



Istituto Nazionale di Fisica Nucleare
SEZIONE DI TORINO

TOP Calibration summary

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Overview

The first look at the PID in the collision data showed non-sense performances

<https://www.phys.hawaii.edu/elog/iTOP+Cosmic+Ray+Telescope/3308>

This is due to two major bugs (or miscalibrations if you prefer) that are affecting our data:

→ Carrier-by-carrier offset

At each power-cycle few carrier pick up a +1 writewindow shift (~ 48 ns)

<https://www.phys.hawaii.edu/elog/iTOP+Cosmic+Ray+Telescope/3295>

<https://www.phys.hawaii.edu/elog/iTOP+Cosmic+Ray+Telescope/3311>

→ Common T0 offset

The TOP as a whole is shifted by 0.5 ns with respect to the RF clock

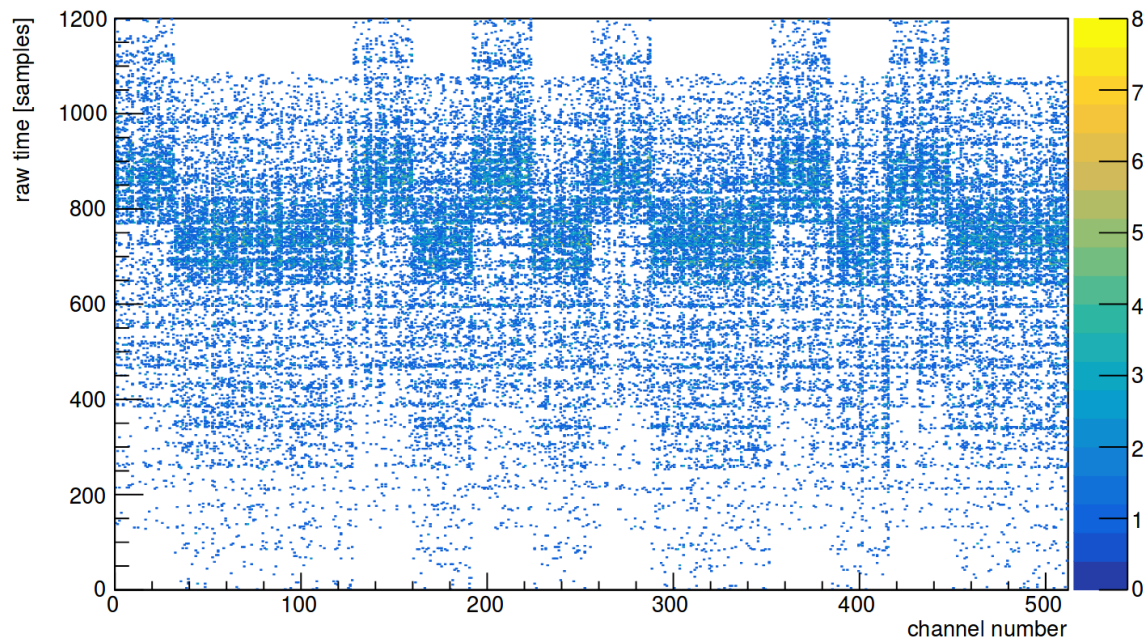
<https://www.phys.hawaii.edu/elog/iTOP+Cosmic+Ray+Telescope/3318>

Marko showed that both the effects can be corrected deriving new calibrations from the data

<https://www.phys.hawaii.edu/elog/iTOP+Cosmic+Ray+Telescope/3319>

Carrier offset correction

We can process the cdst files of the collision data, flag the shifted carrier and modify the LocalT0 calibration accordingly

