Proton Beam for K2K

Hiroyuki Noumi (KEK) for BCG and K2K

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  - Time Structure/Emittance/BL Optics
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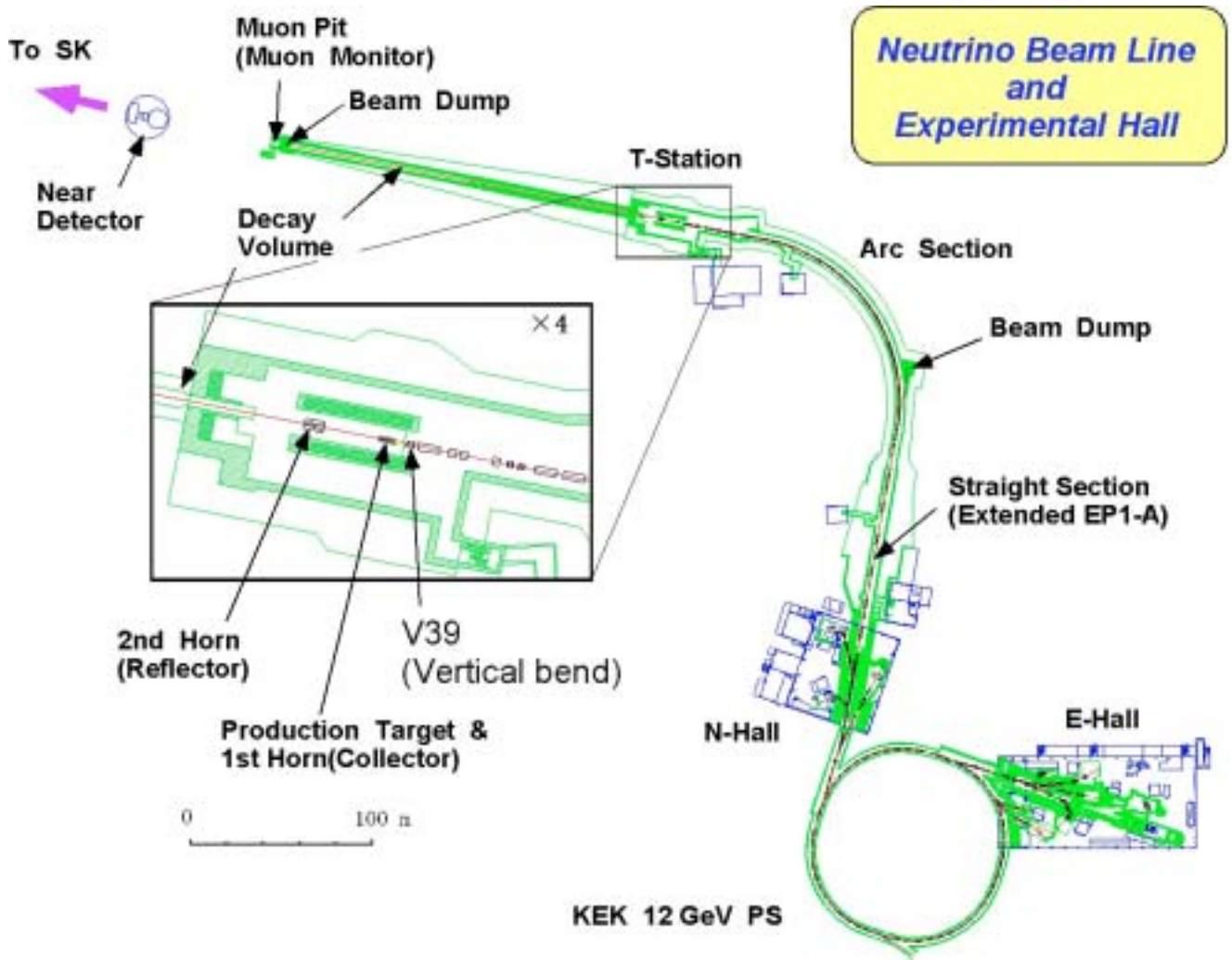
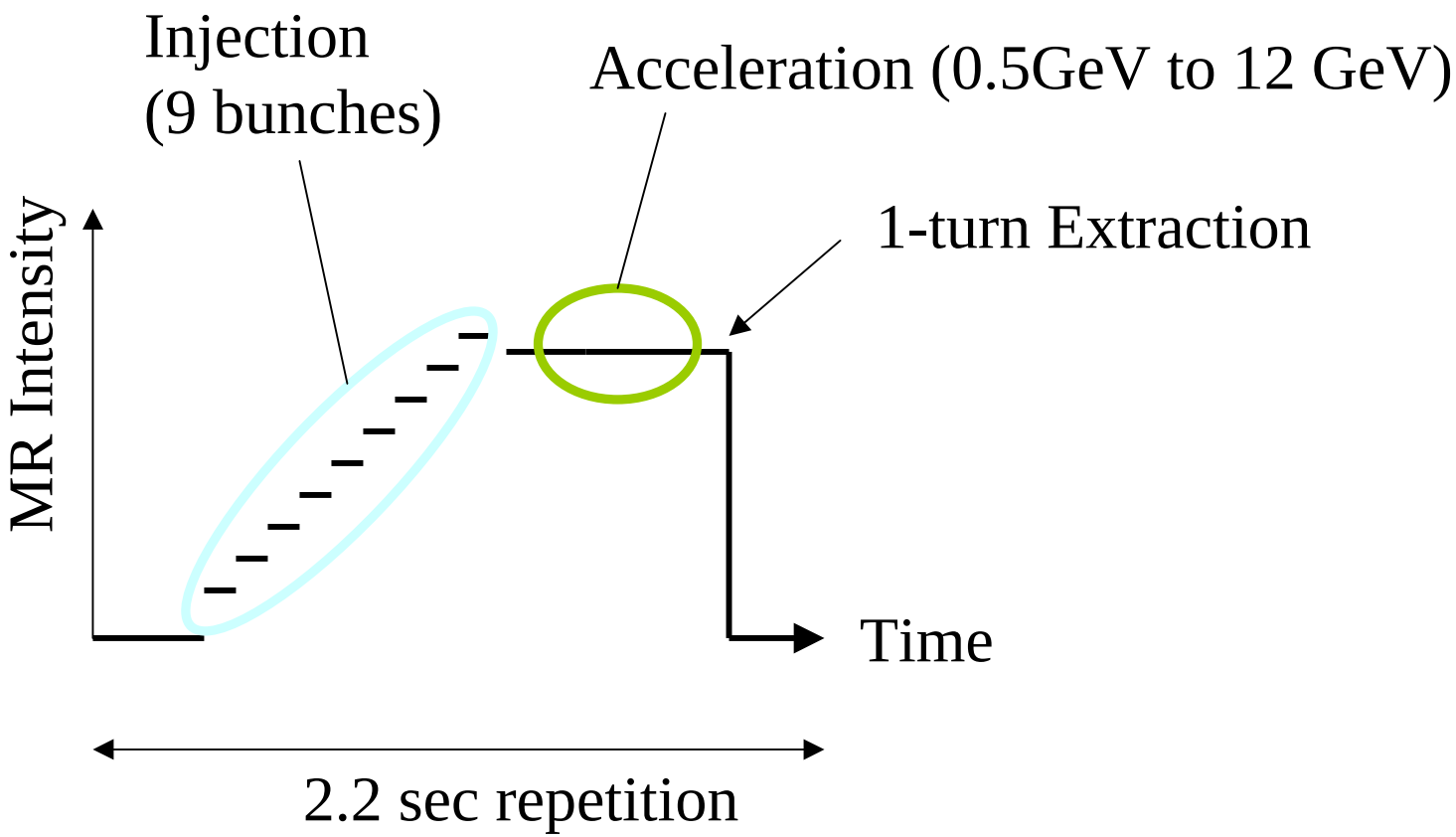
Beam Line Layout



