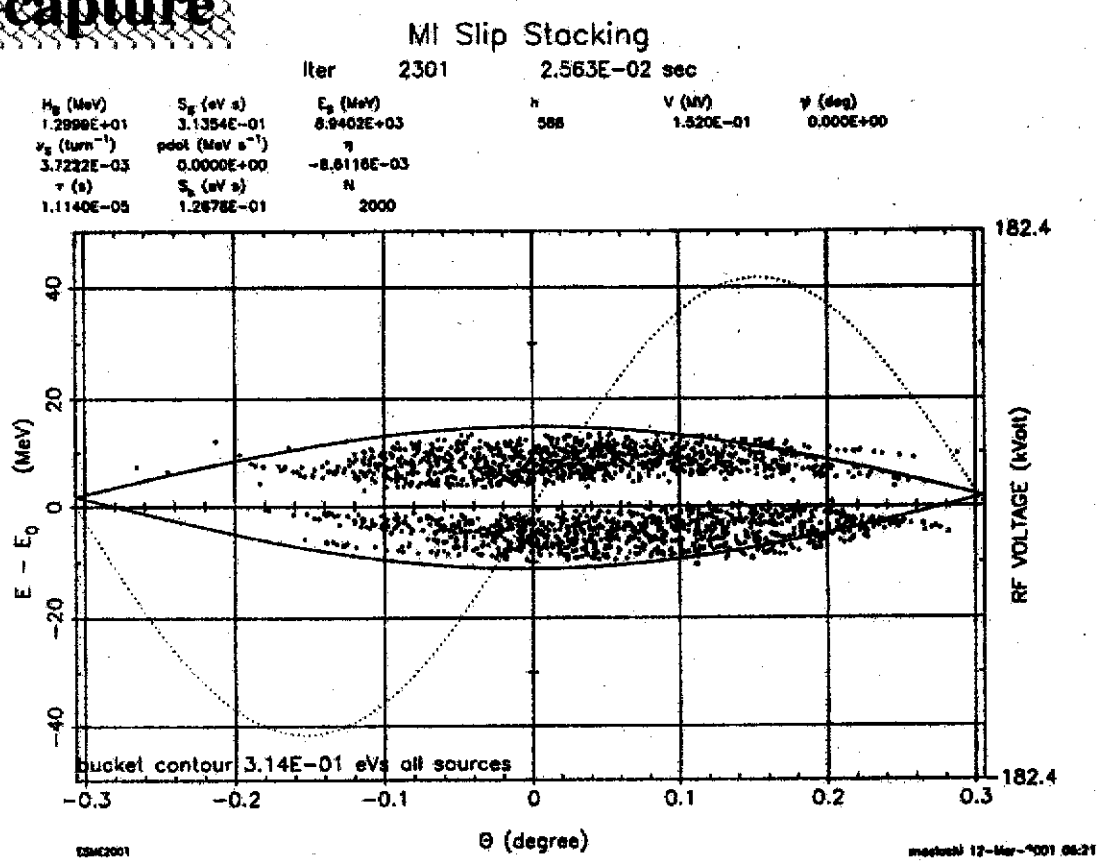
Antiproton production cycle (29 cycle)