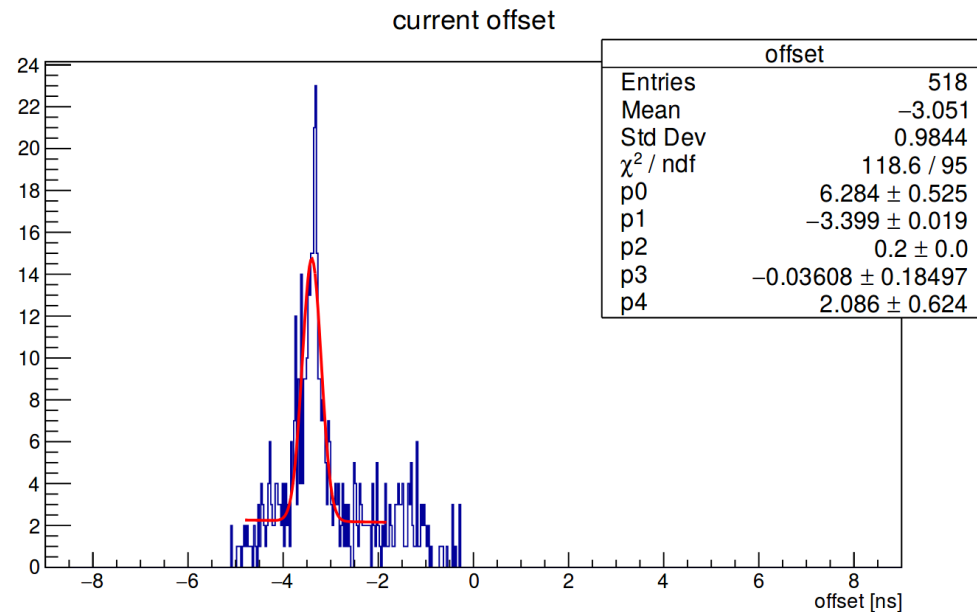
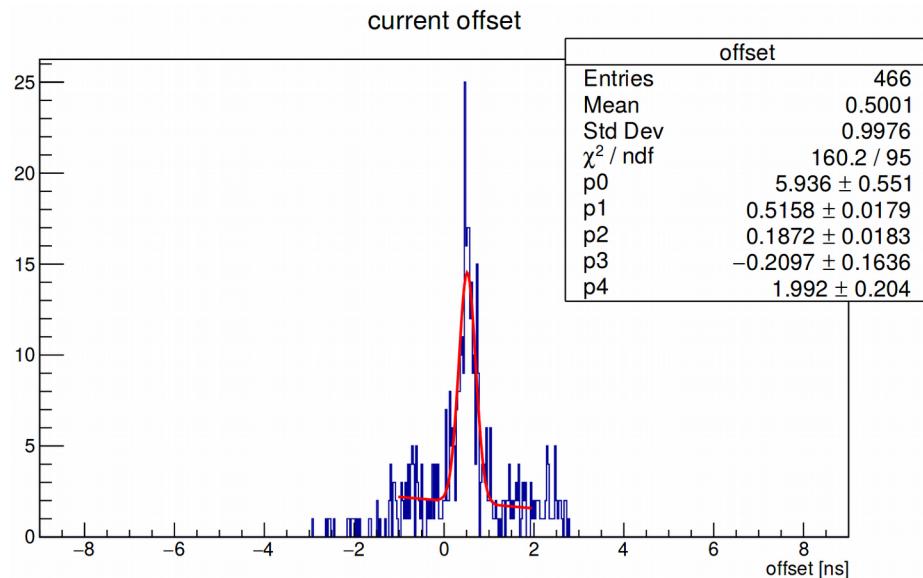


A new calibration must be provided after every powercycle

Please log somewhere (elog, mail, phone call, post-it...) the Run Numbers comprising a powercycle (not only the time!!!)

