

Beam summary data in MR Run42 (T2K Run3c)

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Overview

- Apply the Good spill selection to the beam data in the MR Run42
 - Used data set : Beam line Run# **420022 (4/8) ~ 420324 (5/23)**
- Horn current setting in this period : **250kA**

Spill selection

1. Physics run
 - “run_type” is “physic run” and all Horn ON
 - exclude spills for beam tuning, beam study
2. TriggerFlag is “Beam Trigger” (beam during MR operation)
3. Good GPS status
4. CT05 # of protons per spill $> 1e11$ in order to exclude spills which no beam in MR (due to machine interlock etc...) **Quick spill selection**
5. Normal condition cut
 - exclude unusable spills (e.g. PV2 magnet unstable etc...)
6. Horn current cut
 - Nominal current ± 5 kA for all three horns
7. MUMON cut
 - beam angle within 1mrad ($|Si \text{ fit } X| < 10\text{cm}$ & $|Si \text{ fit } Y| < 10\text{cm}$)
 - Si total Q / CT05 cut : mean of Q/CT05 $\pm 5\%$ **Good spill selection**

Horn & MUMON cut

- Horn current & MUMON Si Q /CT5 cut are defined as the followings table.
 - Horn cut : (Mean of three horns current in physics run) ± 5 kA
 - MUMON SiQ / CT5 cut : (Mean of this ratio in physics run) $\pm 5\%$
- Consider different threshold of MUMON SiQ/CT5 cut according to the period ($\rightarrow$ back up)

run#	Horn current setting	Horn current cut	MUMON SiQ/CT5 cut
420022~420136	250kA	$249.07 \pm 5\text{kA}$	$32.24 \pm 5\%$
420137~420324	250kA	$249.07 \pm 5\text{kA}$	$31.98 \pm 5\%$

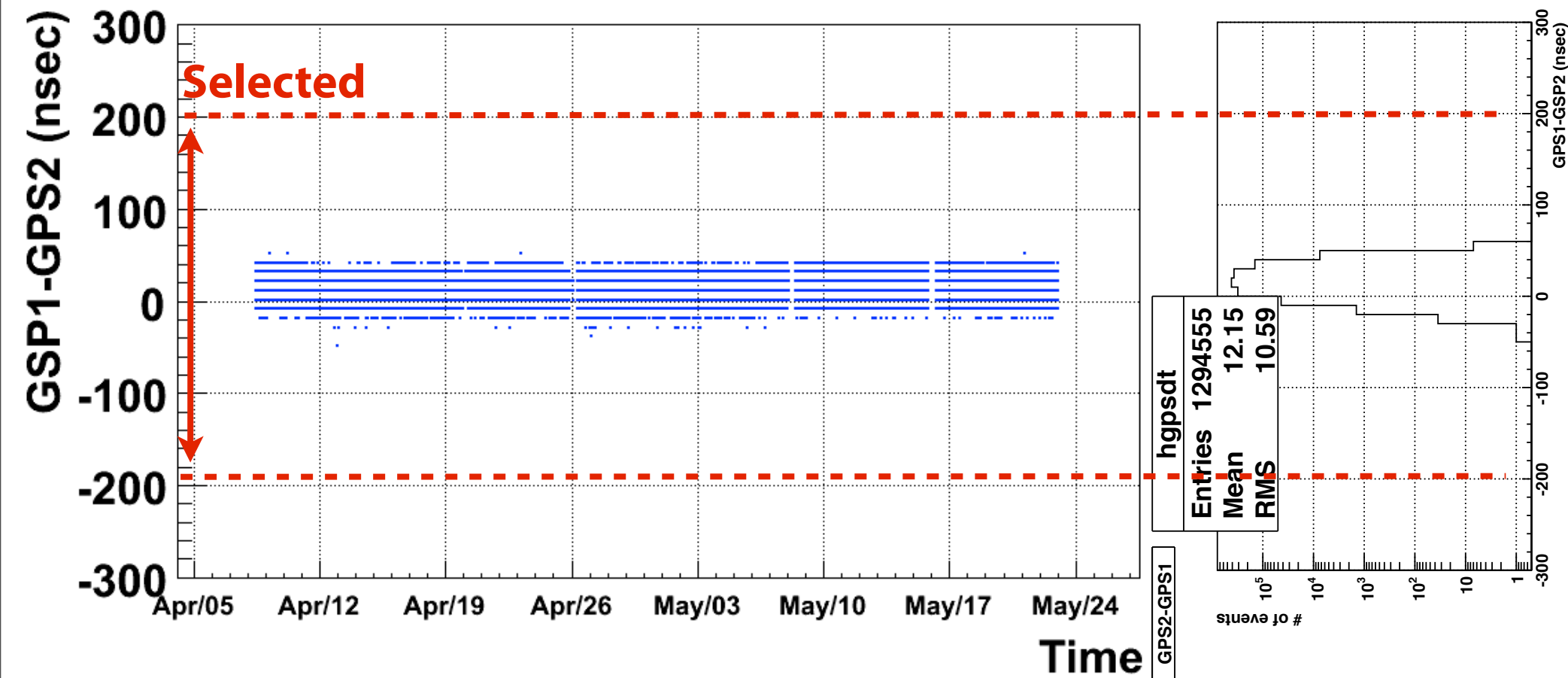
Normal condition cut

- Remove 1 spill by normal condition cut
 - Run#420189, Spill#3032400 : Neutrino BLM MPS

