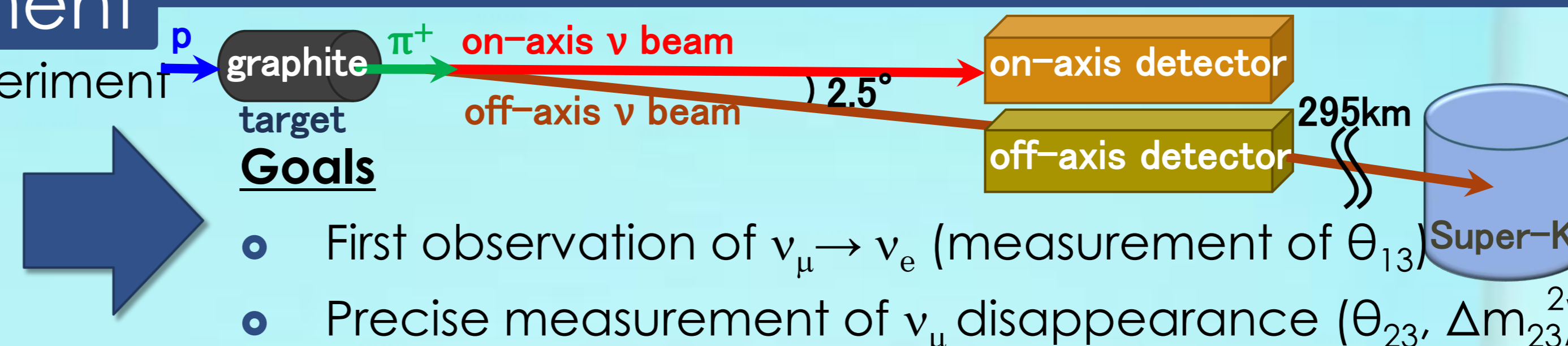


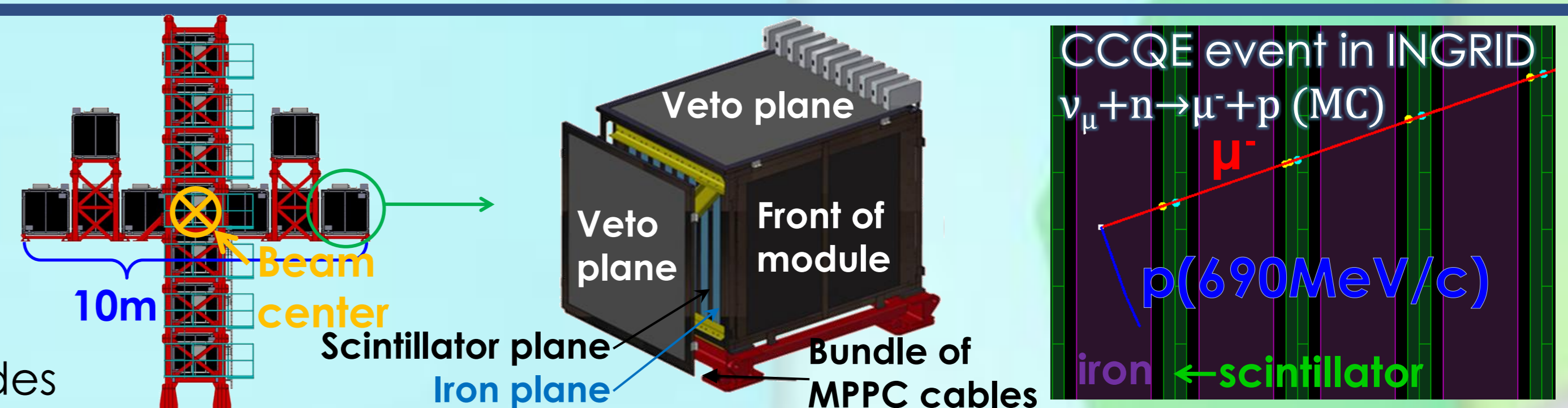
## The T2K (Tokai to Kamioka) experiment

- Long-baseline (295km) neutrino oscillation experiment
- Generate  $\nu_\mu$  beam at J-PARC in Tokai
- Detect the neutrinos with Super-K in Kamioka
- First application of off-axis beam



## INGRID (Interactive Neutrino GRID)

- On-axis neutrino detector (16 identical modules) to monitor the beam direction
- Sandwich structure of iron target and scintillator tracking planes
- High statistics because of large target mass (116 tons)
- Unable to detect particles other than muon from neutrino interactions (i.e. protons & pions stop in iron layers) → Unable to identify neutrino interaction modes



