Beam summary data in MR Run42 (T2K Run3c)

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Overview

- Apply good spill selection for the beam data in the MR Run42 (Beam line Run# **420022 (4/8) ~ 420178 (4/25 morning)**)
- Horn current setting in this period : **250kA**

Reminder : Spill selection

Quick 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...)

5. Normal condition cut
   - exclude unusable spills (e.g. PV2 magnet unstable etc...)

Good spill selection

6. Horn current cut
   - Nominal current ± 5 kA for all three horns
7. MUMON cut
   - beam angle within 1mrad (|Si fit X|<10cm & |Si fit Y|<10cm)
   - Si total Q / CT05 cut : mean of Q/CT05 ± 5%

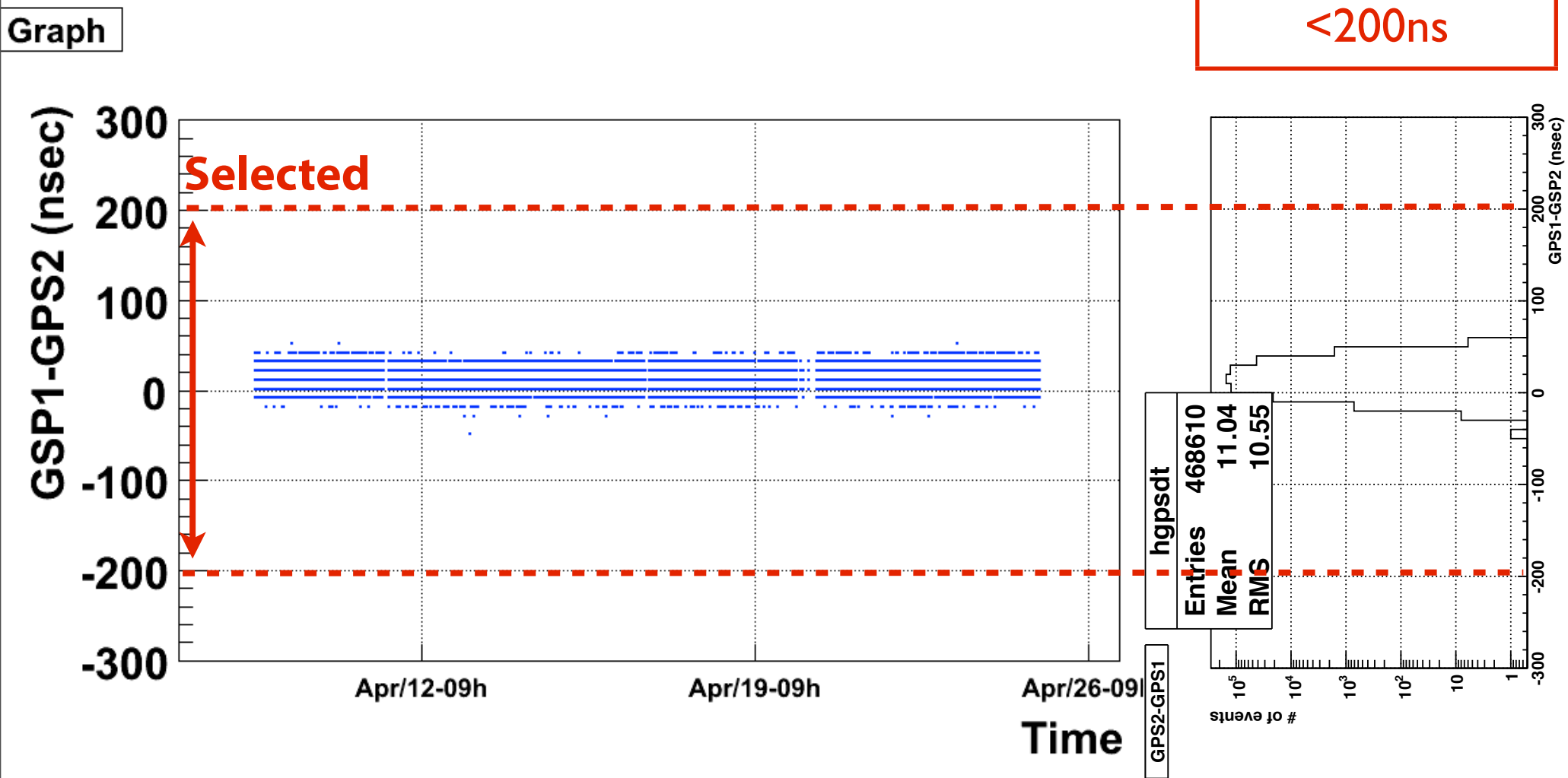
Threshold of horn & mumon cut

- Horn current & MUMON Si Q /CT5 cut threshold 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) ± 5%

run#	Horn current setting	Horn current cut	MUMON SiQ/ CT5 cut
420022~420178	250kA	249.8 ± 5kA	32.21 ± 5%