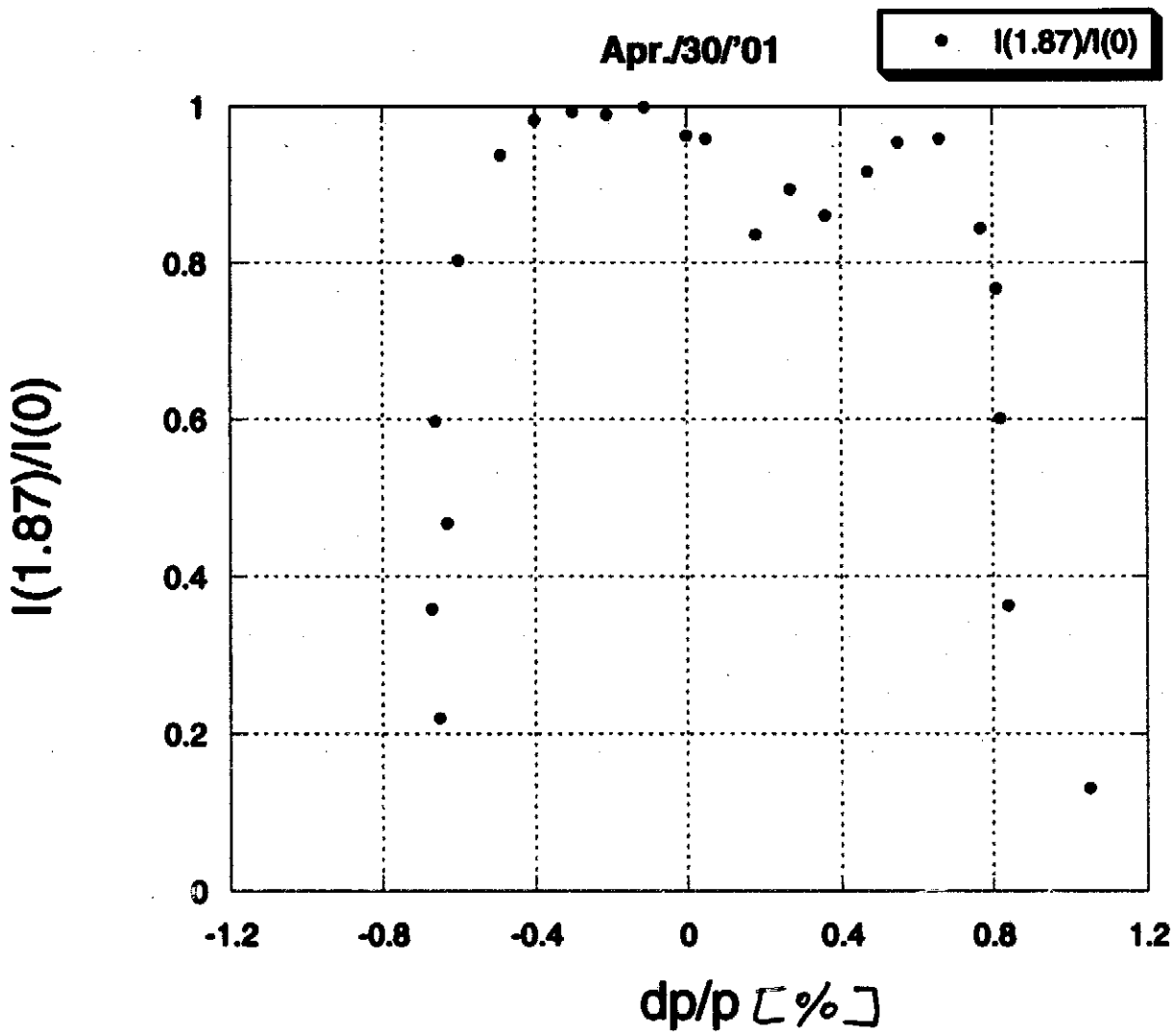

ΔE/E
Δϕ
time

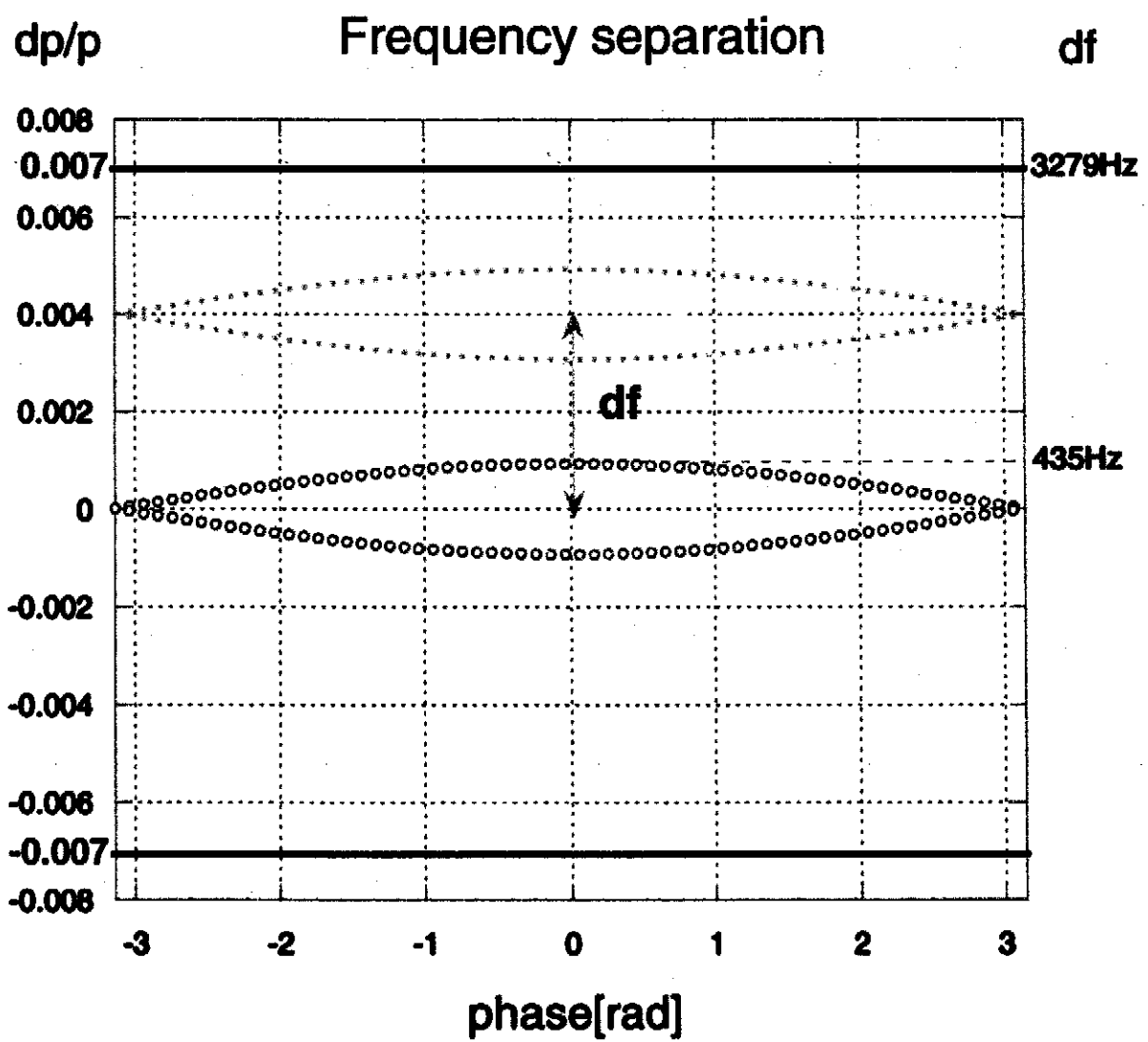
Initial



After the capture

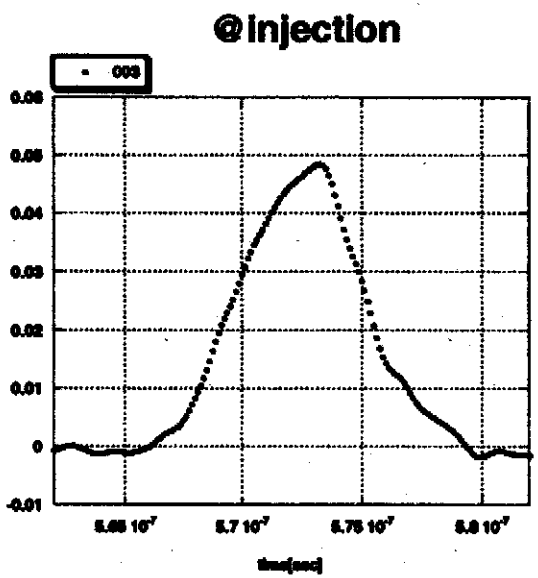


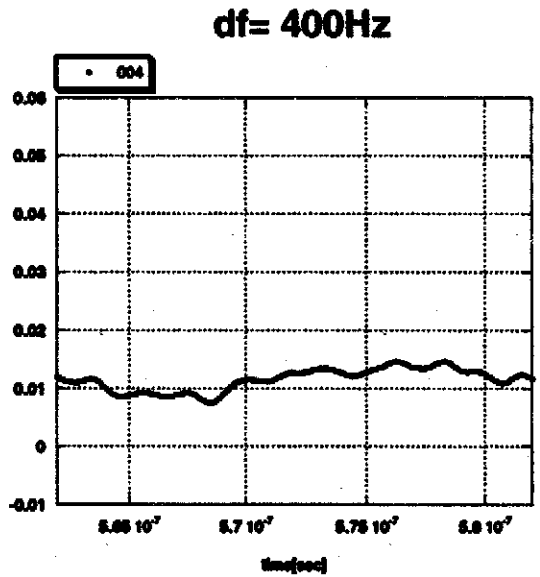

Apr./30/'01
I(1.87)/I(0)
1
0.8
0.6