GPS Status

Graph

$|\text{GPS1} - \text{GPS2}|$
 $< 200\text{ns}$



GPS1,2 status are good during this period

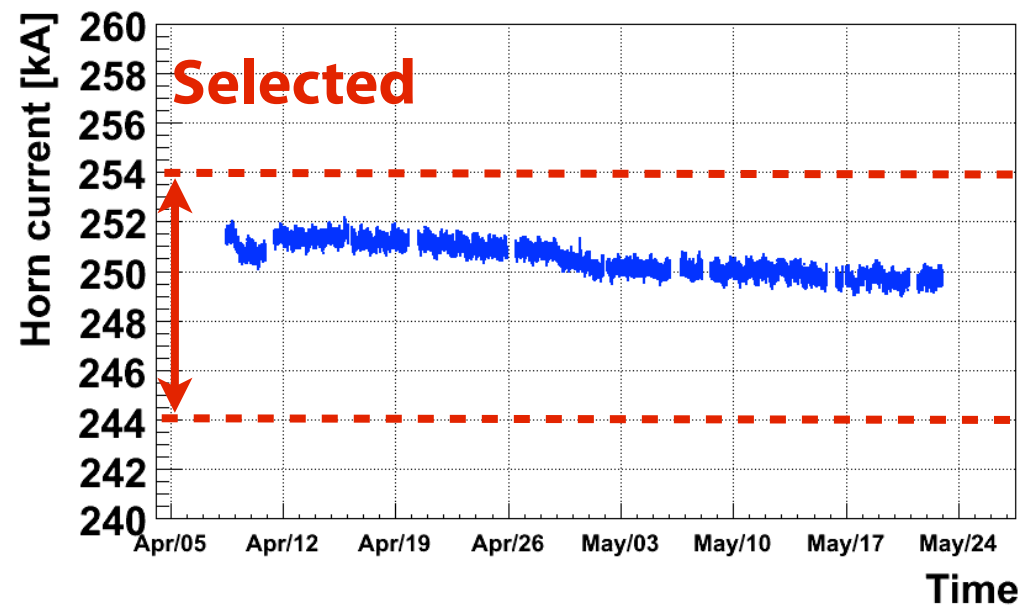
(1 warning status for GPS2, but no effect for good spill → back up)