## INGRID proton module

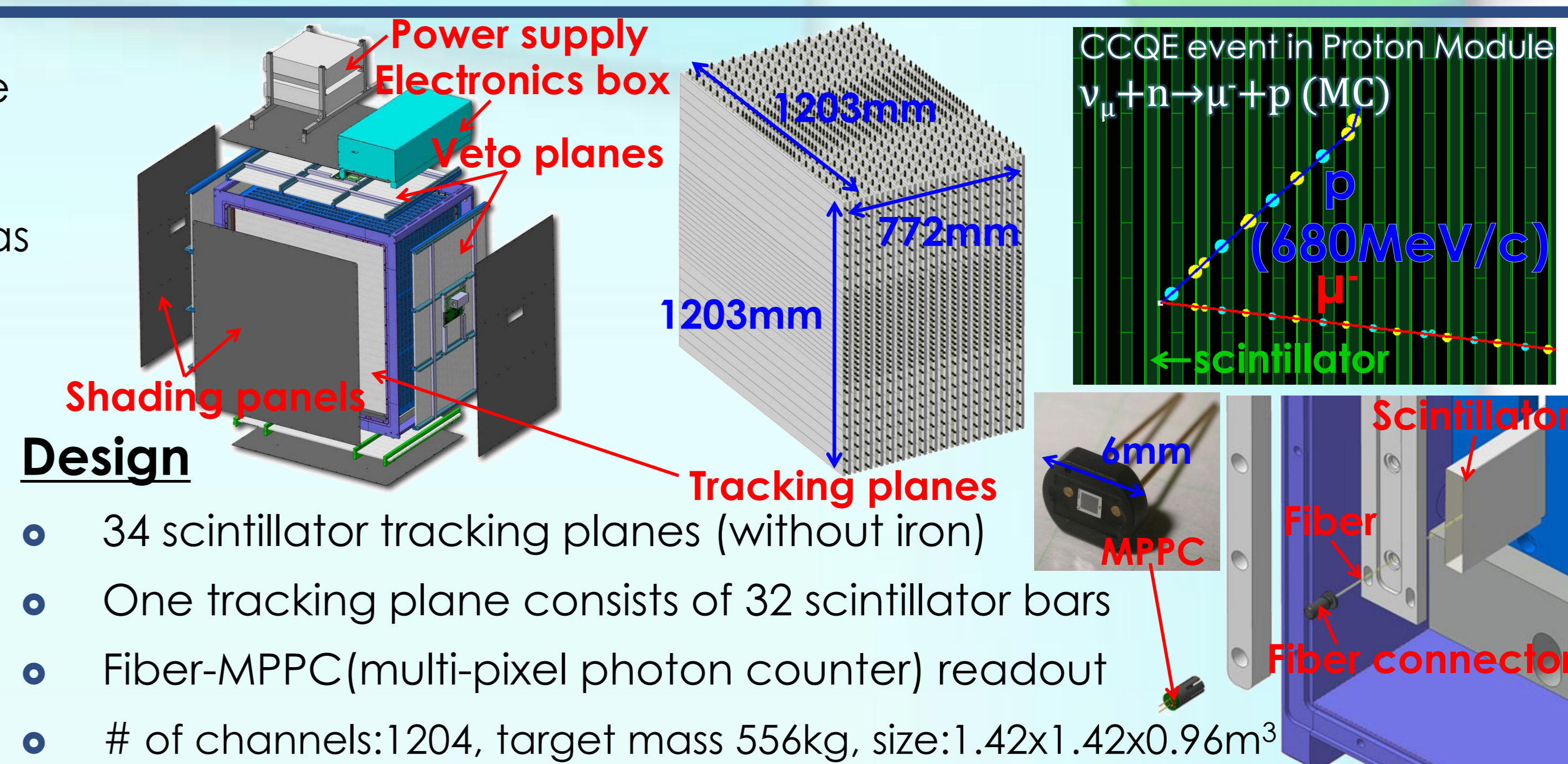
- New additional on-axis neutrino detector in front of the central INGRID module

### Motivations

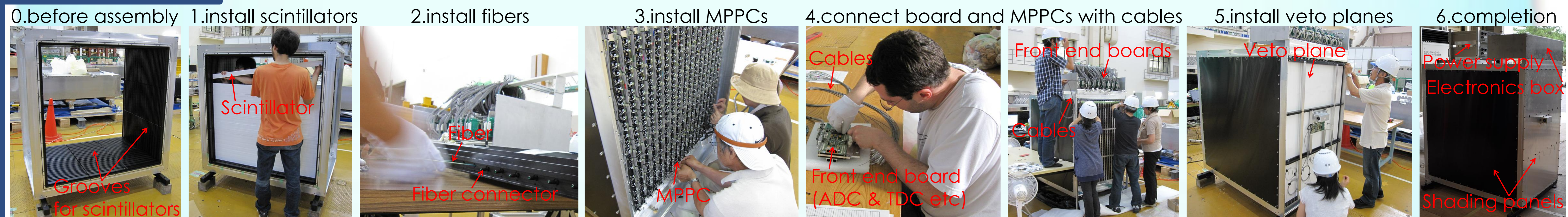
- Better understand neutrino interactions in INGRID by detecting particles such as hadrons and low-energy muons that INGRID is unable to detect
  - Identify neutrino interaction mode.
- Reduce the uncertainty of neutrino interactions & cross sections

### Requirement

- Reconstruct tracks of all kinds of charged particles from neutrino interactions
- Identify the kinds of the charged particles from  $dE/dx$
- Sufficient number of neutrino events