CommonT0 correction

Determine the shift from the bunchFinder offset using two-tracks events
(bunch finder estimation of the interaction time – time closest bunch crossing)



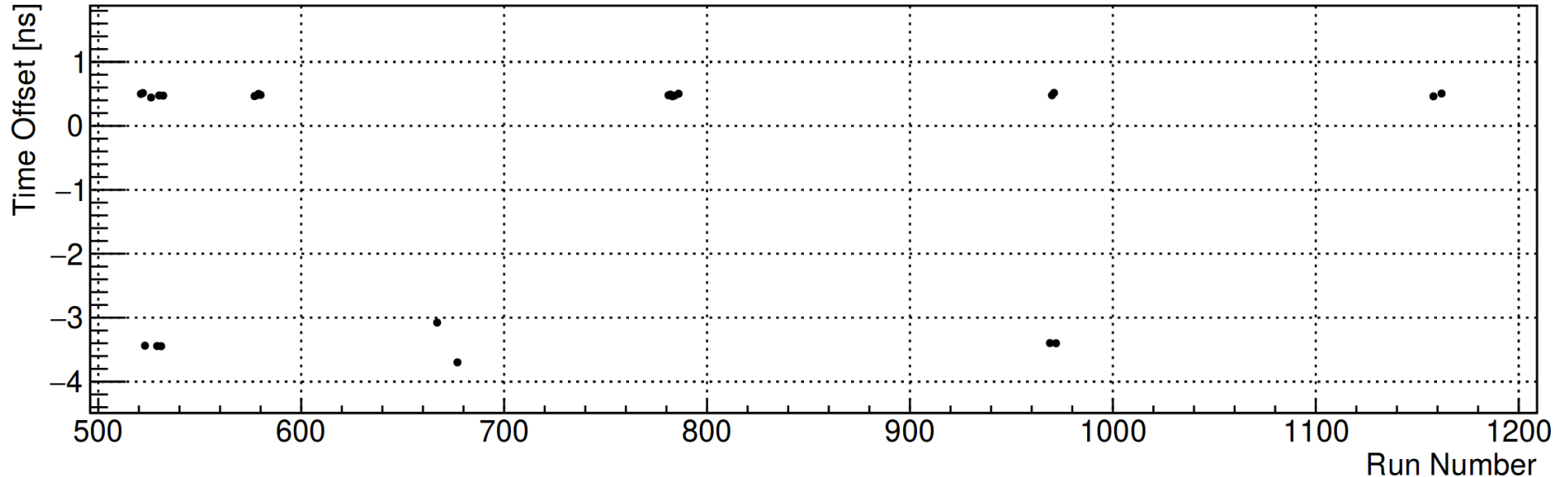
Works surprisingly well even without correcting for the carrier shifts!

Precision < 10 ps in every IOV

Carrier offset correction

The common T0 calibration is derived run-by-run.

Only few of the runs flagged as “collision” actually have di-muon events



The bimodal distribution is due to the facts that, sometimes, the offset is calculate w/respect to the next bunch instead of the previous one. Not an issue: due to initial, loose settings of the bunchfinder

Good runs, bad runs

Since we need di-muons to have a common T0 calibration, not all the runs have been calibrated.

The runs of the prompt processing are never good

The reprocessed TOP good runs are:

521, 522, 529, 530, 531, 532, 577, 578, 579, 580, 781, 782, 783, 784, 786, 969, 970, 971, 972, 1158, 1162.