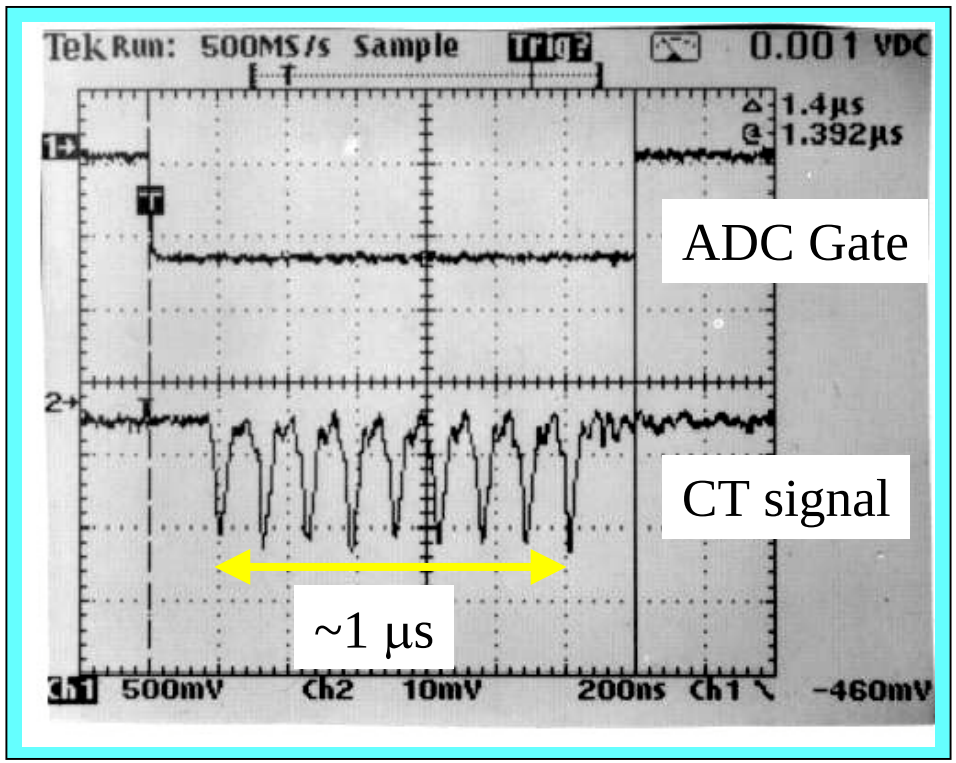
Primary Beam Characteristics



Primary Beam Characteristics

- Time Structure

- 12-GeV Proton Fast Extracted Beam



f_{RF} = *7.9 MHz*

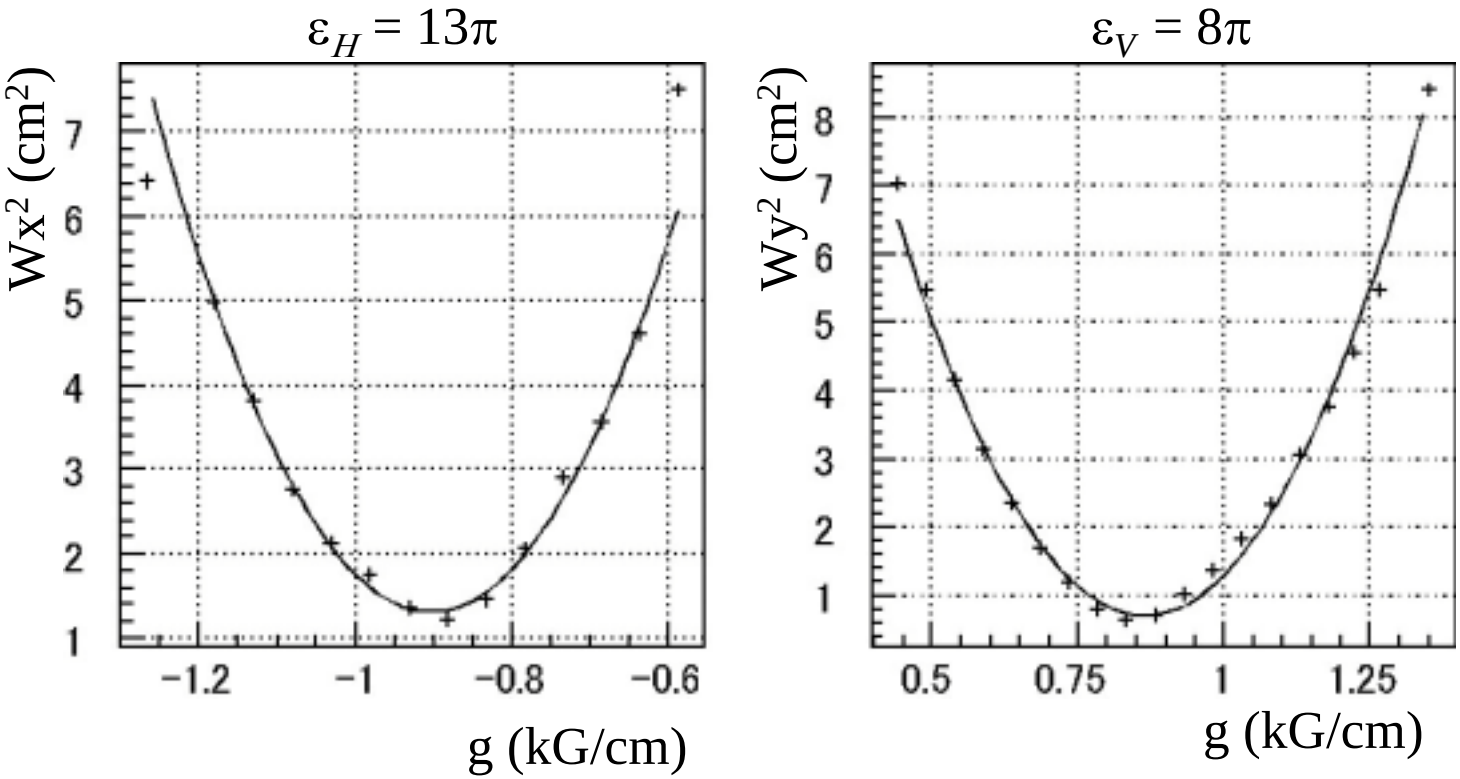
I_{beam} = *5.6E12 ppp*

Primary Beam Characteristics

- Emittance

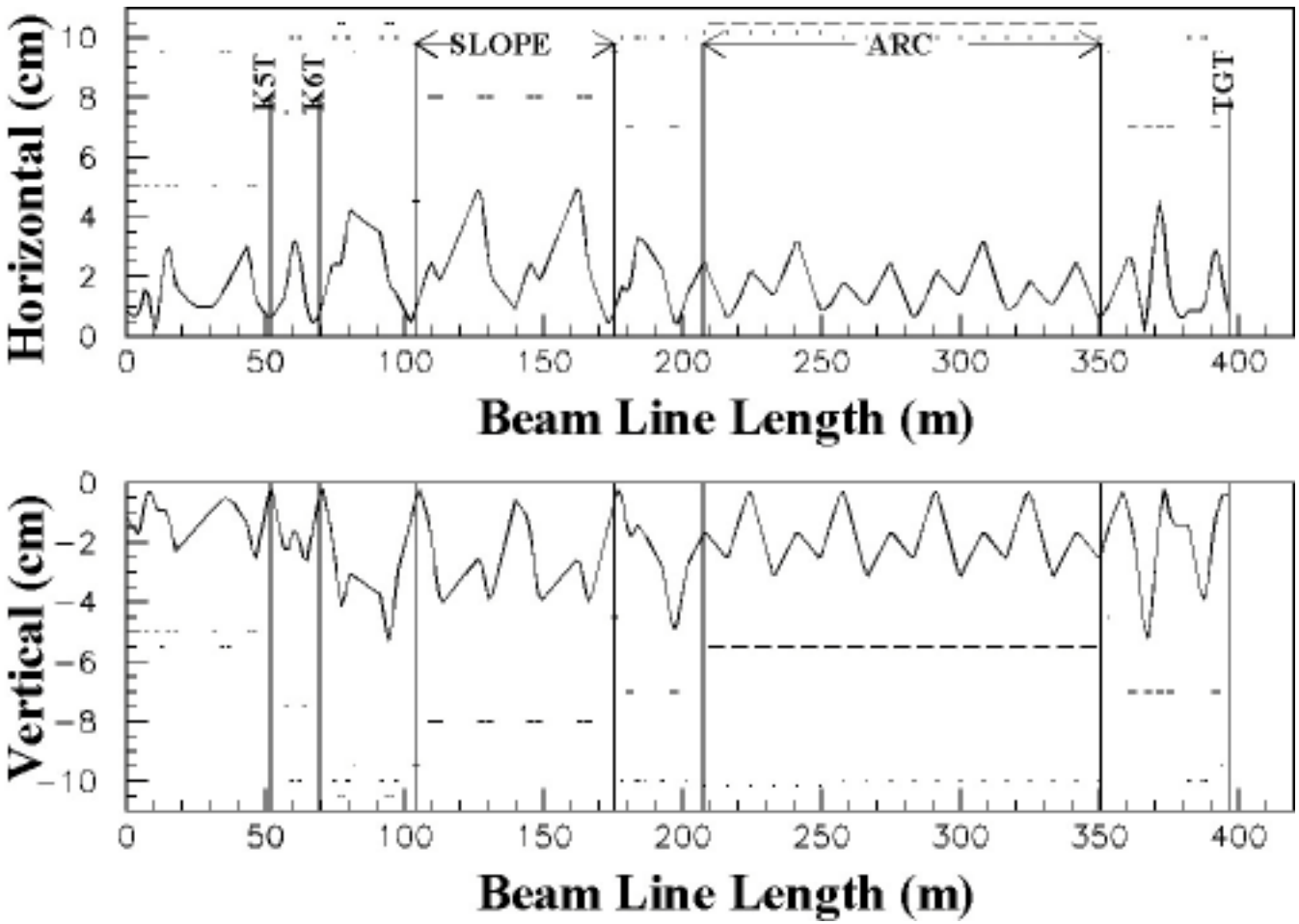
- ε：Measured Emittance (FW1/e^{2}M) in mm・mr

  by Parabola Fitting Method at q11-in (31m from Extraction)



