INGRID Update

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Update topic

- Update of the expected # of neutrino events of INGRID with new tuned flux (10d-tuned-v3.1).
- Update of the neutrino event rate with Run I&II data and the Data/MC ratio.
- Update of the beam center with Run I&II data.

Note : We have updated the INGRID technical note about these topic.

Update of expected # of events

- Calculate the expected # with Jnubeam 10d tuned version 3.1 flux (the latest version provided from beam MC group).
- The calculation method is same as previous calculation (calculation with 10d tuned version 2).
  - Re-weight the energy spectrum of MC with the new flux ratio : 10d tuned version 3.1 / nominal 10d.
- Calculate at three beam parameter cases:
  - Average of only RUN I data.
  - Average of only RUN II data.
  - Average of RUN I&II data.

Summary of expected # of events update

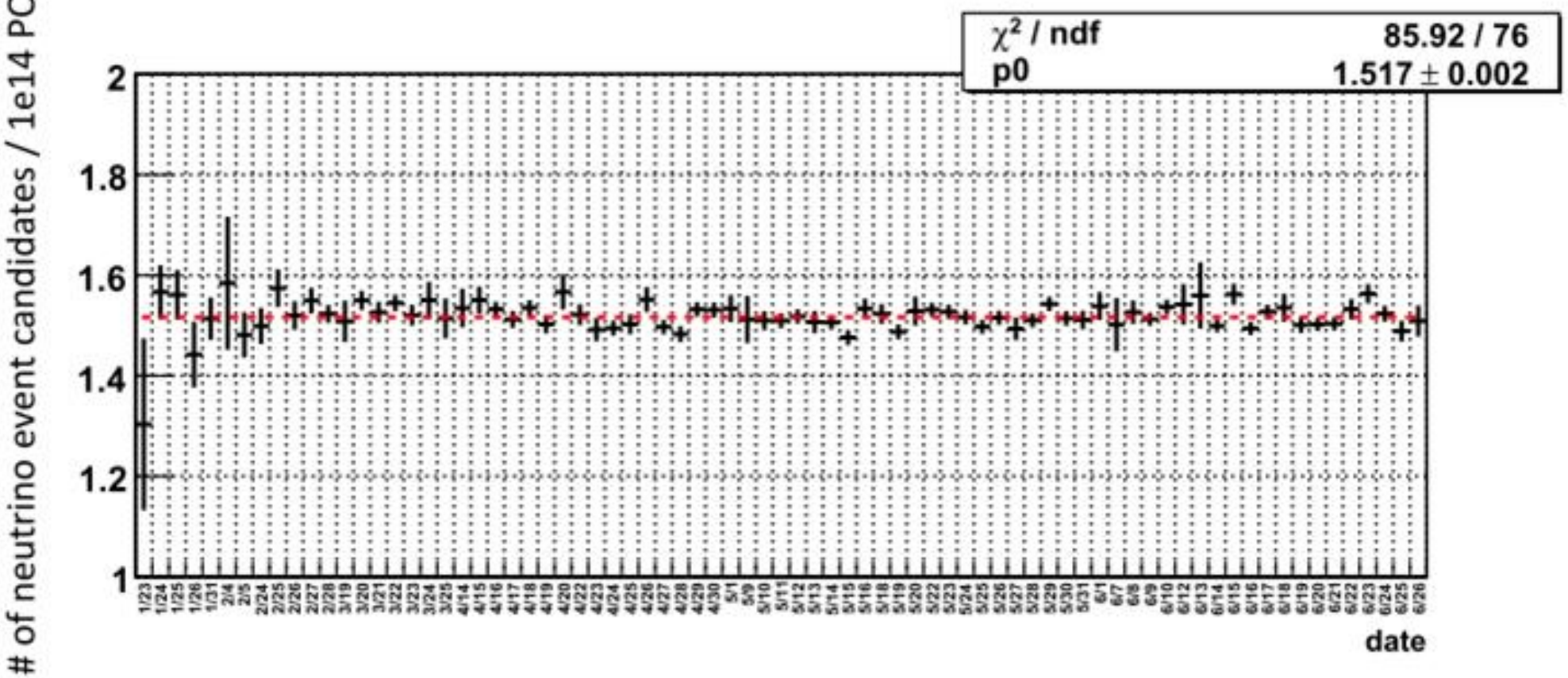
Expected # of events at 14 INGRID modules (horizontal and vertical modules)