No Bad spill

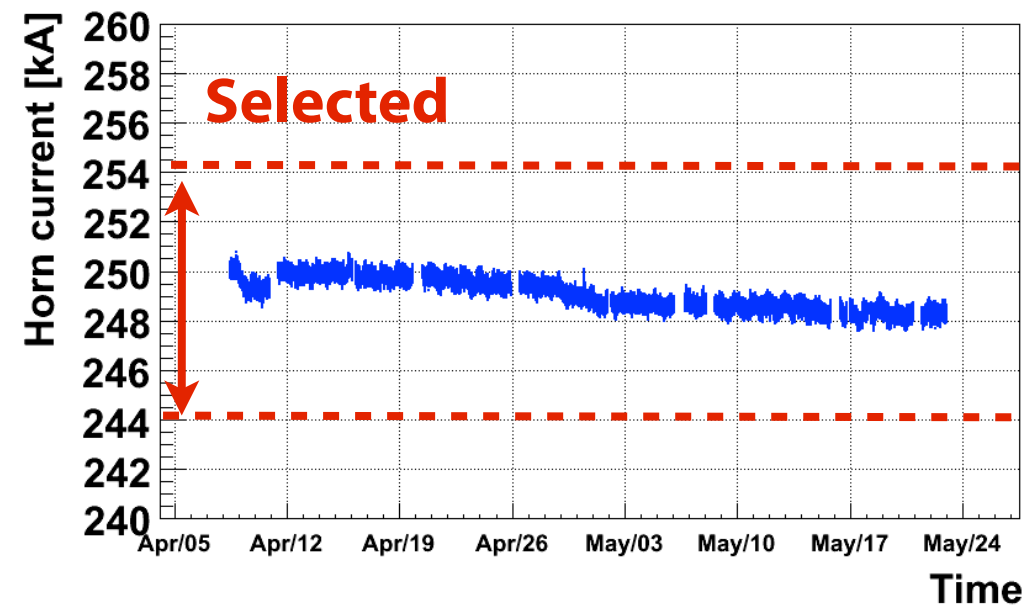
Horn current

$249.07 \pm 5\text{kA}$

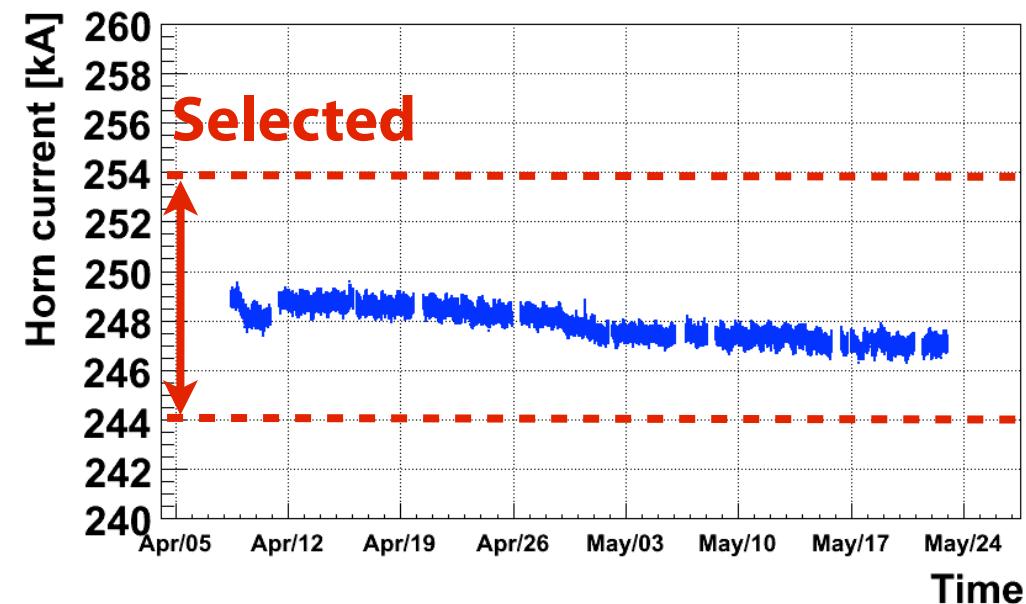
Horn1 current



Horn2 current



Horn3 current

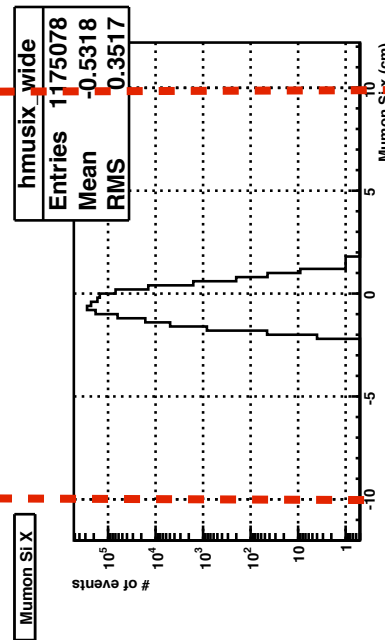
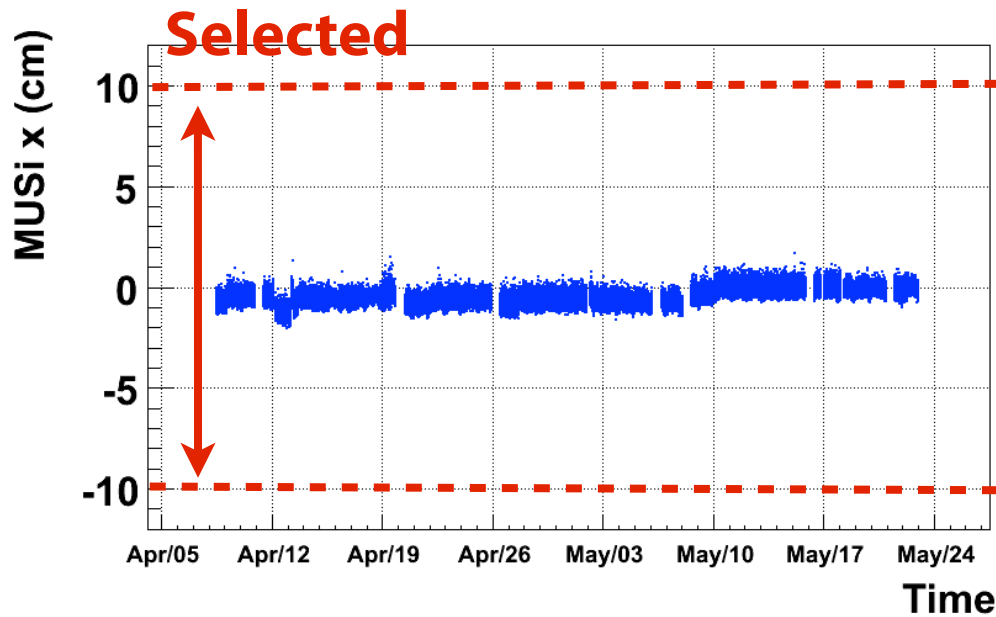


No bad spill

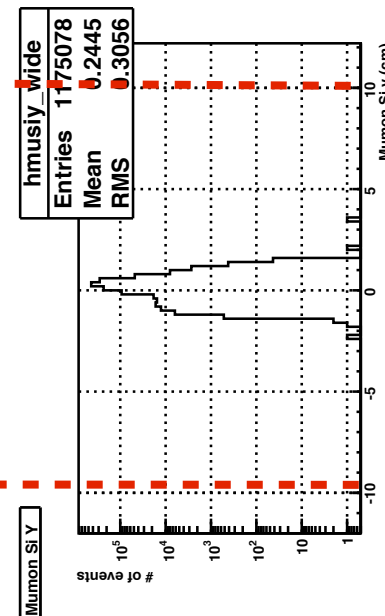
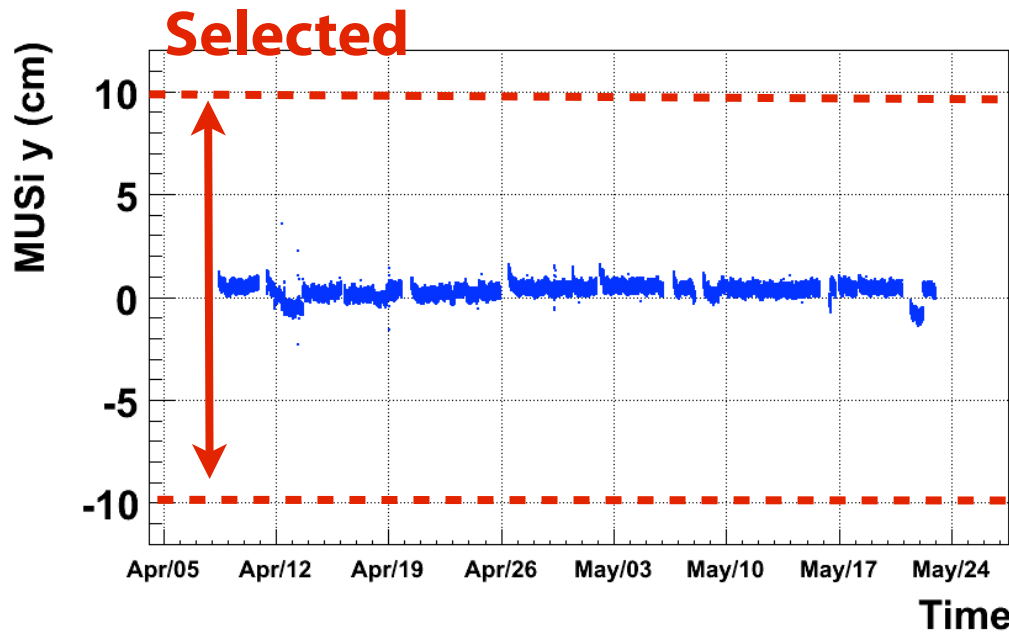
MUMON Si fit center