0.4
0.2
0
-1.2
-0.8
-0.4
0
0.4
0.8
1.2
I(1.87)/I(0)
dp/p [%]

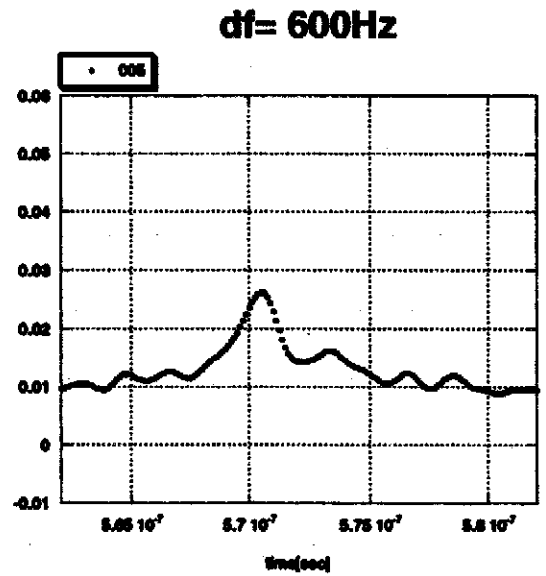

dp/p
Frequency separation
df
0.008
0.007
0.006
0.004
0.002
0
-0.002
-0.004
-0.006
-0.007
-0.008
3279Hz
df
435Hz
-3
-2
-1
0
1
2
3
phase[rad]

