

# CTF 3 Injector Studies.

Dian Yermian

Feng Zhou.

May 2, 2000

- Appropriate Gun bunch length.  
in Simulations For 150 KV. gun V.
- Bunch arrival time vs. Gun Voltage.
- Space Charge effects Vs Gun Voltage.
- 90KV vs. 150KV gun voltage.
- Relatively optimized 3SHB injector.
- Future Work.

How long should the Gun Bunch length be in simulations?

| Phase span (cycles) of S-band | Mesh span (cm)                                         | Mesh size (mm)   | Initial position (cm) | Right satellite | Left satellite | $\sigma_z$ (ps) (fwhm/fw) | $\sigma_E$ (keV) (fwhm/fw) |
|-------------------------------|--------------------------------------------------------|------------------|-----------------------|-----------------|----------------|---------------------------|----------------------------|
| 2                             | 13.4 (-shb2)<br>13.4 (shb2 exit-pb)<br>13.4 (pb exit-) | 1<br>0.5<br>0.15 | -6.2                  | 9.0%            | 12%            | 6/19                      | 120/1400                   |
| 2*                            | 13.4 (-shb2)<br>13.4 (shb2 exit-pb)<br>2.0 (pb exit-)  | 1<br>0.5<br>0.15 | -6.2                  | 9.0%            | 12%            | 6/21                      | 150/1400                   |
| 2 (3 SHBs)                    | 13.4 (-shb3)<br>13.4 (shb3 exit-pb)<br>13.4 (pb exit-) | 1<br>0.5<br>0.15 | -6.2                  | 5%              | 6%             | 6/30                      | 340/1500                   |
| 6                             | 40.2 (-shb2)<br>40.2 (shb2 exit-pb)<br>40.2 (pb exit-) | 1<br>0.5<br>0.15 | -18.6                 | 20.5%           | 20.0%          | 6.5/20                    | 80/1300                    |
| 6*<br>(followed by 1m drift)  | 40.2 (-shb2)<br>40.2 (shb2 exit-pb)<br>40.2 (pb exit-) | 1<br>0.5<br>0.15 | -18.6                 | 20.0%           | 19.5%          | 7.0/20                    | 85/1300                    |
| 10                            | 67 (-shb2)<br>67 (shb2 exit-pb)<br>67 (pb exit)        | 1<br>0.5<br>0.15 | -31                   | 20.0%           | 20.0%          | 6.5/20                    | 140/1400                   |

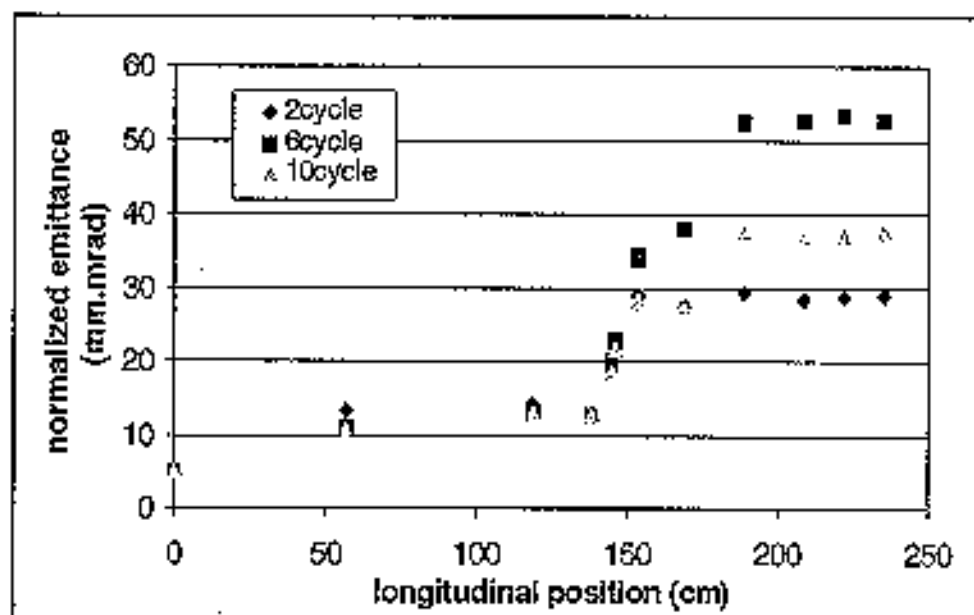
| Phase span (cycles) | $\sigma_x/\sigma_y$ (mm, from outgraf) | $\sigma_x/\sigma_y$ (mm, from own program, all particles) | $\sigma_x/\sigma_y$ (mm, from own program, one main bunch) |
|---------------------|----------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|
| 2                   | 30/28                                  | 30/28                                                     | 32/30                                                      |
| 2*                  | 30/28                                  | 30/28                                                     | 32/30                                                      |
| 2 (3 SHBs)          | 28/27                                  |                                                           |                                                            |
| 6                   | 49/56                                  | 49/56                                                     | 52/54                                                      |
| 6*                  | 50/56                                  | 50/56                                                     | 53/57                                                      |
| 10                  | 38/37                                  | 38/37                                                     | 40/40                                                      |

140 KV gun pulse

Feng Zhou  
Dian Yermenian

| Phase span<br>(cycles) <i>S-band</i> | Mesh span<br>(cm)                                      | Mesh size<br>(mm) | Initial position<br>(cm) | $e_x/e_y$<br>(mm.mrad) |
|--------------------------------------|--------------------------------------------------------|-------------------|--------------------------|------------------------|
| 6                                    | 40.2 (-shb2)<br>40.2 (shb2 exit-pb)<br>40.2 (pb exit-) | 1<br>0.5<br>0.15  | -18.6                    | 49/56                  |
| 6+<br>(new mesh region)              | 40.2 (-shb2)<br>13.4 (shb2 exit-pb)<br>2.0 (pb exit-)  | 1<br>0.5<br>0.15  | -18.6                    | 23/25                  |
| 6*<br>(followed by 1m drift)         | 40.2 (-shb2)<br>40.2 (shb2 exit-pb)<br>40.2 (pb exit-) | 1<br>0.5<br>0.15  | -18.6                    | 49/56                  |
| 2.                                   | 13.4<br>13.4<br>13.4                                   | 0.5<br>0.15       |                          | 30/28                  |
| 2 (remesh)                           | 13.4<br>13.4<br>2.0                                    | 0.5<br>0.15       |                          | 30/28                  |