## Construction

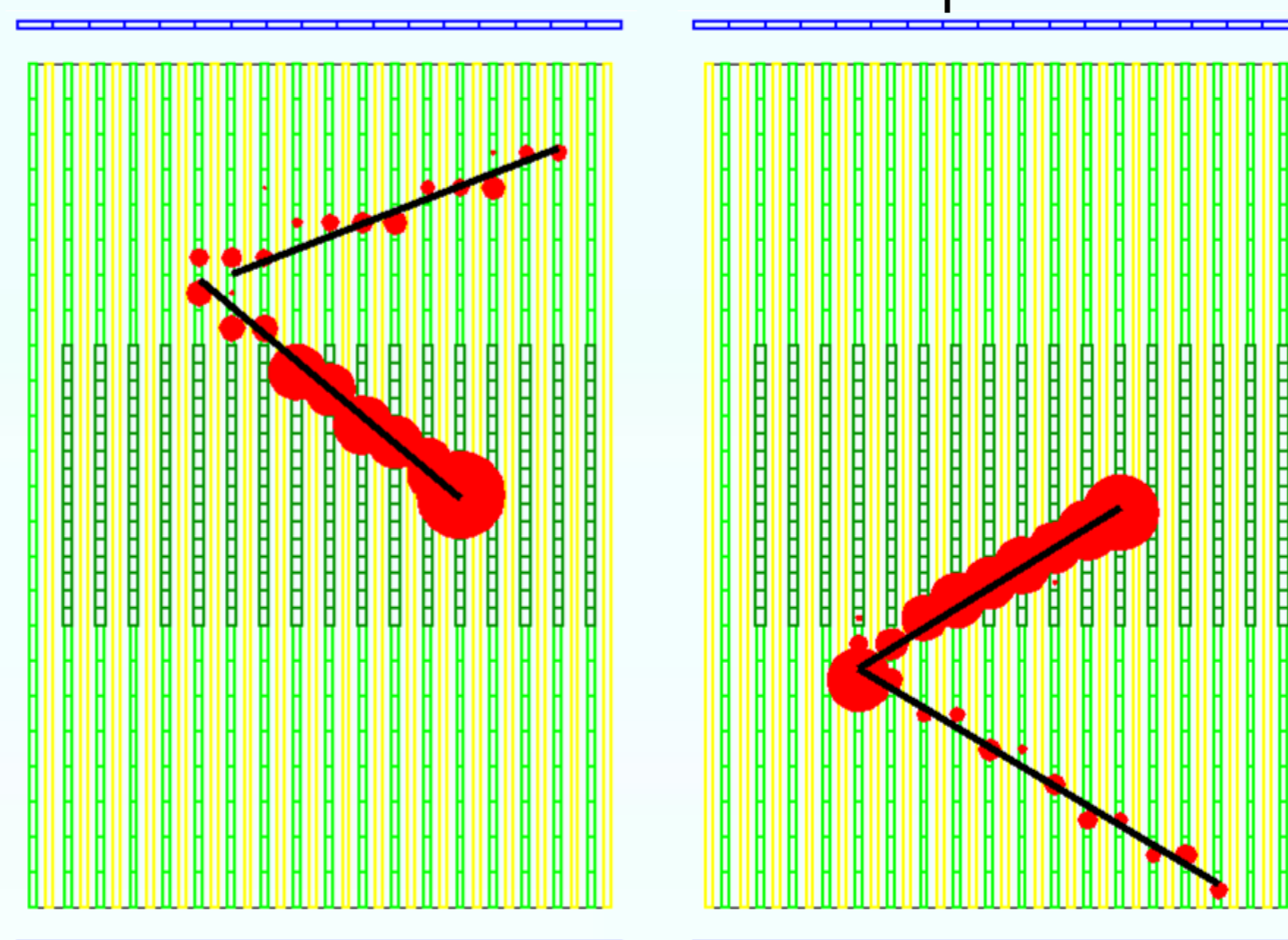


## Beam commissioning

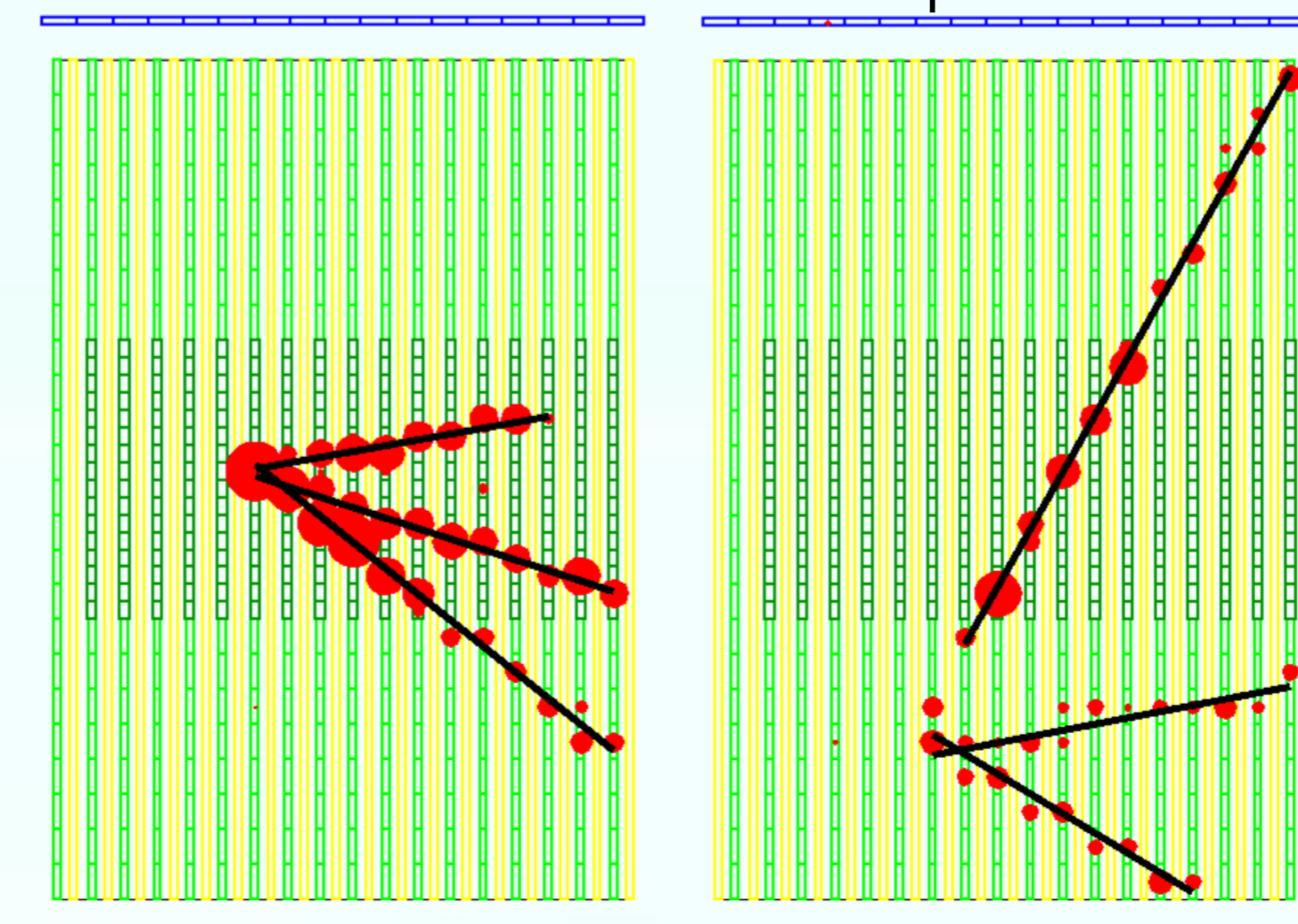
### Event display of beam data

- Scintillator for tracking plane
- Scintillator for veto plane
- Hit in scintillator (Size corresponds to light yield)
- Reconstructed track