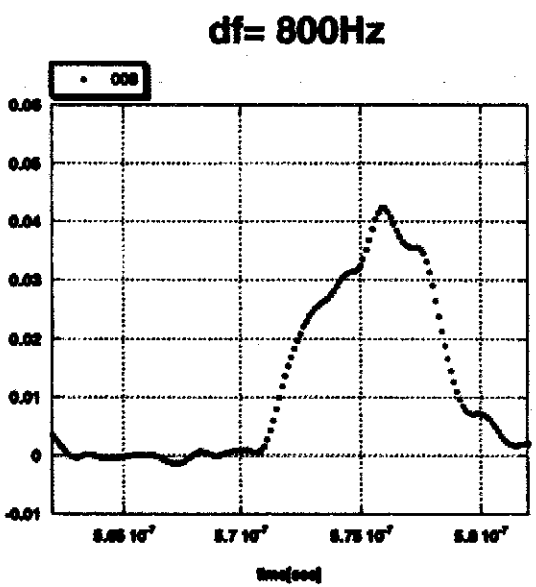
@ 0.12 sec

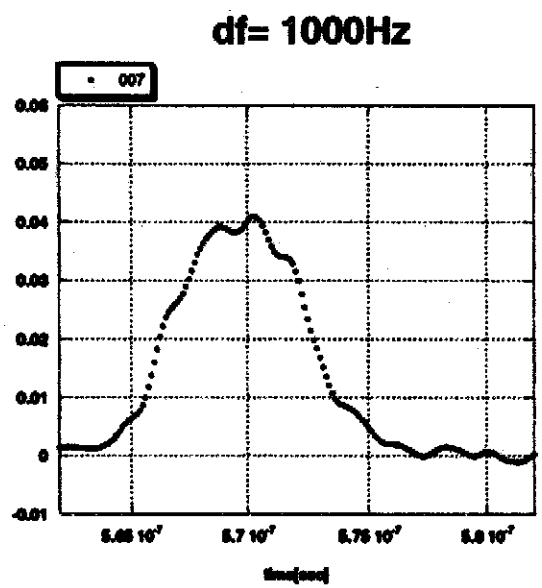
@ 0.21 sec

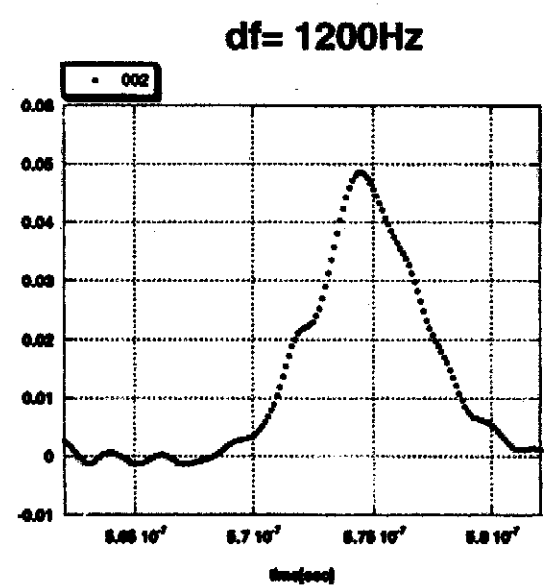


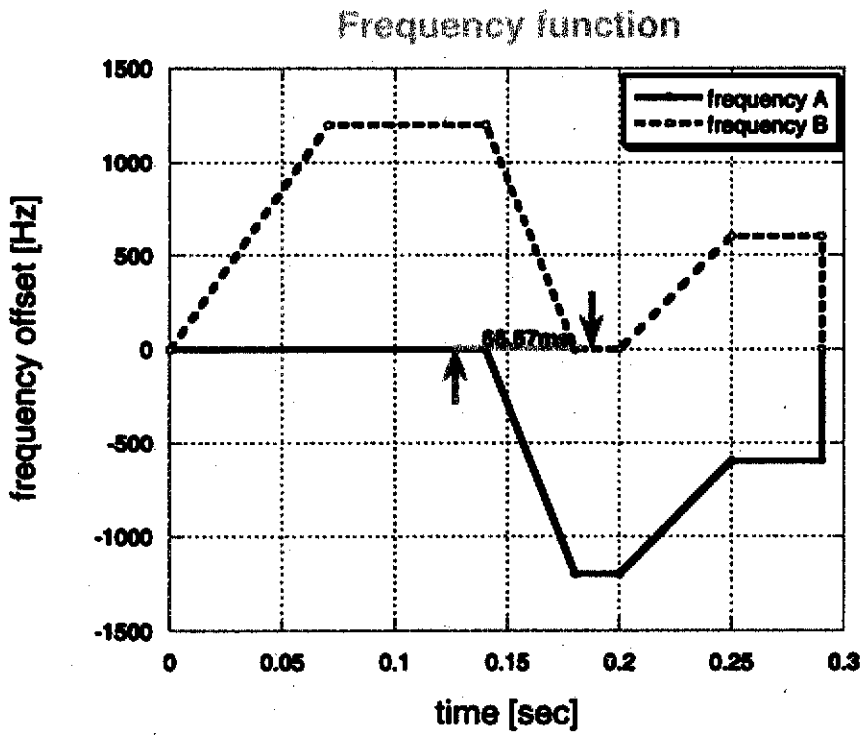


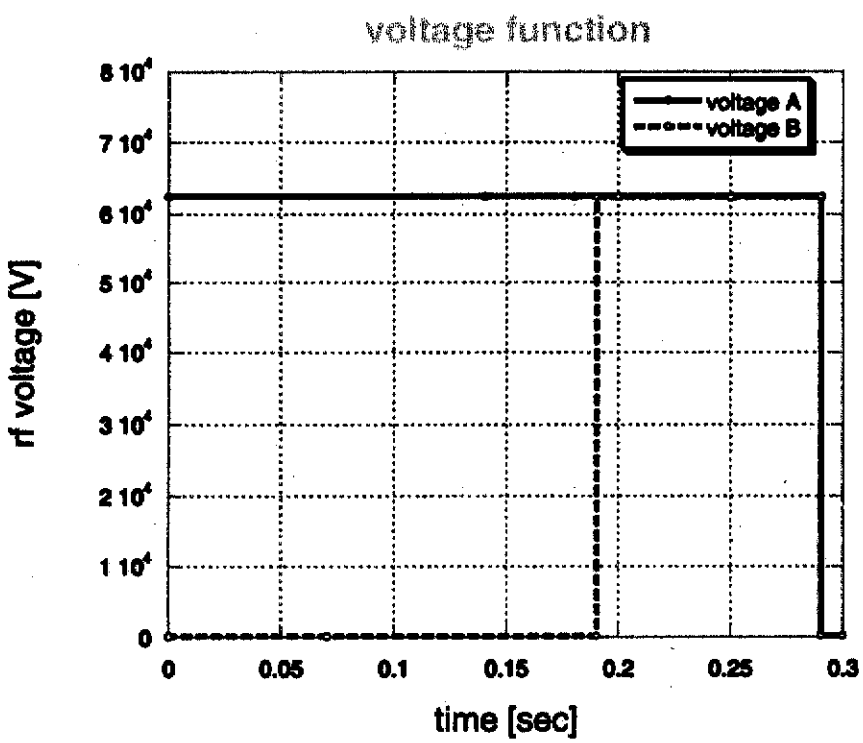


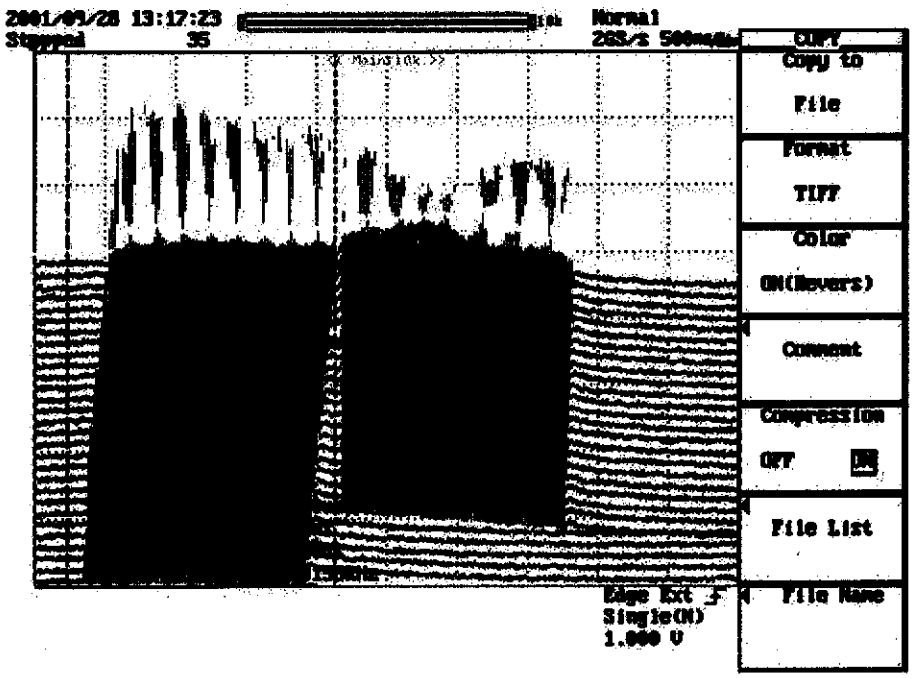


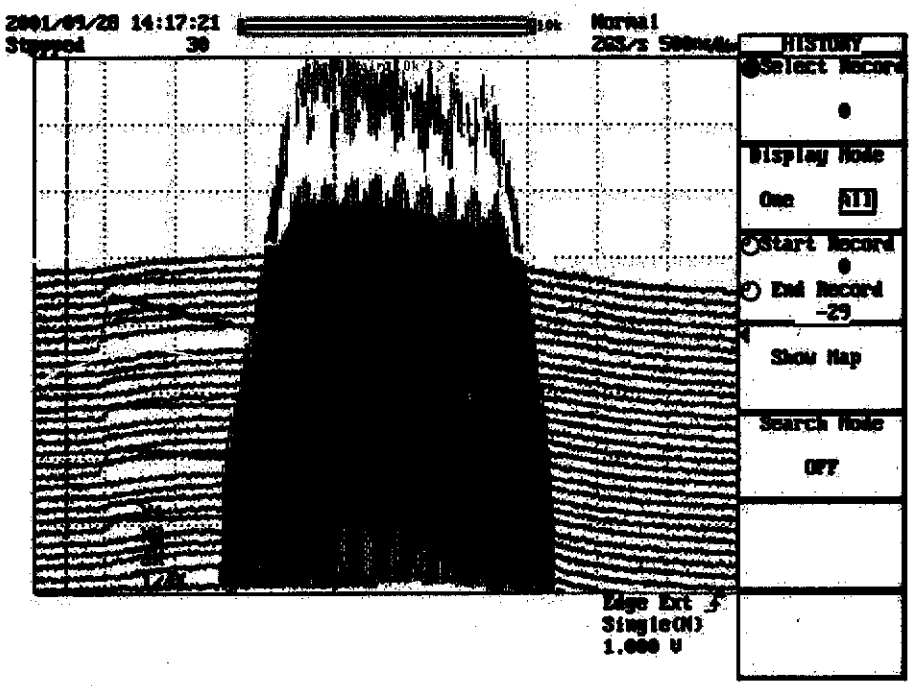


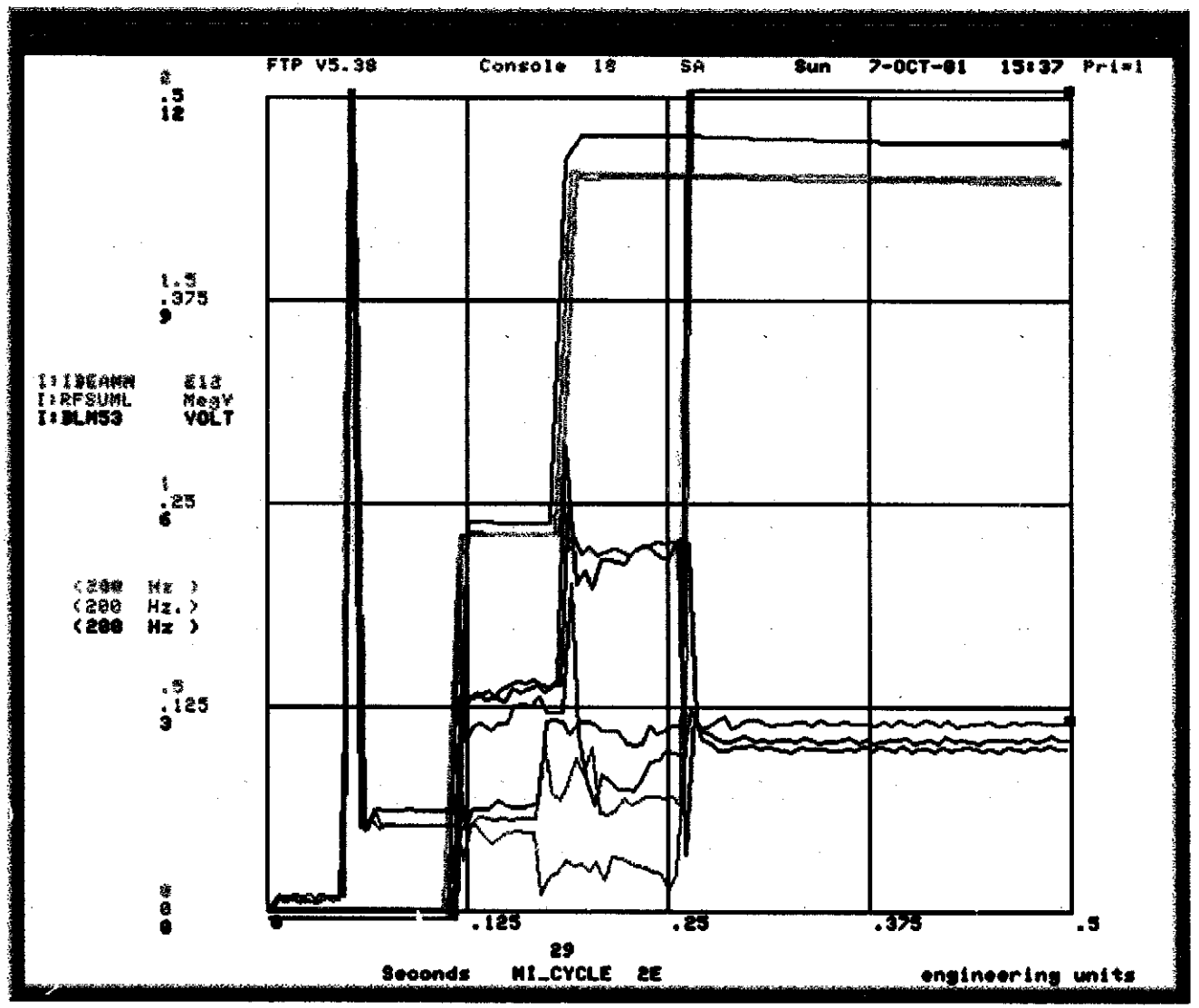