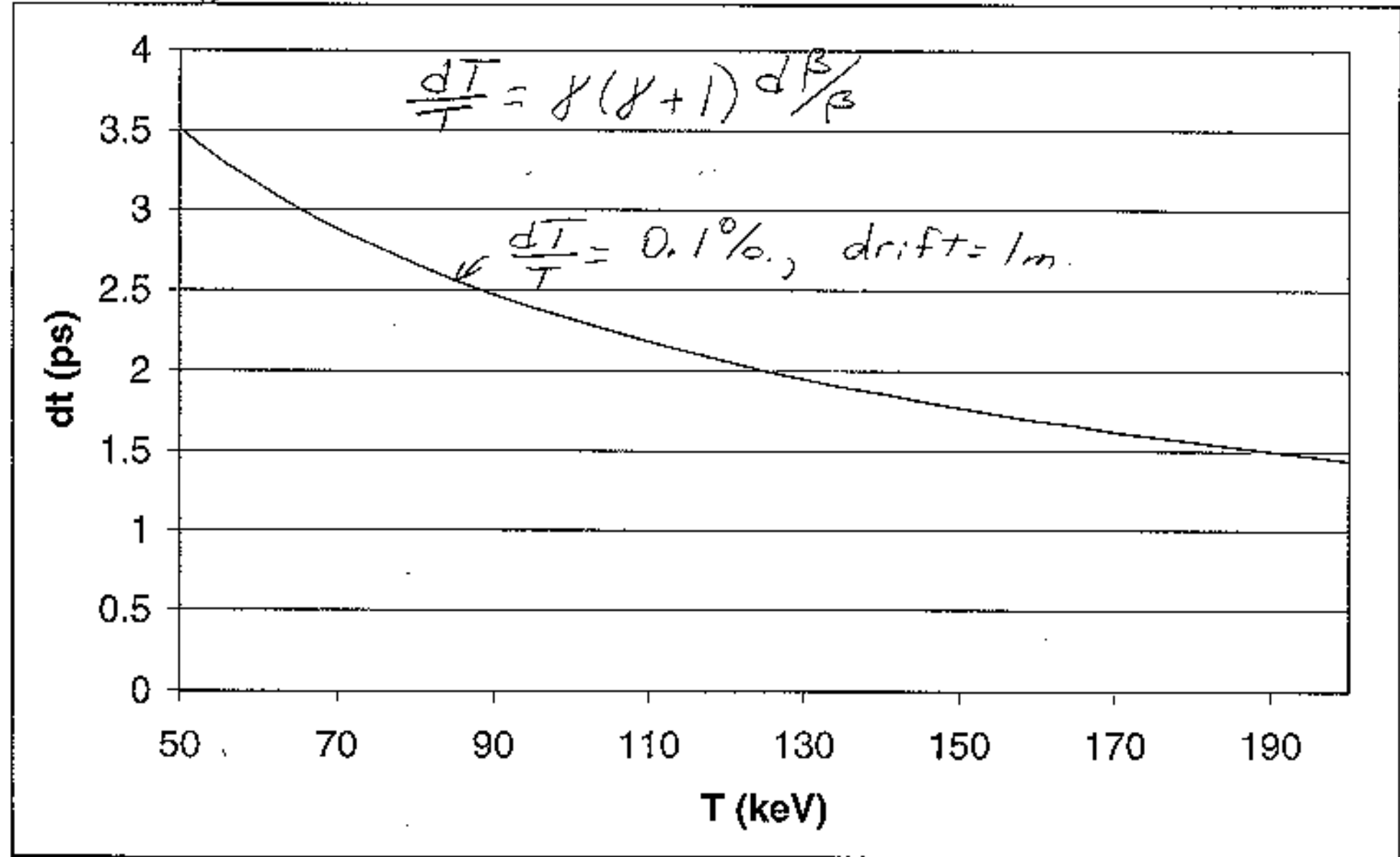
## 2.5HB Injector Gun Bunch Length Comparison Studies.



Fang Zhou  
Dian Yermian

# Time of Arrival Variation Vs Gun Voltage.

Diont Feng, 5/2/00



## $\Sigma N_{edge}$ from E GUN Simulations

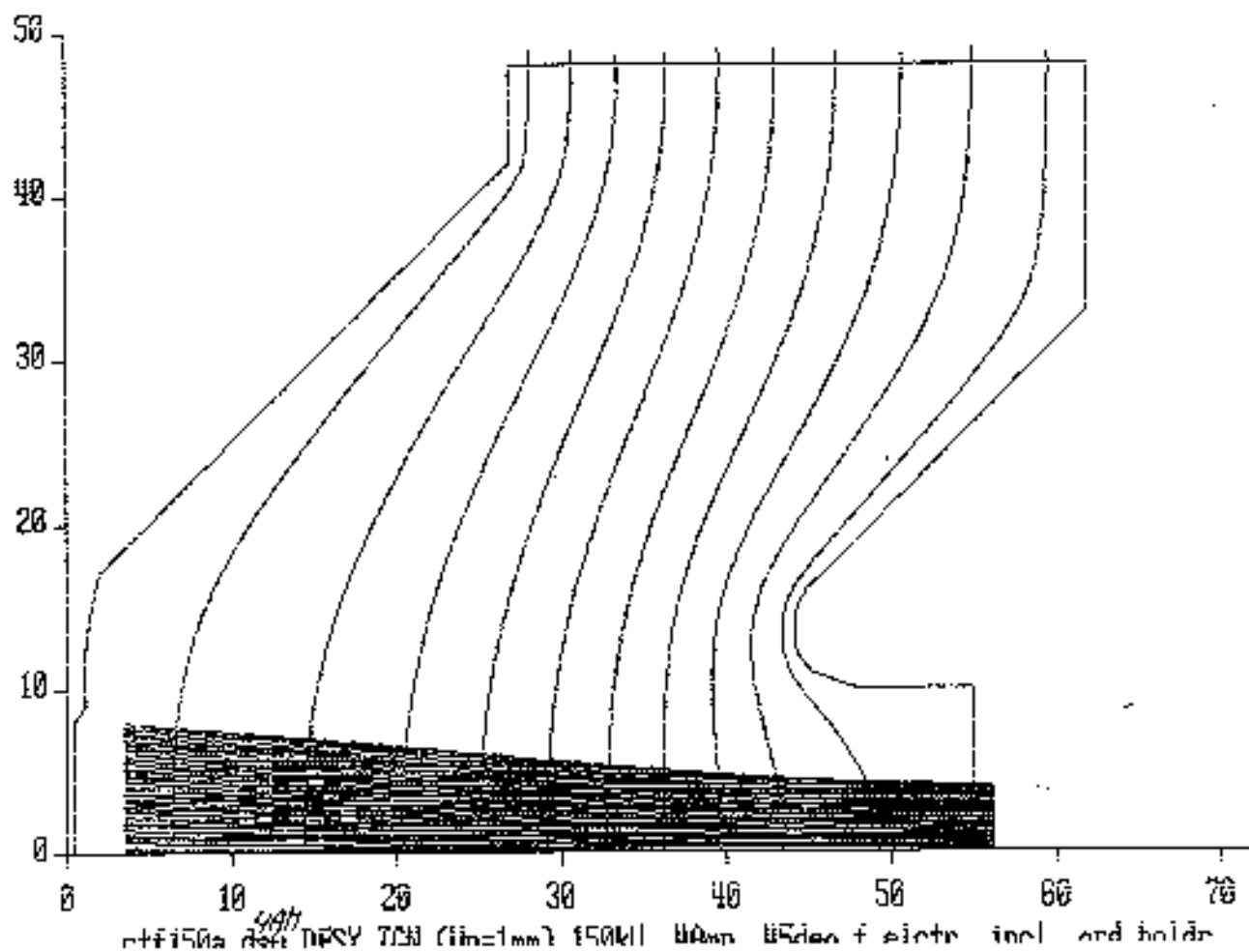
|       | 7A Space Charge.<br>Limited | 4A Grid.<br>Limited.      |
|-------|-----------------------------|---------------------------|
| 90KV  | $9.2 \times 10^{-6} m$      | $11.43 \times 10^{-6} m.$ |
| 110KV | $9.3 \times 10^{-6} m.$     | $11.42 \times 10^{-6} m.$ |
| 130KV | $9.15 \times 10^{-6} m$     | $11.09 \times 10^{-6} m.$ |
| 150KV | $9.36 \times 10^{-6} m.$    | $11.7 \times 10^{-6} m.$  |