All the results shown in the following slides are obtained from these runs

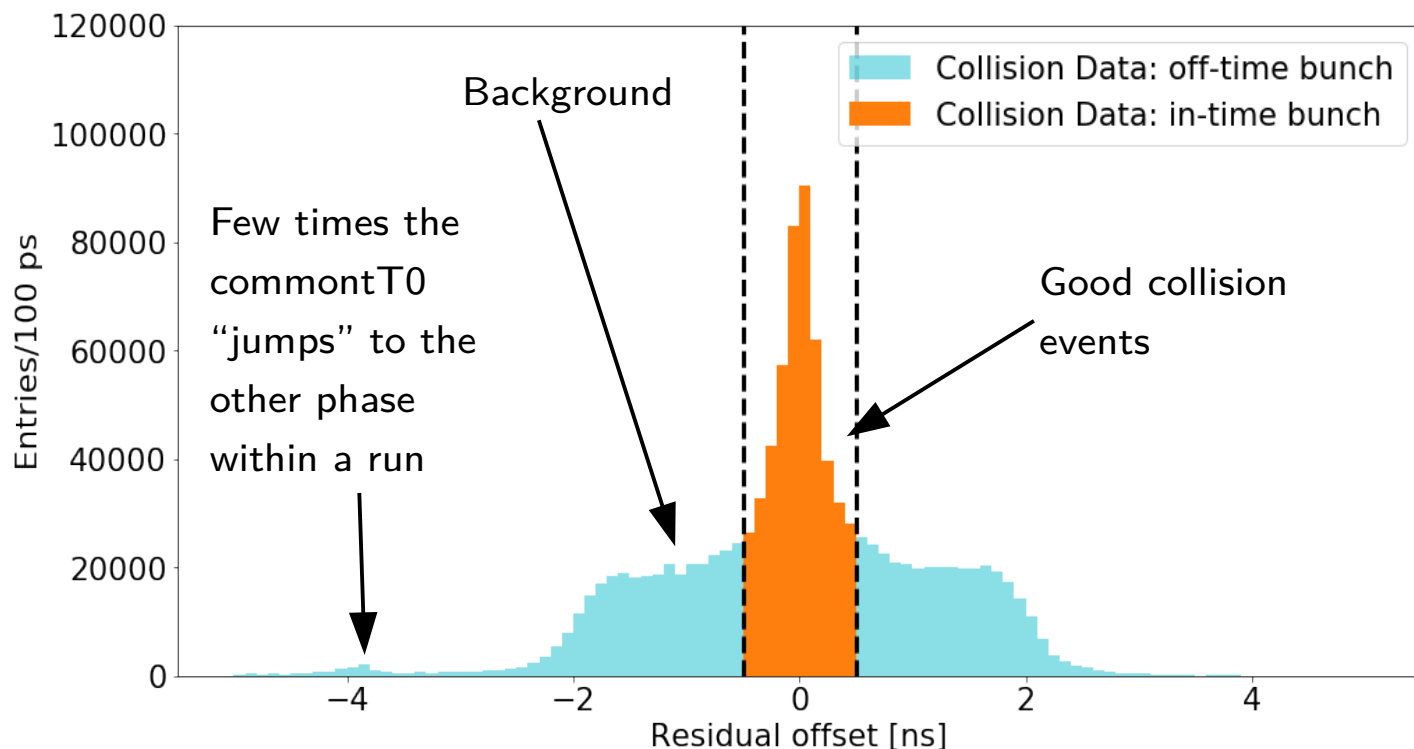
Runs after 1162 have not been calibrated yet

Run list and info: <https://confluence.desy.de/display/BI/Experiment+3>

Analysis of the re-calibrated data: bunch offset

The new calibrations have been uploaded to the Global Tag for the second reprocessing, that took place over the week-end.