Frequency function
frequency A
frequency B
frequency offset [Hz]
1500
1000
500
0
-500
-1000
-1500
0
0.05
0.1
0.15
0.2
0.25
0.3
time [sec]


voltage function
voltage A
voltage B
rf voltage [V]
8 10⁴
7 10⁴
6 10⁴
5 10⁴
4 10⁴
3 10⁴
2 10⁴
1 10⁴
0
0
0.05
0.1
0.15
0.2
0.25
0.3
time [sec]

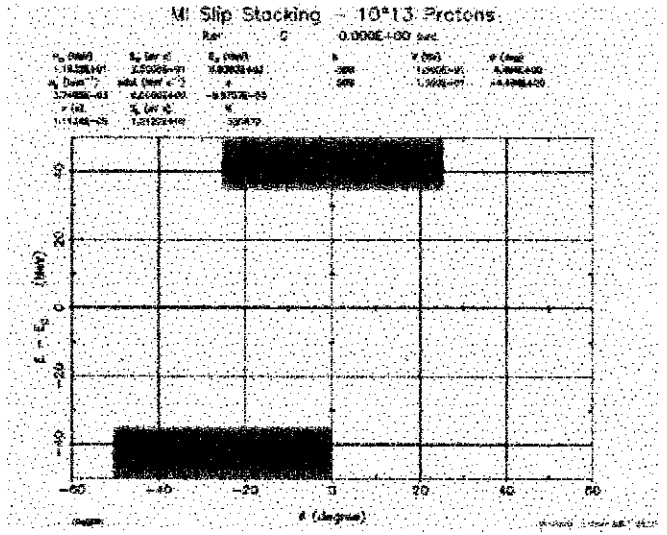

2001/09/28 13:17:23
Stopped 35
Normal
2GS/s 500ns/div
COPY
Copy to
File
Format
TIFF
Color
ON(Revers)
Comment
Compression
OFF ON
File List
File Name
Edge Ext 3
Single(N)
1.000 V


2001/09/28 14:17:21
Stopped 30
Normal
2GS/s 500ns/div
HISTORY
Select Record
0
Display Mode
One All
Start Record
0
End Record
-29
Show Map
Search Mode
OFF
Edge Ext 3
Single(N)
1.000 V



