Neutrino Beam Profile Measurement

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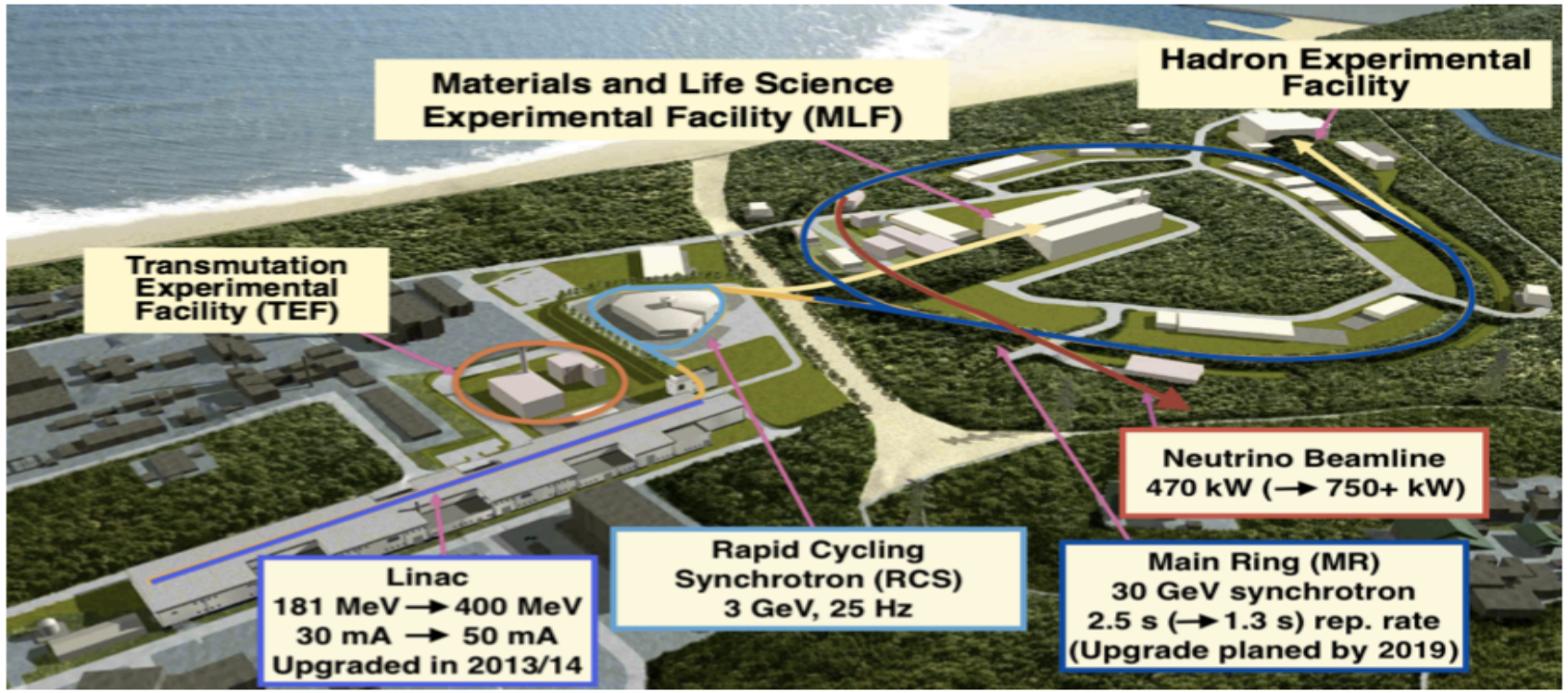
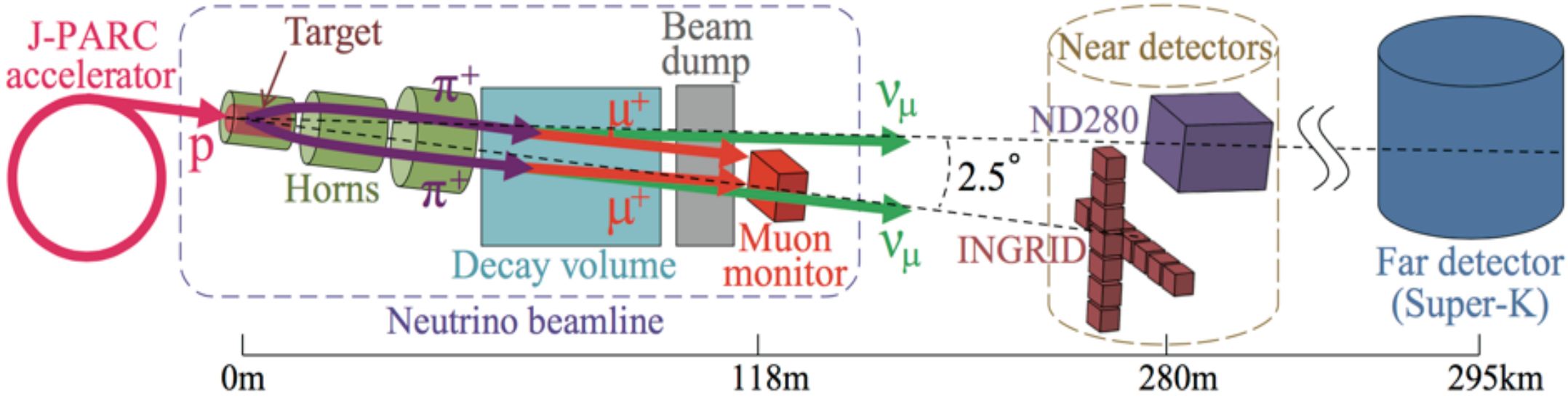
From Megan Friend

J-PARC Accelerator



- J-PARC MR 30 GeV proton beam extracted into the neutrino primary proton beamline by a fast extraction scheme
- MR design beam power: 750 kW (currently ∼470 kW)
  - Delivers $\sim 2.3 \times 10^{14}$ protons per 2.48 s
  - Plan to upgrade beamline to deliver $\sim 2.0 - 3.3 \times 10^{14}$ protons per 1.3 s (∼750 kW) → 1.13 s (∼1.3 MW)

Monitor neutrino beam direction at T2K



PROTON BEAM MONITORS

- To monitor proton beams before hitting the target

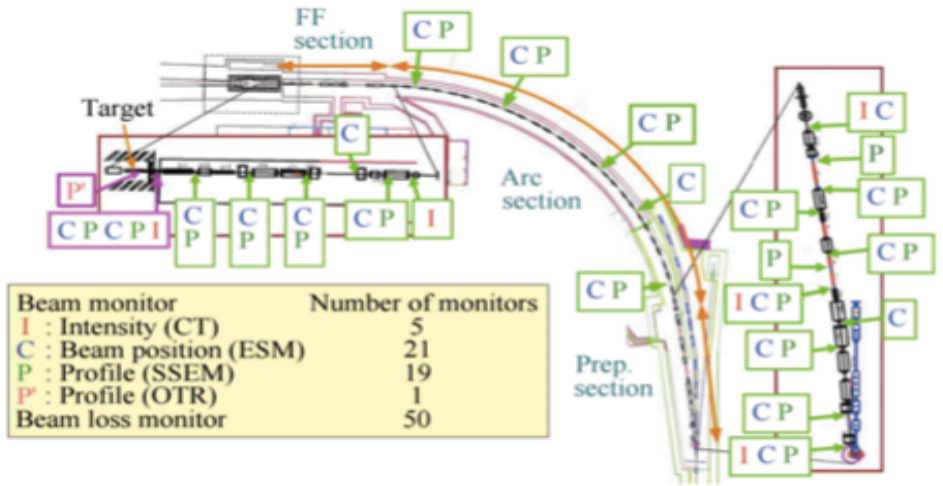
MUON MONITOR (MUMON)