	Expected # of events [/ 10^{21}POT]	Ratio to 10d-v2
10d-v2 (Run I)	**1.45E+07**	**1.000**
10d-v3.1 (Run I)	**1.490E+07**	**1.025**
10d-v3.1 (Run II)	**1.491E+07**	**1.025**
10d-v3.1 (Run I&II)	**1.491E+07**	**1.025**

# of 10d-v2 (Run I&II) increases by **2.5**% from # of 10d-v2.

Event rate stability at Run I

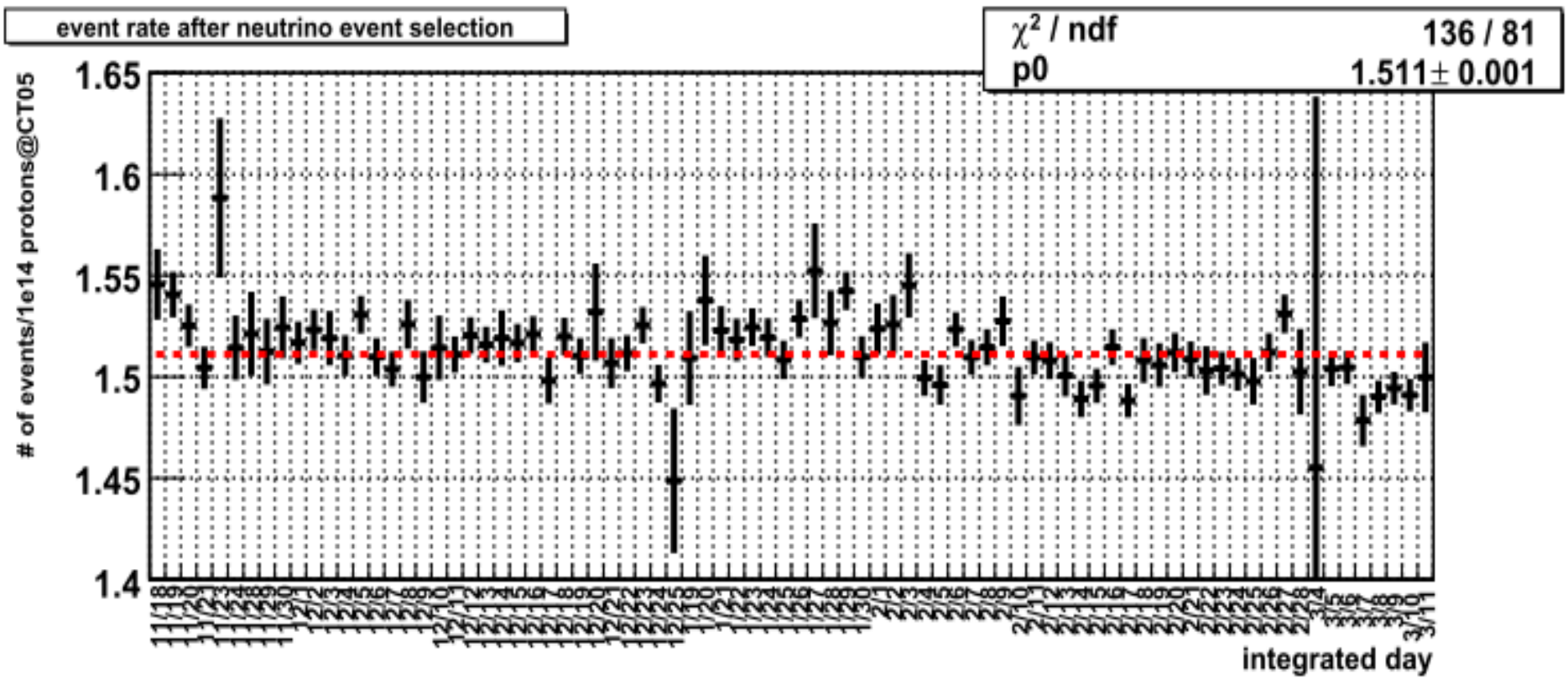
(same as last collabo.)