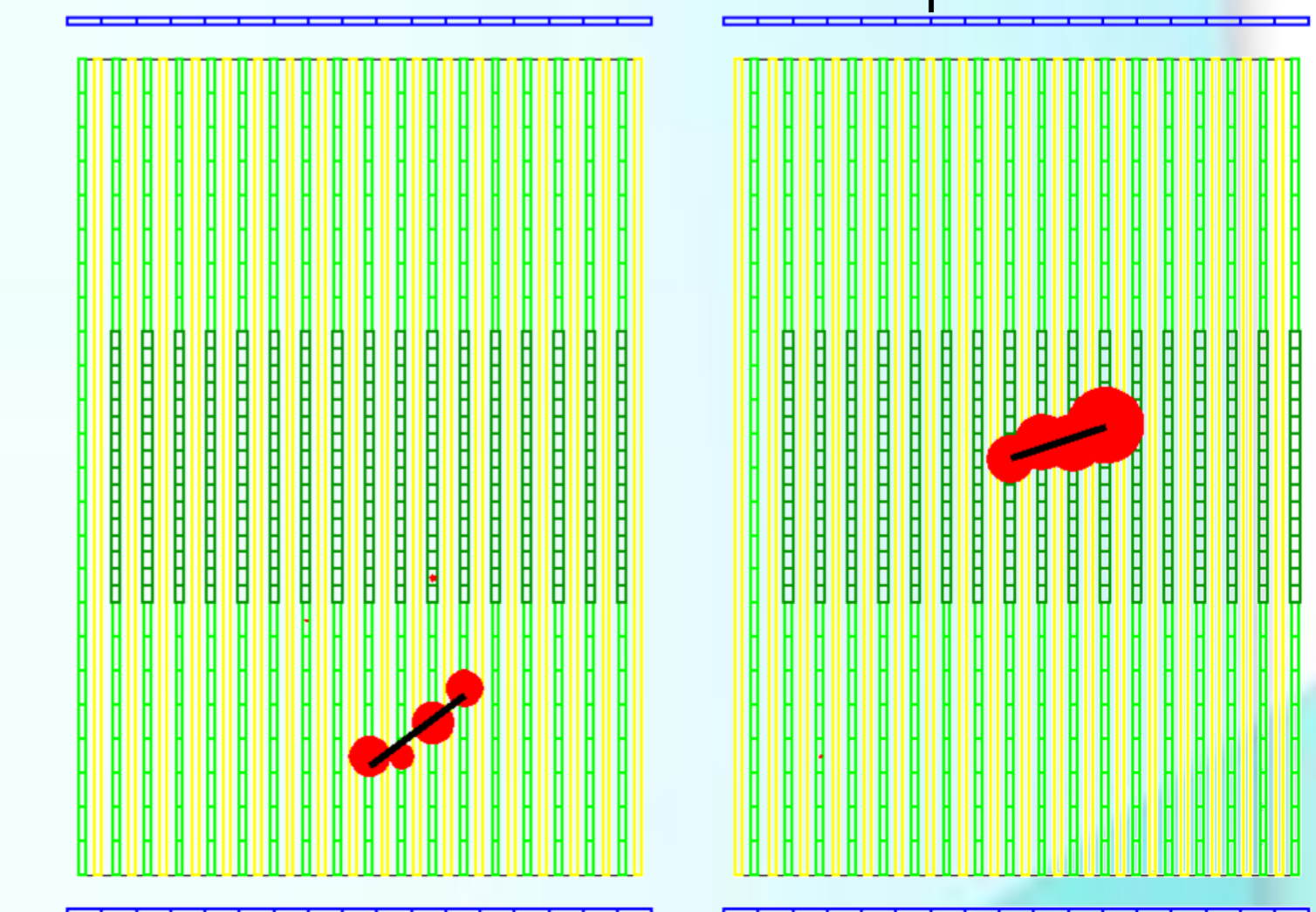
CCQE ( $\nu_\mu + n \rightarrow \mu + p$ ) candidate