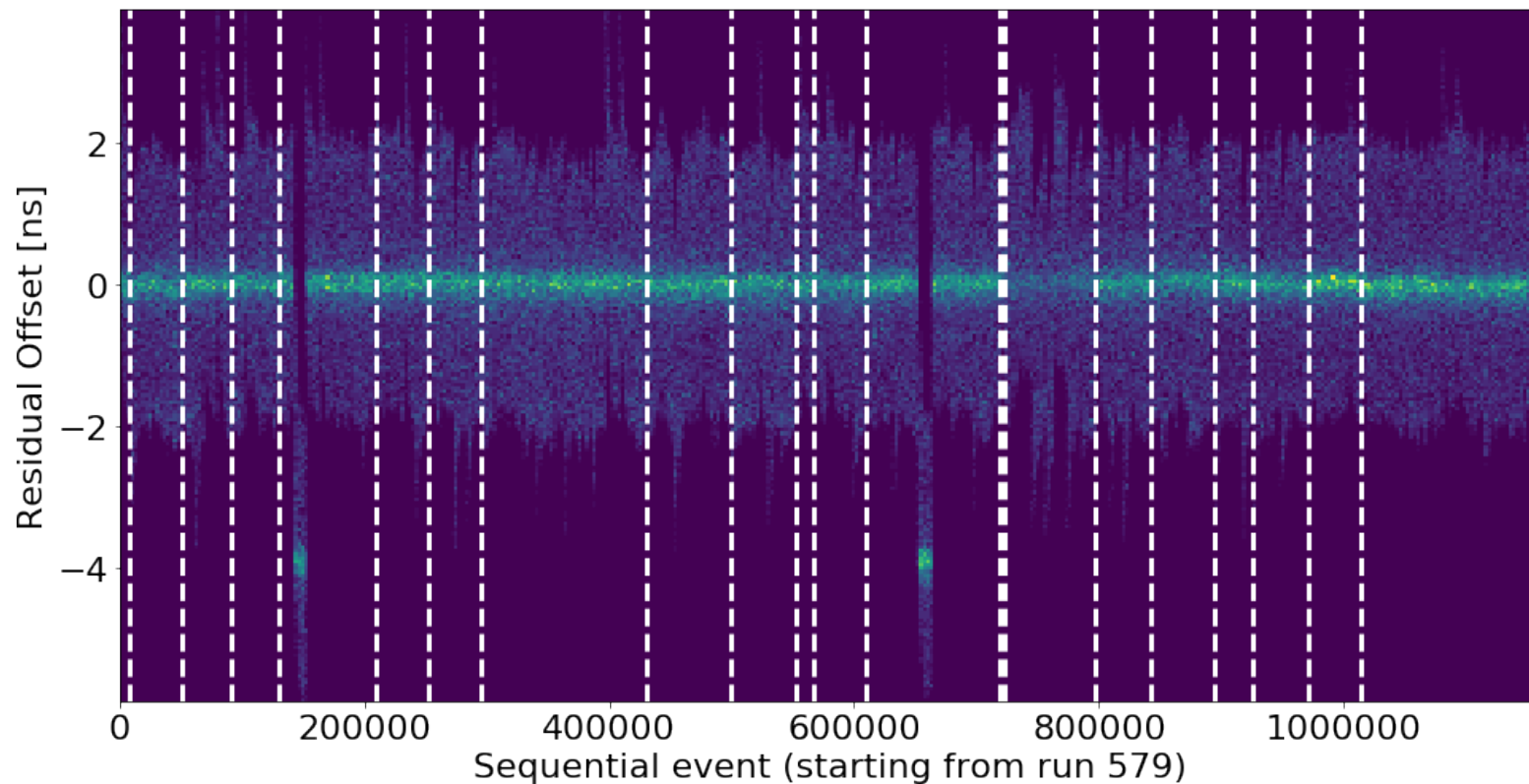
The bunch offset is now correctly centered at zero (most of the time)



We can use the residual offset time to distinguish between collision and beam gas (or other bkg) events

Analysis of the re-calibrated data: bunch offset

The calibrated offset is quite stable in time (white lines separate different runs)

