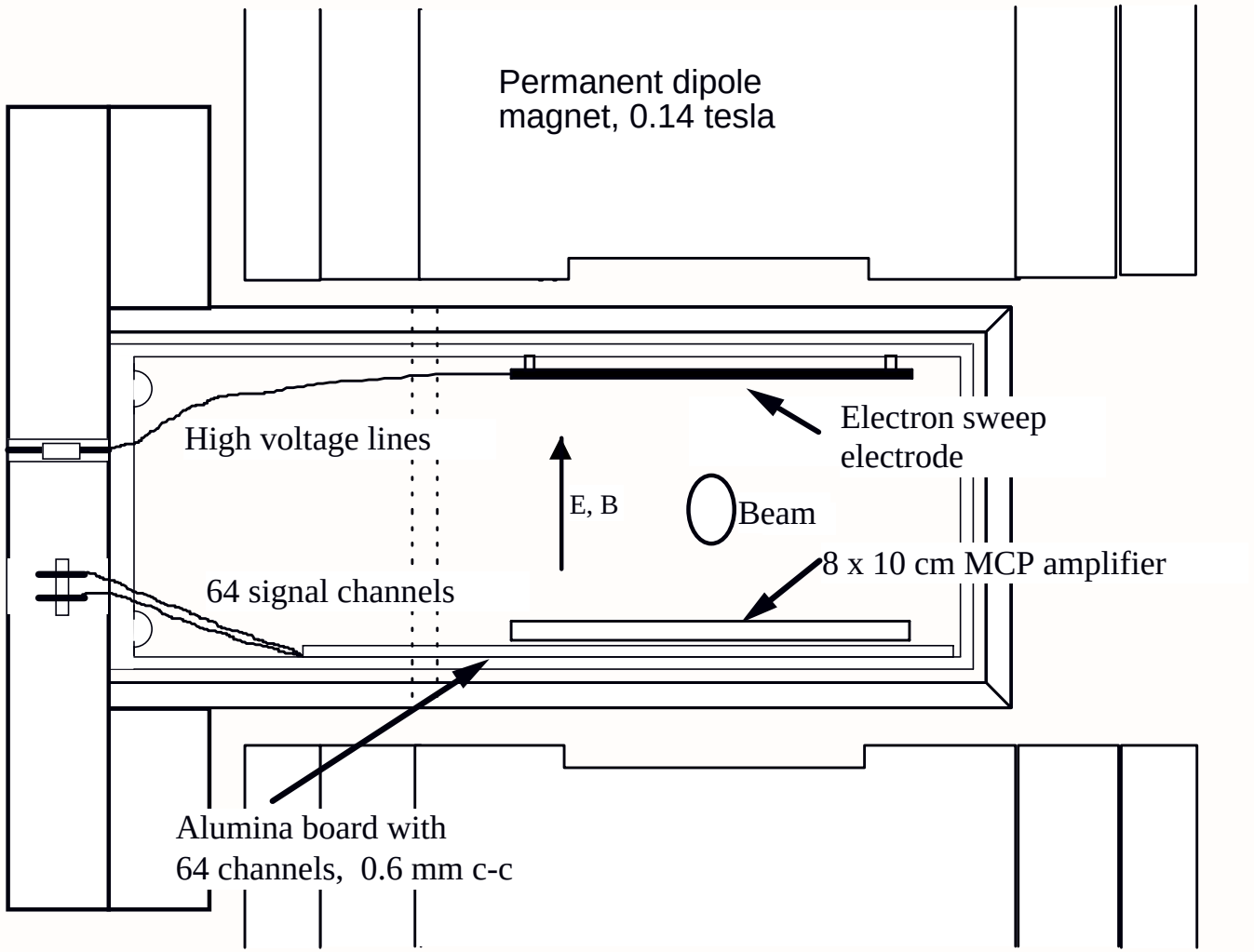