Beam Line Optics

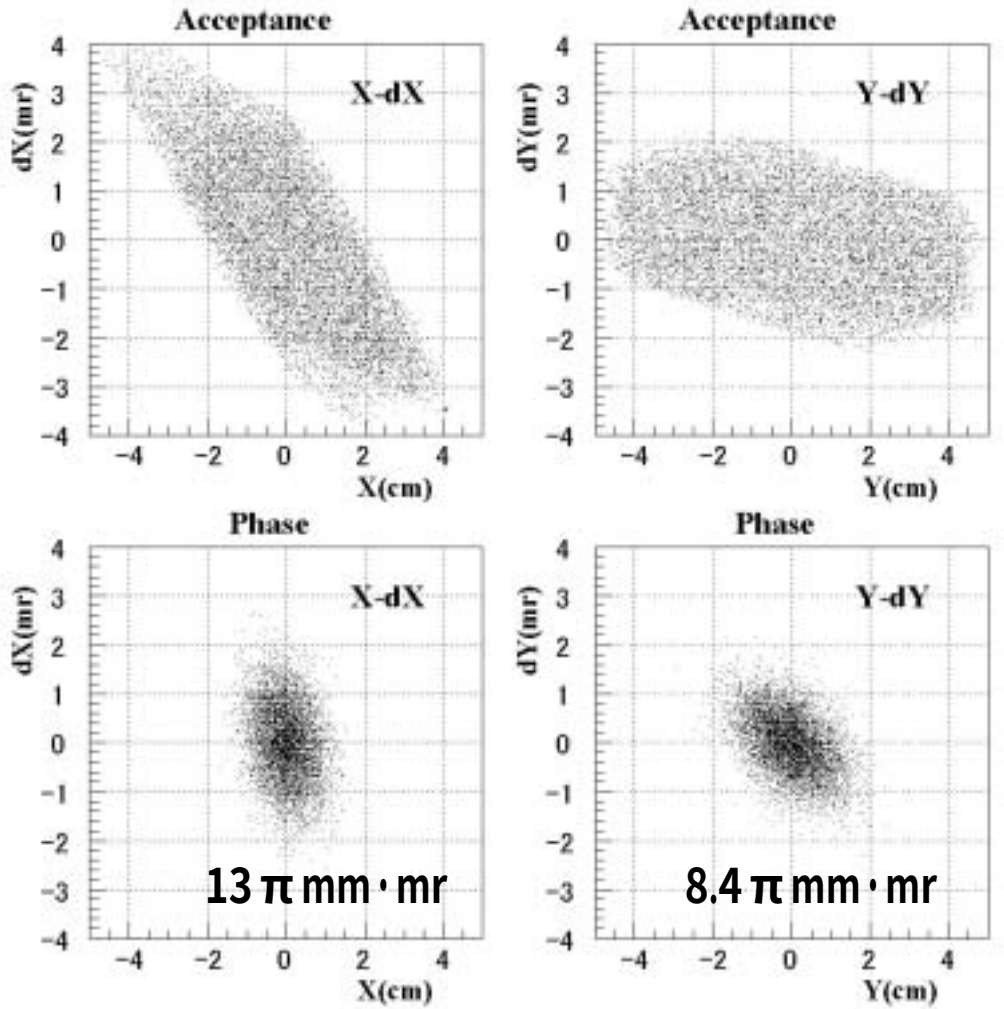
- Beam Envelope



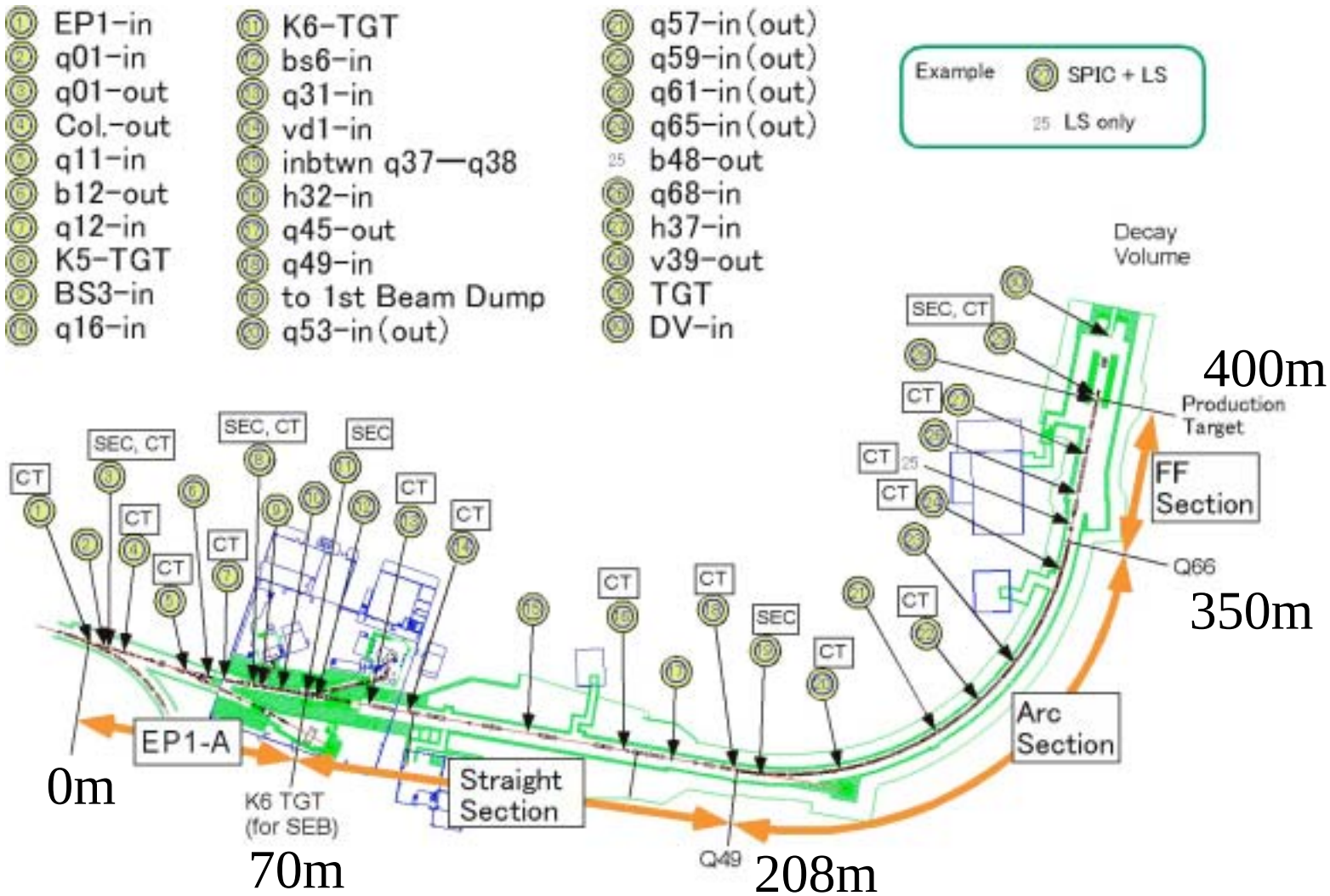
Beam Line Optics

- Acceptance & Beam Profile @ q11-in

- TURTLE



Proton Beam Monitors



Proton Beam Monitors

- SPIC/LS/CT

- **Profile Monitors**

  SPIC：Segmented parallel Plate Ionization Chamber

  LS: Luminescence Screen (Cr-doped Almina Ceramic Plate)

- **Intensity Monitor**