- 118m from target
- Measure muon profile
- Monitor neutrino beam direction indirectly

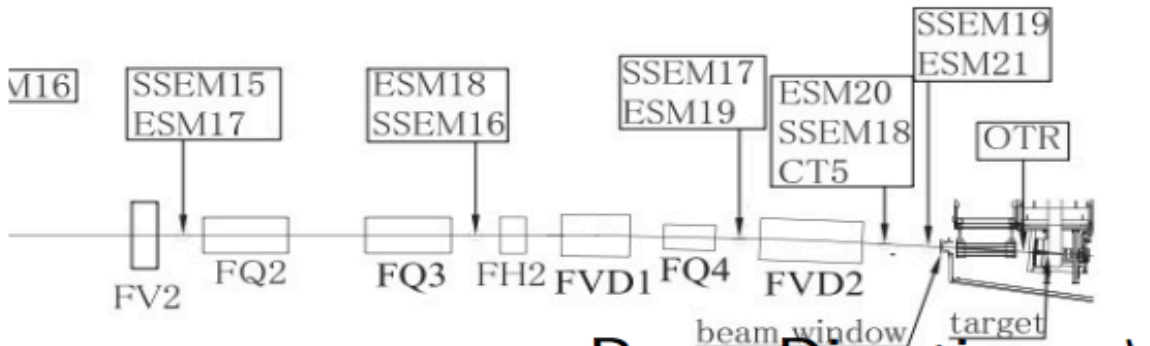
INTERACTIVE NEUTRINO GRID (INGRID)

- 280m from target
- Measure on-axis neutrino beam profile
- Monitor neutrino beam direction

Neutrino Primary Proton Beam Monitors

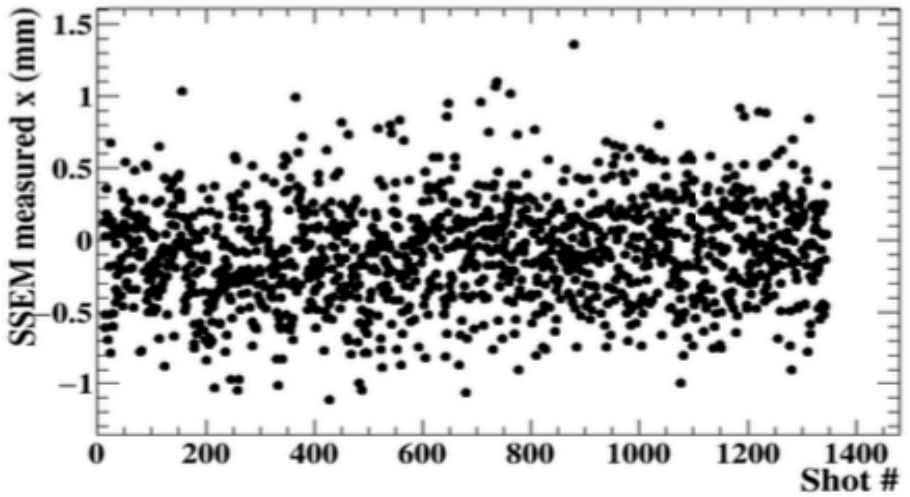


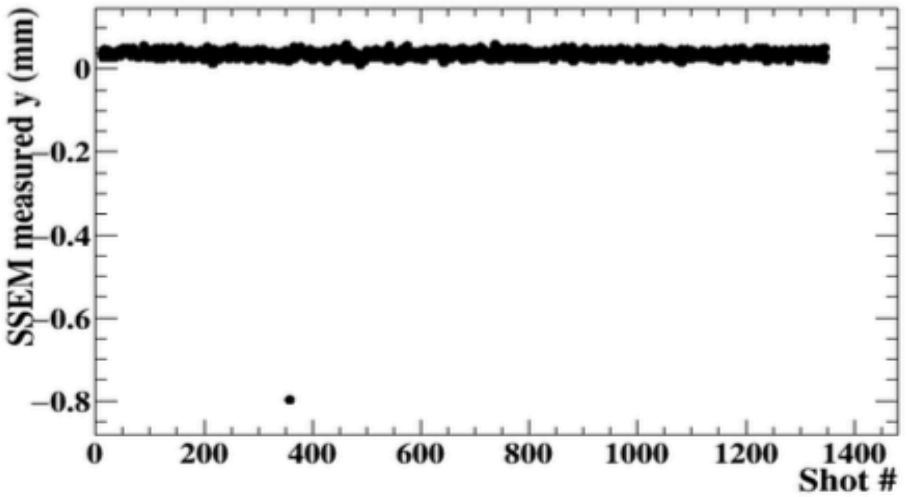
Beamline Final Focusing Section

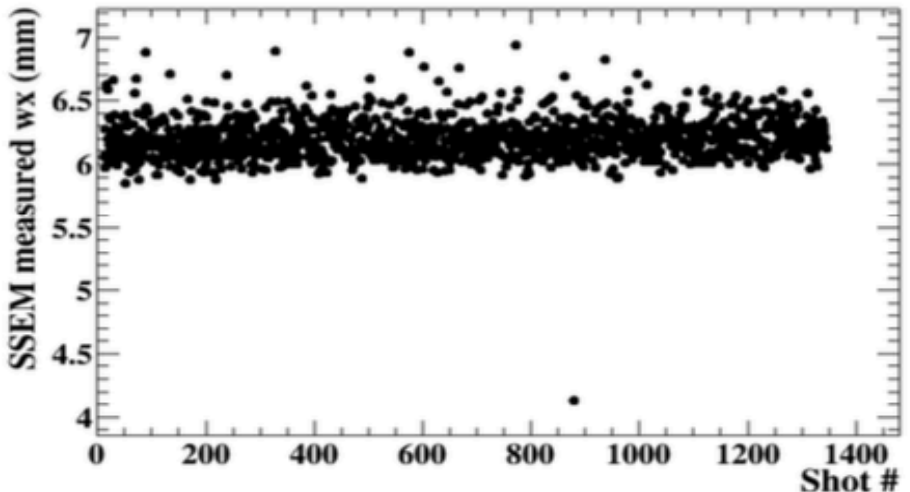


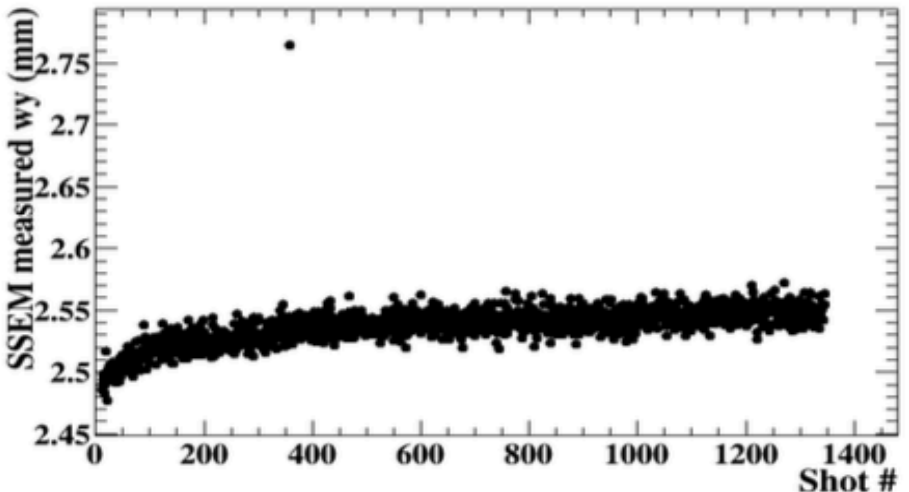
- Beam monitors are essential for protecting beamline equipment and understanding proton beam parameters for neutrino flux MC
- 5 CTs (Current Transformers) – monitor beam intensity
- 50 BLMs (Beam Loss Monitors)
- 21 ESMs (Electrostatic Monitors) – monitor beam position
- 19 SSEMs (Segmented Secondary Emission Monitors) – non-continuously monitor beam profile
- 1 OTR (Optical Transition Radiation) Monitor – continuously monitors beam at target → See talk by M. Yu
- MUMON (Muon Monitor) – continuously monitors secondary muon beam position and profile → See talk by Y. Ashida