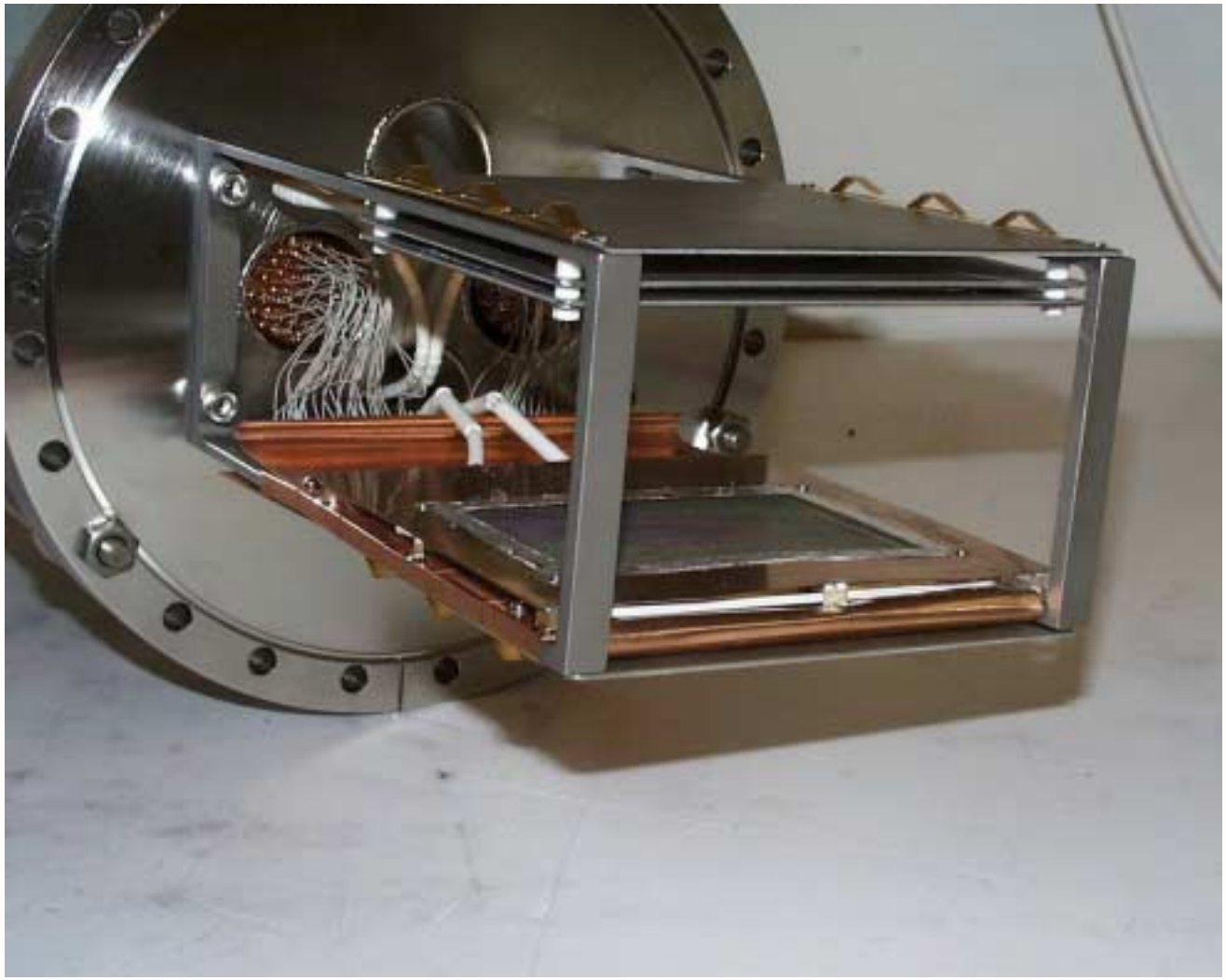
Ionization Beam Profile Monitor (IPM)