GPS Status

|GPS1-GPS2|
<200ns



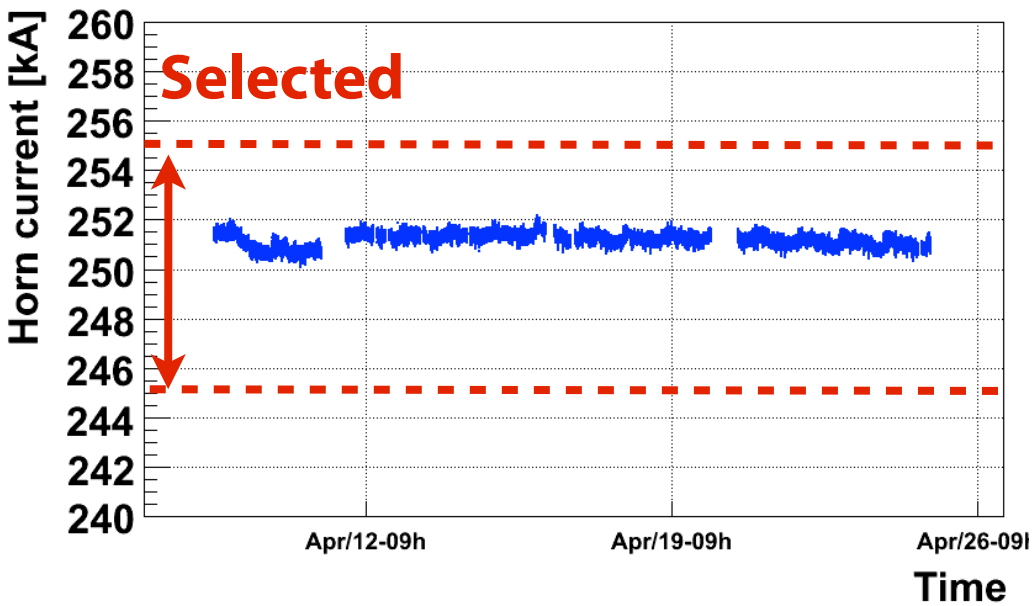
GPS1,2 status are good during this period