  CT: Current Transformer

  SEC: Secondary Emission Chamber (for Supplíment)

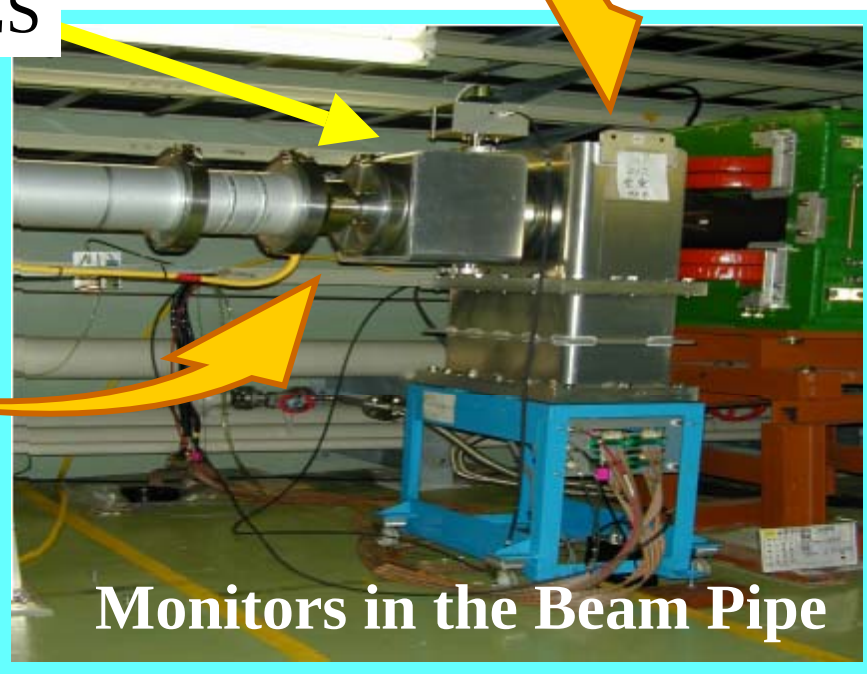
Beam Monitors

- SPIC/LS/CT

SPIC

LS

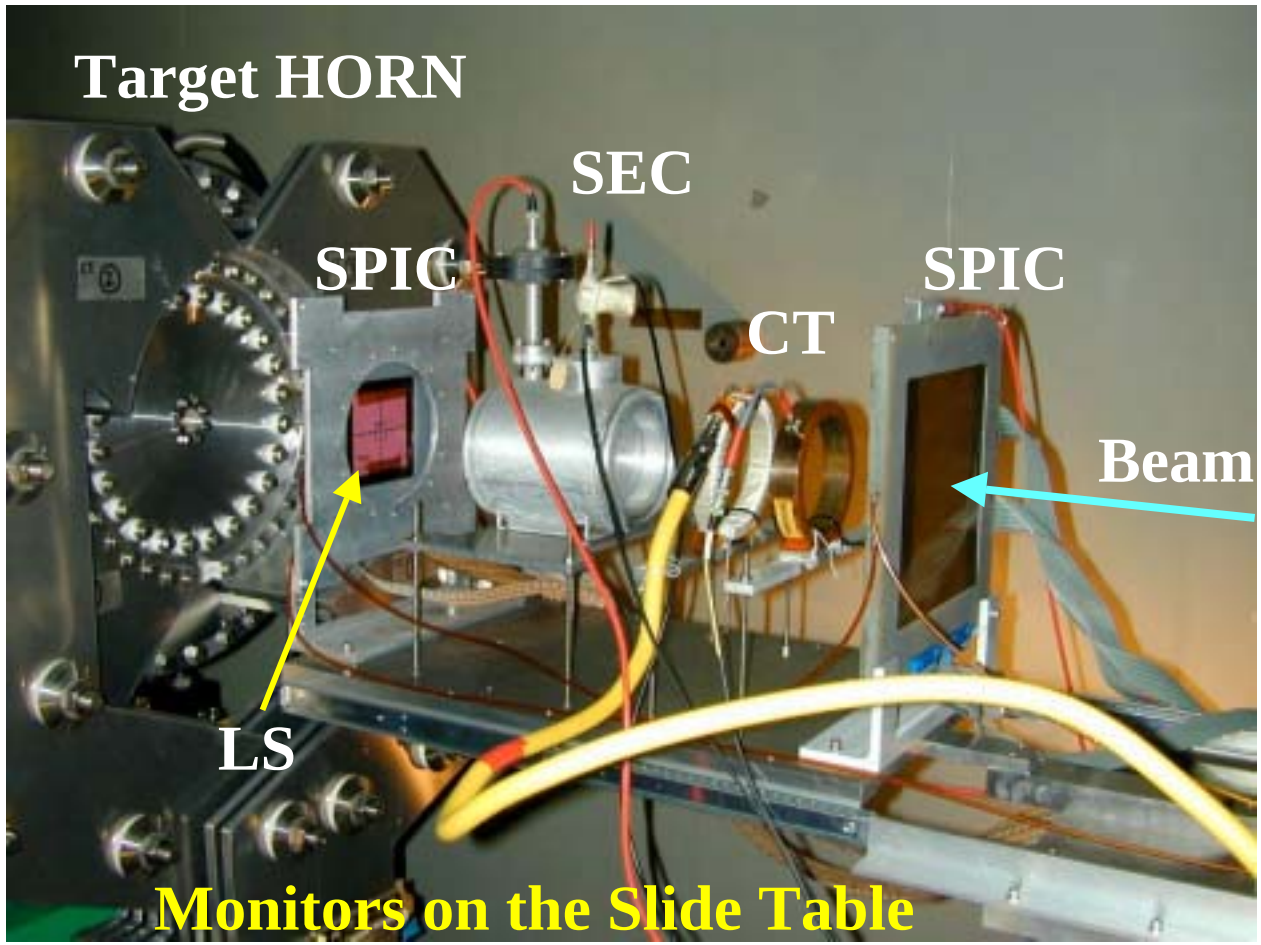
CT



Monitors in the Beam Pipe

Beam Monitors

-at the Production Target



Operations

- Transmission

- at Extraction
  - ○ Vacuum Window (300μm Ti foil)
  - ○ 5 m Air in Septa
  - ○ Fixed Beam Monitors (SEC/SPIC/LS/SUS foils)