|fit center|
< 10cm

Mumon Si fit-X



Mumon Si fit-Y

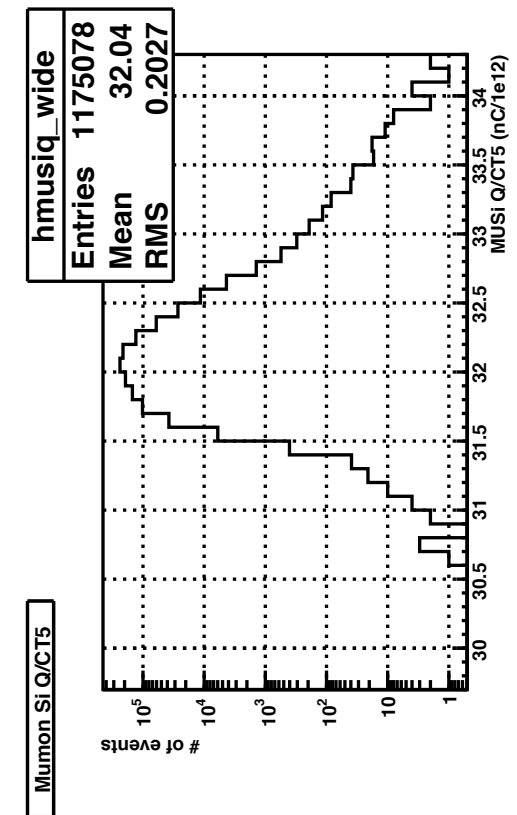
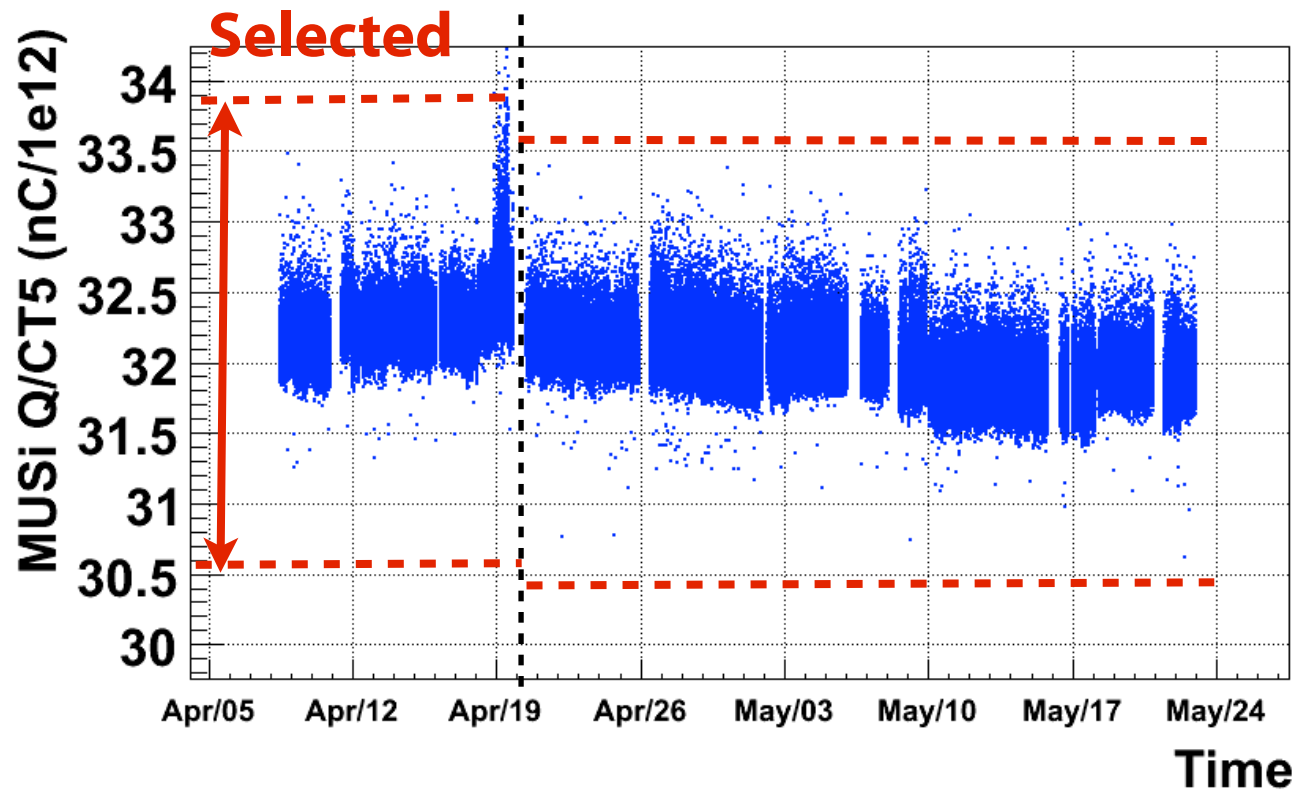


No Bad spill

MUMON Si Q / CT05

~Apr/20 : $32.24 \pm 5\%$
Apr/20~ : $31.98 \pm 5\%$

Mumon Si Qtotal/CT5



15 Bad spill (not change from prev. report)

Summary of Good spill selection (Run3c)

Beam line Run# 420022(4/8)~420261(5/15 morning)

	# of spills	Ratio
Physics spills	1186179	1
Beam trigger	1176955	0.992
Good GPS	1175955	0.991
Spill flag (ppp(CT5)>1e11)	1175079	0.991
Normal beam	1175078	0.991
Horn cut	1175078	0.991
MUMON cut	1175063	0.991