No Bad spill

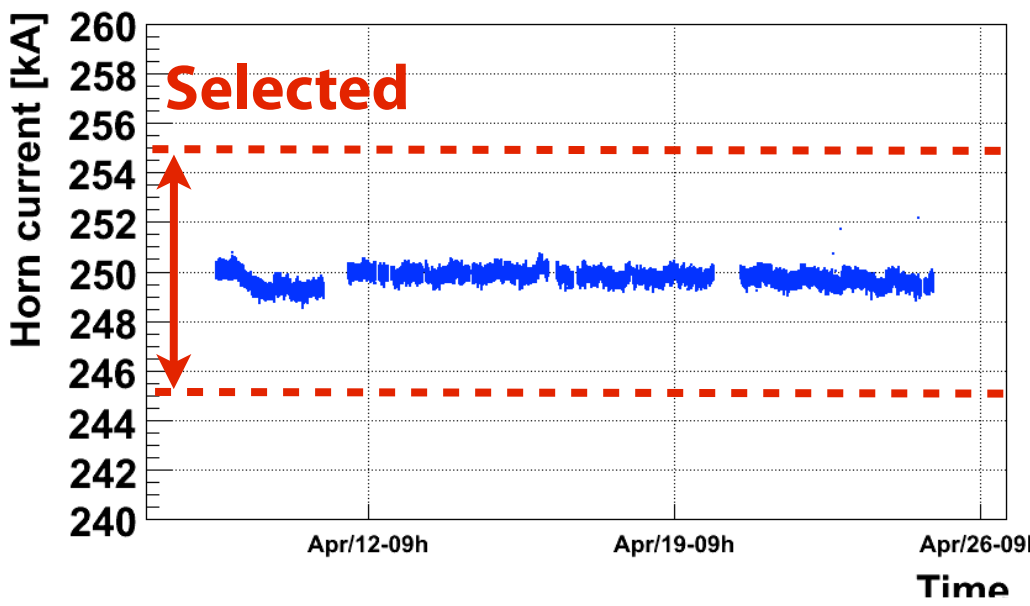
Horn current

249.8 ± 5kA

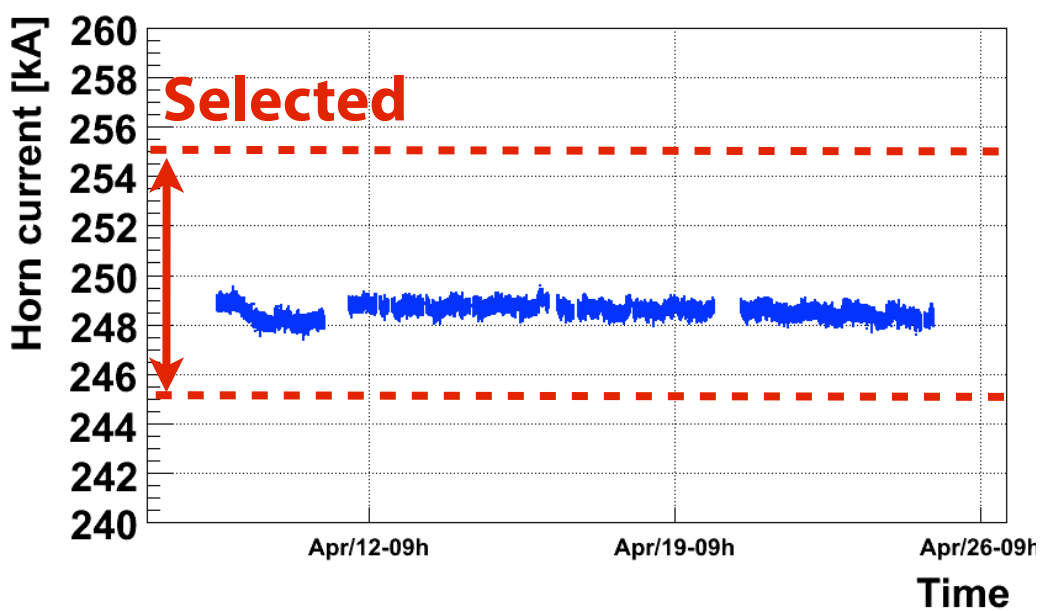
Horn1 current



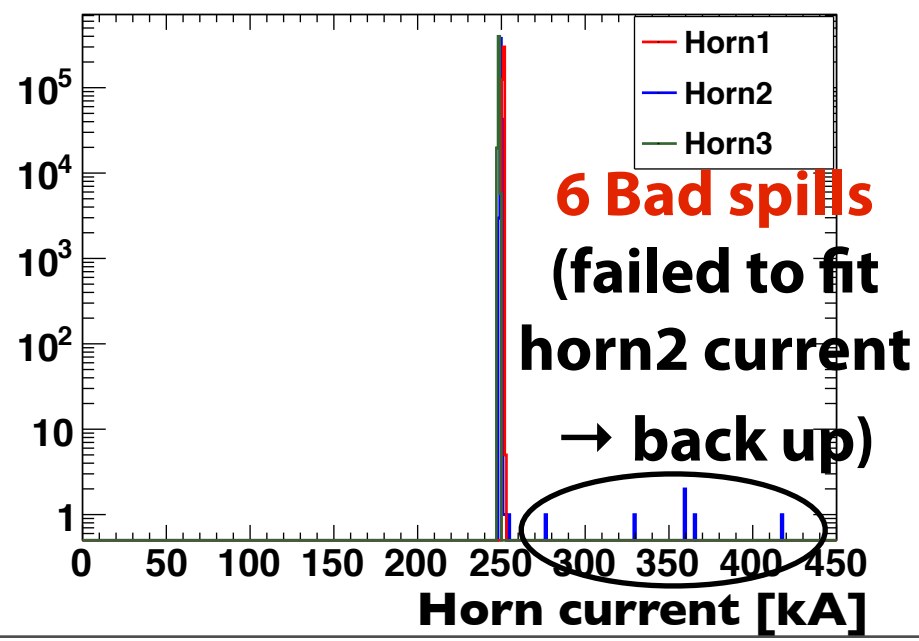
Horn2 current