1. The RHIC IPM
2. SNS design
3. Space-charge & sweep field energy spread
4. Gas bump
5. Schedule
6. Conclusion

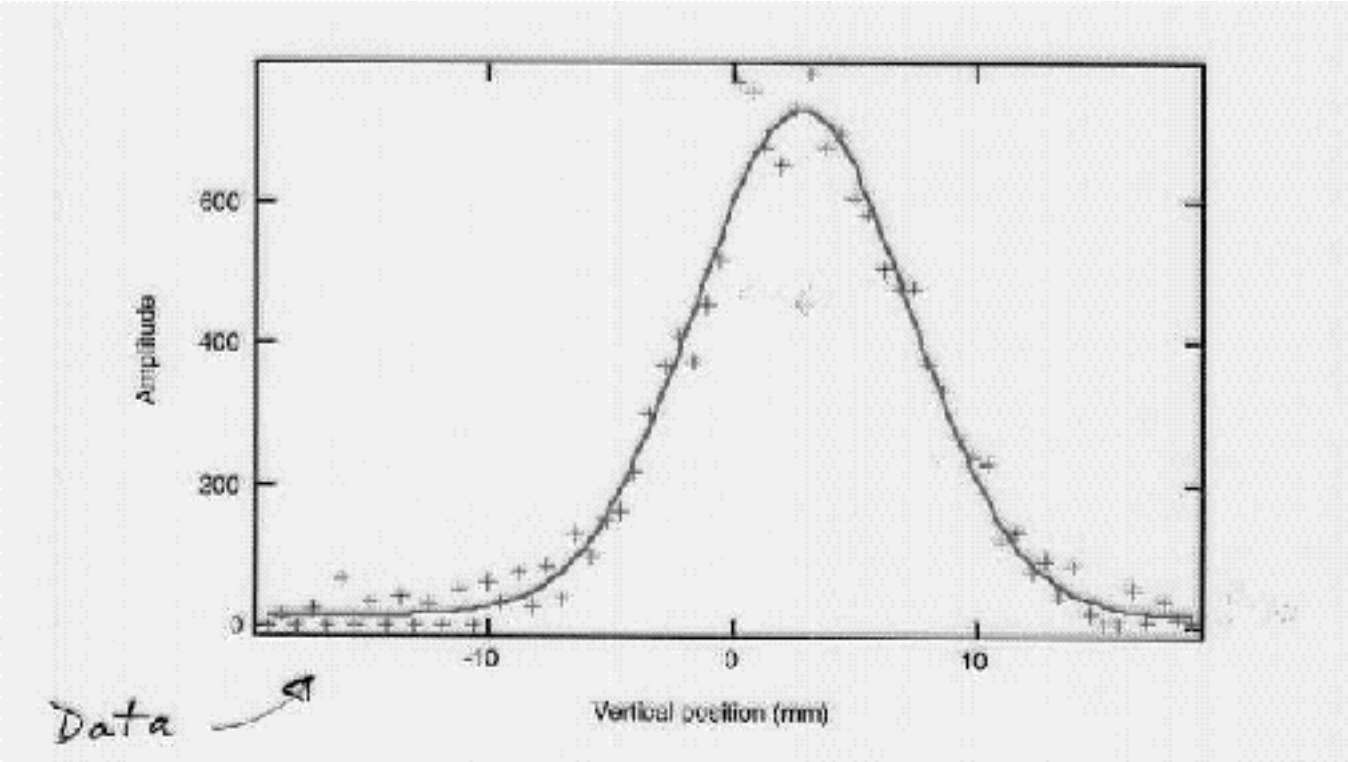
Cross section of RHIC IPM



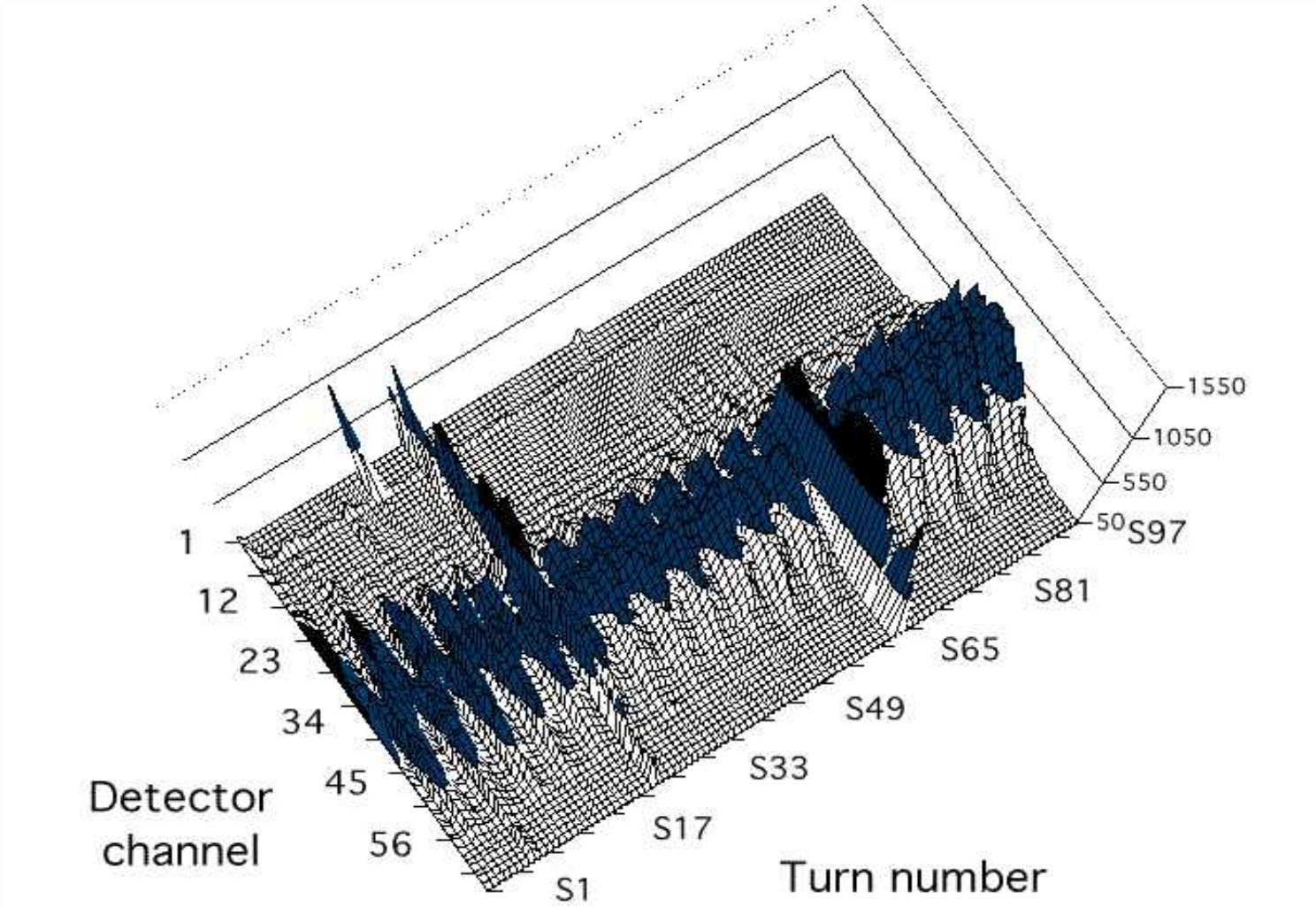
RHIC IPM transducer



Single bunch profile with fitted Gaussian



First 100 turns after injection



SNS IPM parameters

- 64 channels spaced 2.0mm, ±64 mm
- Digitize at 10 MSPS
- Analog bandwidth ~3.5 MHz
- 5-7 profiles in each turn
- 0.1-0.2 T magnetic field