    cause

    6-8% Beam Loss & ✕3-4 Emittance Growth
- Transmission

  TGT/Ep1-in = 0.85 w/ full of Monitors in the BL

  ~5% improved when ½ of LSs (~2.5g/cm^2) out

Operations

- Beam Tuning

Tuning Routine

- Steer the Beam Orbit to the Beam-Line Center

  1^{st} Beam Dump Mode

  ⇒ Arc Transfer Mode

- Targeting

  Direct ν-Beam to Super-K

  Muon Profile is Sensitive to the Primary beam

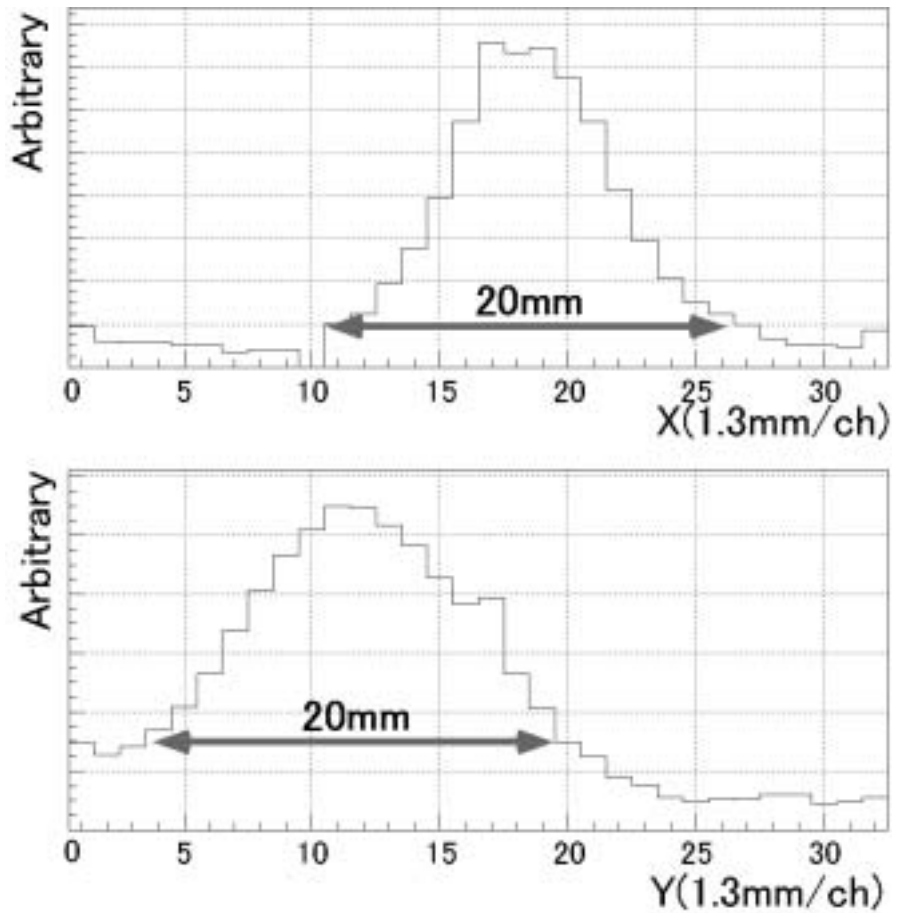
  (work as a proton-beam monitor)