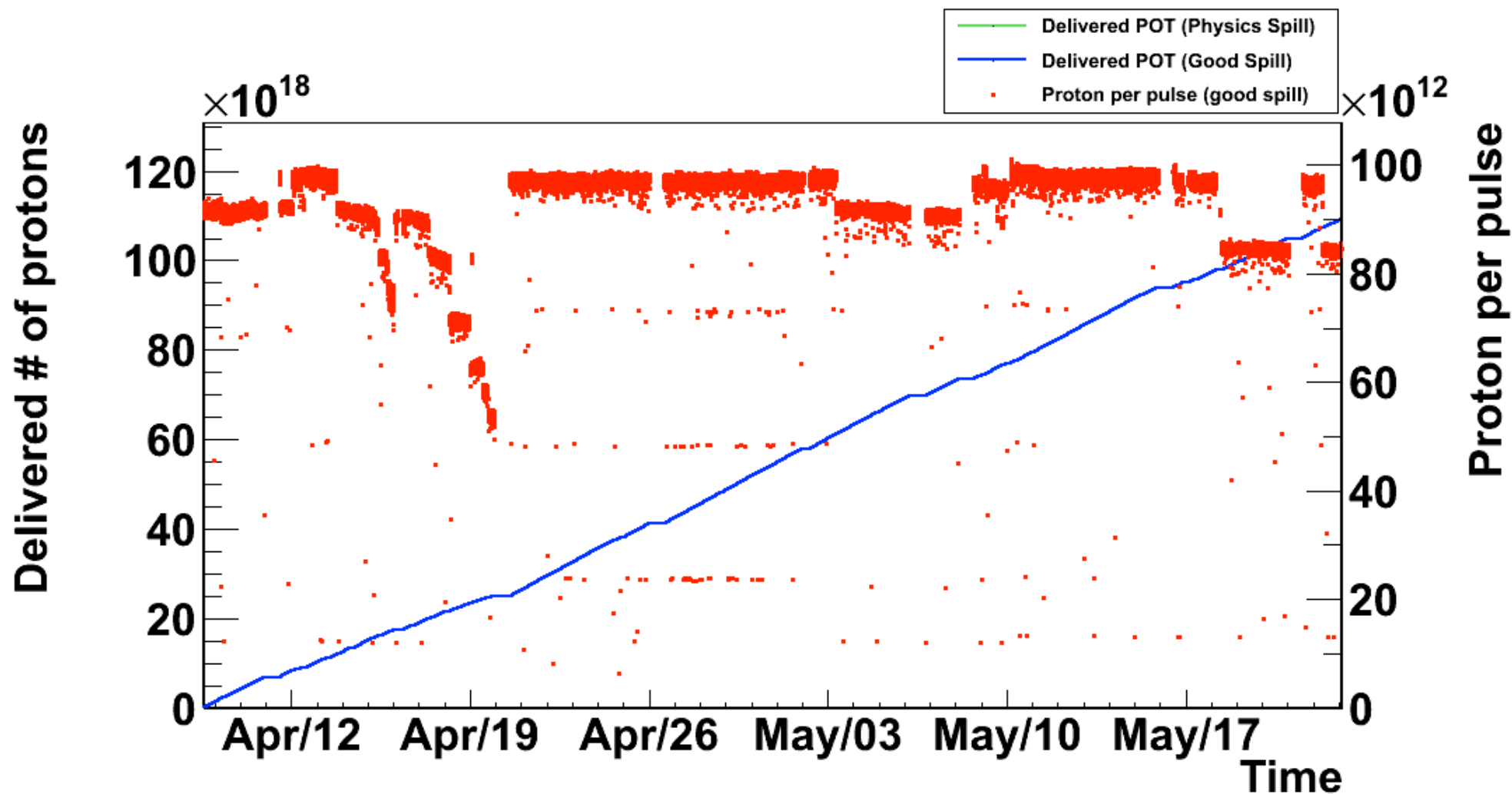
Bad spills (by MUMON cut) : **15 = 0.0013%** of good spills

of delivered protons (CT5) after Good spill selection :

1.092 e+20

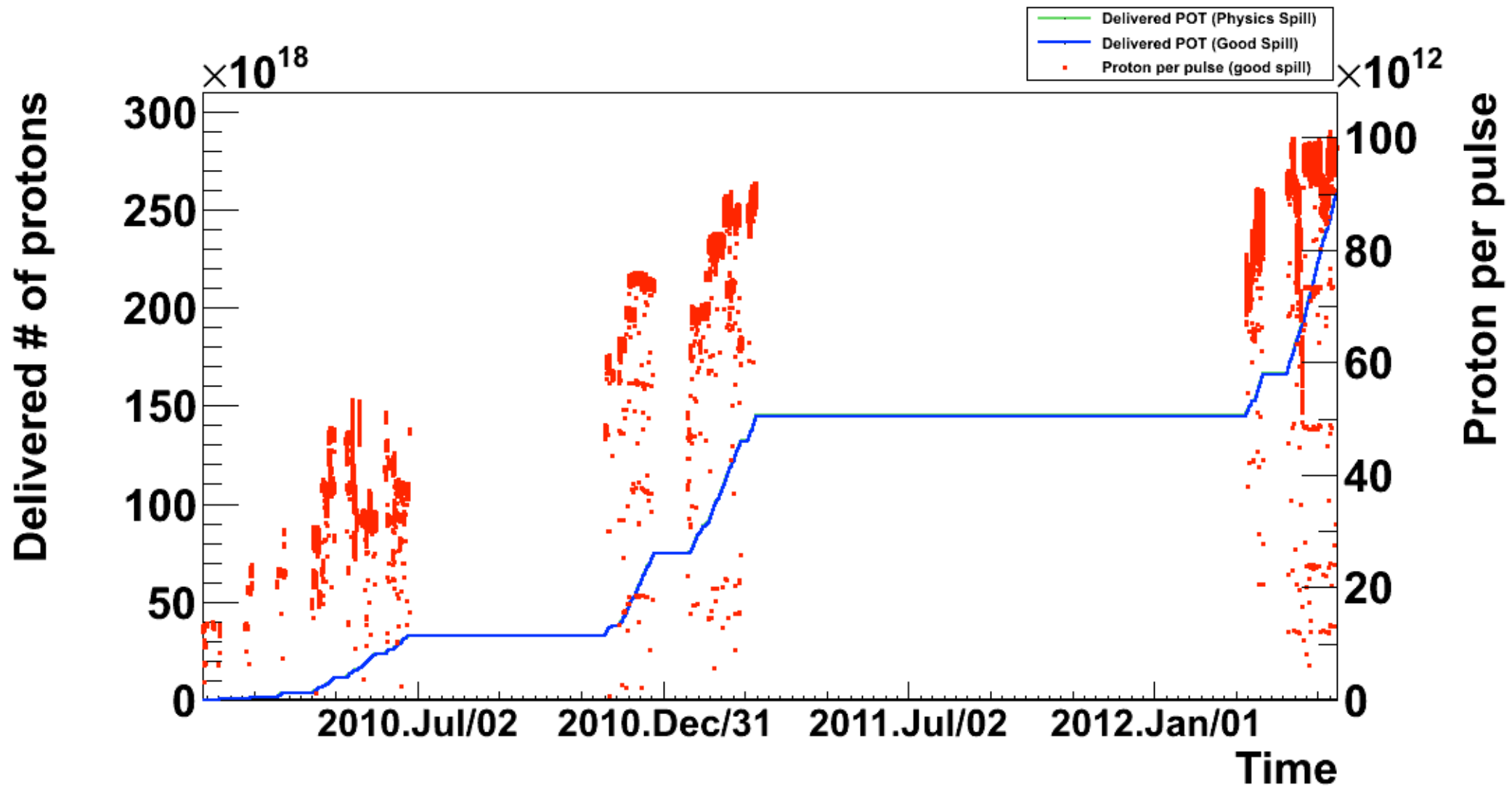
POT history (Run3c)