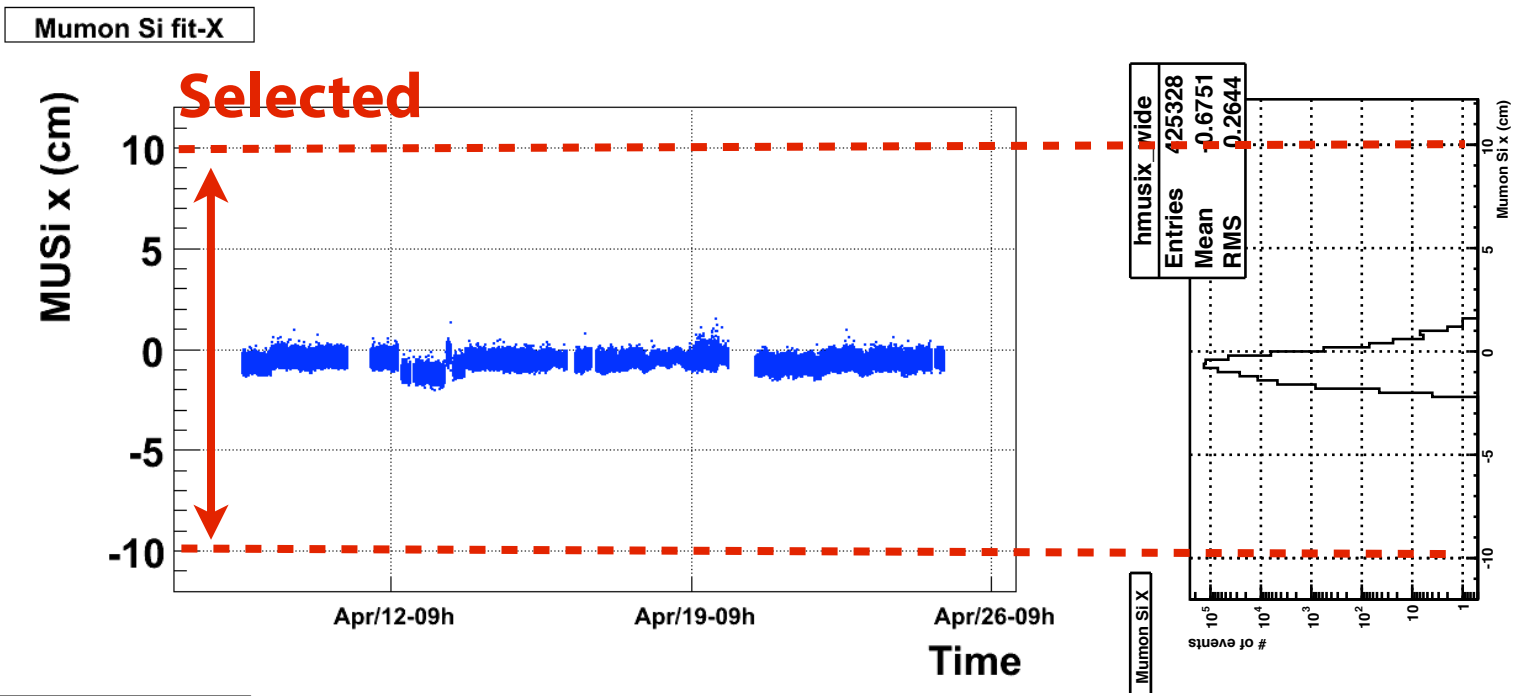
Horn3 current

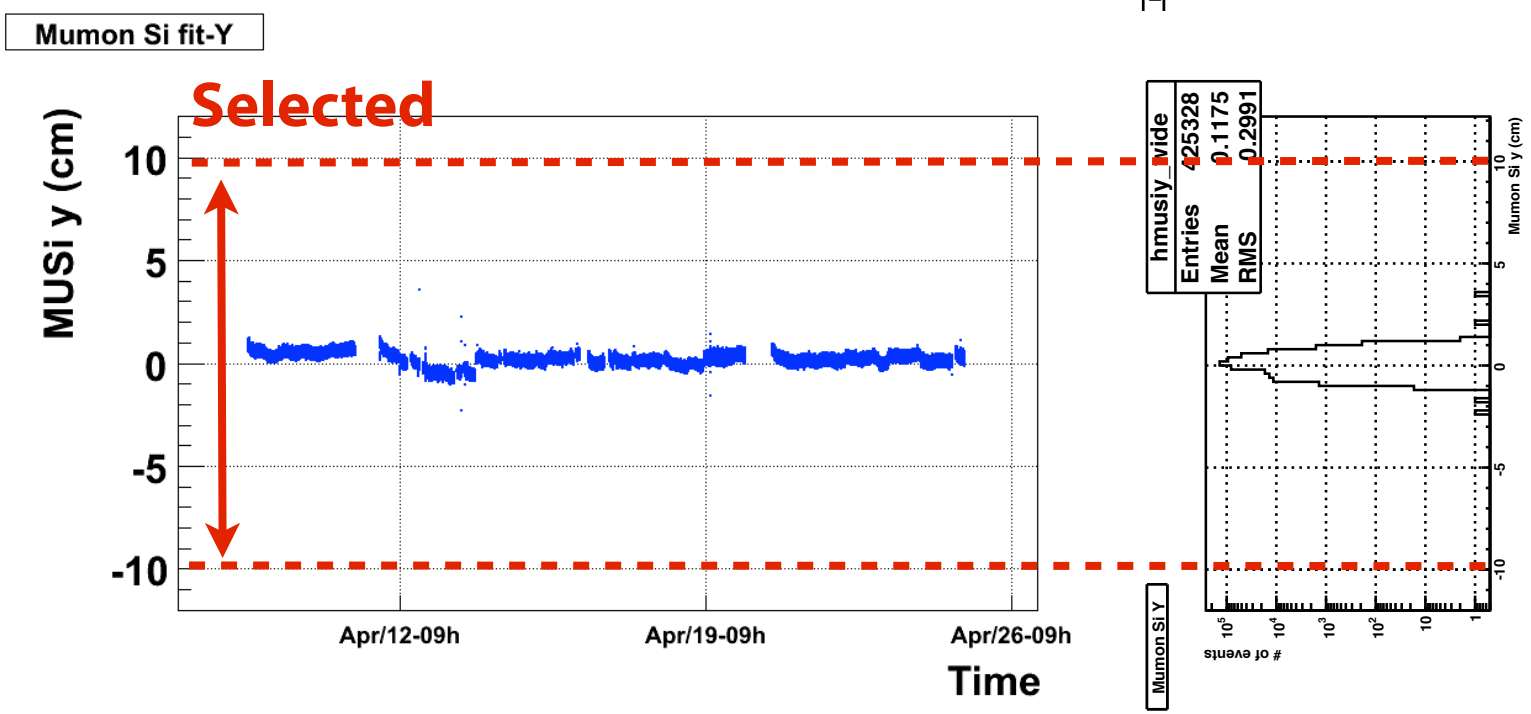


Curren of 3 horns, with wide range



MUMON Si fit center



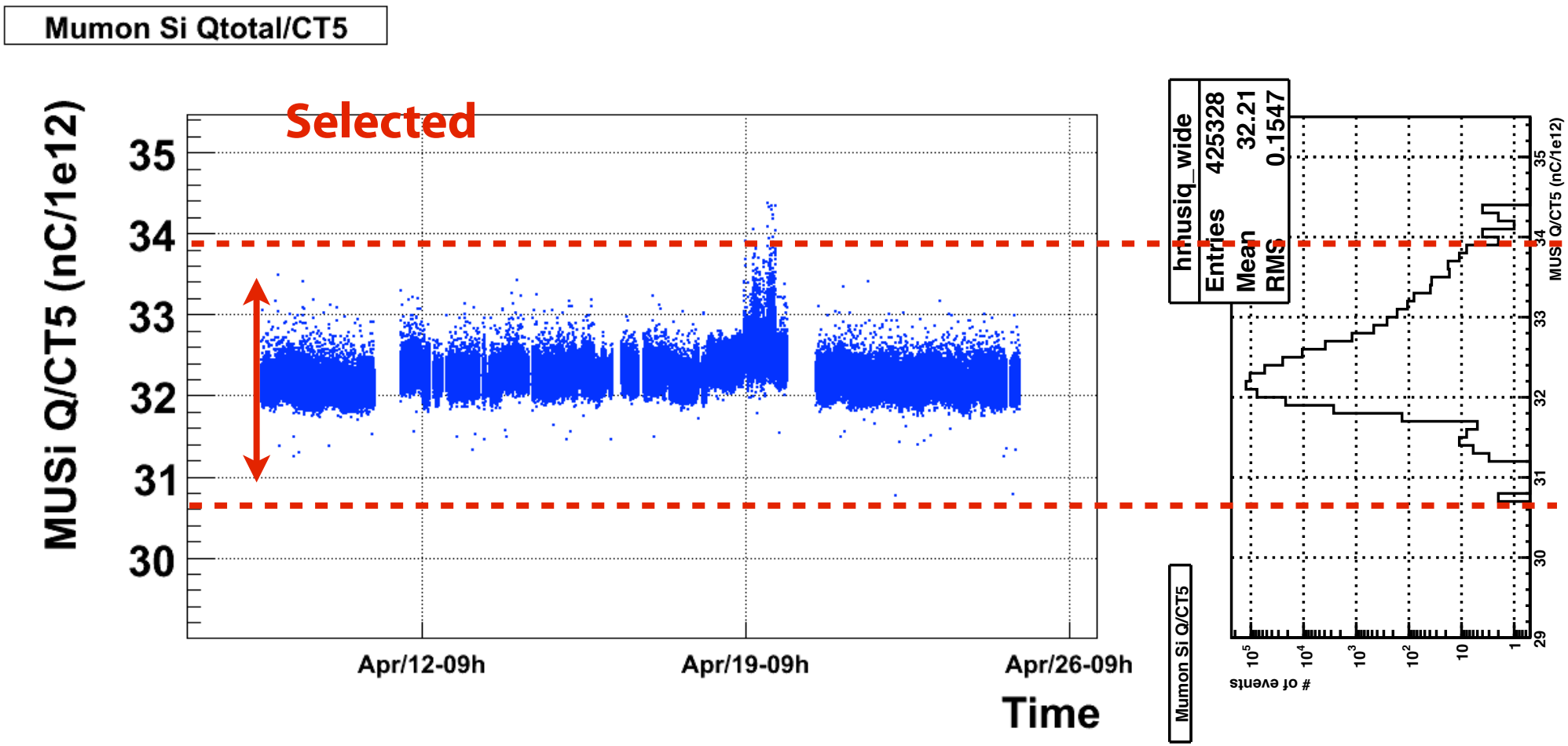


|fit center| < 10cm