Average value : 1.517 events/10^{14} POT ± 0.13%(stat.)

Event rate stability at Run II

(same as last collabo.)



Average value :1.511 events/10^{14} POT ± 0.07%(stat.)

Update of event rate

- The event rate after the collections (Iron mass, etc) at each module at each period (run29~38).
  - The detail is explained in INGRID technical note.
- The collection method is same as previous.

	Event rate [/10^{14}POT]	Data/MC
Run I only	**1.562**	**1.048**
Run II only	**1.581**	**1.060**
Run I & II	**1.577**	**1.058**

Updated Data/MC (Run I&II) = 1.058

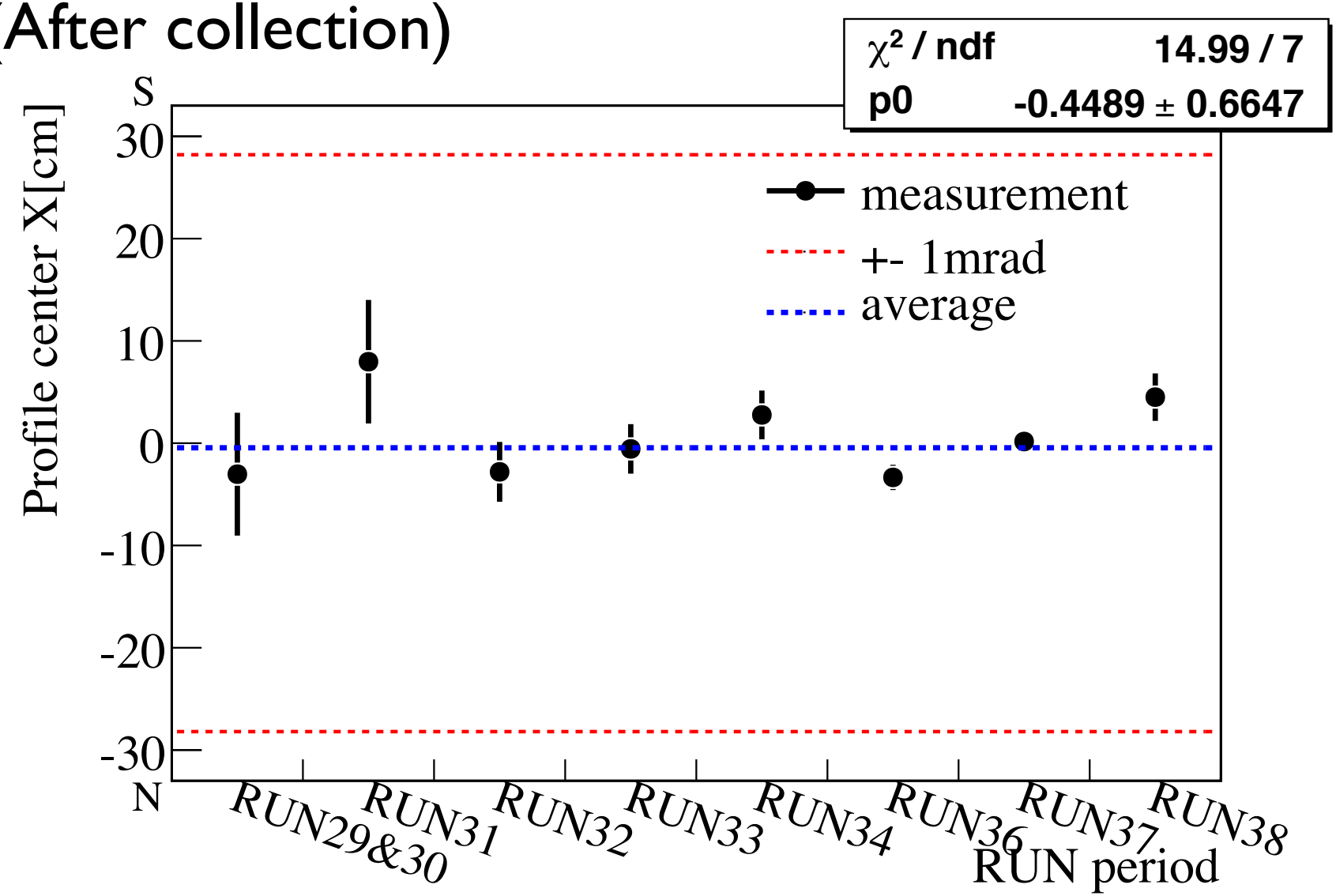
Previous Data/MC (Run I) = 1.073

Update of beam center

- Collect the observed # of events at each module at each period.
- Update the reconstructed beam center with collected # of events.
  - The detail is explain in the technical note.
- Add Run II data on stability plot of beam center and calculate the average of center.