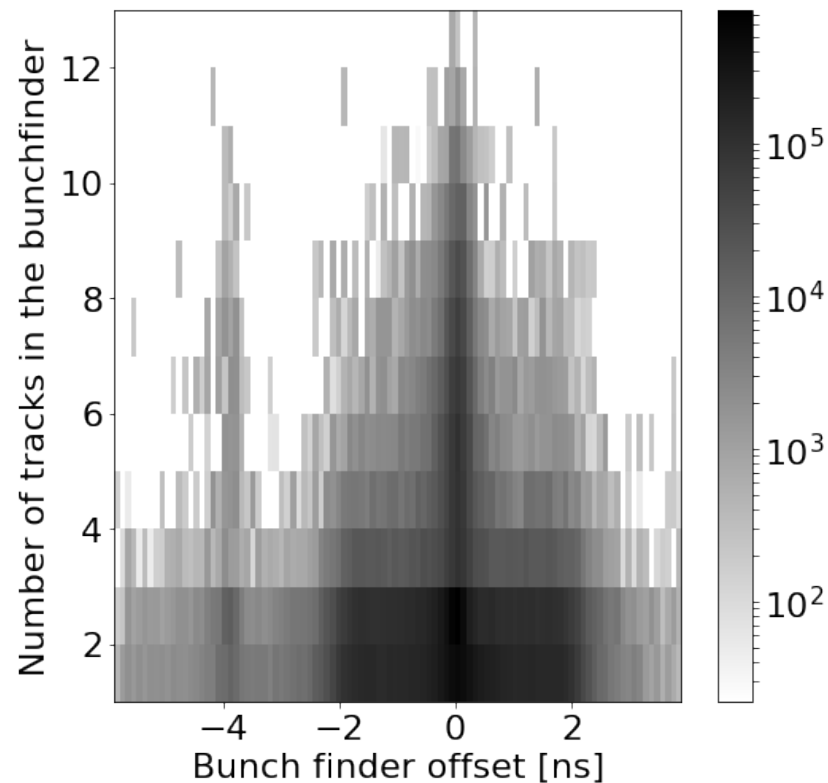
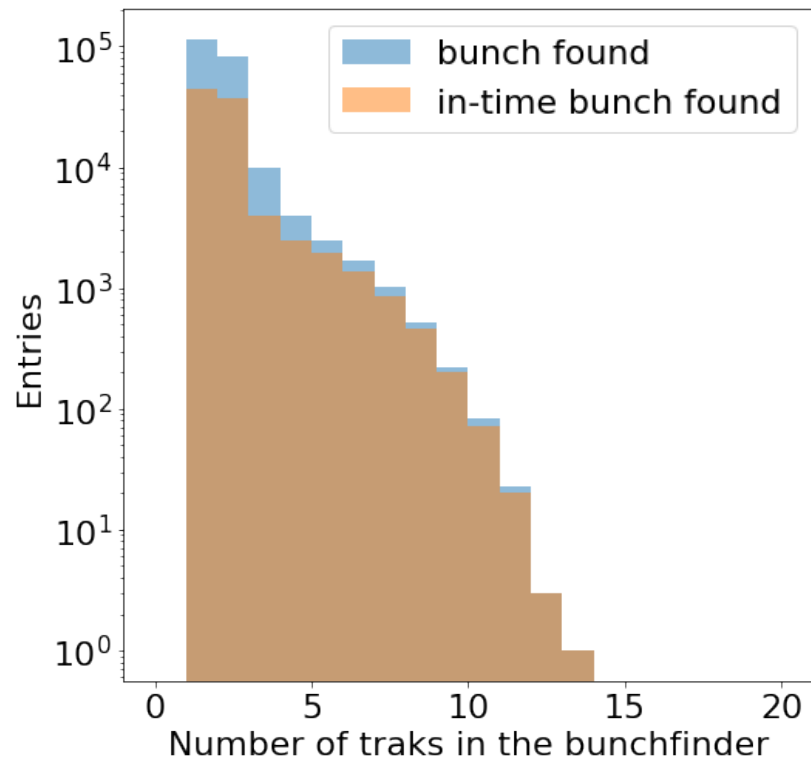


For two runs
the commonT0
changed phase
suddenly for a
while.

