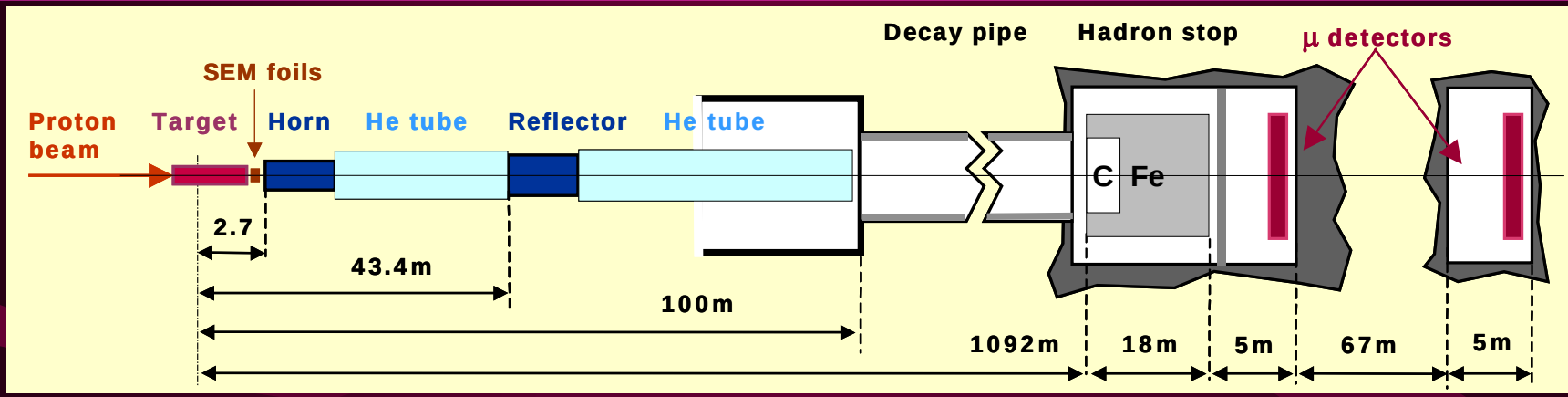
CNGS Muon Monitoring Using Ionisation Chambers