Beam profile stability from proton beam monitor (SSEM)

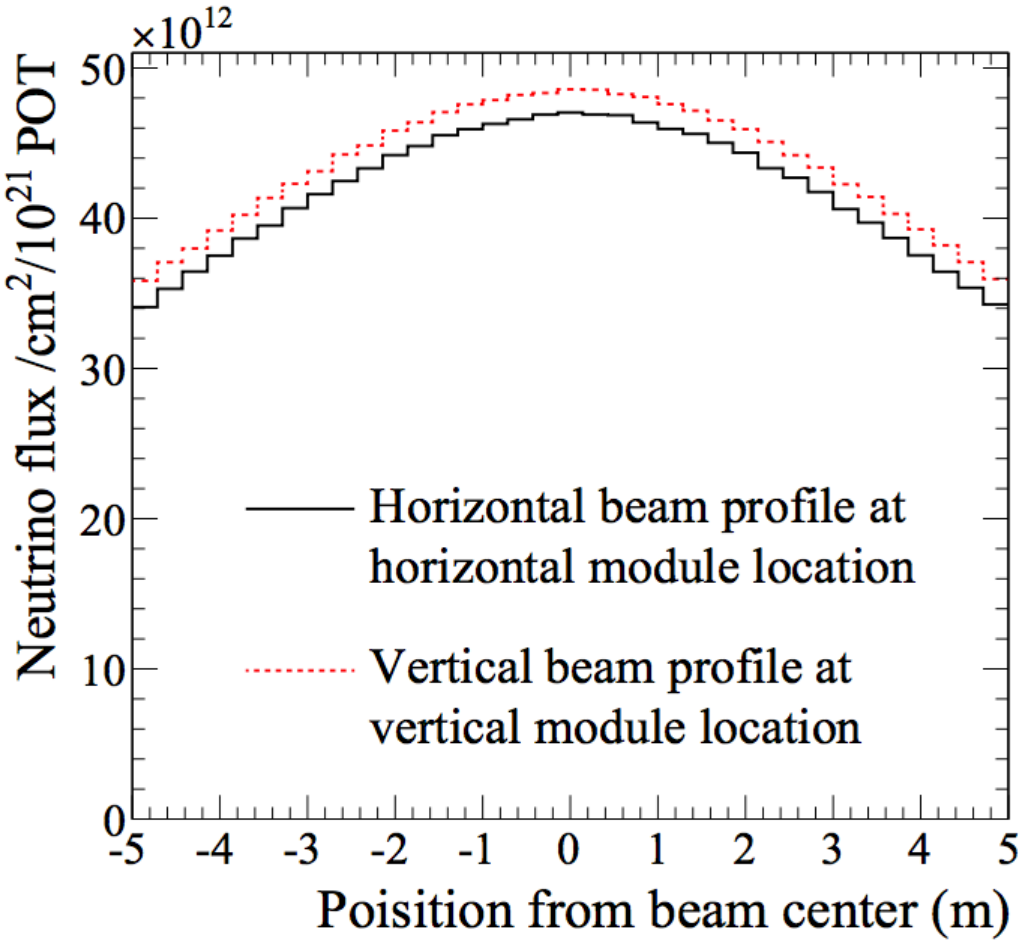


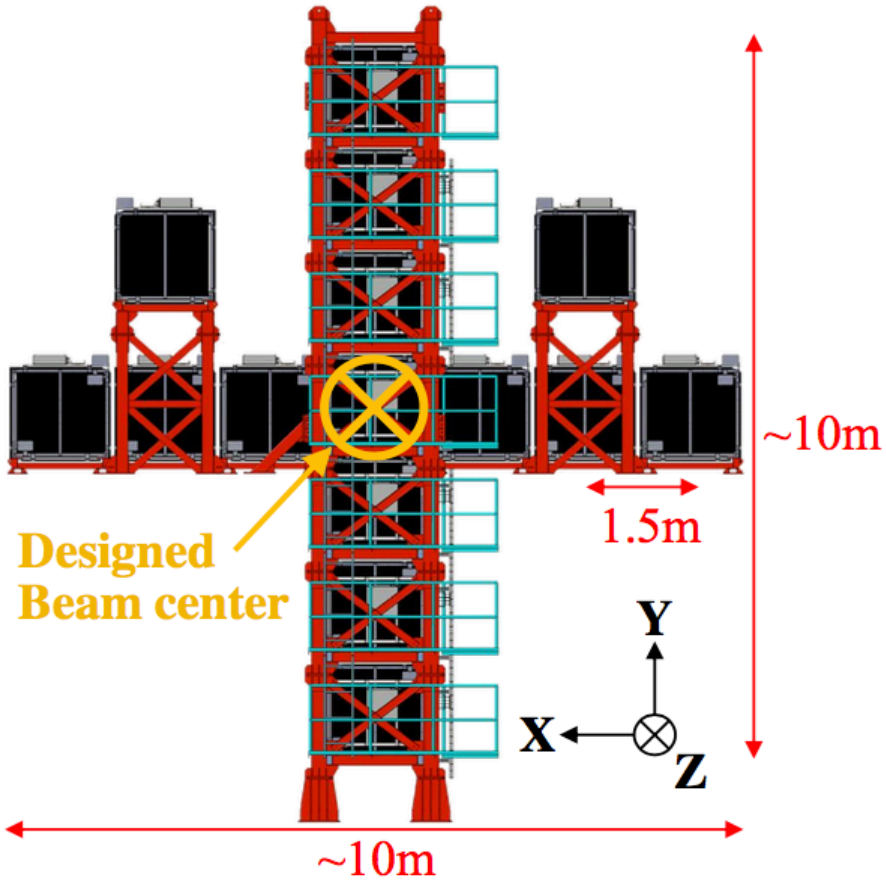




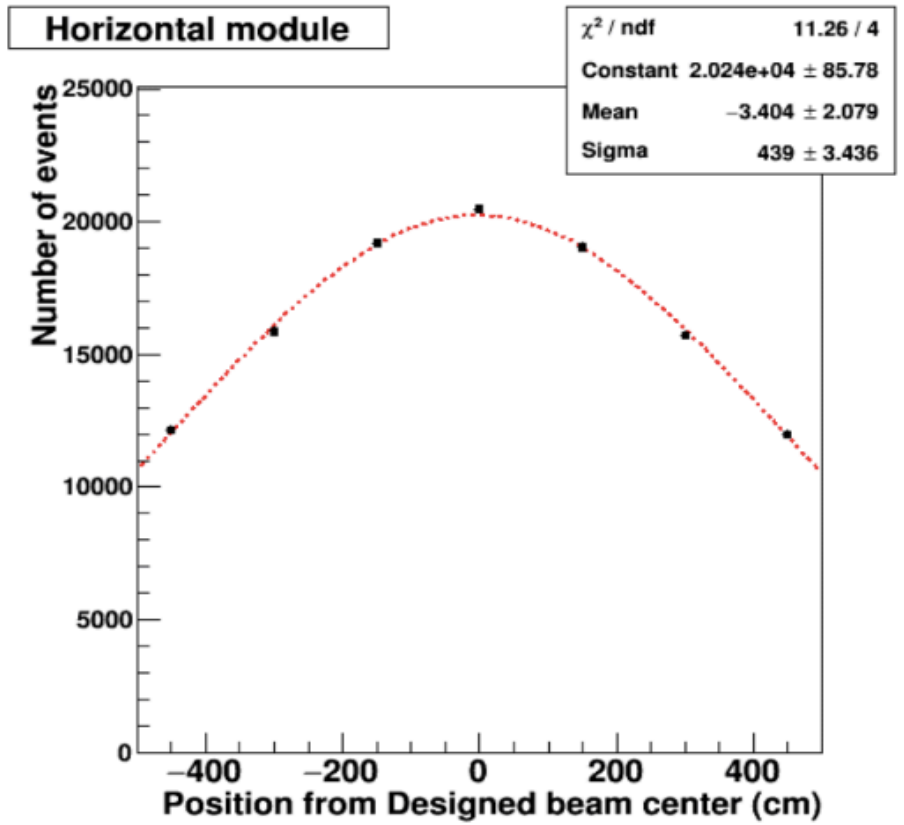


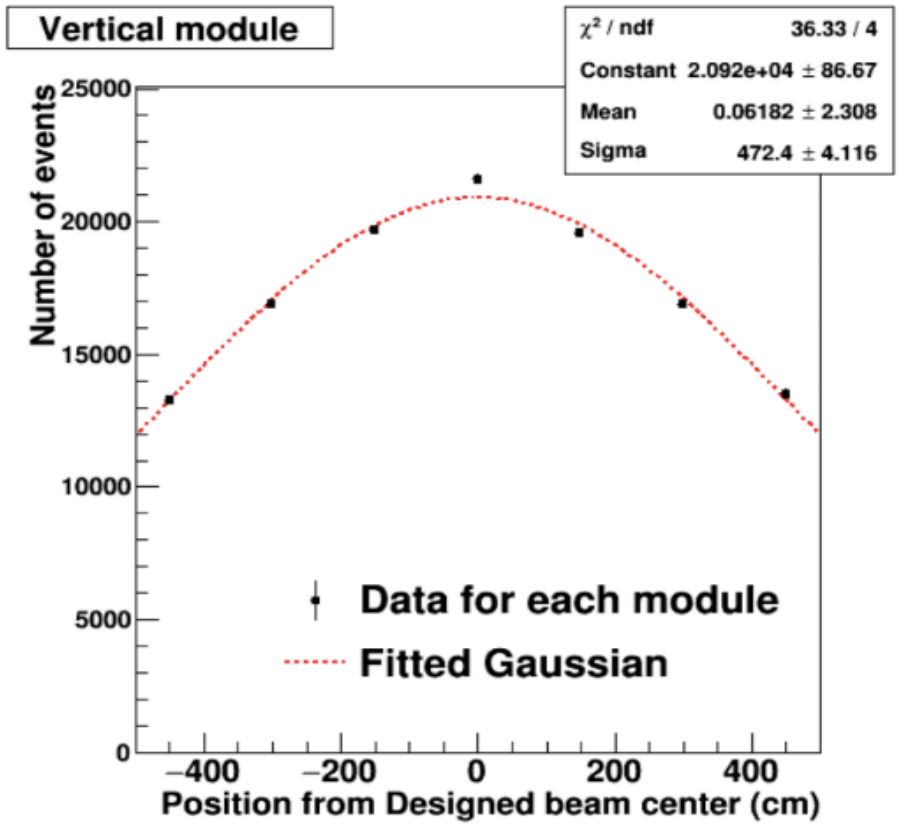
Beam profile from INGRID