Reduce beam power due to bad condition of the MR injection kicker around Apr/19



Delivered POT in Run3c : 1.092×10^{20}

POT history (so far)



Delivered POT in all physics runs : $2.578e+20$

= (Delivered POT in Run1-2) $\times$ 1.8

Definition of Good spill flag

- In order to distinguish the Horn-off spill from the horn ON spill, the value of the good flag will be re-defined.
- flag =0 : Not suitable data for physics analysis.
- flag =1 : Good spill for Horn 250kA operation.
- flag =100 : Good spill for Horn OFF.
- flag = 2, 3 ... 99: Reserved for the other horn operation mode.
- flag =-1,-2 ... -99: Reserved for the other horn operation mode with opposite polarity.

horn current	0 kA	200 kA	250 kA
good spill flag	100	2	1

T2K RUN1, 2, 3c : Flag = 1 T2K RUN3b : Flag = 2

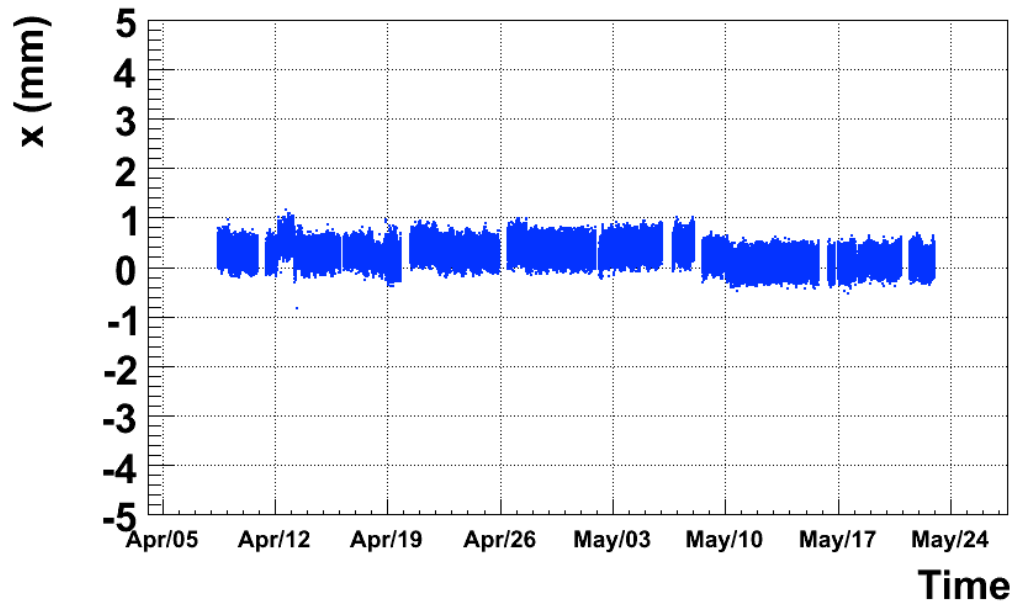
Summary

- Apply Good spill selection for physics run data until 5/23 (Beam lin Run# ~420324)
- There are 15 bad spills (=0.003% of total good spills in MR Run42)
 - Failed by MUMON SiQ / CT5 cut
 - At this moment, these spills are judged as “bad”.
- Integrated POT in MR Run 42 is **1.092e+20**