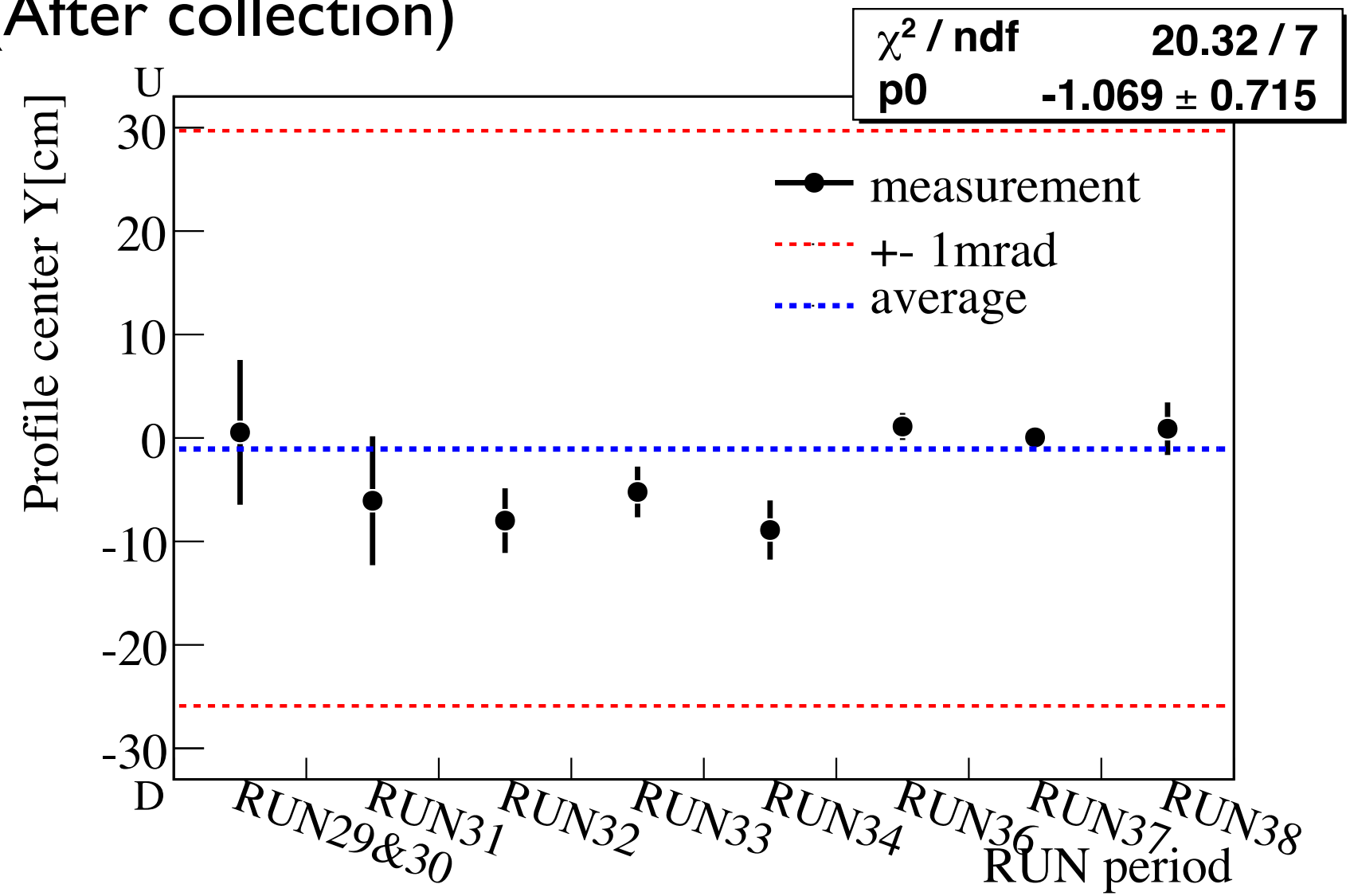
Stability of horizontal beam center

(After collection)



Stability of vertical beam center

(After collection)



Summary of beam center update

Calculate the average of beam center.

Beam center from the INGRID center	X center[cm]	Y center[cm]
RUN1 + RUN2	-0.4 ± 0.7 ± 9.2	-3.0± 0.7 ± 10.4
RUN1 only	0.4 ± 1.4 ± 9.2	-8.6± 1.5
RUN2 only	-0.7± 0.8 ± 10.4	-1.4± 0.8

Note : the alignment constant for INGRID vertical modules, -1.9cm, is applied in this table.