Dian & Feng.  
5/2/2008

2,688

CYCLE= 7

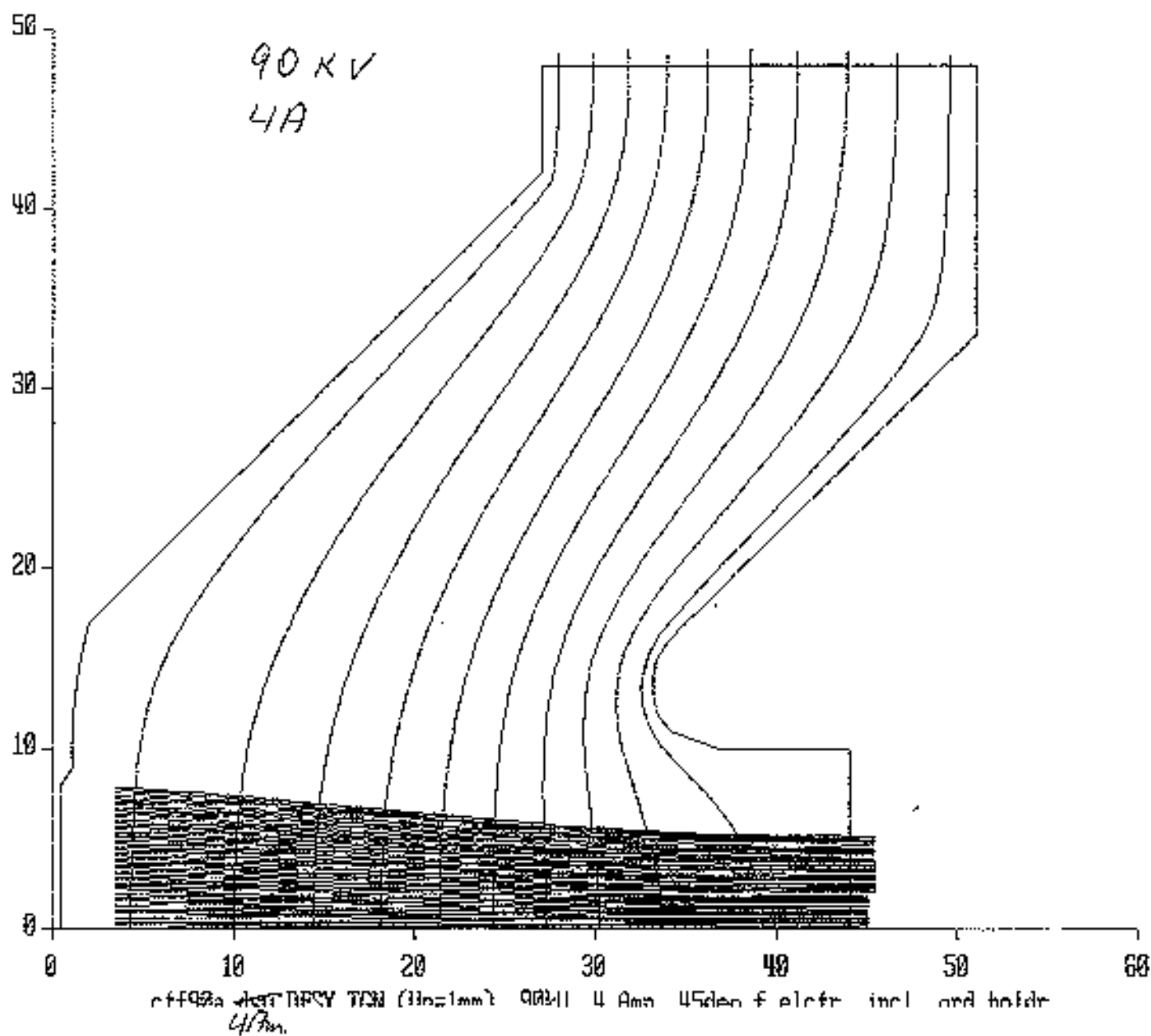
150 KV  
4A



Dian & Feng  
5/2/2000

ECN: 2.088

CYCLE= 7

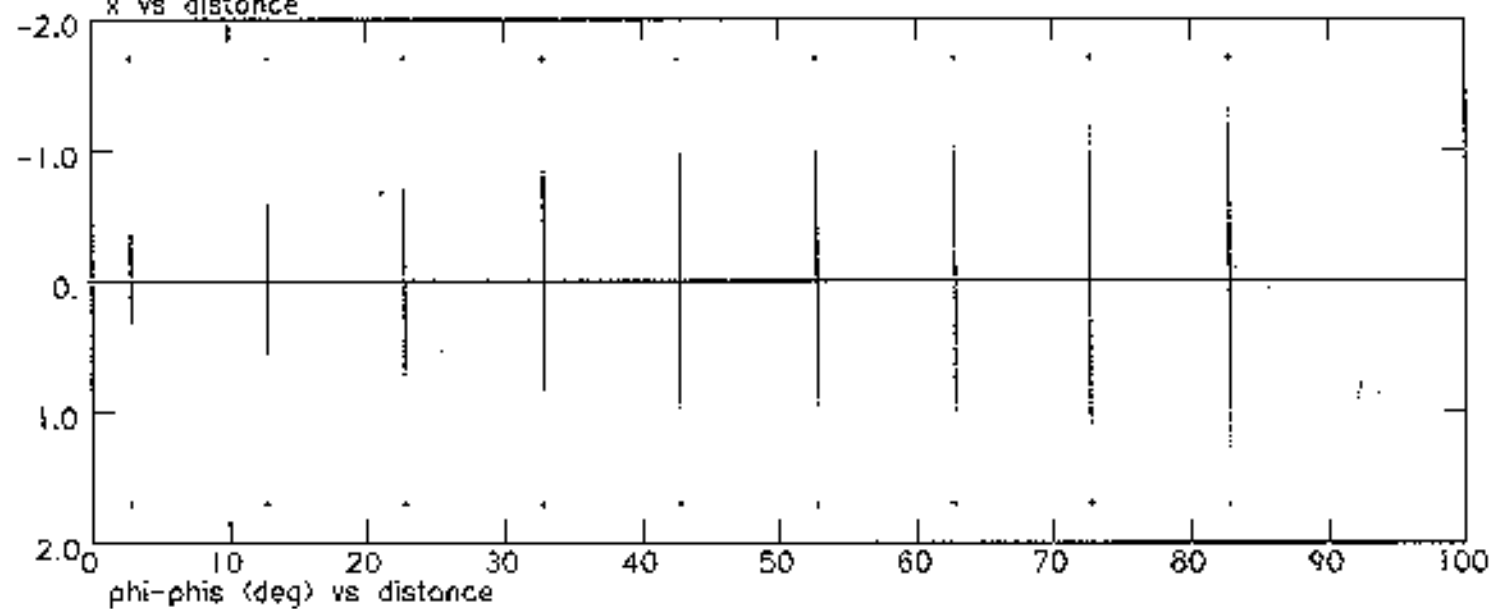


Dian, Feng  
5/2/2000

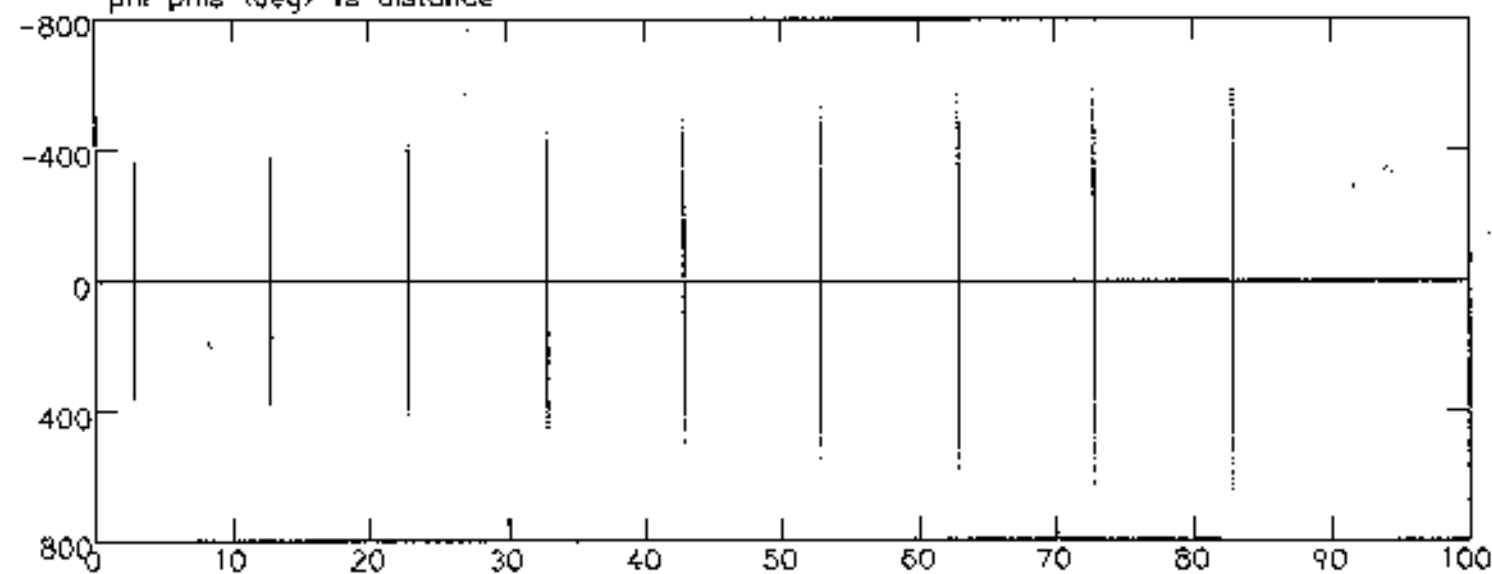