Close Duplicate

Initial

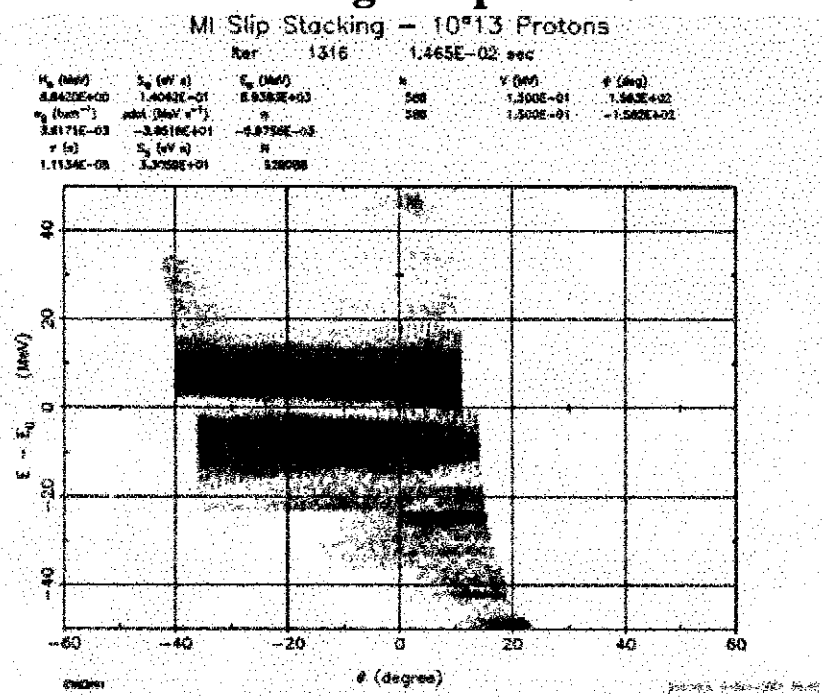


Intensity: $5.0*10^{12}$ for each batch

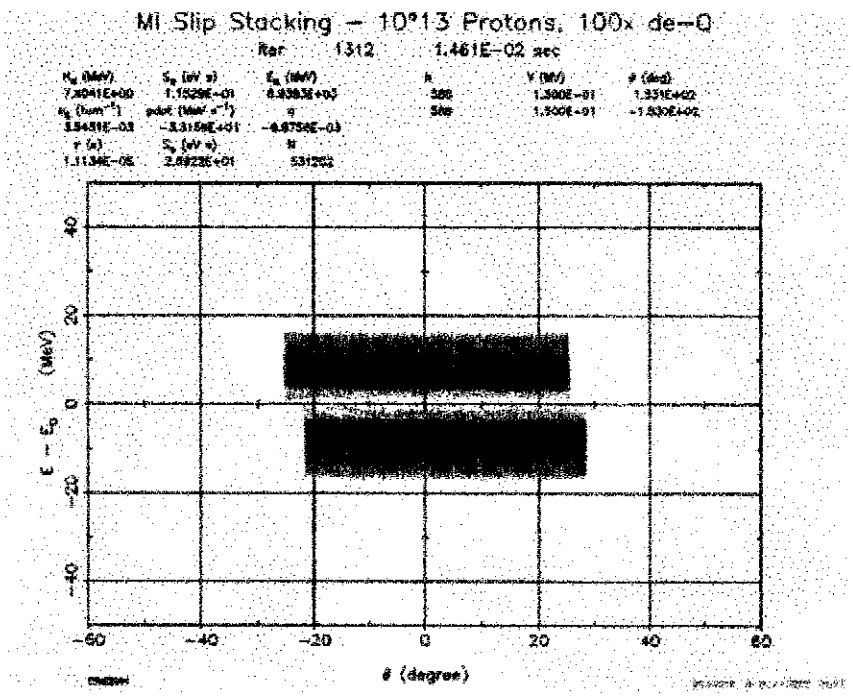
84 bunches / batch

Final

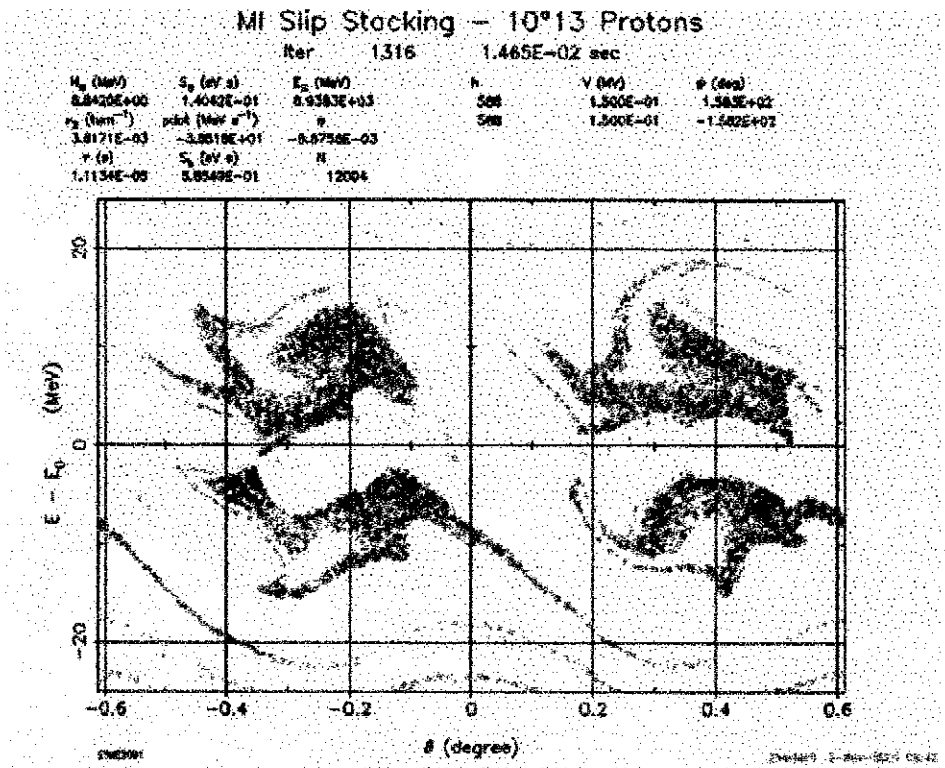
w/o Beam loading compensation



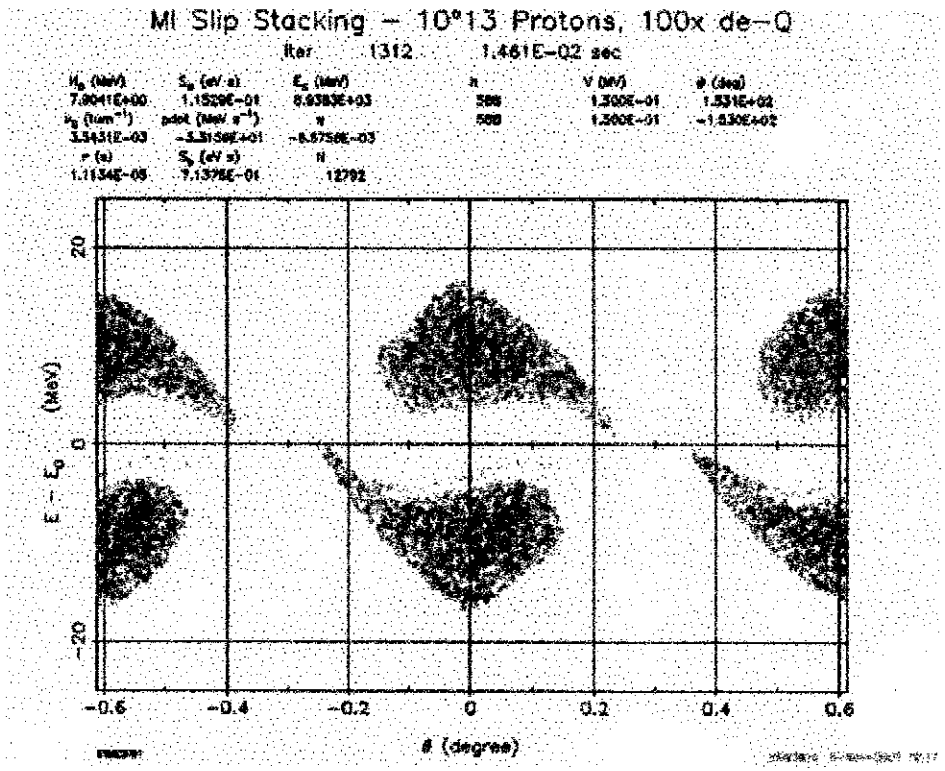
with Beam loading compensation



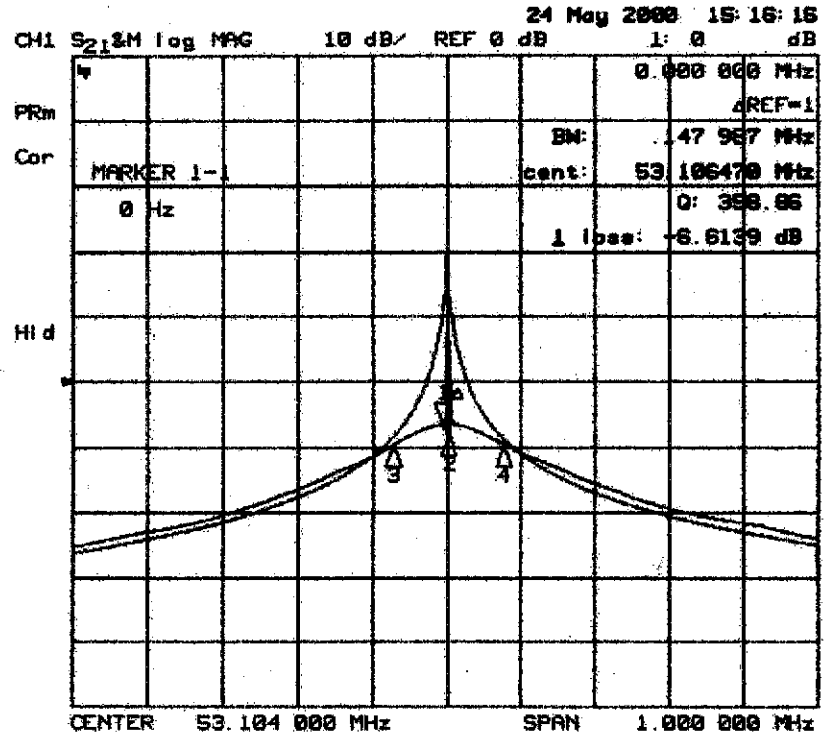
w/o Beam loading compensation



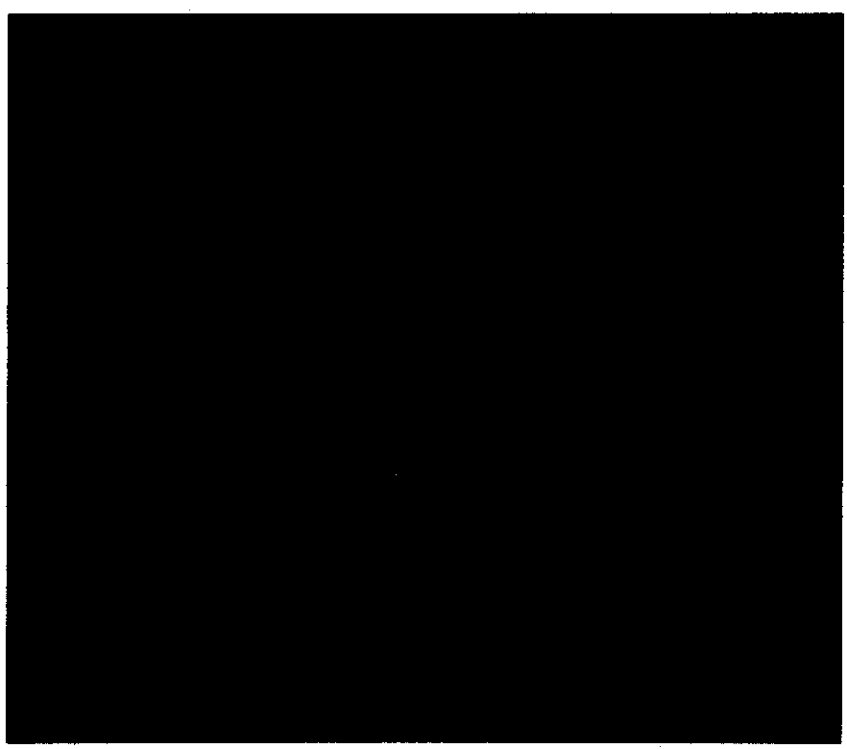
with Beam loading compensation 40dB of loop gain



Feedback beam loading compensation



Feedforward beam loading compensation



Summary

We have begun 'Slip stacking' studies to increase proton intensity which is extracted from Main Injector to the target.

Basically 'Silp Stacking' is working with low intensity.

For high intensity operation, the development of the feedback and feedforward beam loading compensation system are under way.