OUTLINE

1. Recap of Planned CNGS Set-up

2. Recent results from CERN-PS Booster Tests

CNGS Muon Monitoring



Muon Fluxes

- $1.5 \times 10^4 - 4.5 \times 10^7$ μ/cm²

Burst Duration

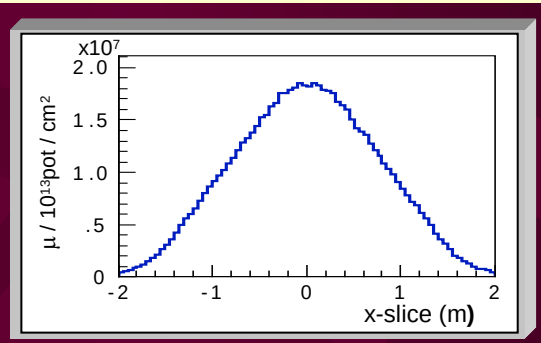
- 10.5 μs

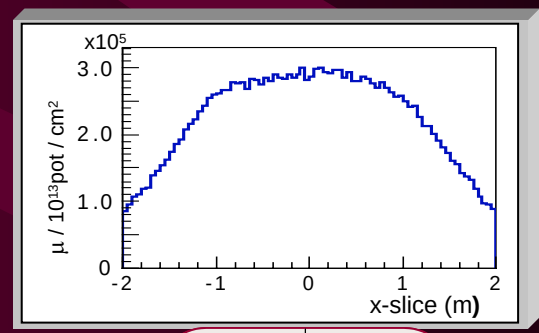
Time between bursts

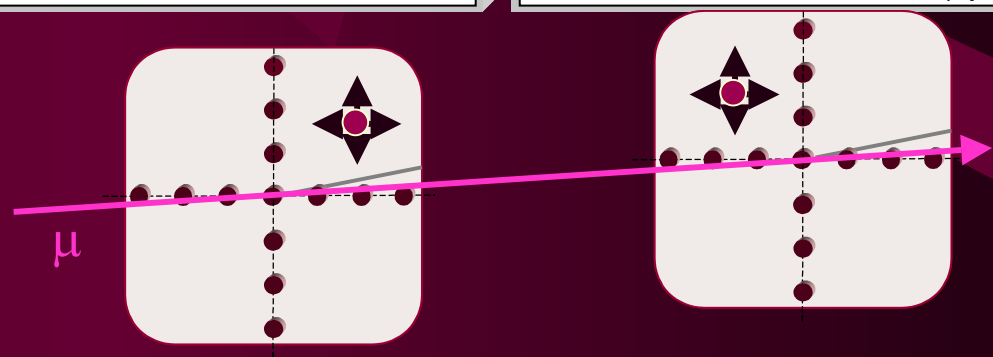
- 50 ms / 6 s

Detectors

- Fixed cross of monitors
- 1 moveable monitor







CNGS Muon Monitoring

Probable Candidate - SPS Type Beam Loss Monitor

- Ionisation Chamber
- N_2 filled chamber
- Radius = 4.75 cm
- 30 gaps
- Gap-width = 0.55cm
- Bias = 800-1500 V

PS Booster Beam Loss Monitor Tests

No significant difference in ionisation effects from Muons at 20GeV & protons at 1GeV.

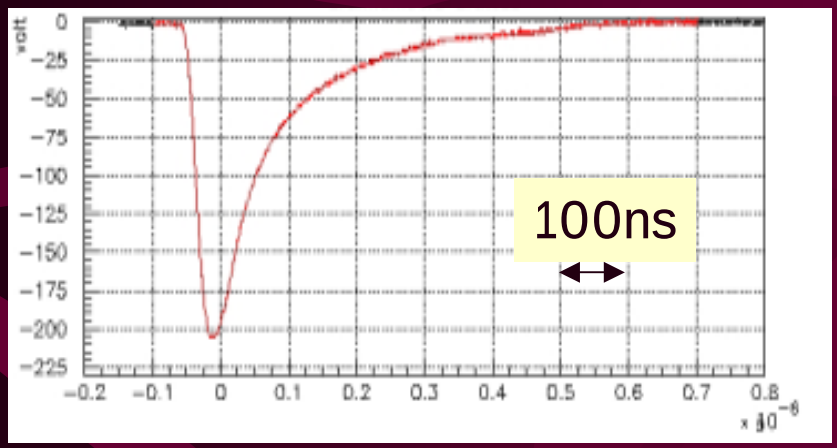
Beam Conditions:

Intensity: ~ 8×10^9 protons in 50ns bunch

Beam Size: $\sigma_H = \sigma_V = 3.5$ mm

$E_{kin} = 1.4$ GeV

Electron Signal

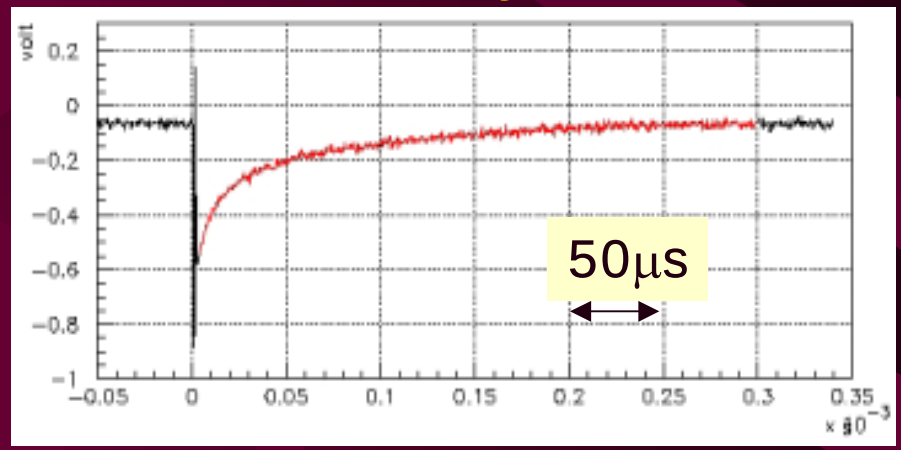


Model:

$\tau_{el} = 270$ns

(for $v_{el}=20.2\cdot10^5$ cm/s at E=3000V/cm)

Ion Signal

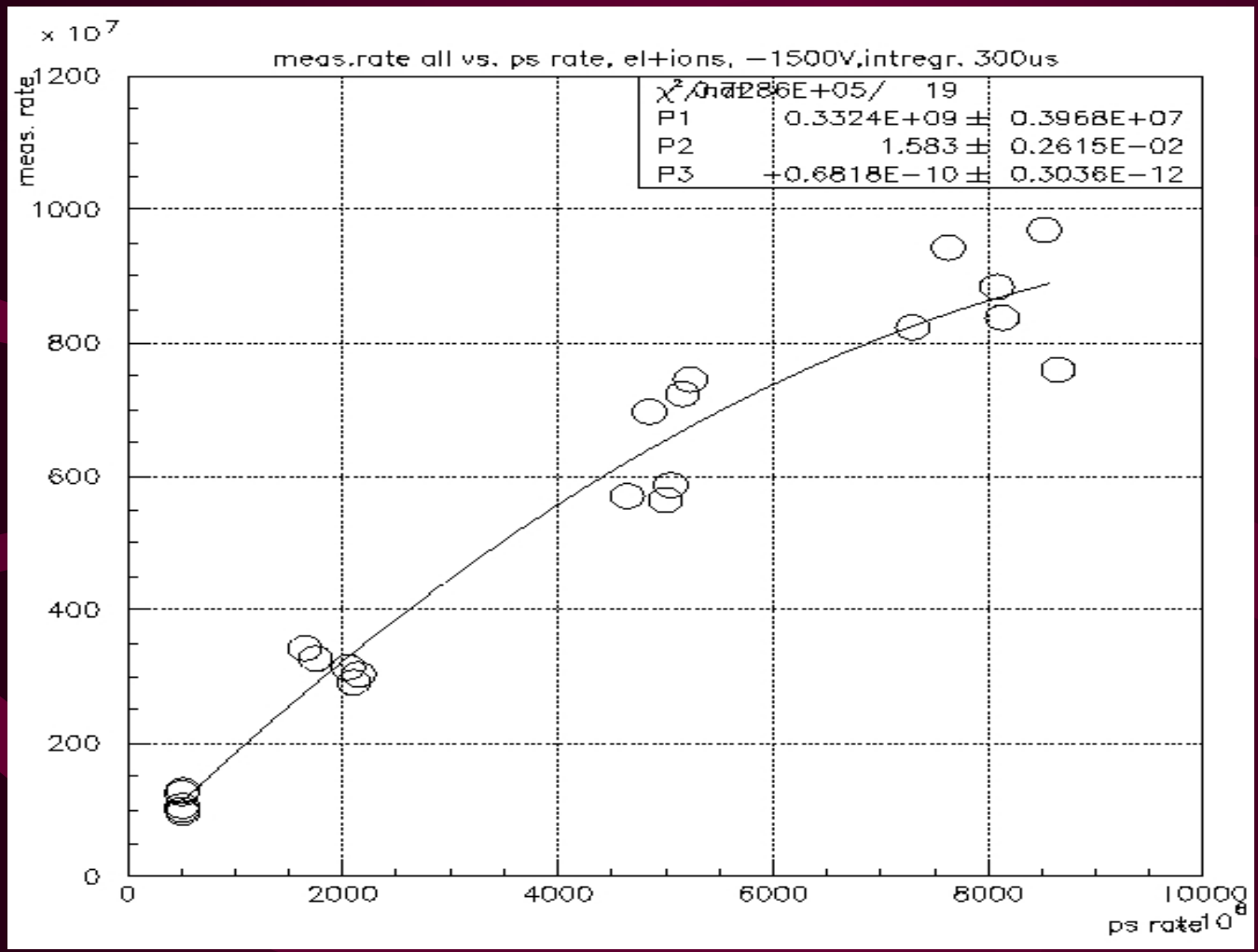


Model:

$\tau_{ion} = 69\mu$s

(for $v_{ion} = \mu E = 8010$ cm/s, $\mu=2.67$cm^2/Vs)

PS Booster Beam Loss Monitor Tests



Calculated Proton Intensity (×10⁷)

Actual Proton Intensity (×10⁶)

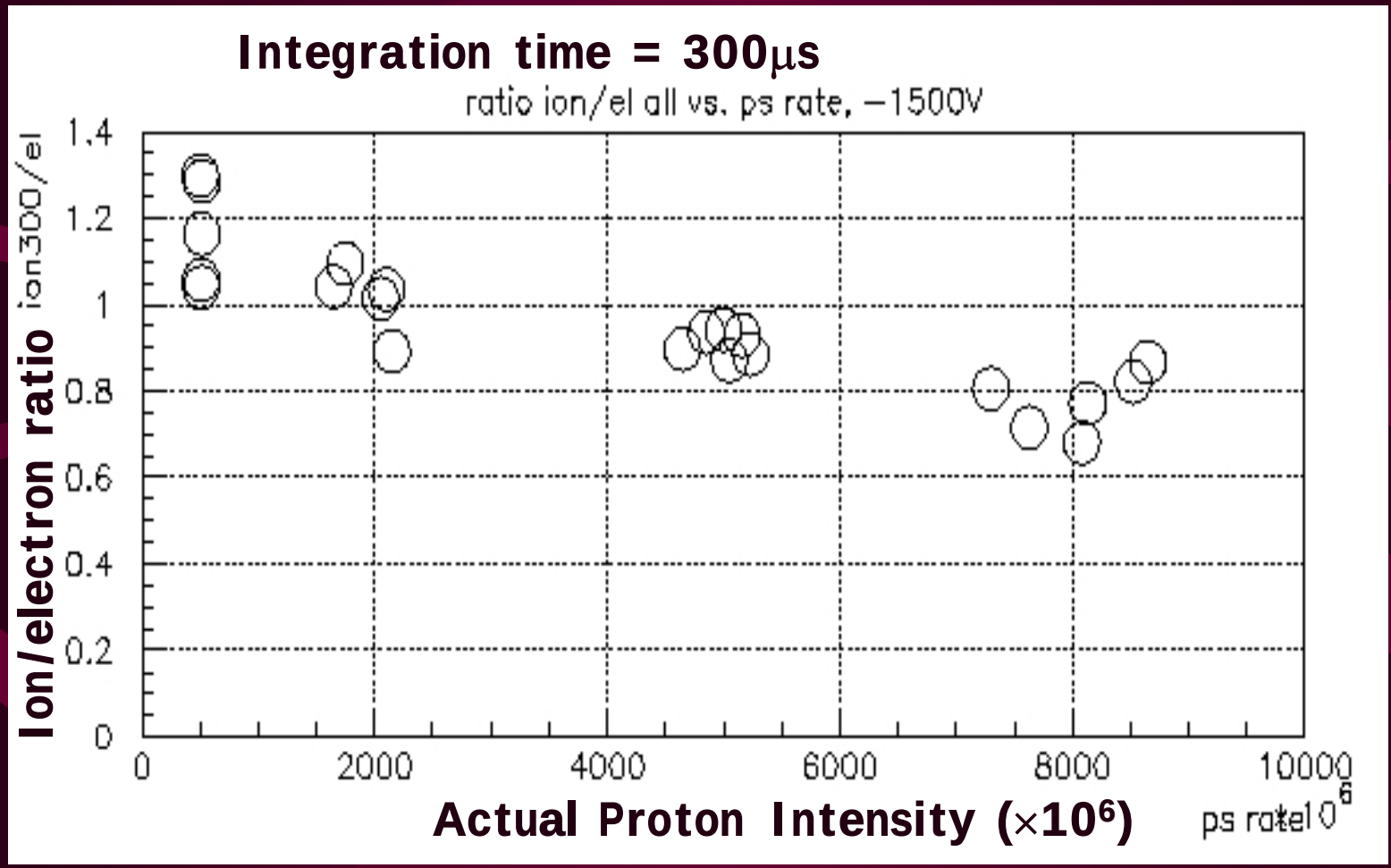
Beam Area (1σ):
~ 1cm²

CNGS max flux:
~ 4.5×10⁷ μ/cm²

i.e. an order of magnitude below the lowest Booster intensity

PS Booster Beam Loss Monitor Tests

Electron to Ion Ratio for various PS booster intensities



Conclusions

Response Time:

- Electron response time < 1μs
- Ion response time < 300μs [LHC requires < 89μs]

⇒ Response time not an issue for CNGS (50ms between trains)

Agreement with Theory:

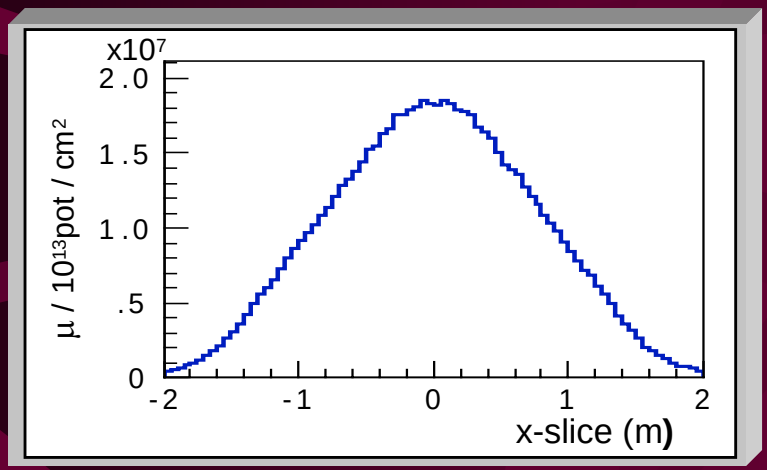