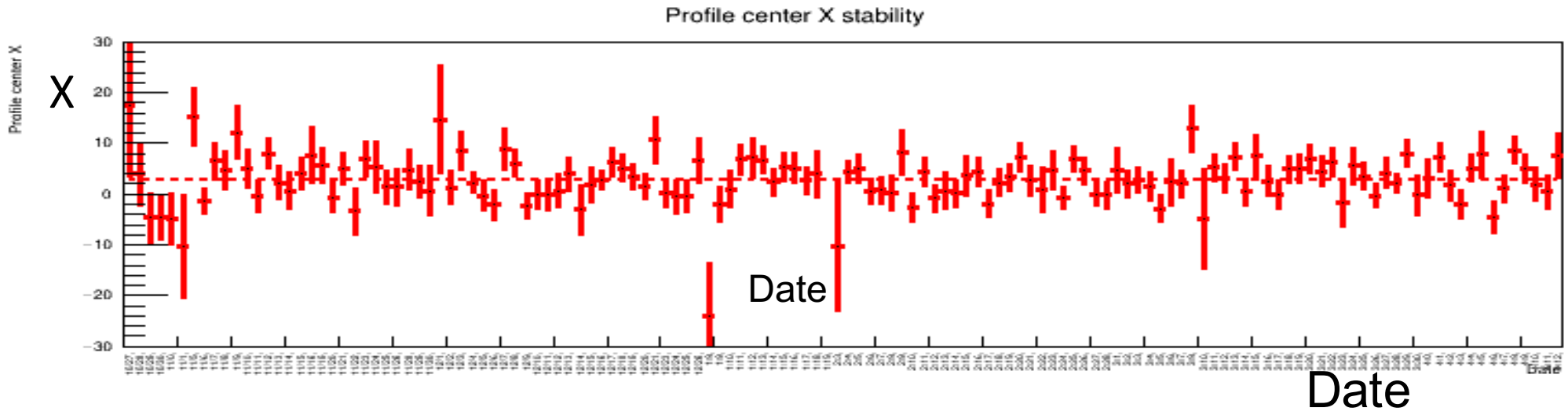
Beam Profile

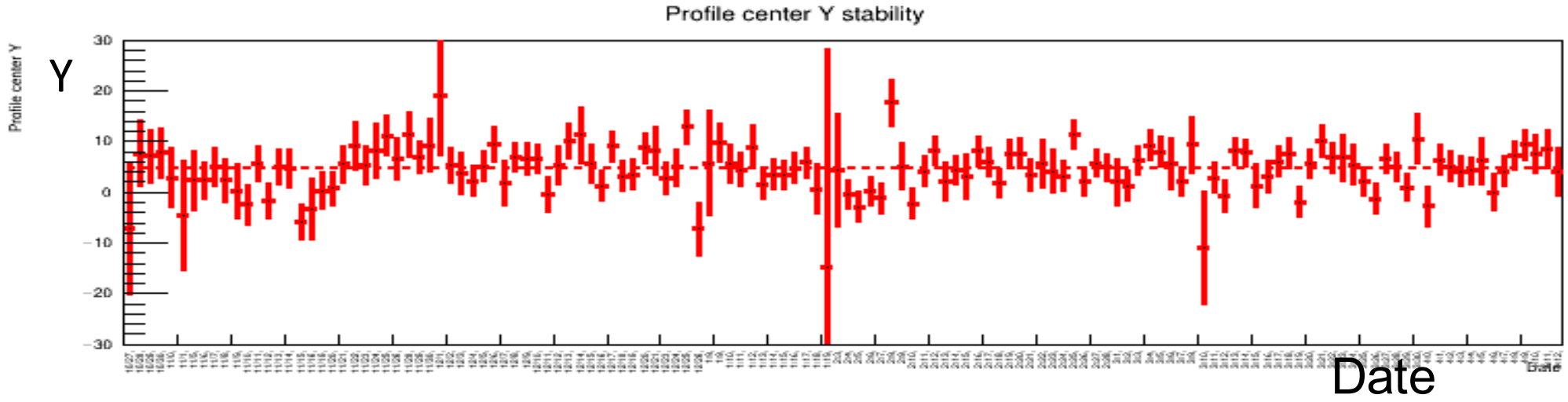




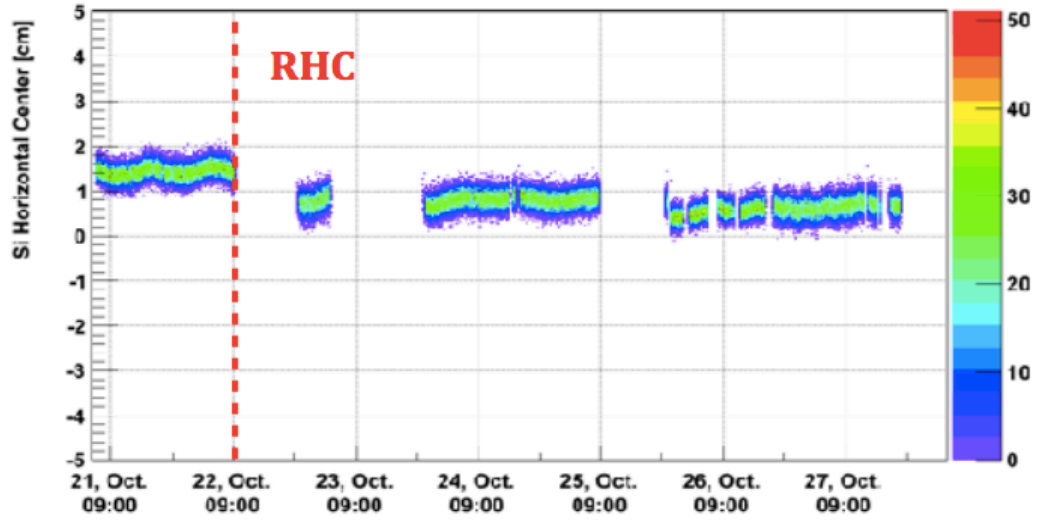
Hor. Beam center	Hor. Beam width	Ver.Beam center	Ver. Beam width
-3.404±2.079cm	439±3.46 cm	0.062±2.308 cm	472.4±4.116cm