gun drift 90KV, 4 Amp, 2 S-cycles

x vs distance



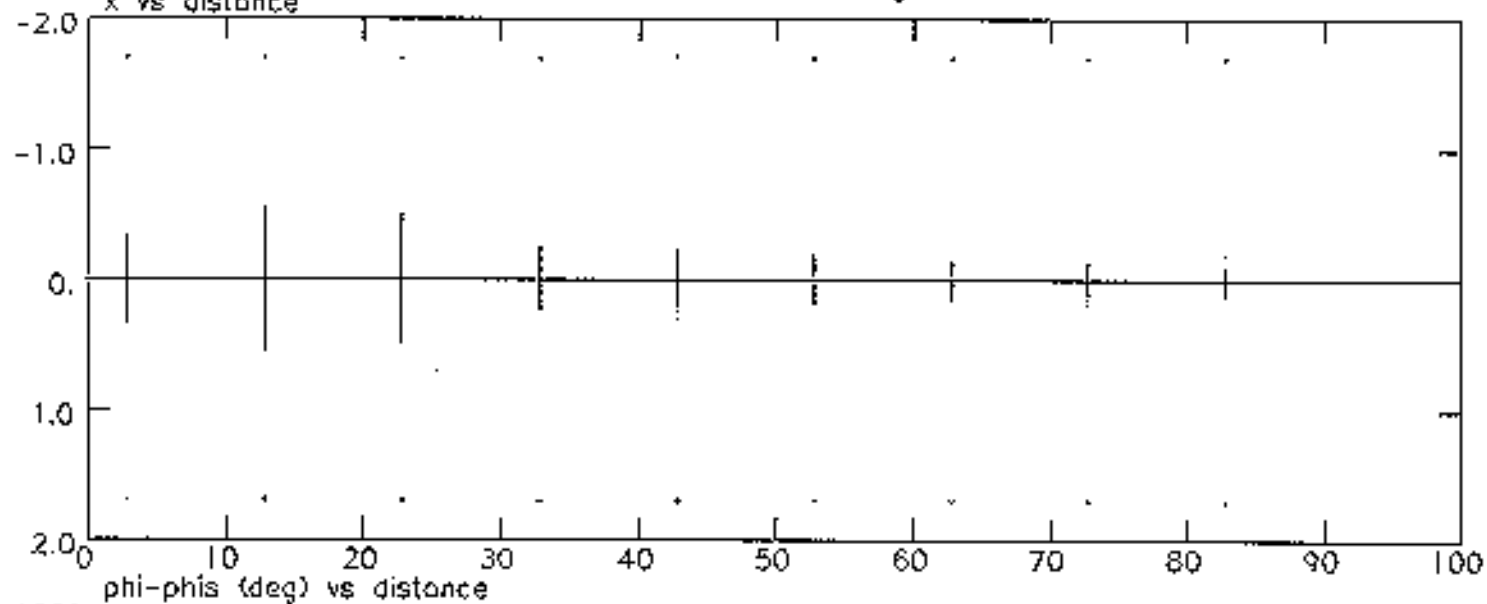
phi-phis (deg) vs distance



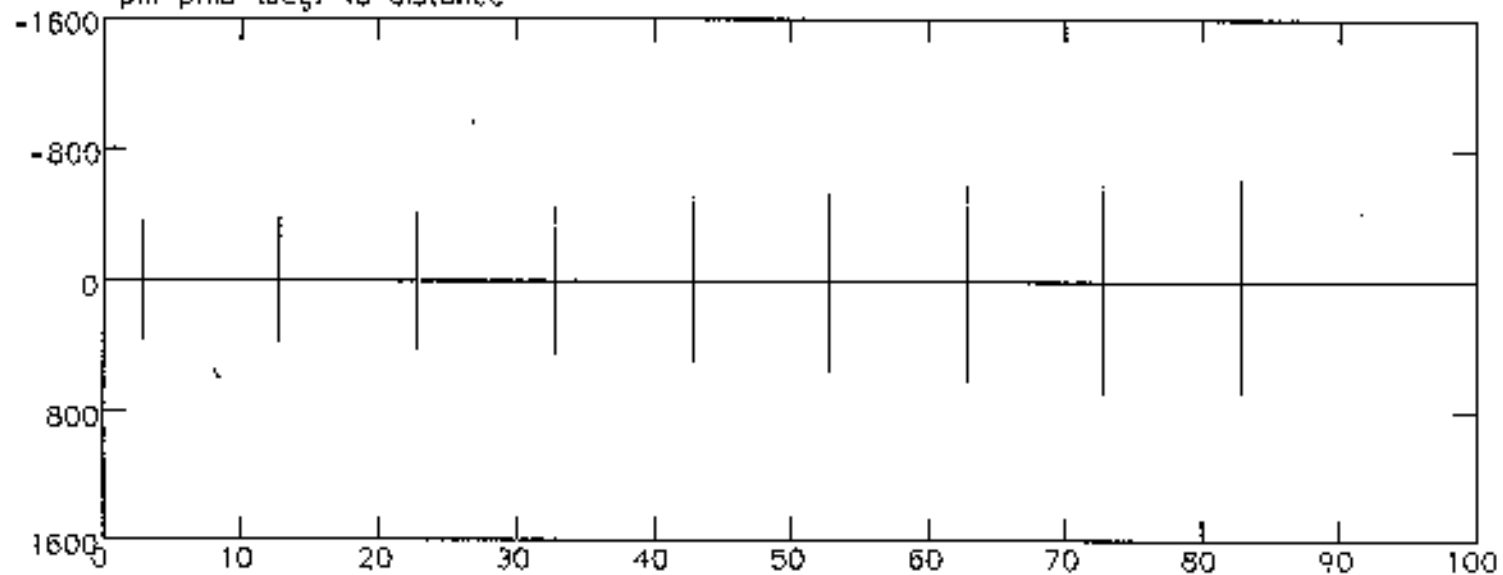
Dian Feng  
5/2/2000

gun drift 90KV, 4 Amp, 2 S-cycles  
x vs distance