- Actual and calculated proton intensity does not agree for low intensities (factor of 2)
- Ion response seems to be too low for high intensities

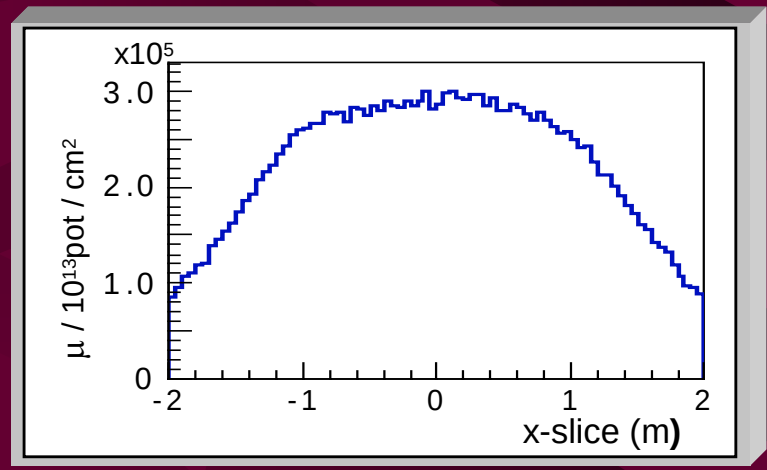
⇒ More experiments and theoretical work required to understand these discrepancies

Outstanding Issue

Outstanding Issue from last NBI Workshop:

- Linearity at highest intensity (4.5×10^7 μ/cm^2 for nominal beam)
  - space charge limit at 4×10^7 μ/cm^2 (for a 6mm gap at 1kV)





- A single measurement will cover a small intensity range (< factor 10)
  - ⇒ Linearity within this range should be sufficient
  - ⇒ Further tests at lower intensities will try to verify this