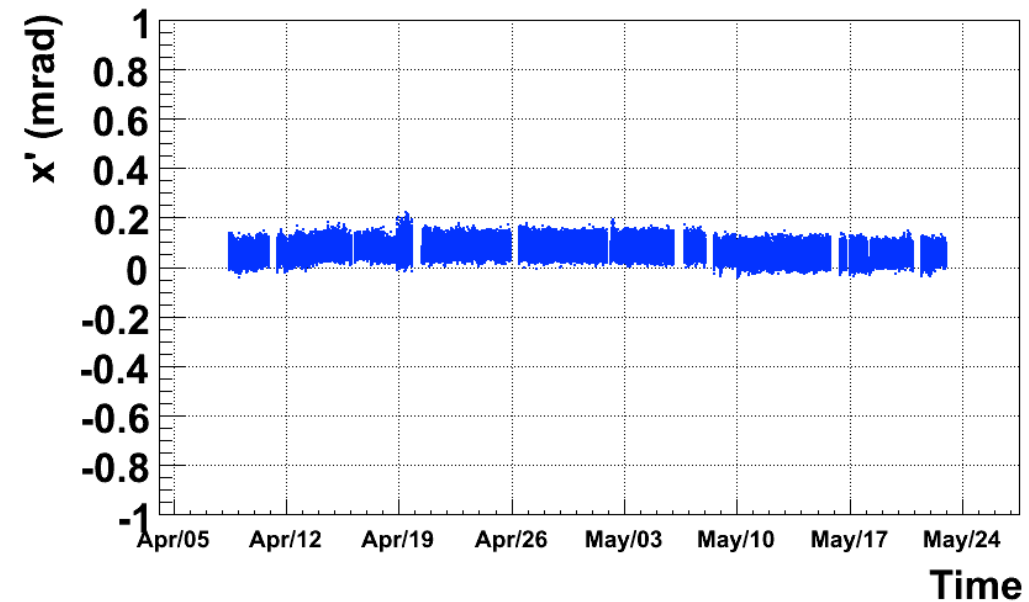
Back up

Stability plot of proton beam (at baffle) :horizontal

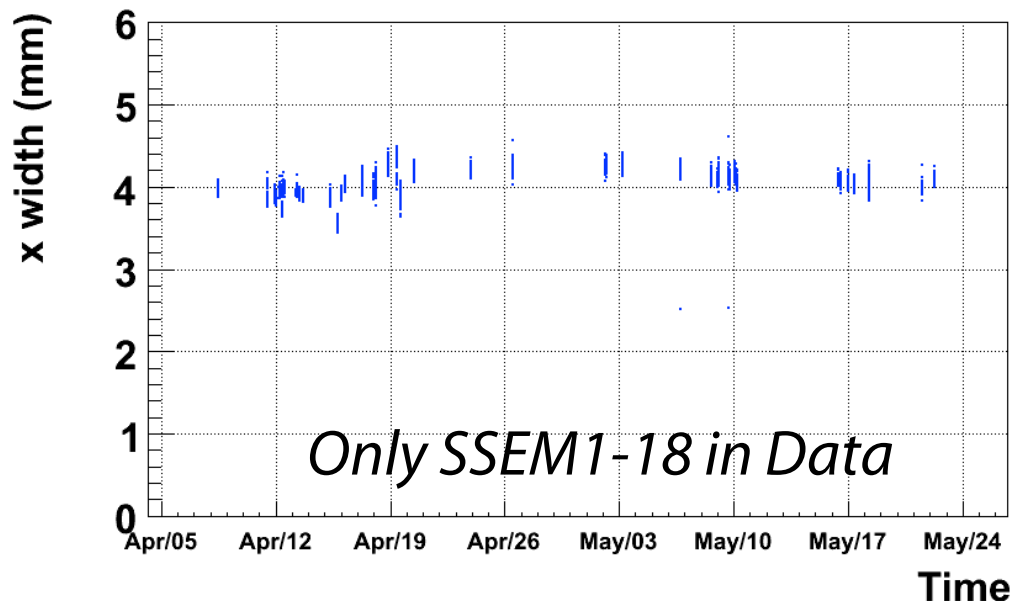
Beam X position (baffle), physics run



Beam X direction (baffle), physics run



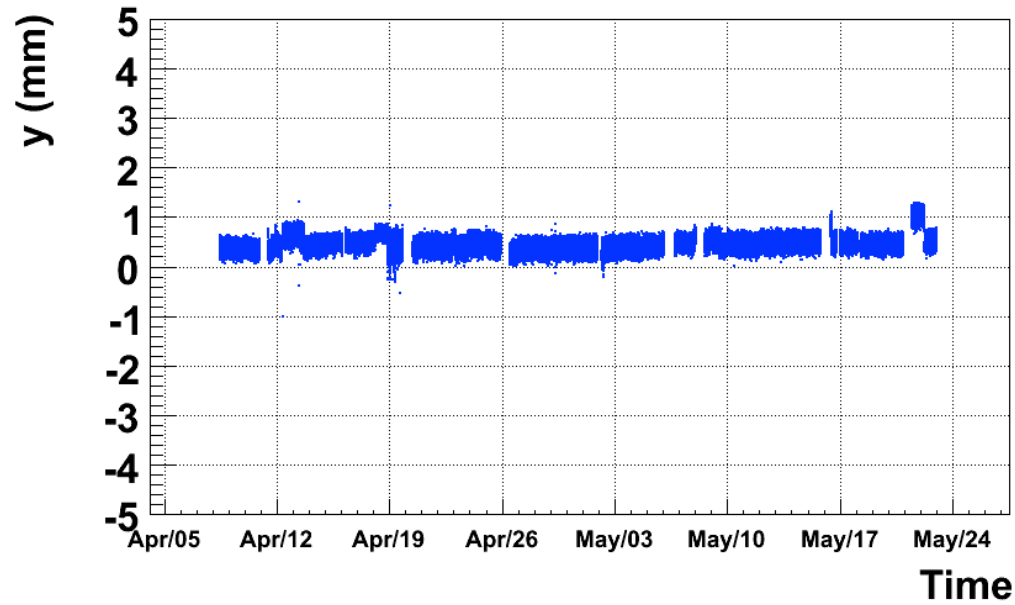
Beam X width (baffle), physics run



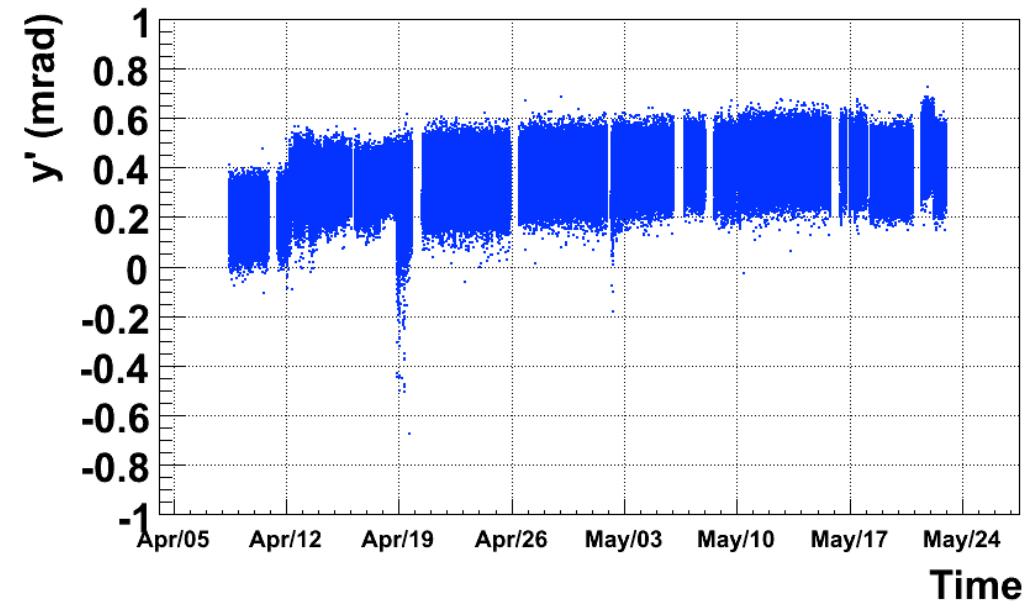
*Analysis Proton beam orbit by
using ESM&SSEM (not use OTR)
data to reduce process time.*

Stability plot of proton beam (at baffle) :vertical

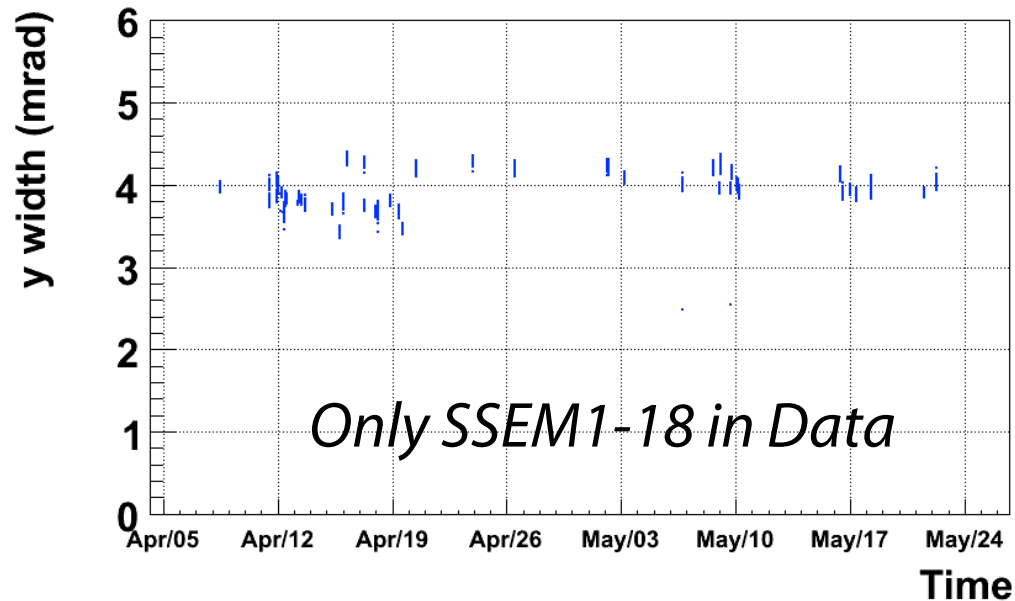
Beam Y position (baffle), physics run



Beam Y direction (baffle), physics run



Beam Y width (baffle), physics run



Analysis Proton beam orbit by using ESM&SSEM (not use OTR) data to reduce process time.

GPS warning status

Beam line DAQ run# : 420256 (sub run=5)

Spill# : 3490968

GPS2 recv. status = [GPS_DATA_EXISTS][SYNC_OK][IPPS_GT_200NS]

- warning code “[IPPS_GT_200NS]”

- $|(\text{time interval from previous IPPS}) - I| > 200 \text{ nsec (and } < 500 \text{ nsec)}$ ”

- And next spill, GPS2 became good status.

- Accidental fluctuation to GPS2 cause this error (GPS1 at same place was good status)

ref.

Good status = [GPS_DATA_EXISTS][SYNC_OK][IPPS_IN_100NS]