stronger  $B_2$



phi-phis (deg) vs distance



Dian Feng  
5/2/00

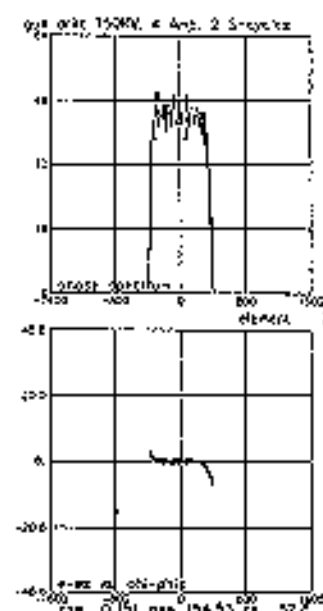
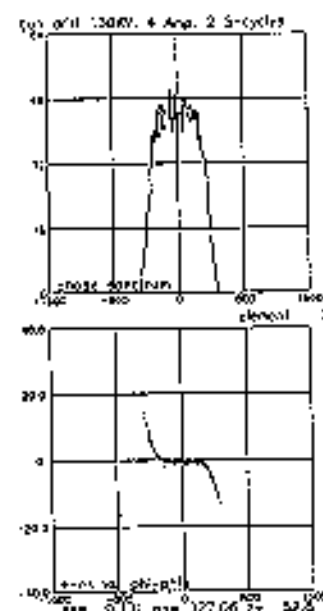
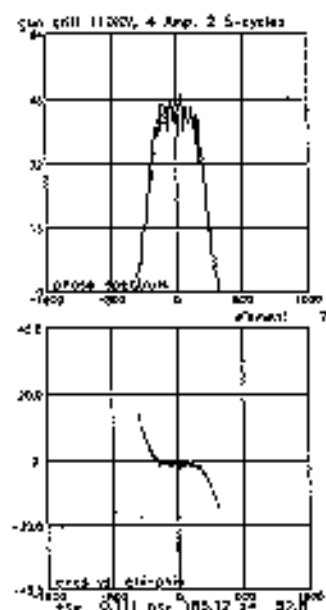
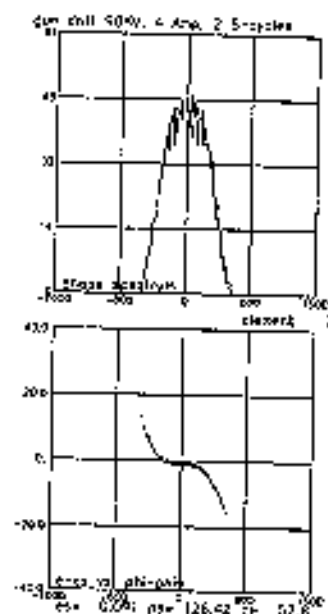
90KV