Updated beam center (Run I&II) =

(-0.4±0.7(stat.)±9.2(syst.),

-3.0±0.7(stat.)±10.4(syst.)) [cm]

Summary of update

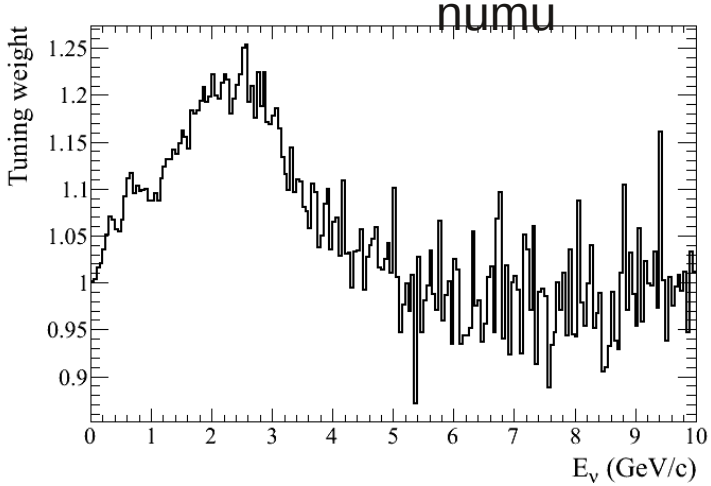
- Data/MC (Run I&II) : 1.057±0.001(stat.)±0.040(syst.)
- Beam center (Run I&II) :
  - Horizontal = -0.4±0.7(stat.)±9.2(syst.) [cm]
  - Vertical = -3.0±0.7(stat.)±10.4(syst.) [cm]
- Direction difference of beam center from expectation (Run I&II) :
  - Horizontal = -0.014±0.025(stat.)±0.33(syst.) [mrad]
  - Vertical = -0.107±0.025(stat.)±0.37(syst.) [mrad]