Operations

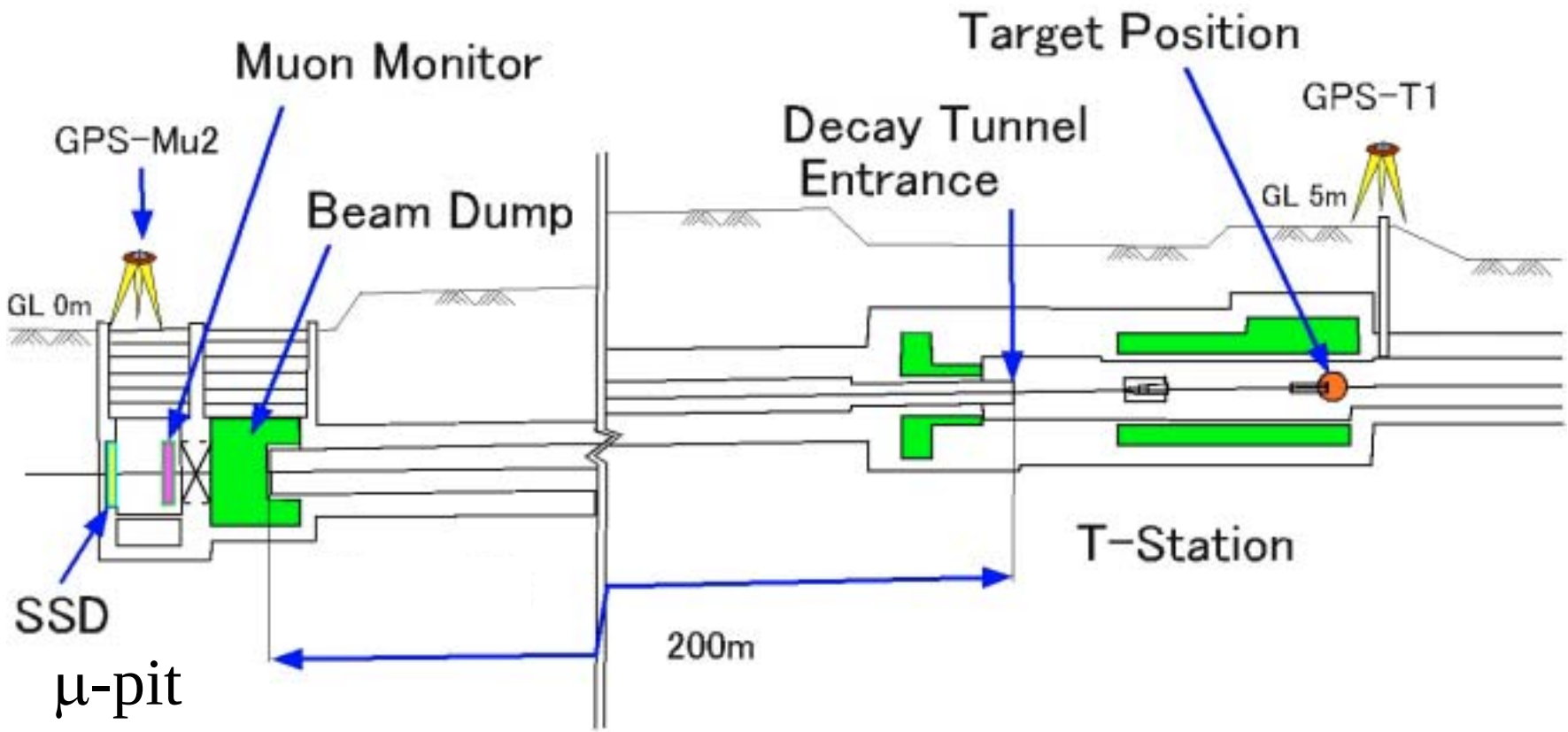
-Proton Beam Profile

LS at the Target

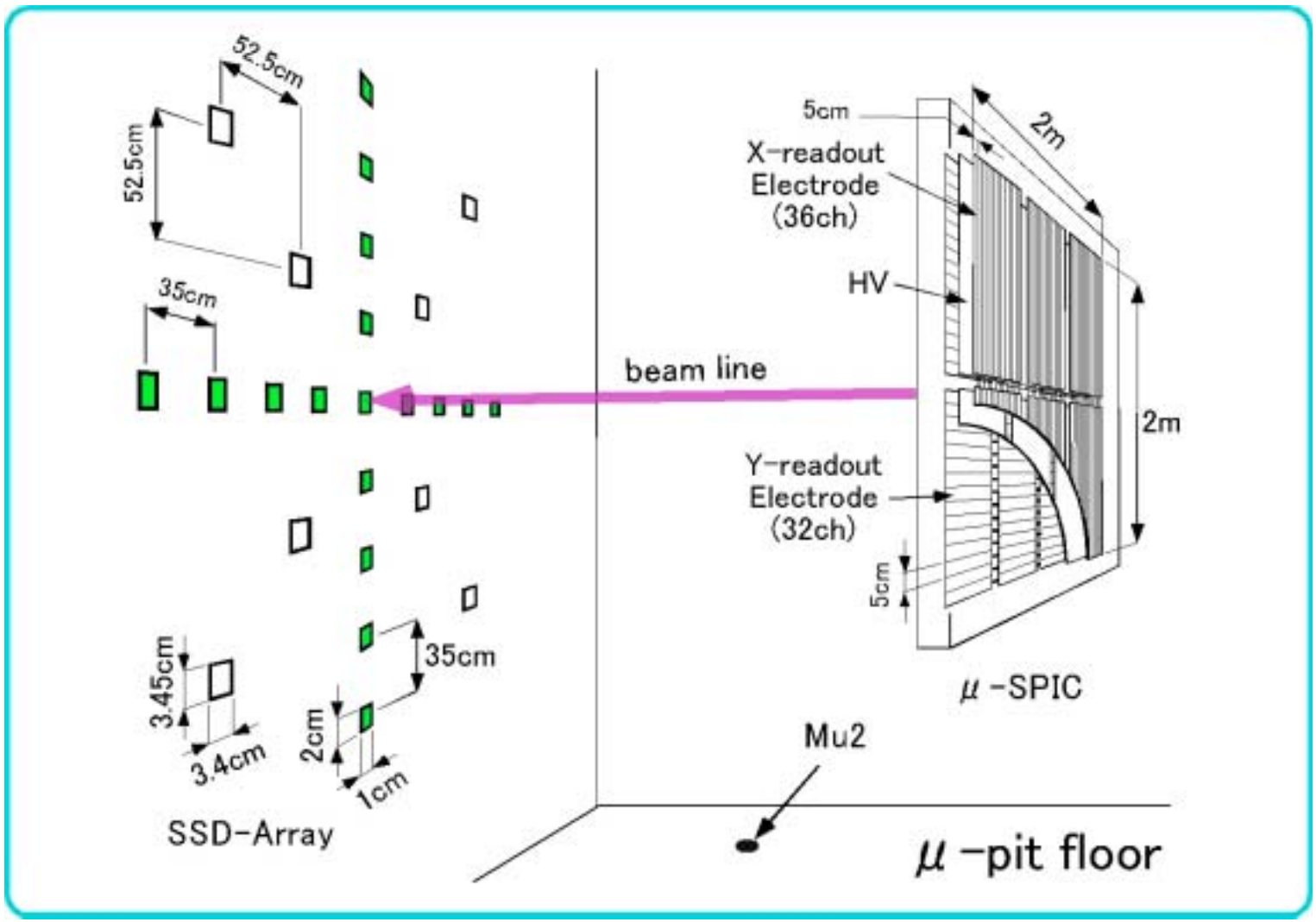
SPIC at the Target



Elevation View of T-Station & μ-pit



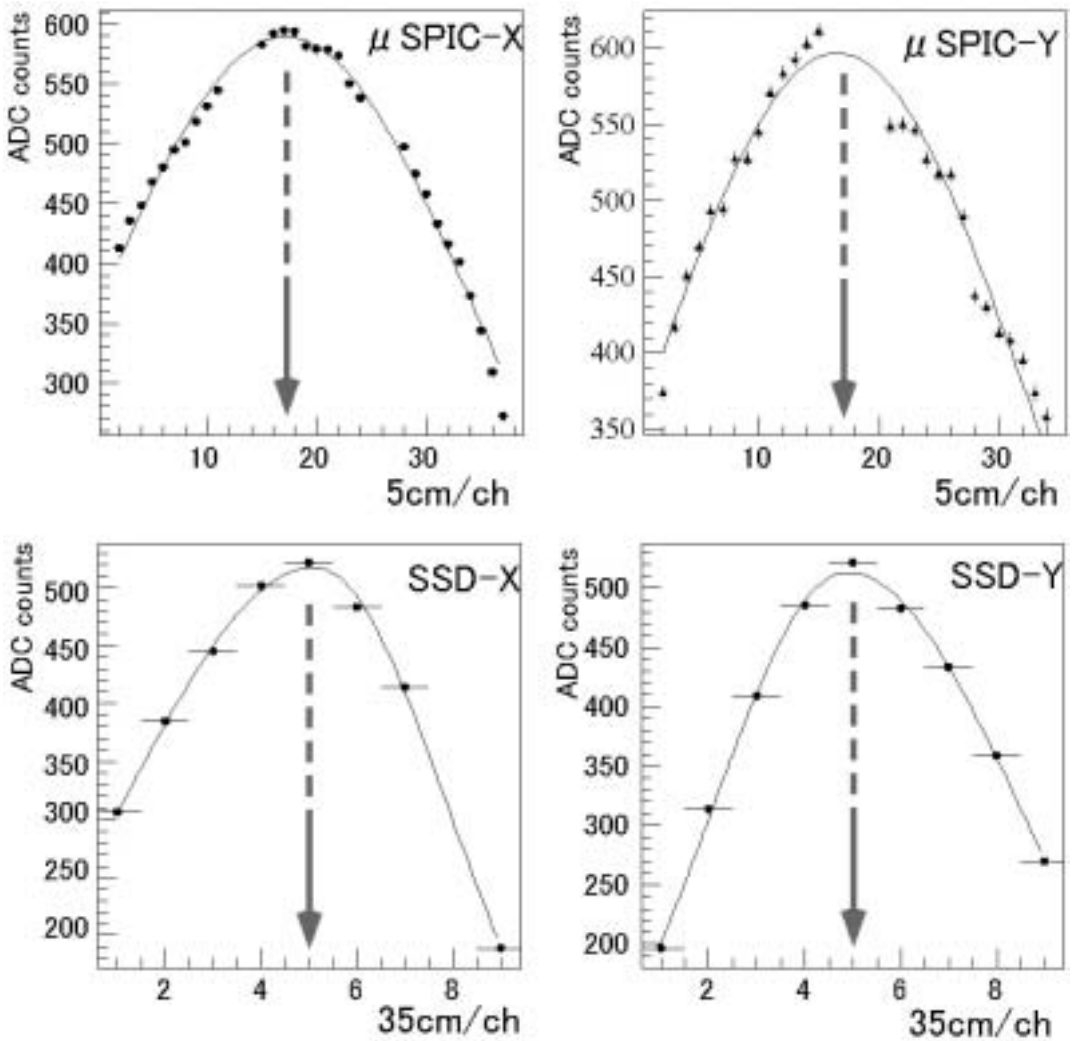
Muon Monitors in the μ-pit



Operations

- ν_μ (Muon) Response (Cont.)