110KV

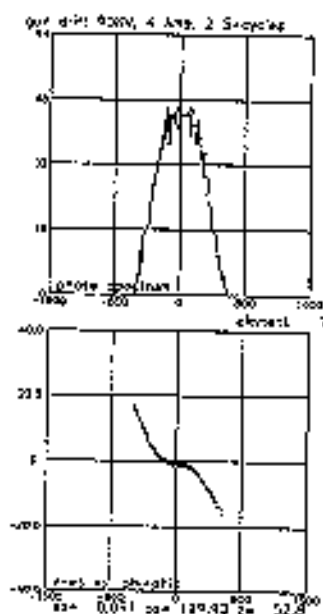
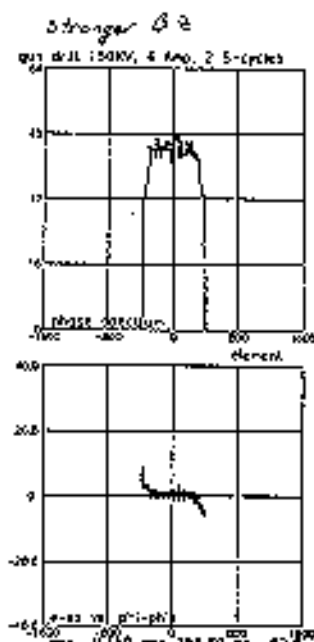
130KV

150KV

← Gun Voltage.

Dian  
Feng.

Stronger B2

52 cm drift  
SHB1 to SHB2Dian, Feng  
5/2/00

# Beam Dynamics Pros & Cons with Gun Voltage.

Dian, et al.

Pros.

Cons.

90 KV

Lower SHB V.

Space Chare dominates.

Gun V stability tougher.

Shorter distances  
Less space in the hall      less space for diagnostic

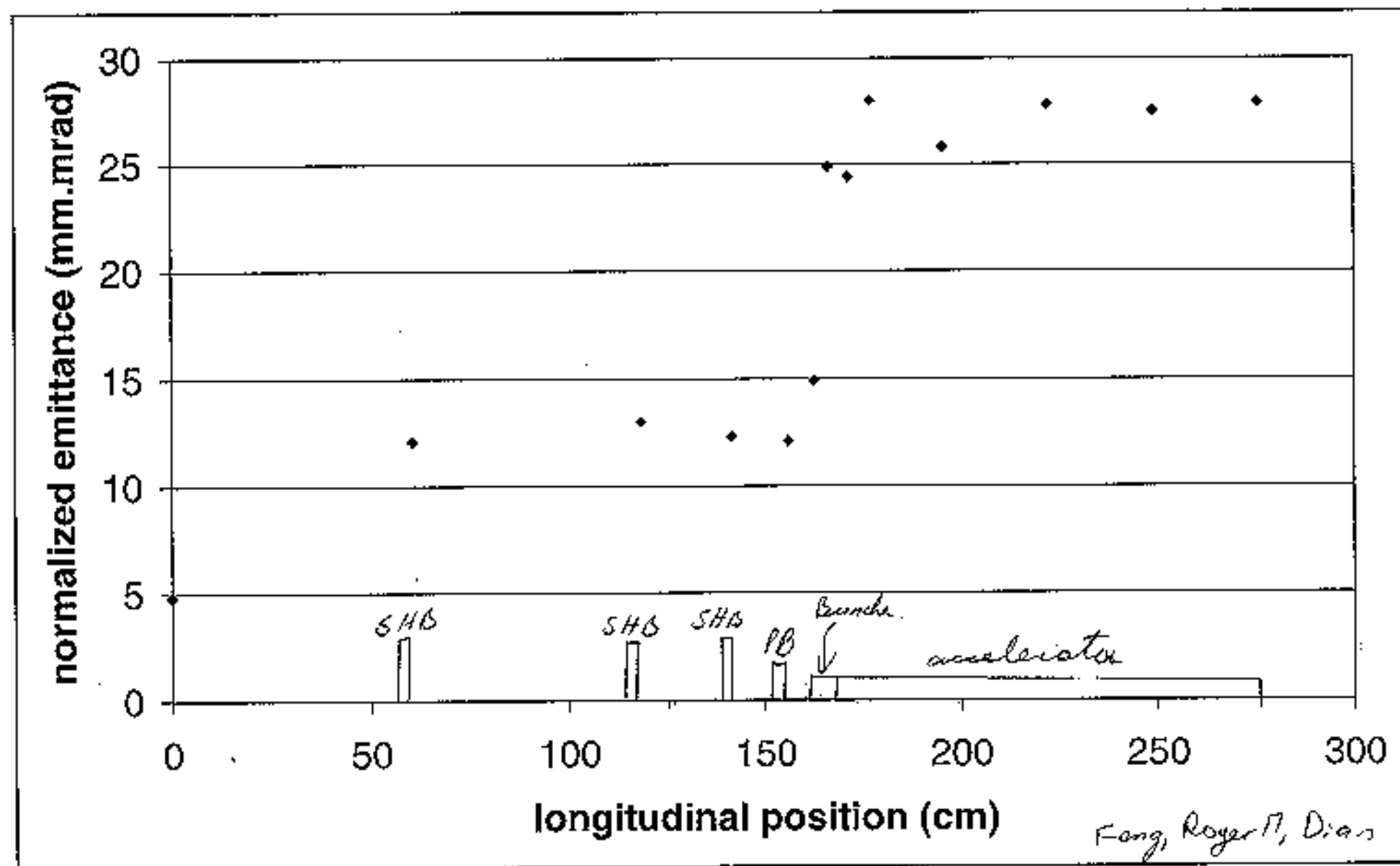
150 KV

S.C. less effective. ....