Back up

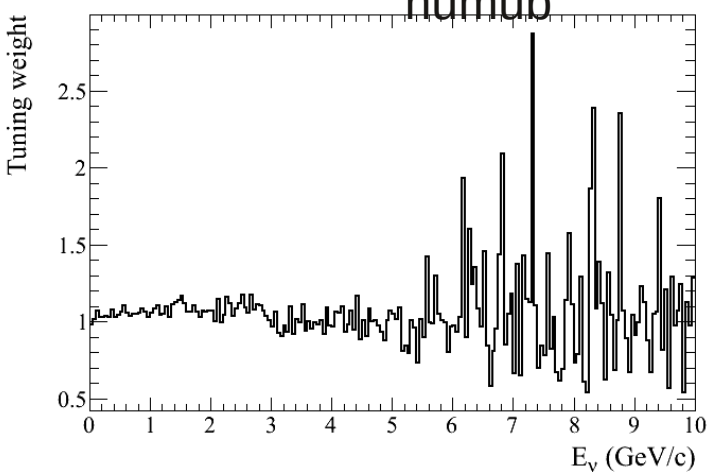
by Slavic

ND3 <Run I & Run II> / nominal 10d

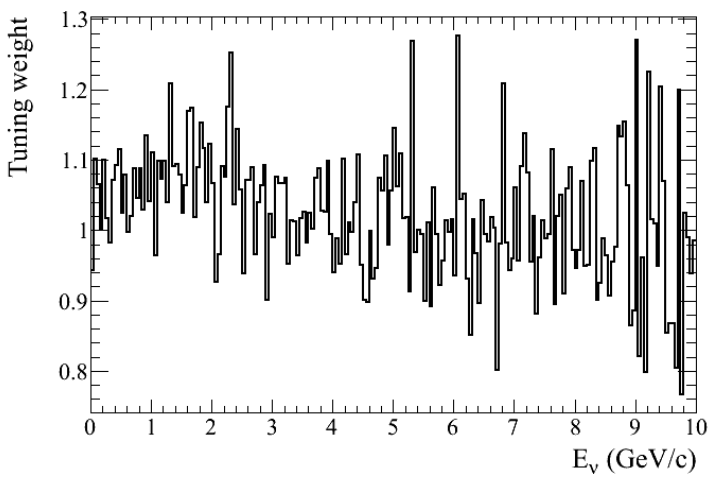
numu



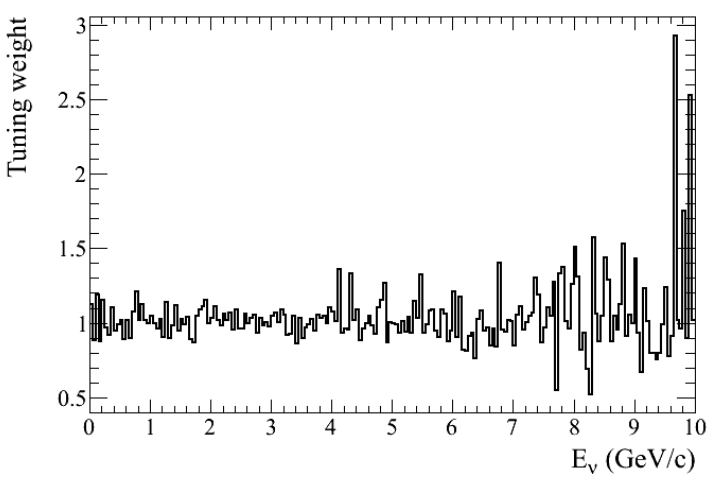
numub



nue



nueb



by Slavic

ND4 <Run I & Run II> / nominal 10d