[IPPS_IN_100NS] = $|(\text{time interval from previous IPPS}) - I| < 100 \text{ nsec}$

Bad spills by mumon/ct cut

The list of 15 bad spills by mumon/ct cut

```
Run# Event# Spill# : MUMON SiQ / CT05 [nC/1e12 pot]
420129 399 2787394 : Bad spill due to si q/ct : 33.8941
420131 4245 2792766 : Bad spill due to si q/ct : 34.0369
420133 282 2802552 : Bad spill due to si q/ct : 34.3632
420133 365 2802635 : Bad spill due to si q/ct : 34.0714
420133 842 2803112 : Bad spill due to si q/ct : 34.3079
420133 1663 2803933 : Bad spill due to si q/ct : 33.9289
420133 2736 2805006 : Bad spill due to si q/ct : 34.3291
420133 3397 2805667 : Bad spill due to si q/ct : 34.2762
420133 3744 2806014 : Bad spill due to si q/ct : 34.1580
420133 3975 2806245 : Bad spill due to si q/ct : 33.9332
420133 4359 2806629 : Bad spill due to si q/ct : 33.8676
420133 4409 2806679 : Bad spill due to si q/ct : 34.2070
420133 5709 2807979 : Bad spill due to si q/ct : 34.0246
420133 5893 2808163 : Bad spill due to si q/ct : 34.0234
420133 6067 2808337 : Bad spill due to si q/ct : 34.3270
```

Now investigate the reason of these bad spills. At this moment, these spills are still “Bad”.