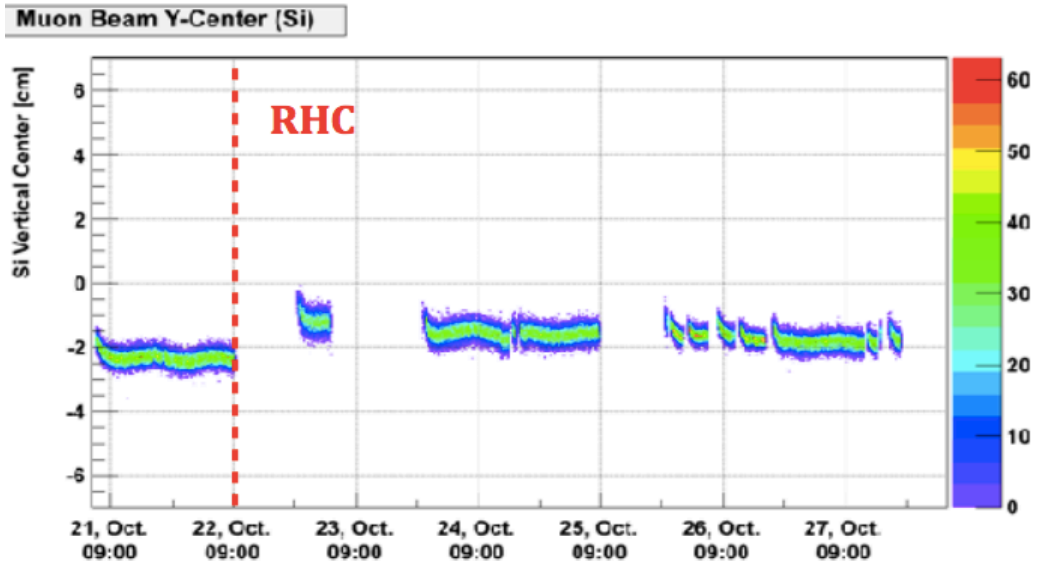
Beam Profile center from INGRID in days

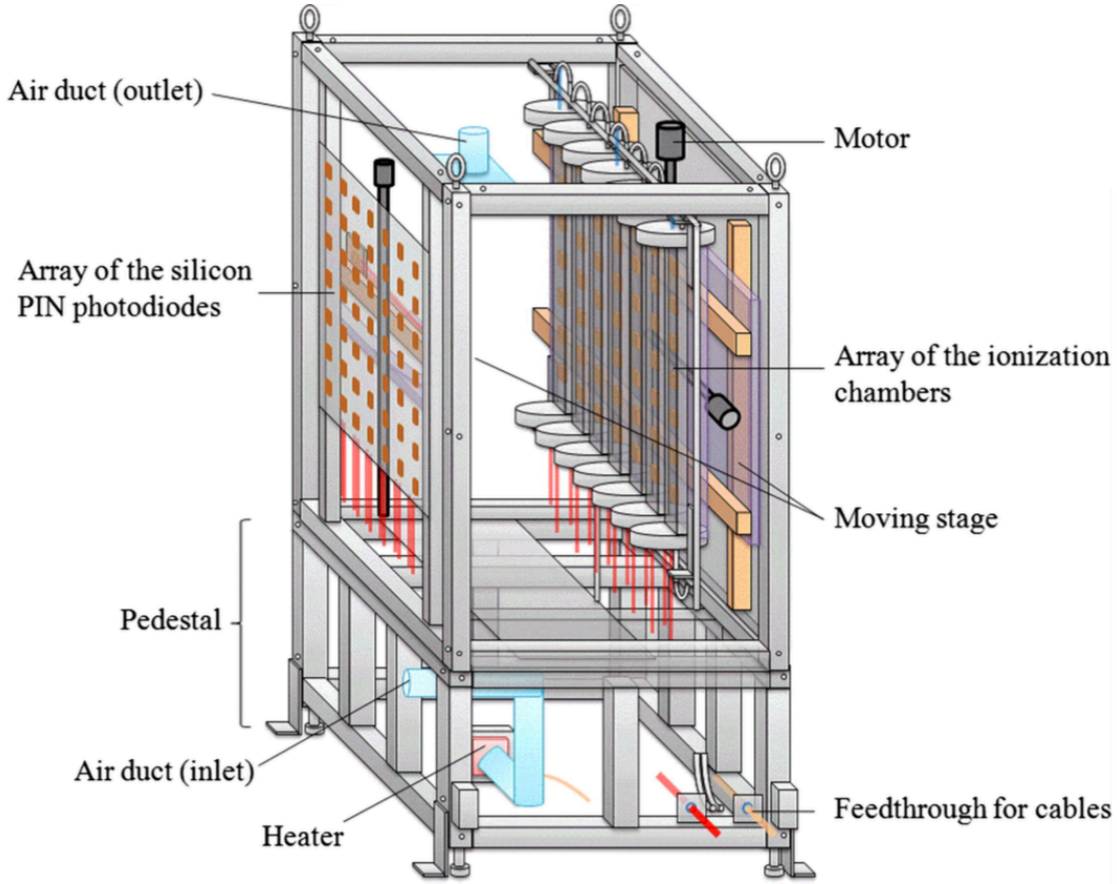




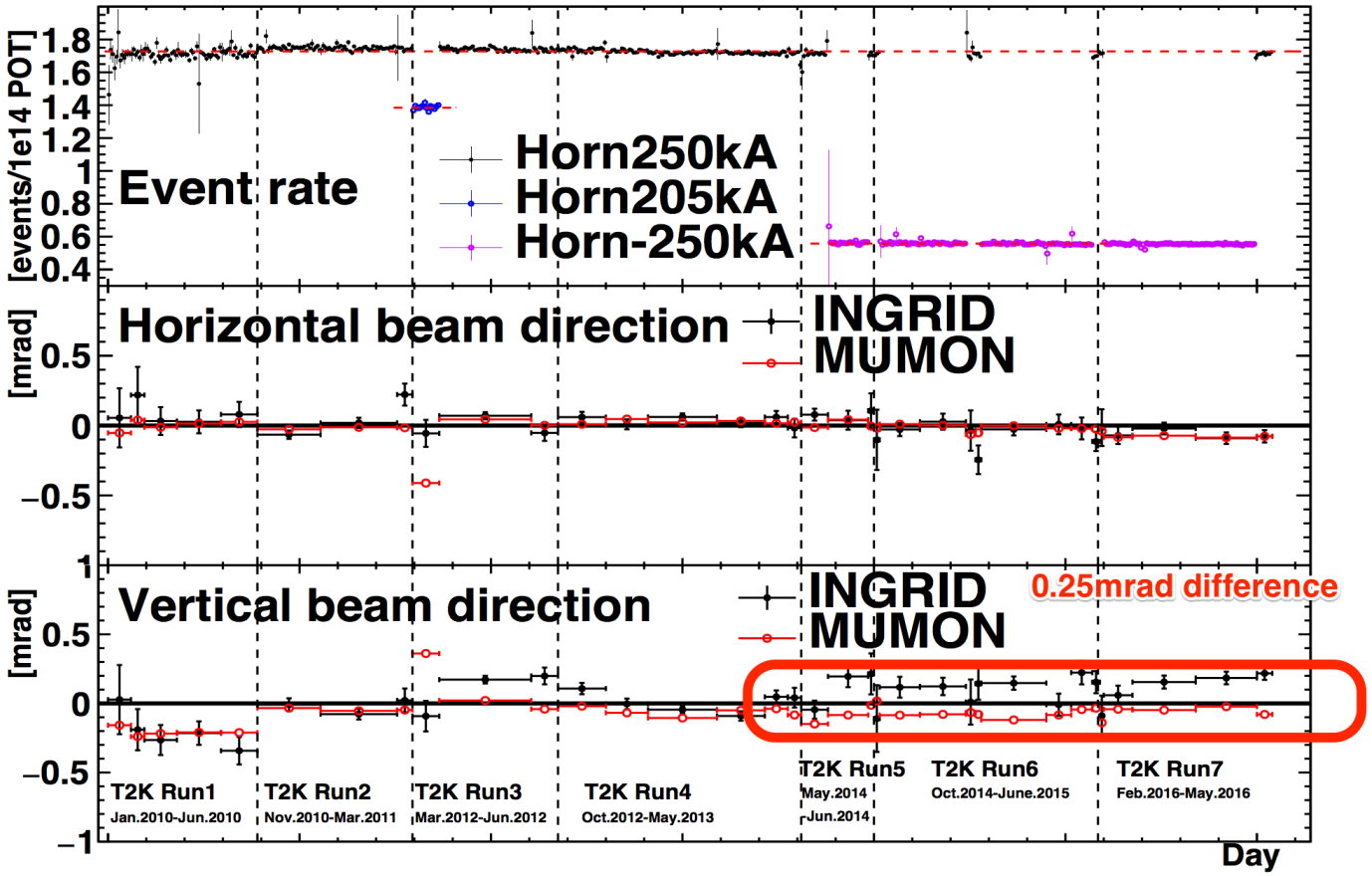
Beam Profile center from MUMON