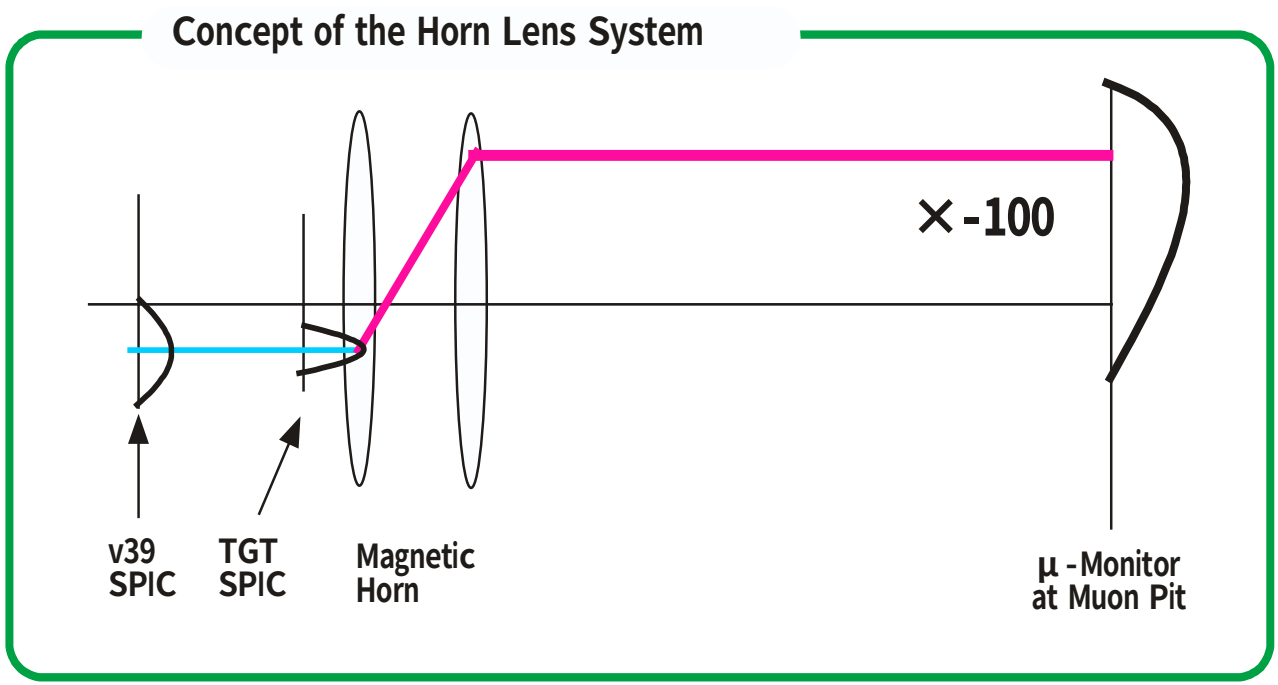
- Muon Profile at the Muon Pit



Operations

- ν_μ (Muon) Response

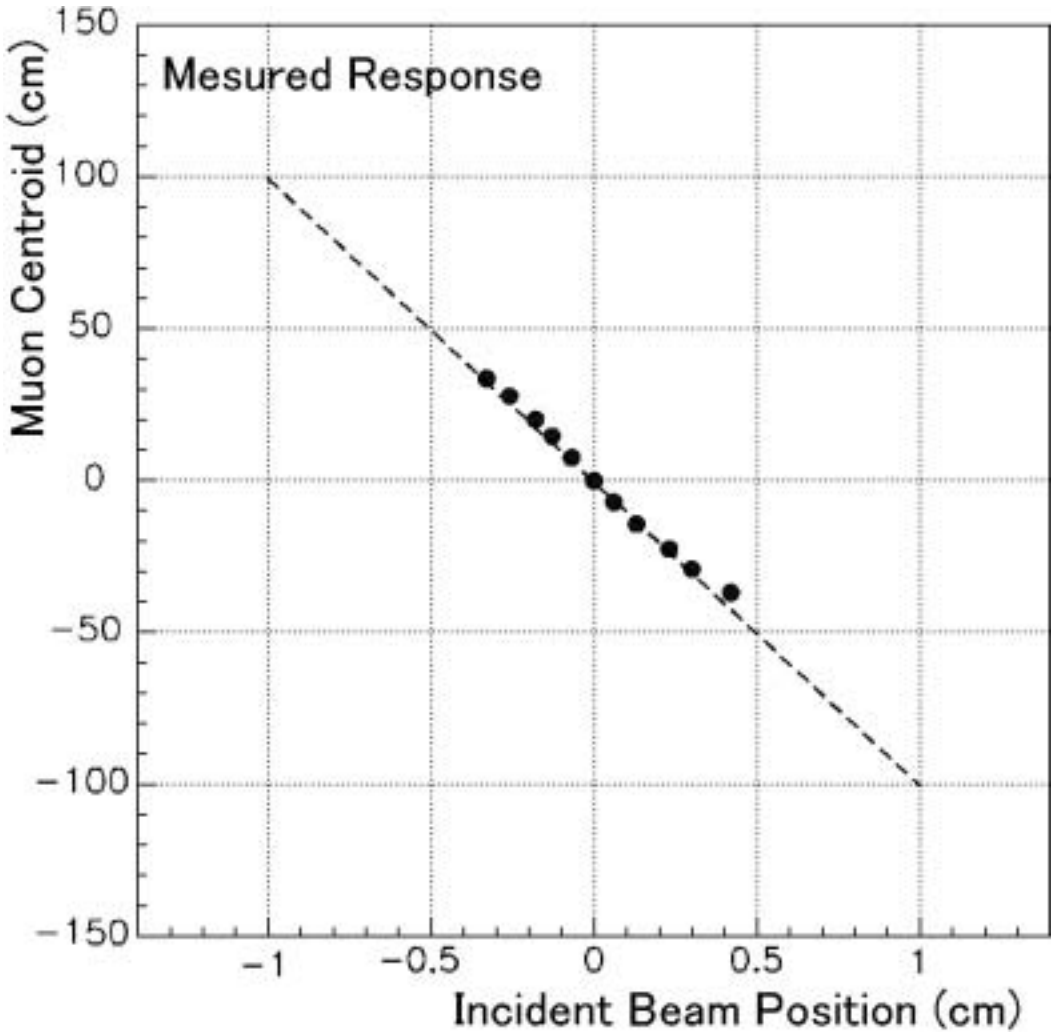
- Horn Lens System (Point to Parallel Optics)



The Horn functions as a lens with the Magnification of ~ -100.

Operations

- ν_μ (Muon) Response (Cont.)