Sweep Electric Field

Bunch length=170m

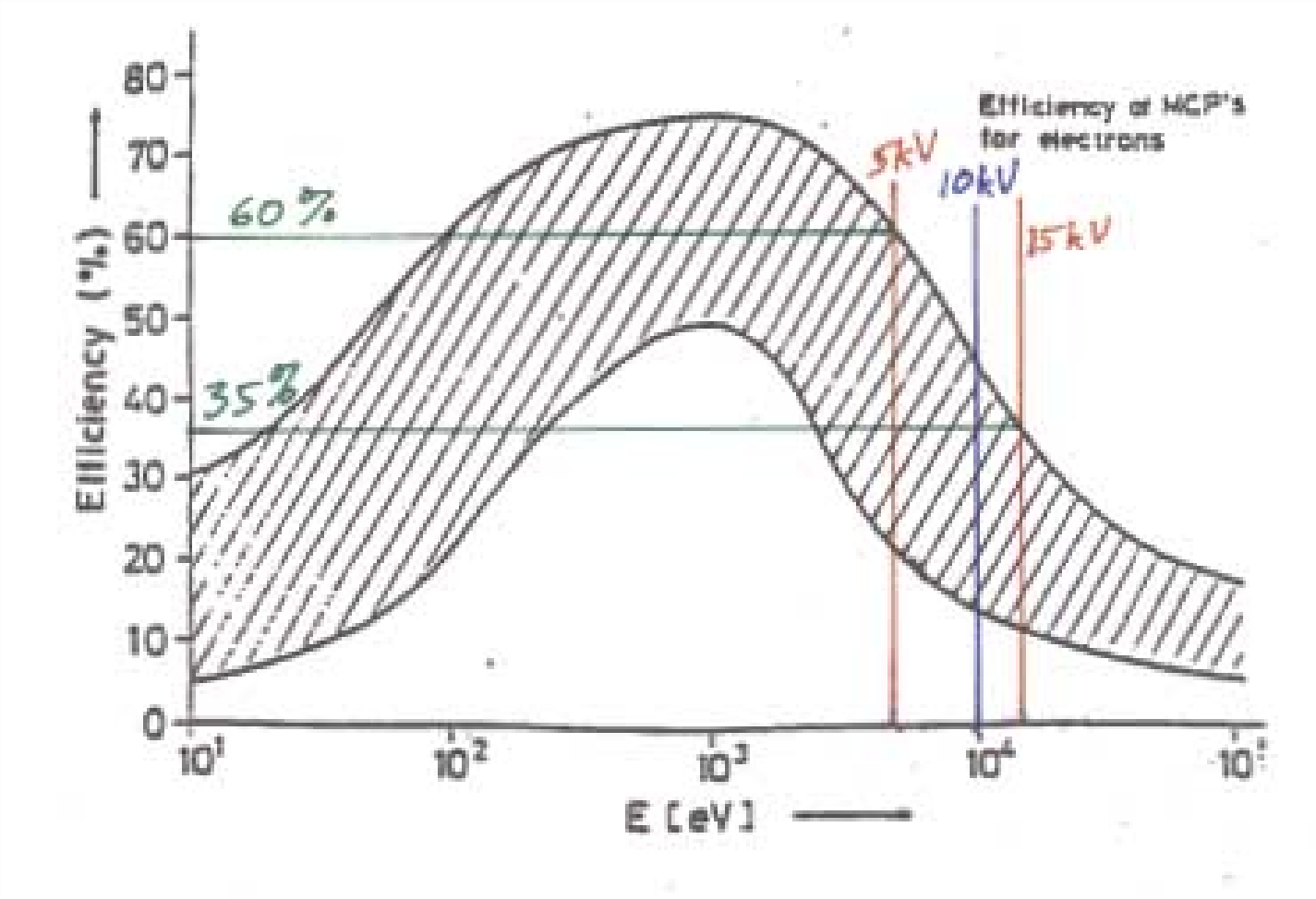
$$\lambda = \frac{(2\times10^{14}\,protons)(1.6\times10^{-19}\,C/proton)}{170\,m} = 1.9\times10^{-7}\,C/m$$

$$E_r = \frac{\lambda}{2\pi\varepsilon_0 r} = \frac{3.4\times10^{3}\,kV}{r}$$

Peak space-charge electric field with r=5cm is 68kV/m.