Beam profile center difference between INGRID and MUMON



Systematic uncertainty?

MUMON pit movement?

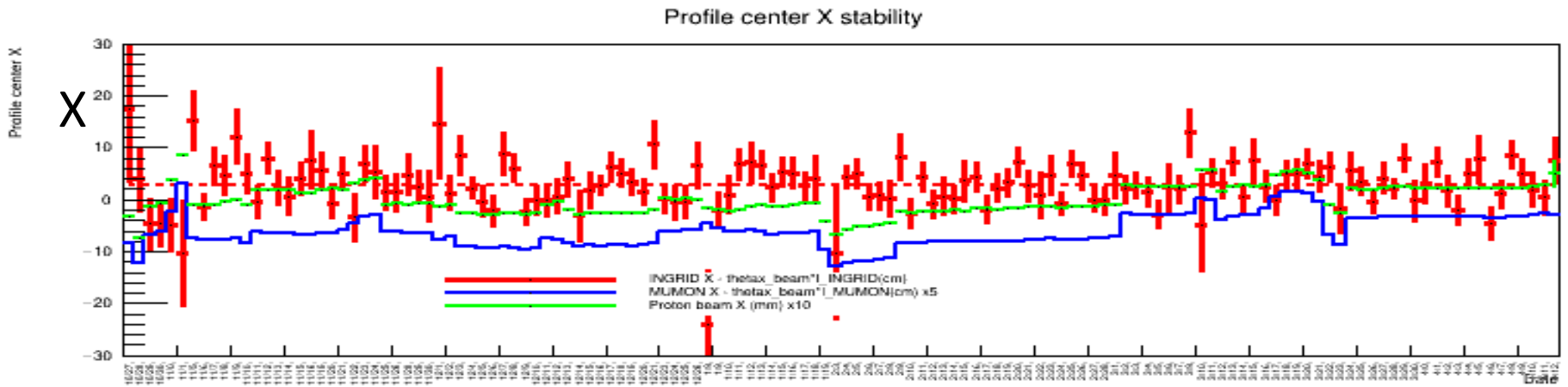
ND280 pit movement?

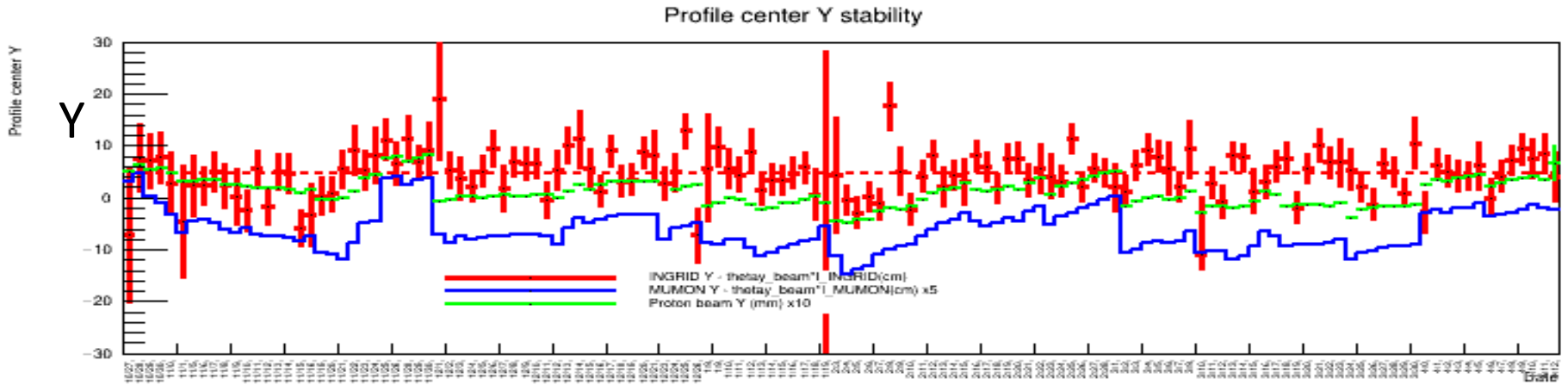
From beam elements?