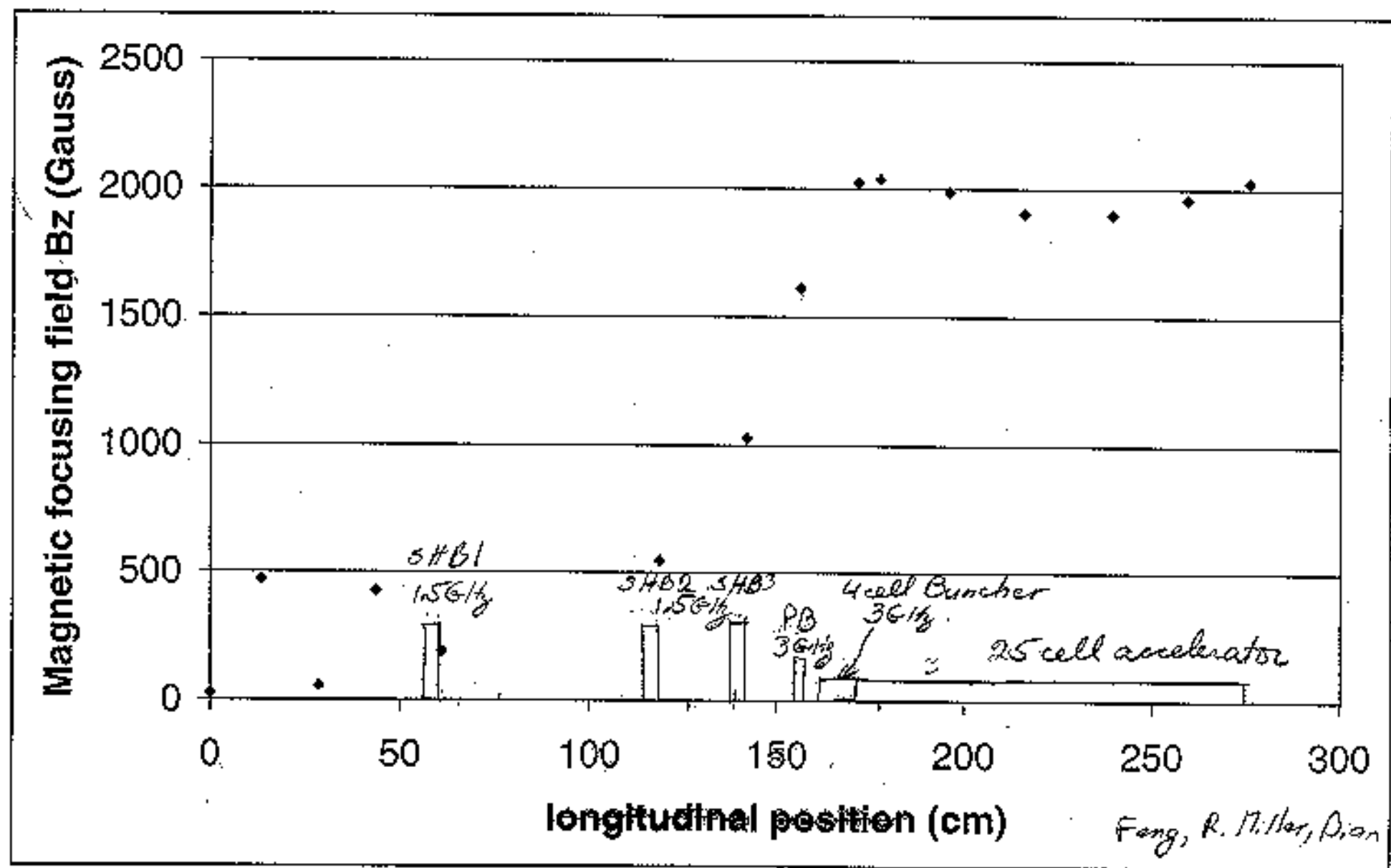
higher SHB V.

Gun V stability easier.  
less effect  
smaller slope.

Longer distances  
More space for diag.      need more space in hall  
less sensitive to tuning error.

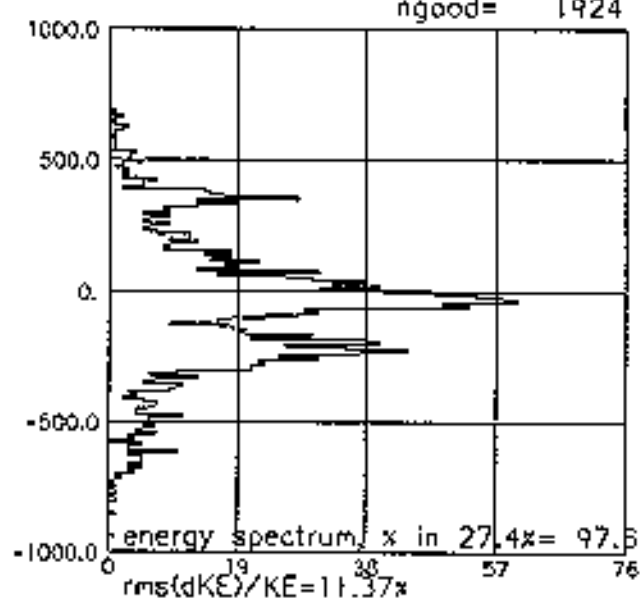
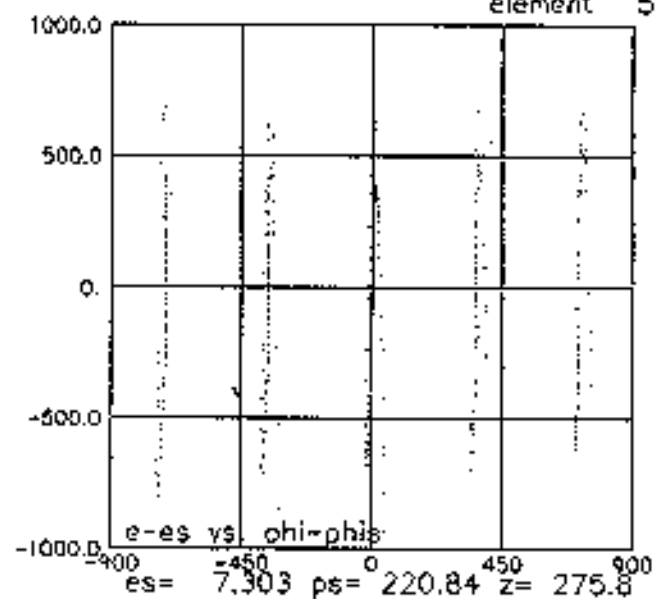
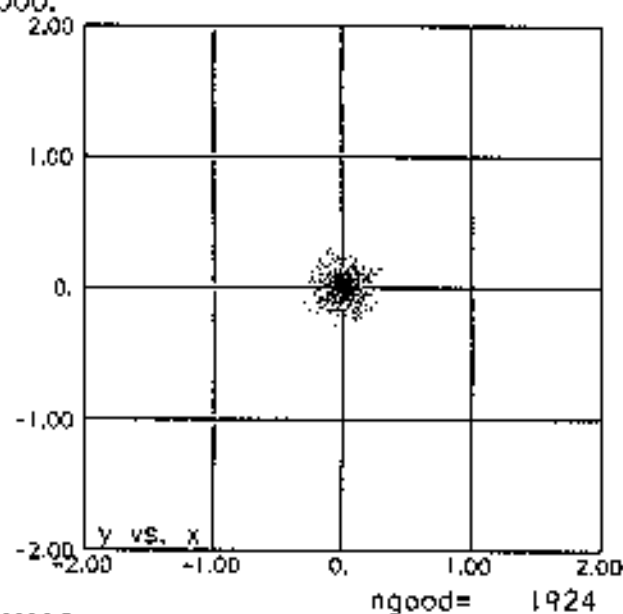
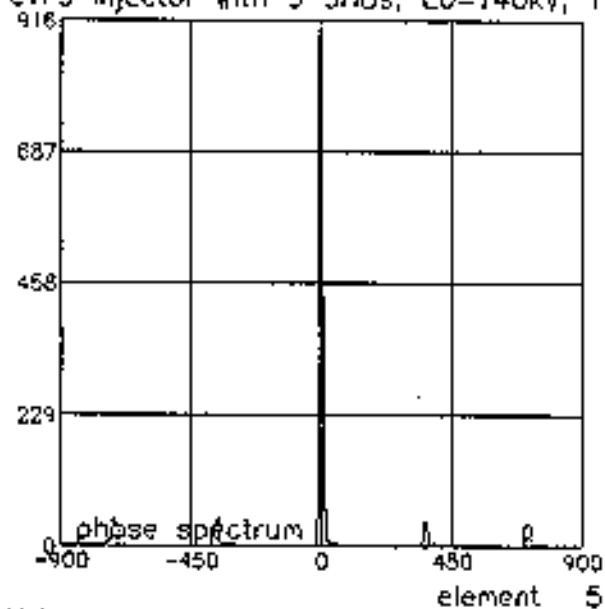