No Bad spill (not including bad spills by horn cut)

MUMON Si Q / CT05

32.24 ± 5%



18 Bad spill (not including bad spills by horn cut)

Summary of Good spill selection (MR Run42)

Run# 420022(4/8)~420178(4/25)

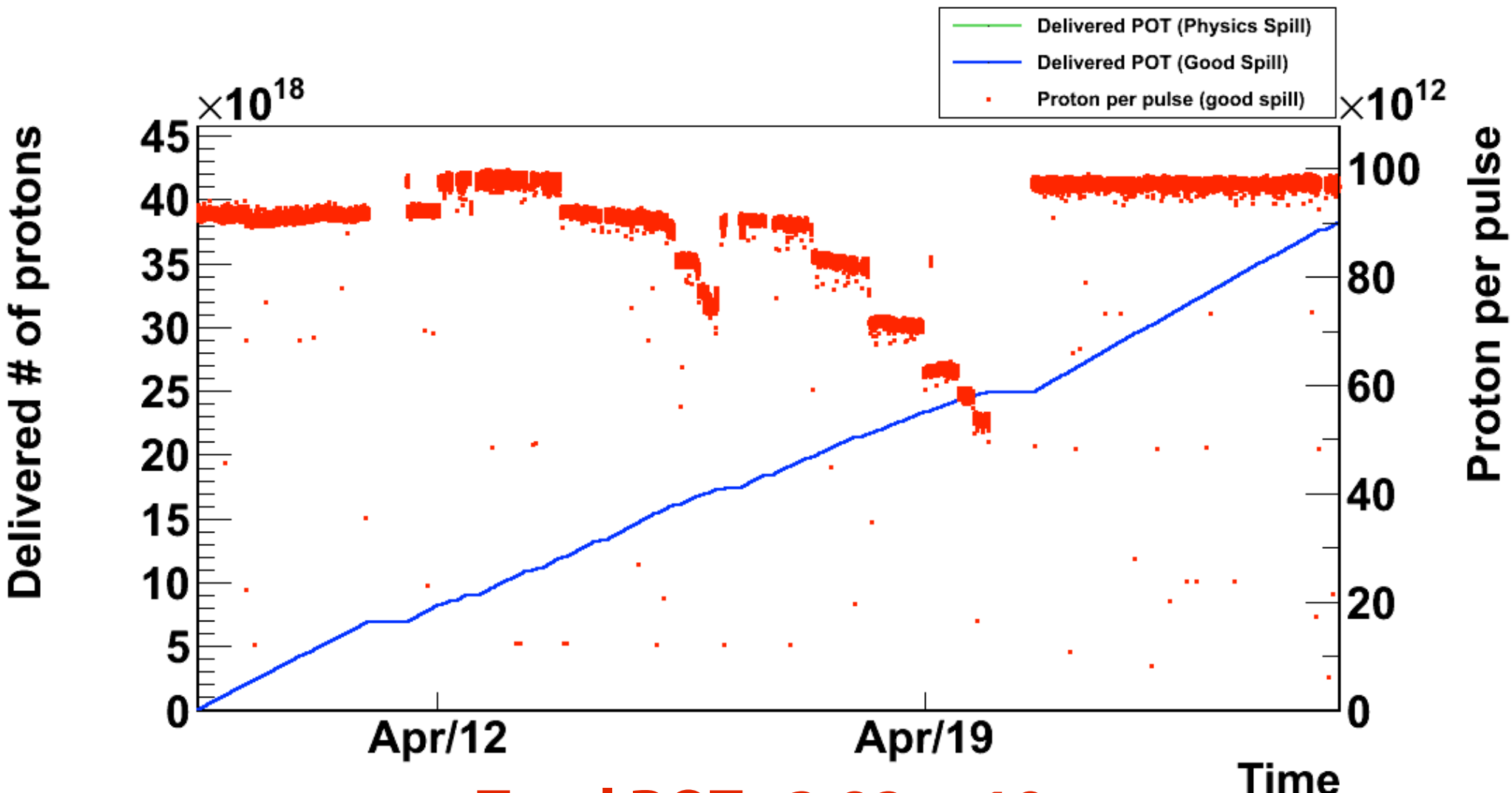
	# of spills	Ratio
Physics spills	431395	1
Beam trigger	425762	0.987
Good GPS	425762	0.987
ppp(CT5)>1e11	425334	0.986
Normal beam	425334	0.986
Horn cut	425328	0.986
MUMON cut	425310	0.986