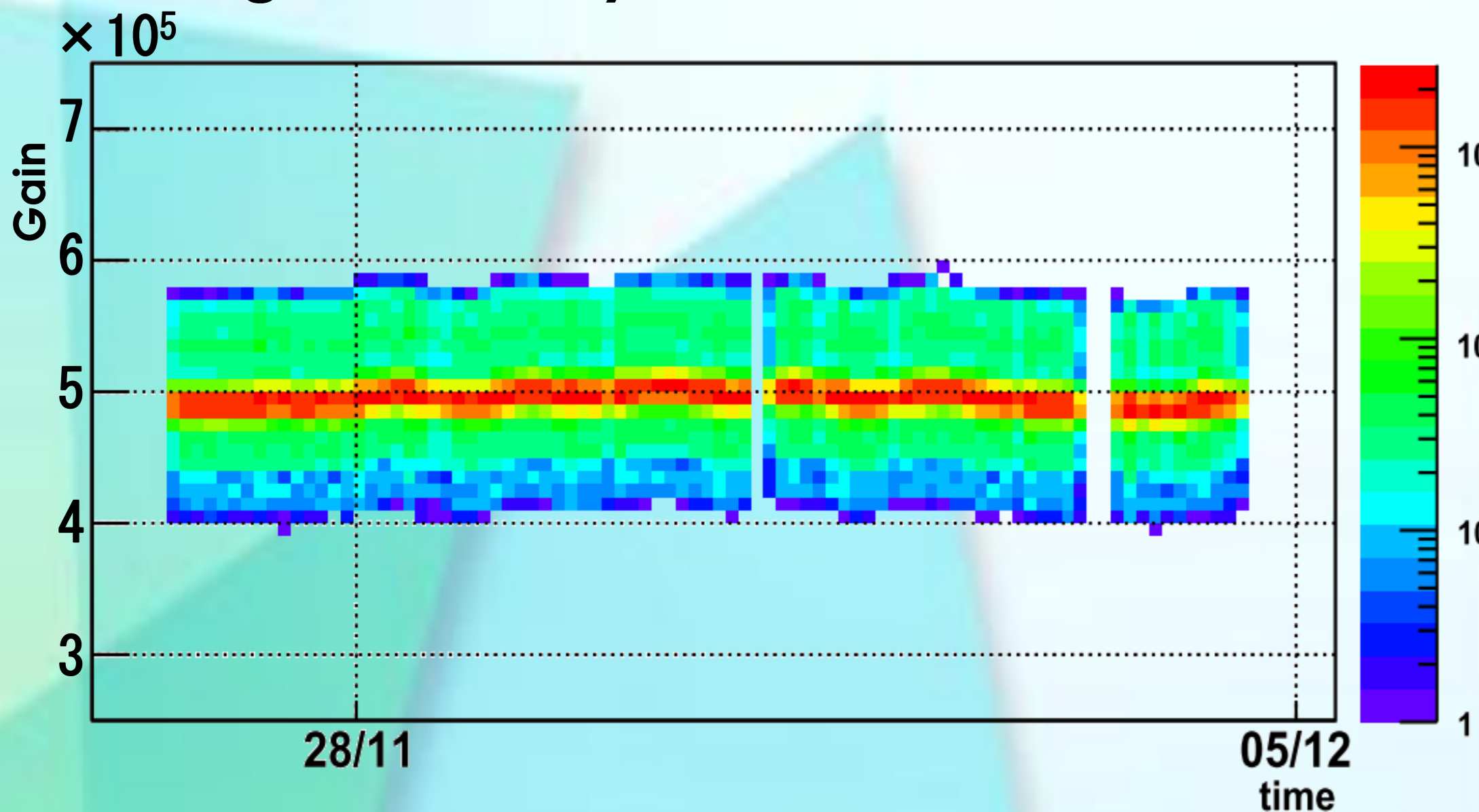
CC1 $\pi^+$  ( $\nu_\mu + p \rightarrow \mu + p + \pi^+$ ) candidate



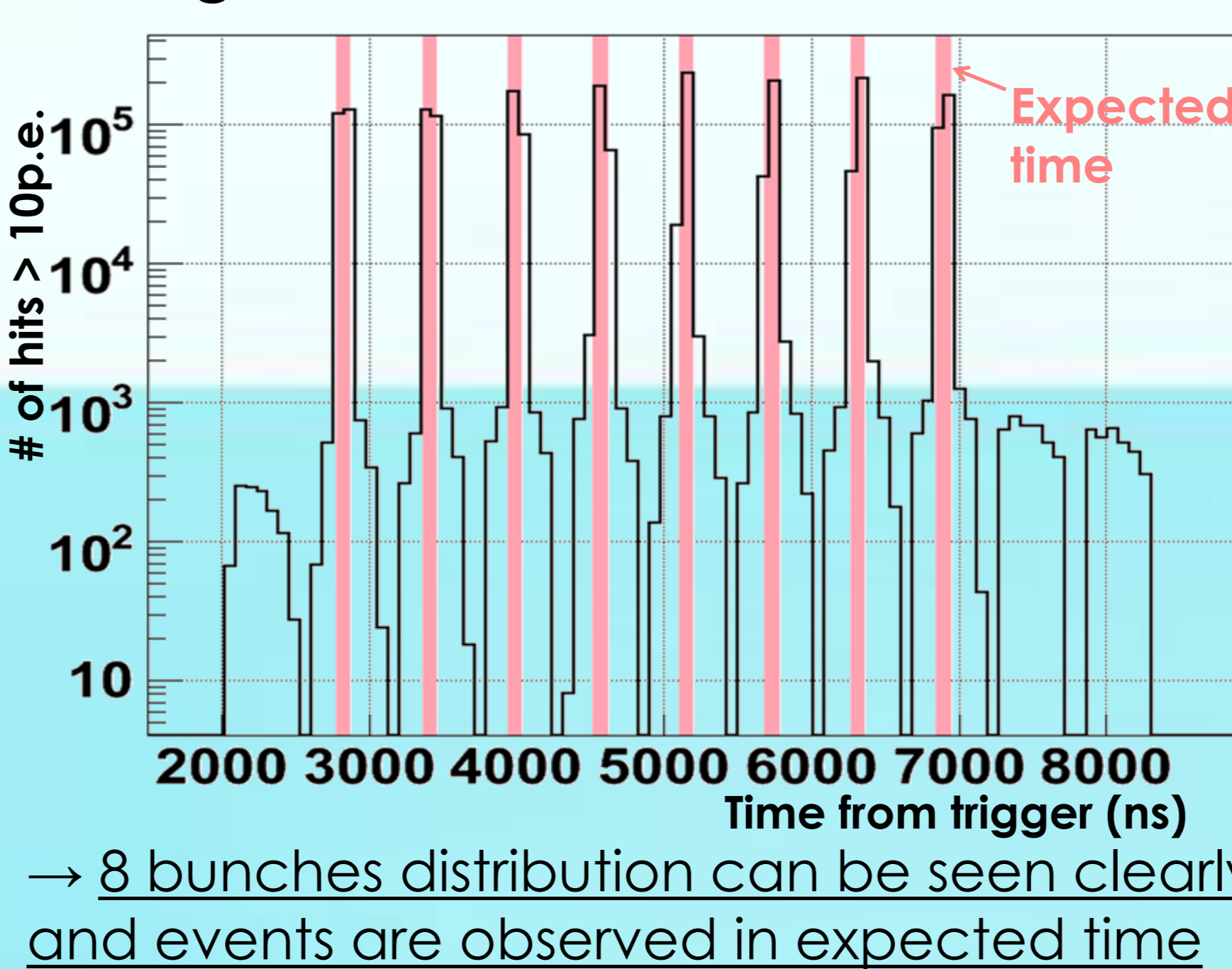
NC elastic ( $\nu_\mu + p \rightarrow \nu_\mu + p$ ) candidate