3 SHBs



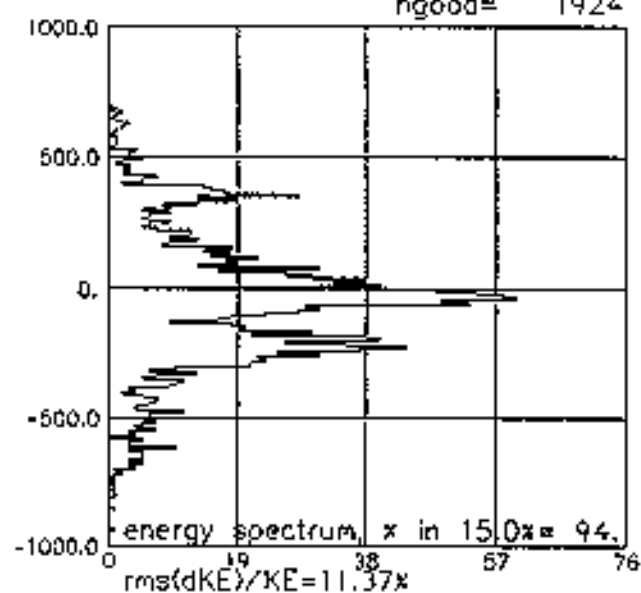
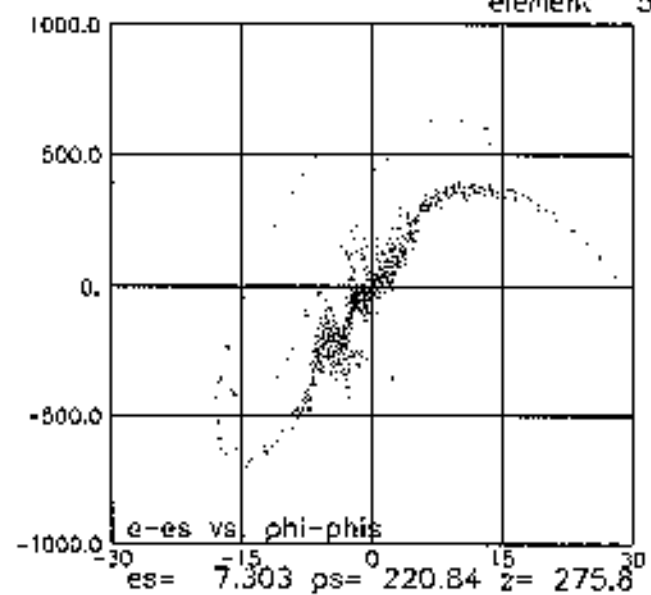
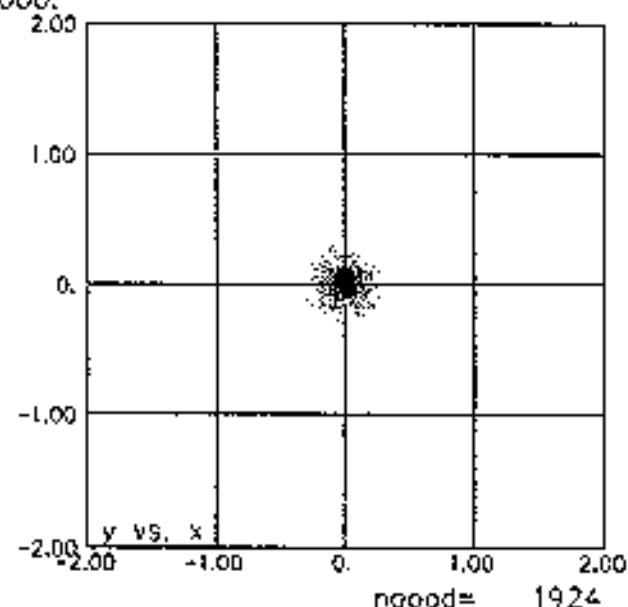
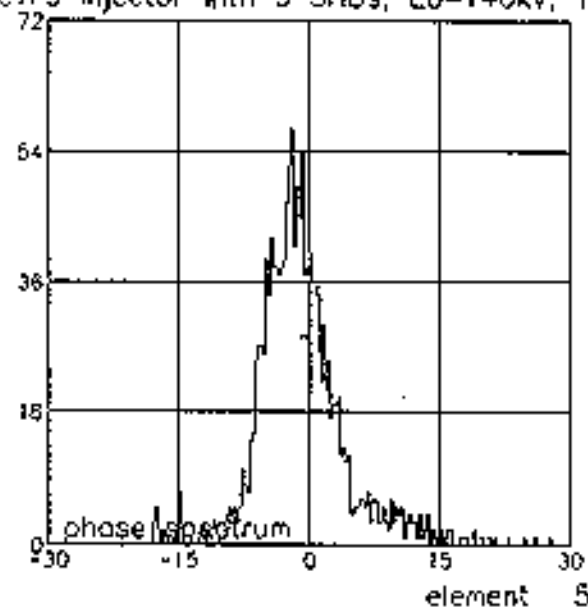
35486

CTF3 injector with 3 SHBs, E0=140kV, 11/1/2000.



Feng,  
R. Miller  
Dran

CTF3 injector with 3 SHBs, E0=140kV, 11/1/2000.



Fang  
Roger H.  
Dian



## Future Work.

- Finish optimizing 90KV injector with CTF space harmonics in TW.
- Finish optimizing 150KV injector with CTF space harmonics in TW.
- Choose Gun V based on all available studies.
- For The Chosen Gun V start refining Injector design for more practical constructable injector.
  - define SHB & PB. shape & Space harmonics
  - Define Solenoid size
  - Locate Solenoids & other beamline comp. So they fit mechanically.
  - Assign diagnostics, steering, pumps... in practical way on the beamline.