# of delivered protons(CT5) after Good spill selection

Total POT : 3.82e+19

Integrated POT (MR Run41)

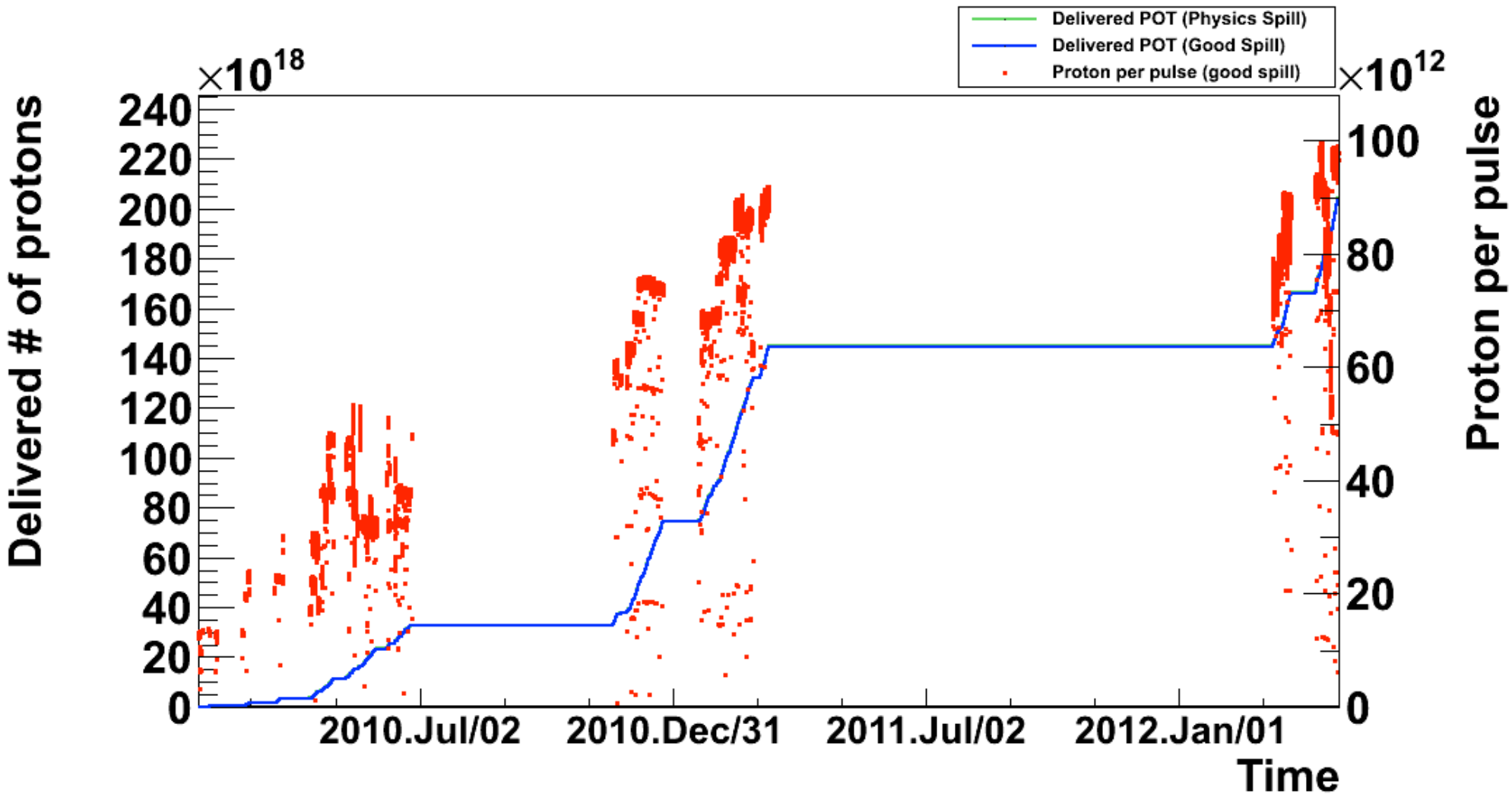
Run# 420022(4/8)~420178(4/25)