Operations

-Tuning Request in 2001

- Tuning Request
  - ○ Scheduled
    - at the beginning of every run (~4 weeks),
    - after the MR study/Tuning,
    - at the Ion Source Maintenance
  - ○ Accidental (User Claimed)

    2 times in 2001 (10^{th} Jan ~ 12^{th} Jul, 5 runs),

    1…Beam Shift/Drift

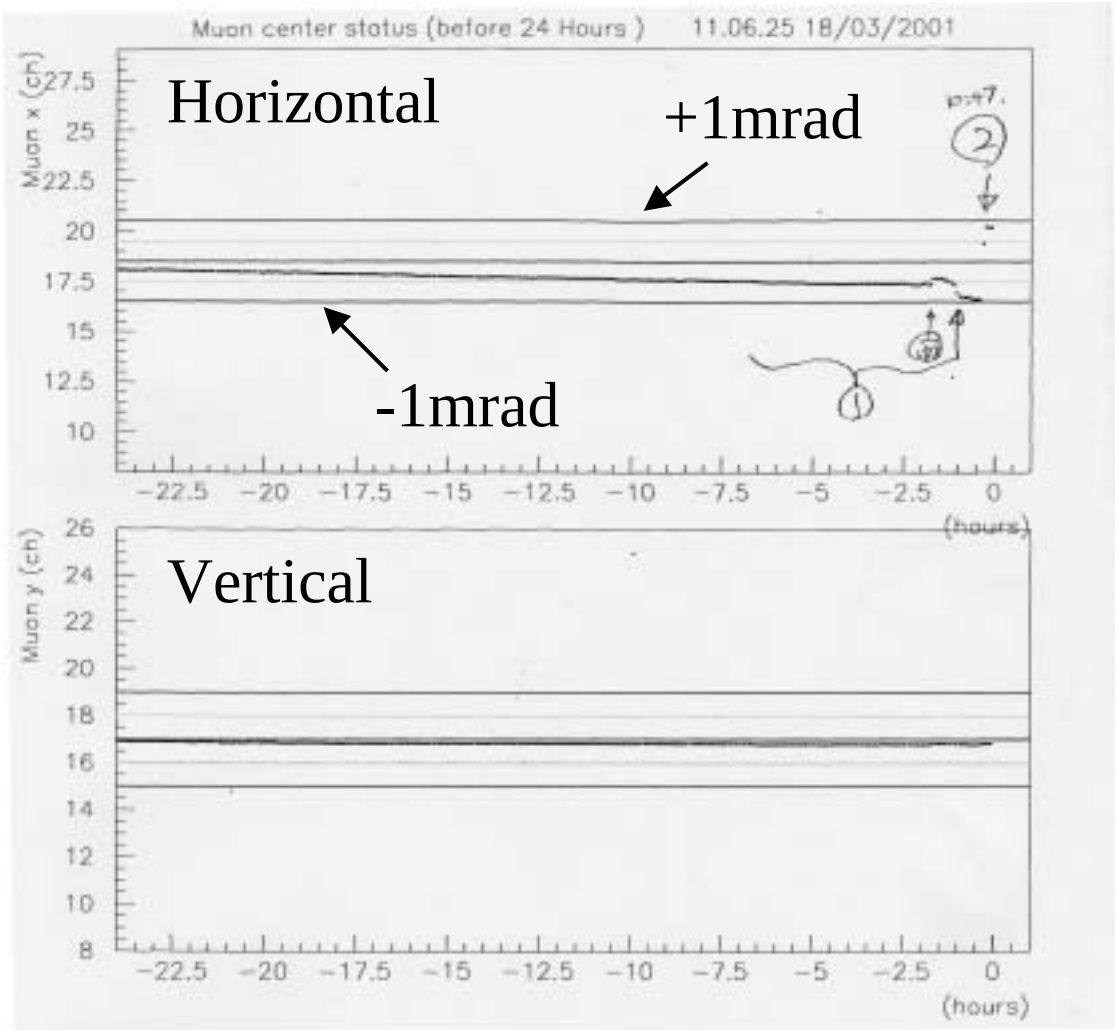
    1…Transmission Down

    ⇛ were found to be caused by failures of the current-readout in Mag.-PS

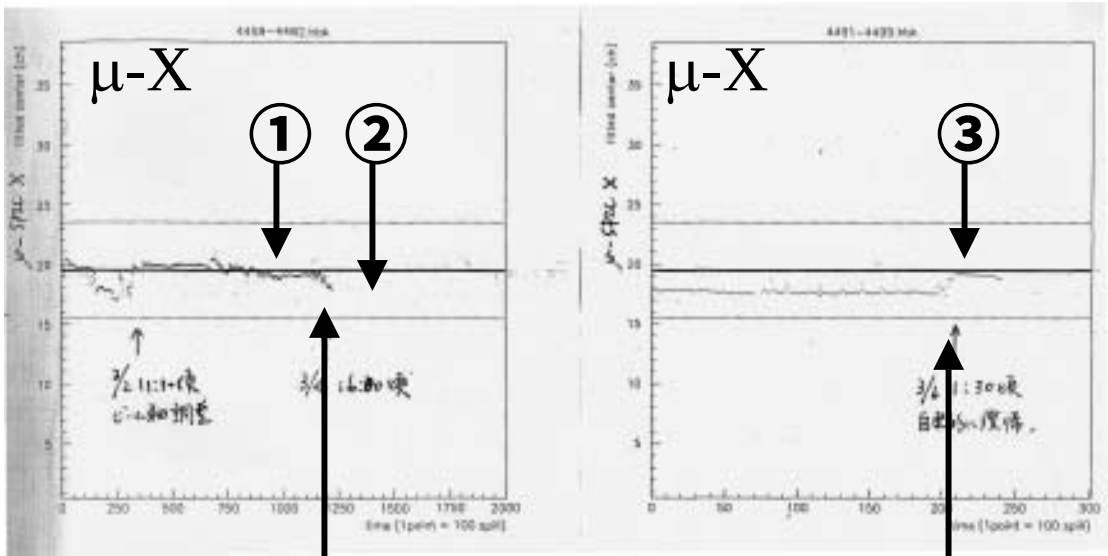
    (▼ 7 times in 2000, due to beam shift/drift)

Beam Shift/Drift in 2001

Muon
Centroid
Drift
in
1 day



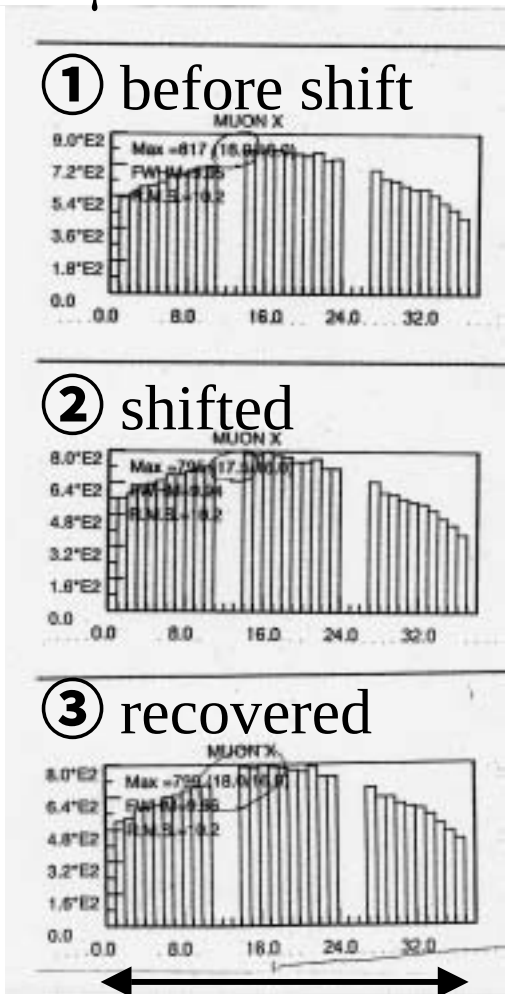
Beam Shift/Drift in 2000



Beam shifted

Recovered after 33 hours

μ-X Profile



2m

Summary

- Fast Extracted Proton Beam

  I_{beam} >6e12ppp@Extraction, 5.6e12ppp@T-station

  $\varepsilon_{H/V} \sim 13\pi/8\pi$ mm･mr (FW1/e^2M)

- Proton Beam Monitors

  30 SPICs/LSs…Beam tuning/monitoring

  16 CTs…Intensity(Transmission) & Time Structure

- Operations

  Tuning Routine…Steer Beam & Targeting

  Only 2 accidental tuning requests in 2001

  Very Stable! ★★★

  Muon monitor is a high-precision proton-beam monitor.