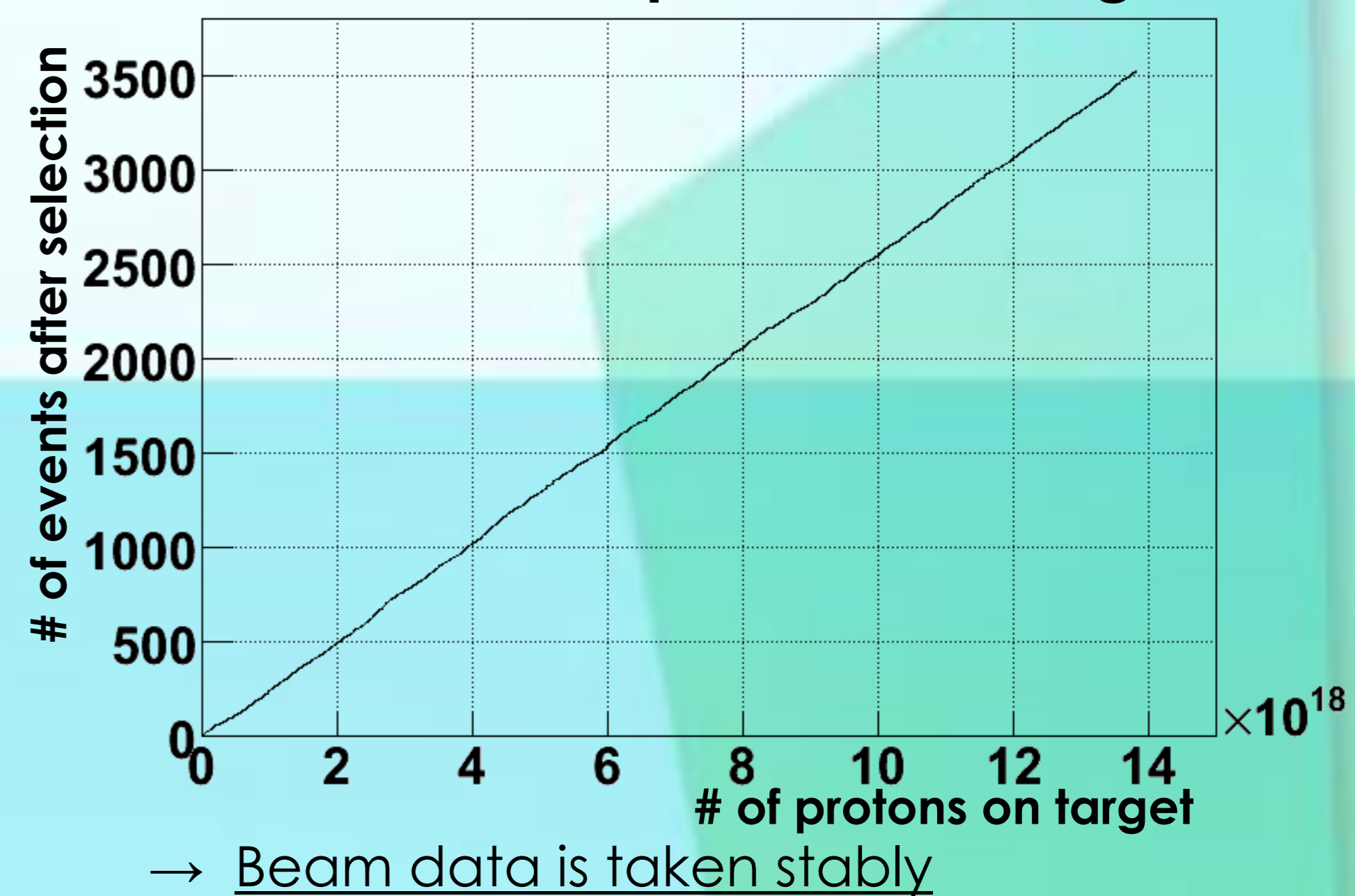
### MPPC gain stability



### Timing distribution



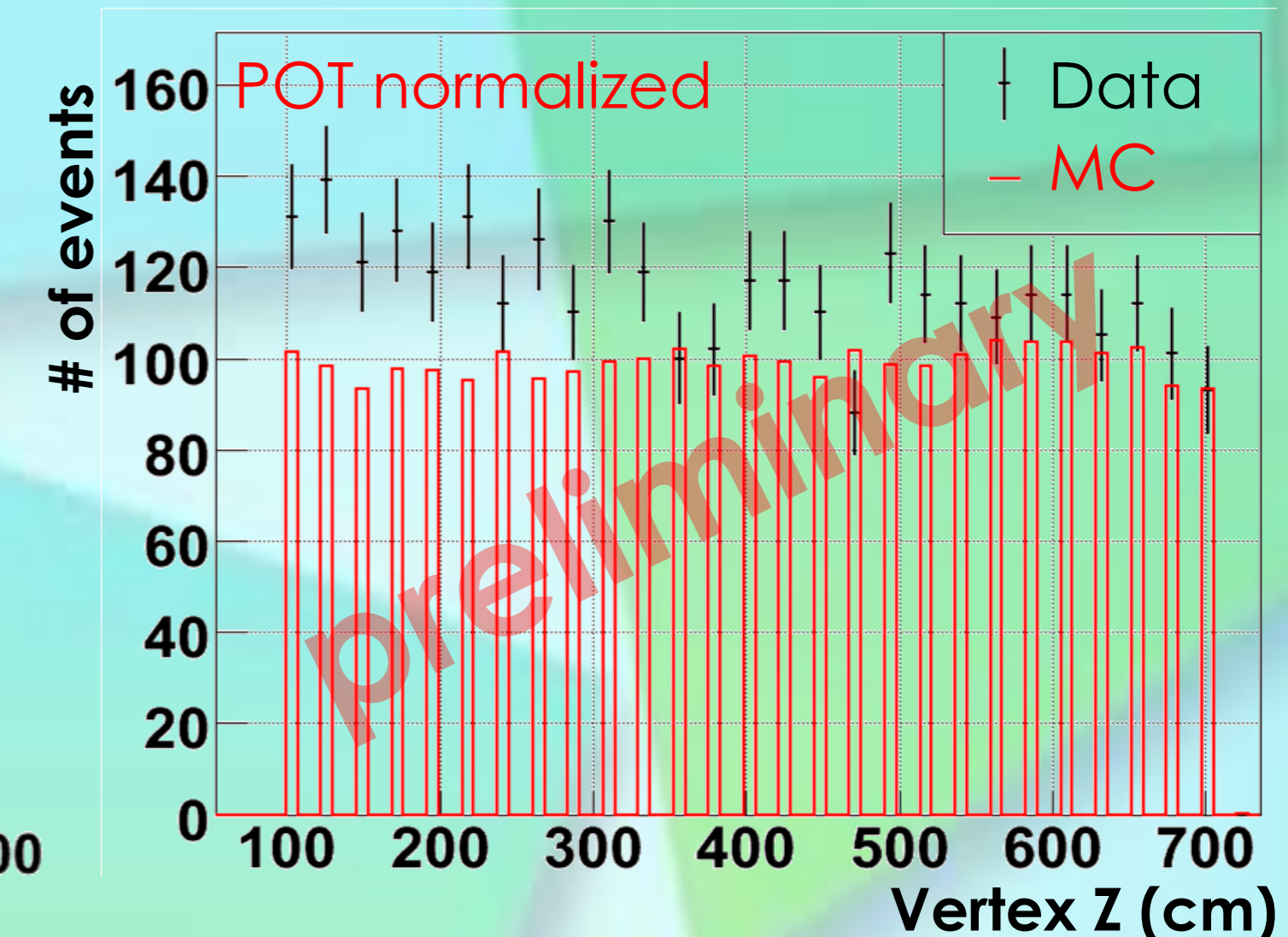
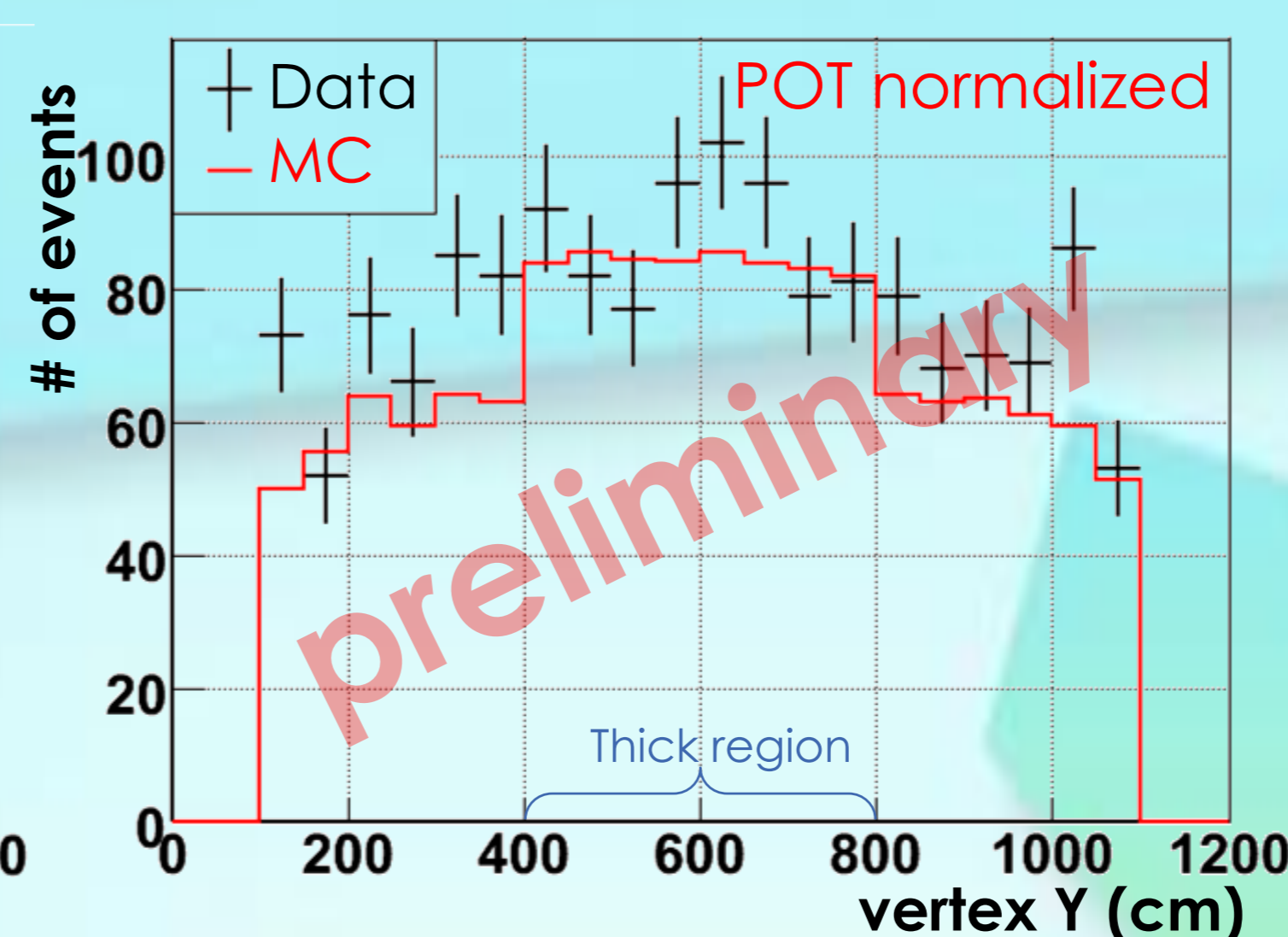
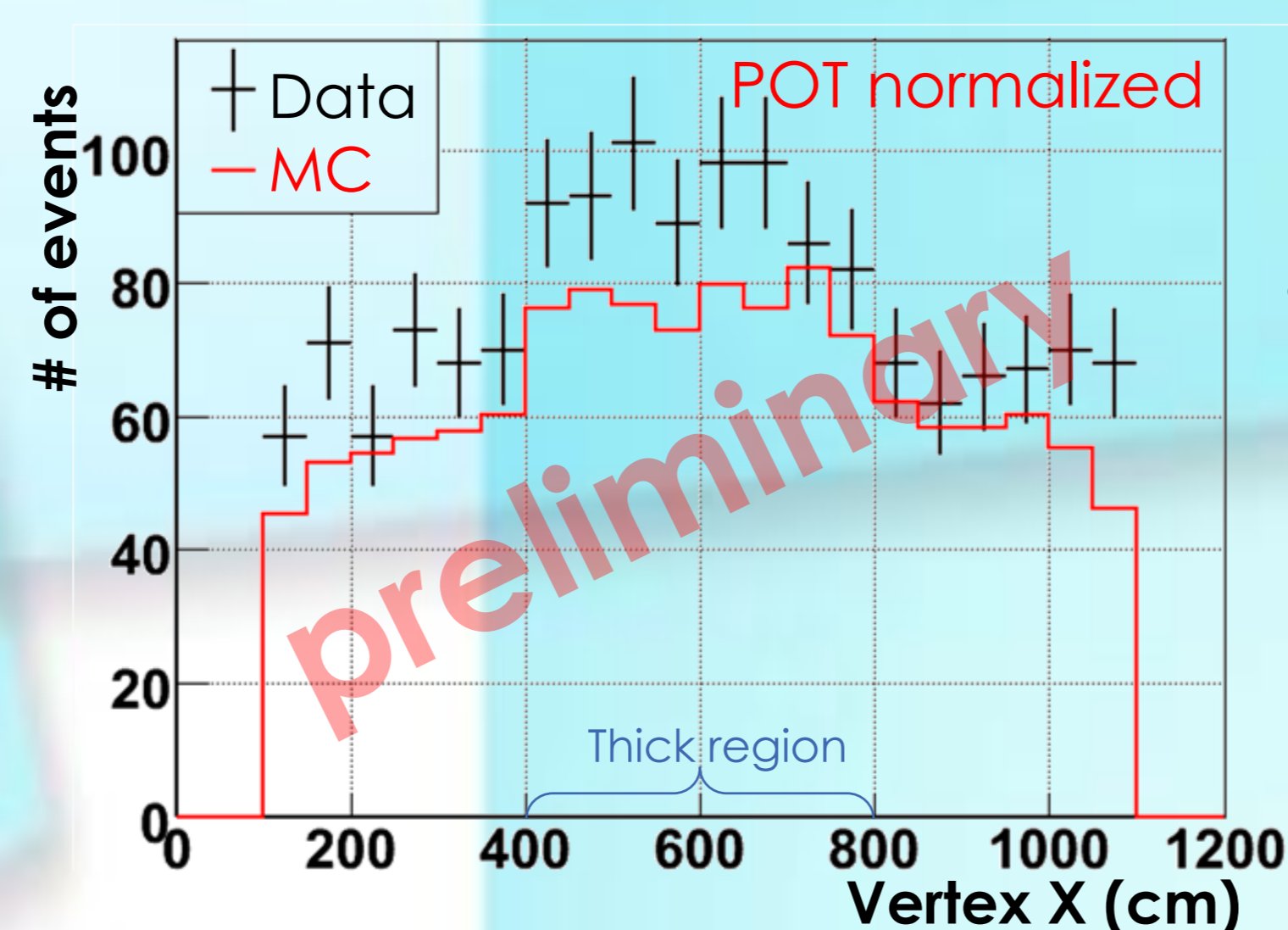
### # of events vs # of protons on target



### Vertex distribution after selection

Select events whose vertices of reconstructed tracks are in fiducial volume. This is very preliminary result.

- To do
- Estimate background with MC
  - Use tuned neutrino flux
  - Tune detector MC with data
  - Update analysis method



**We are successfully taking beam data and study is directed toward first physics result.**