Total POT : 3.82e+19

Integrated POT (so far)

200 & 250 kA Horn current setting



Total POT : 2.04e+20

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

Summary

- Apply Good spill selection for physics run data until 4/25 morning (~Run#420178)
- There are 24 bad spills (=0.004% of total good spills in MR Run42)
  - The reason of 6 bad spills by horn cut seems to be miss-calculation of horn current by bad fitting. It is possible to recover these spills by improving fitting method.
  - The reason of 18 bad spills by MUMON cut are not sure. Now investigate it. These spills can be recovered if this reason is cleared.
  - At this moment, these spills are judged as “bad”.
- Integrated POT in MR Run is 3.82e+19
- Integrated POT in all physic runs is over 2e+20 (at 200 & 250 kA horn current setting)

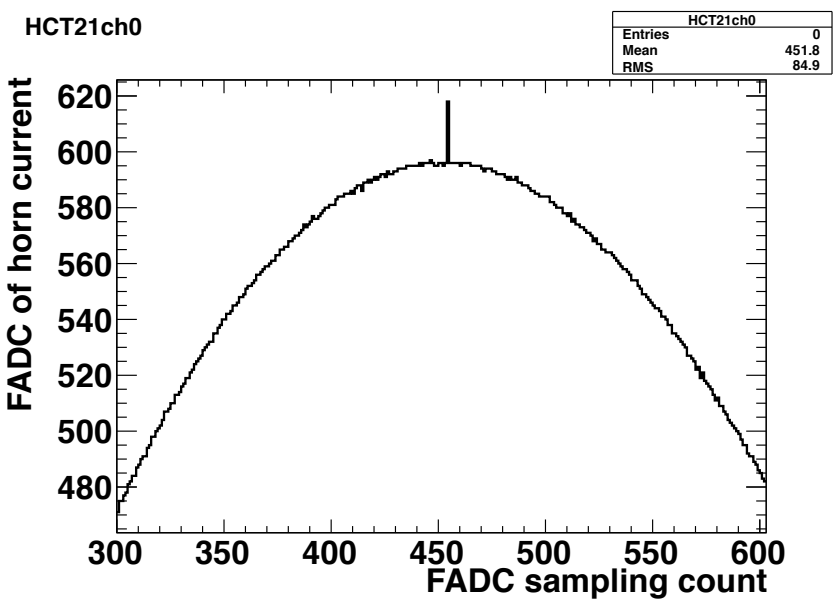
Back up

Bad spills by horn cut

The list of bad spills by horn cut

```
Run# Event# Spill# : Current of Horn1,Horn2,Horn3 [kA]
420167 7629 2838196 : 251.27 359.03 248.72
420167 24317 2854884 : 251.29 359.60 248.63
420170 3511 2899486 : 250.87 365.26 248.35
420170 7509 2903484 : 251.03 417.24 248.42
420170 7579 2903554 : 251.15 329.69 248.52
420171 2170 2910180 : 251.26 276.45 248.67
```

Example: FADC of the horn2 current at a bad spill →



- Fitting the shape of horn current signal to calculate horn current is not good due to the spike around the peak.
- Now improving fitting method to recover these spills.

Bad spills by mumon/ct cut

The list of bad spills by mumon/ct cut

```
Run# Event# Spill# : MUMON SiQ / CT05 [nC/1e12 pot]
420129 399 2787394 : 33.8941
420131 4245 2792766 : 34.0369
420133 99 2802369 : 33.8241
420133 282 2802552 : 34.3632
420133 365 2802635 : 34.0714
420133 842 2803112 : 34.3079
420133 1663 2803933 : 33.9289
420133 2736 2805006 : 34.3291
420133 3397 2805667 : 34.2762
420133 3744 2806014 : 34.1580
420133 3781 2806051 : 33.8342
420133 3975 2806245 : 33.9332
420133 4359 2806629 : 33.8676
420133 4409 2806679 : 34.2070
420133 4540 2806810 : 33.8394
420133 5709 2807979 : 34.0246
420133 5893 2808163 : 34.0234
420133 6067 2808337 : 34.3270
```

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