Why?

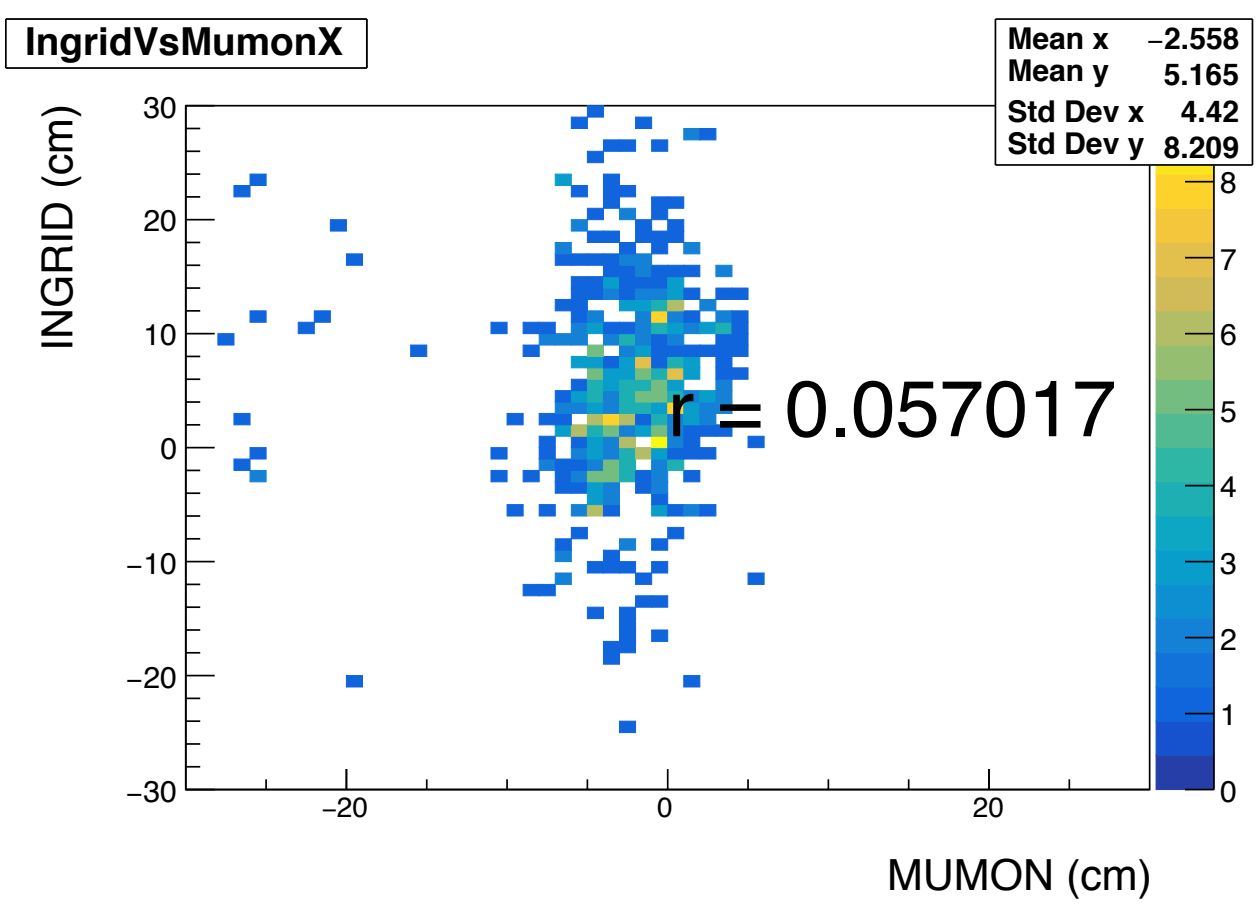
Beam profile stability comparison

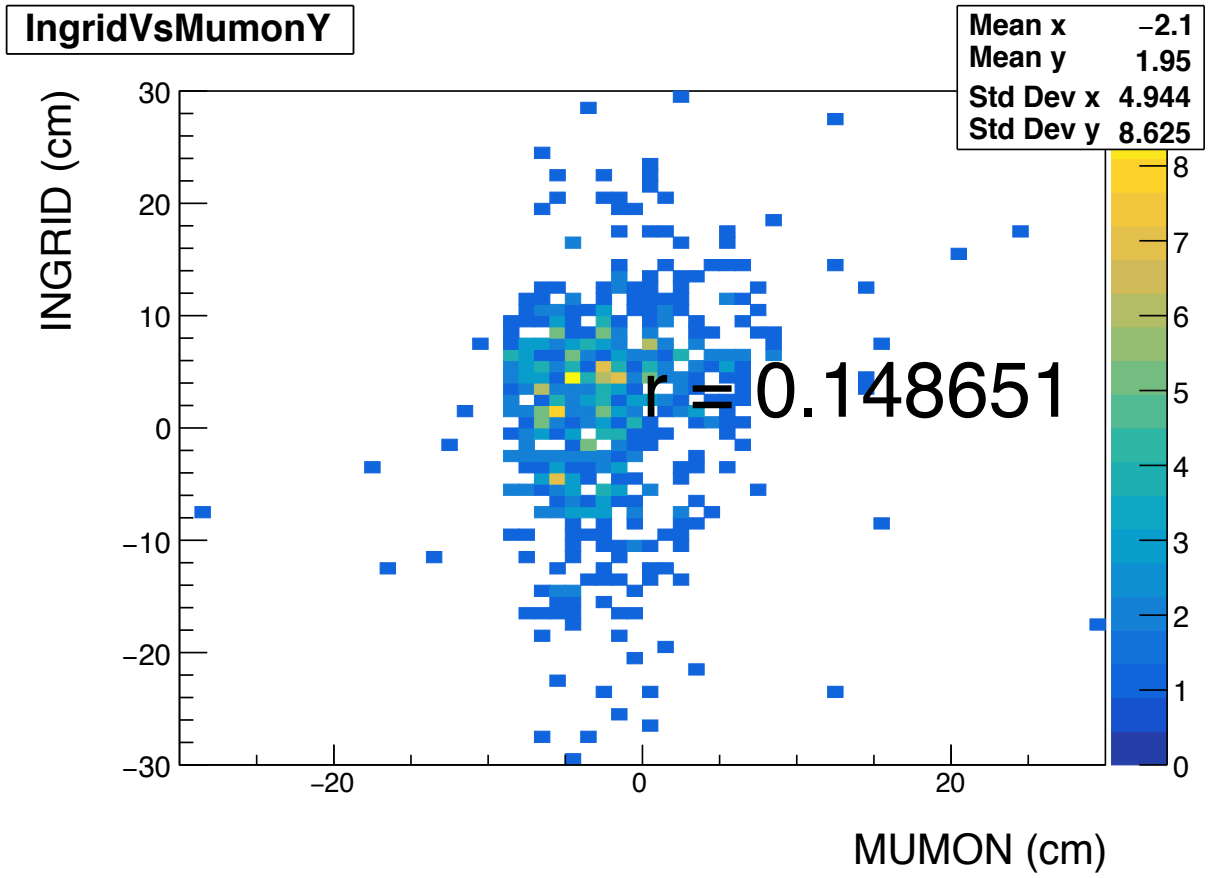
INGRID
MUON
Proton Beam



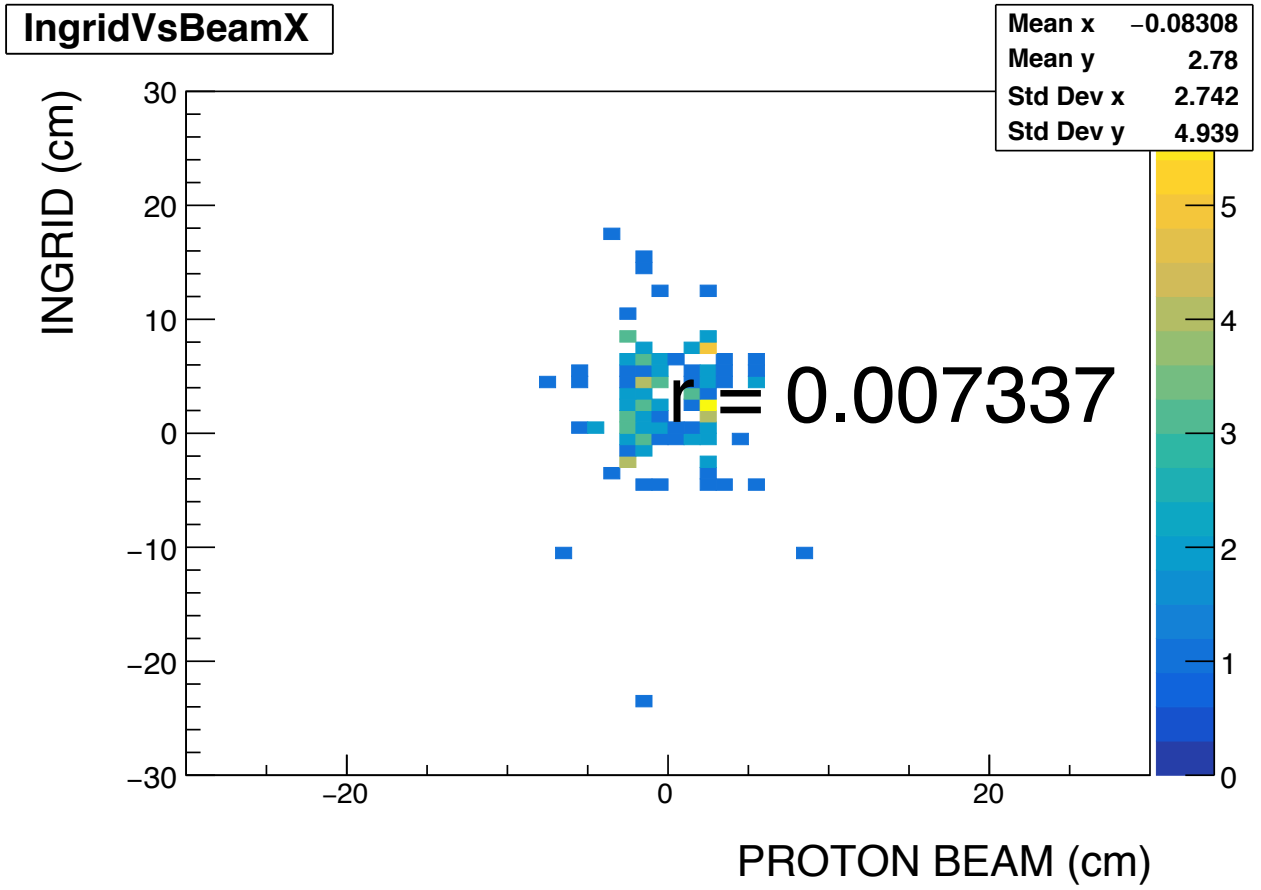