Sweep field will be 20kV across 20cm aperture = 100kV/m

MCP Sensitivity vs. input electron energy



Gains of single and double MCP's

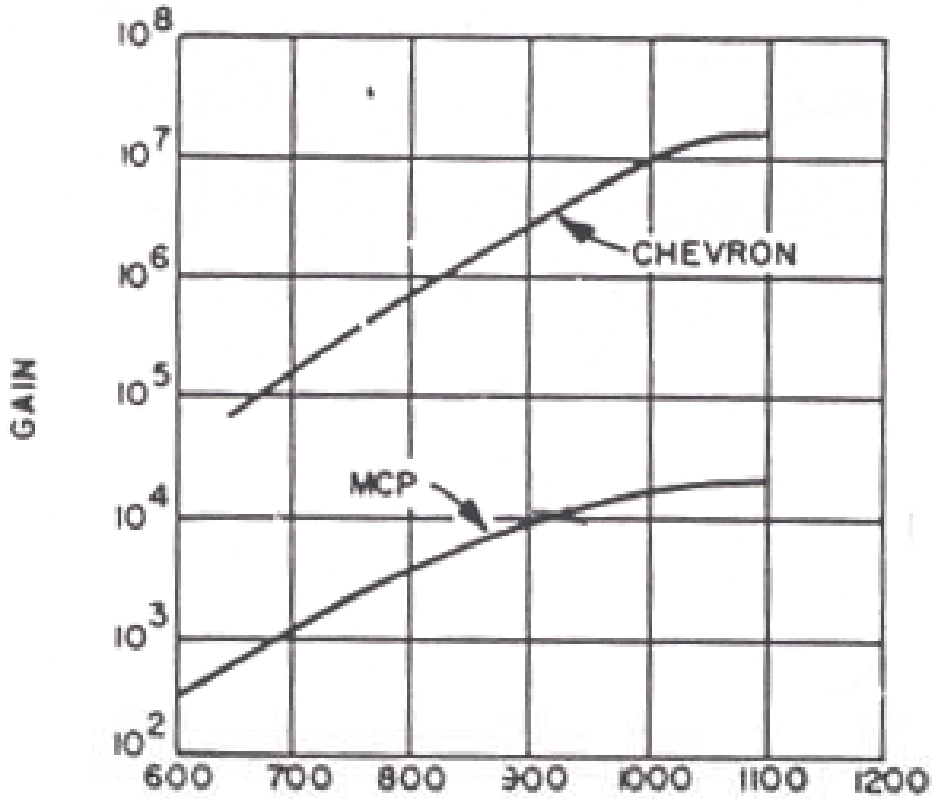
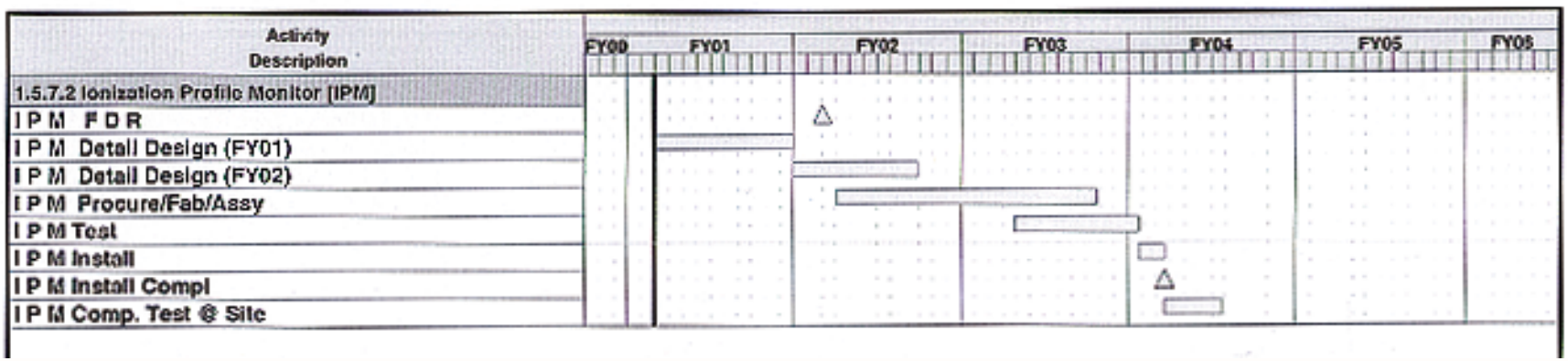


Fig. 3. Gain vs voltage characteristic for a straight channel MCP and a Chevron.

Gas bump prototype in RHIC tunnnel

Schedule


Activity Description
FY00
FY01
FY02
FY03
FY04
FY05
FY06
1.5.7.2 Ionization Profile Monitor [IPM]
I P M F D R
I P M Detail Design (FY01)
I P M Detail Design (FY02)
I P M Procure/Fab/Assy
I P M Test
I P M Install
I P M Install Compl
I P M Comp. Test @ Site

Summary

IPM'S work well (RHIC, Fermi, CERN). However a design for SNS cannot be a copy of existing profile monitors.

1. Similar rings (PSR, BNL booster) accumulate large numbers of background electrons. Will the magnet keep them out of the detector? Experiment at PSR.
2. Large beam size and space-charge electric field introduces large energy spread. This results in detector response which is dependent on ionization position in beam. Need to measure the energy dependent response of MCP with electron gun.
3. Large aperture will result in very large magnets. Can the field be made parallel enough?
4. Will high-radiation environment result in a large MCP background? PSR experiment should provide answer.