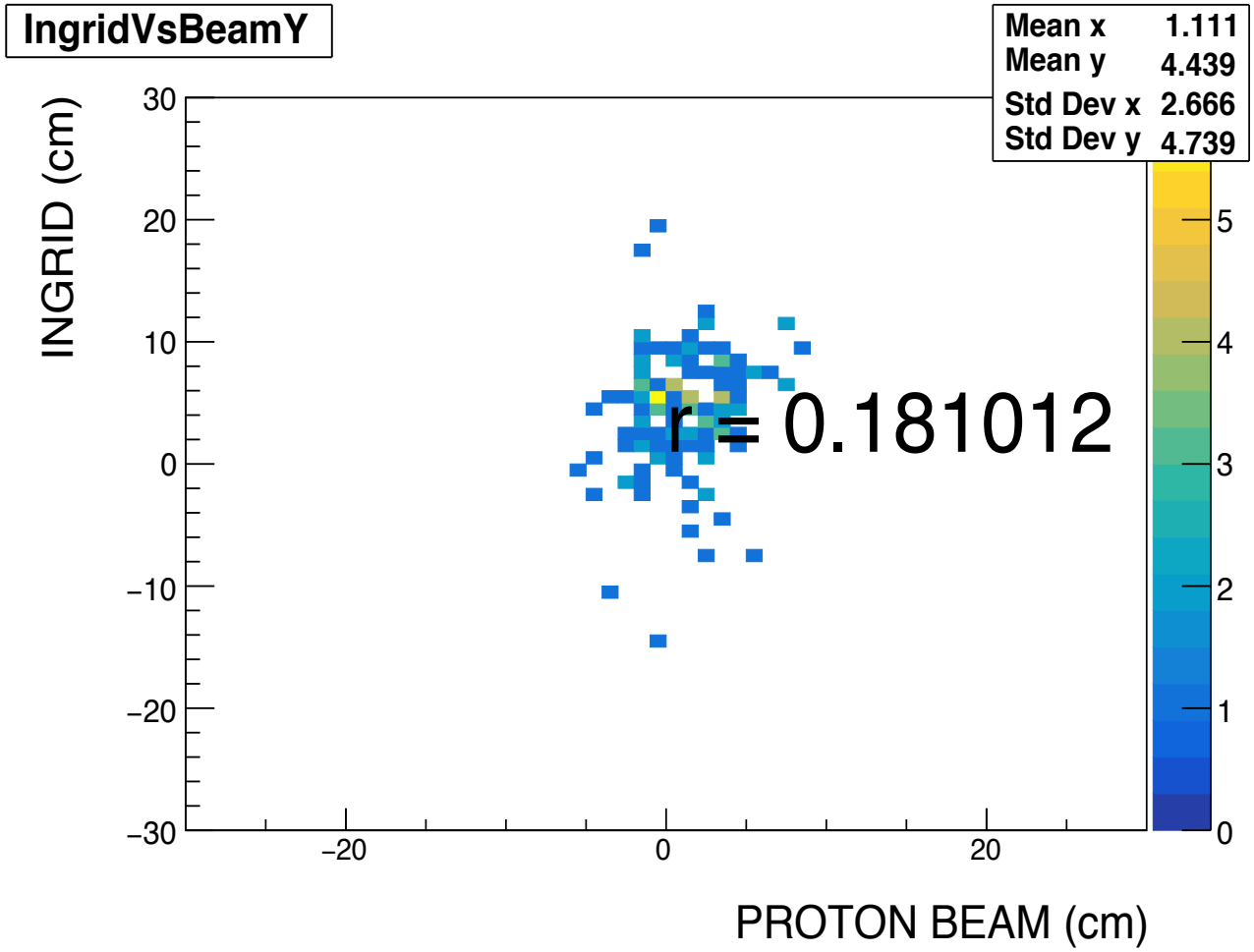
Correlation between INGRID and MUMON





Correlation between INGRID and P BEAM





Correlation between MUMON and p BEAM