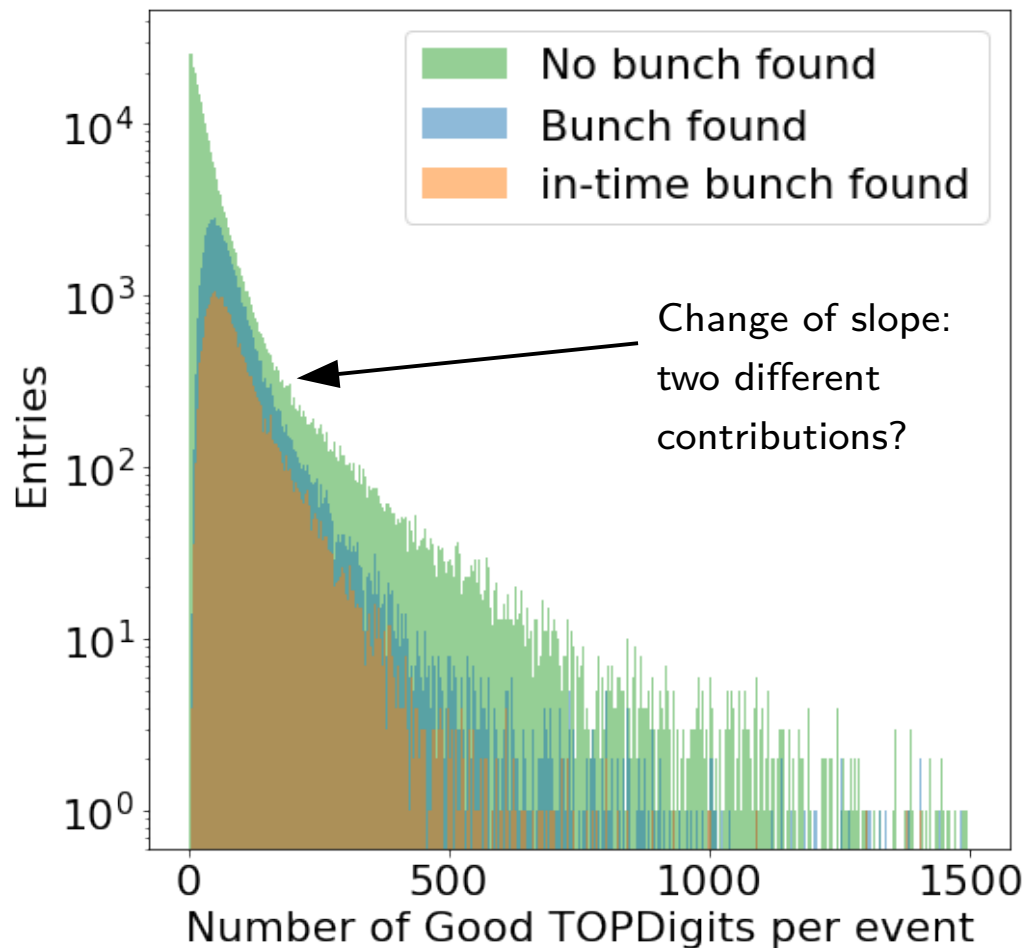


Bunch finder: number of tracks

The on-time events have generally more tracks



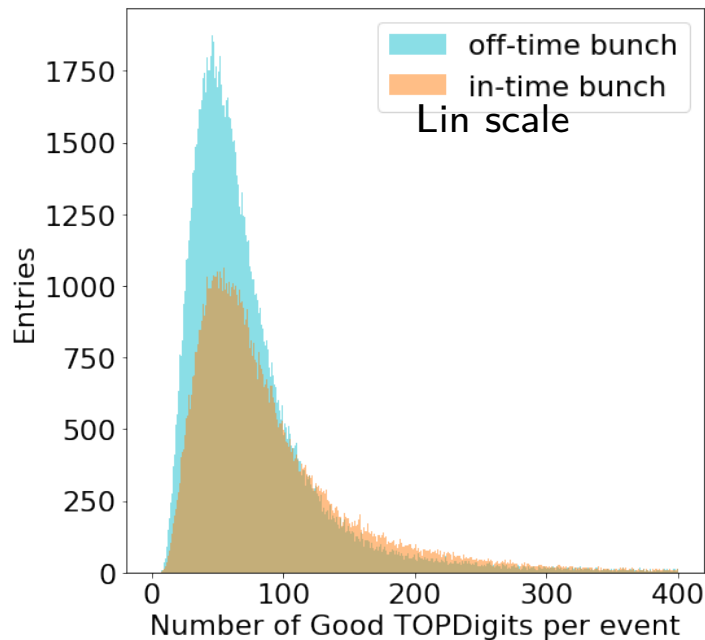
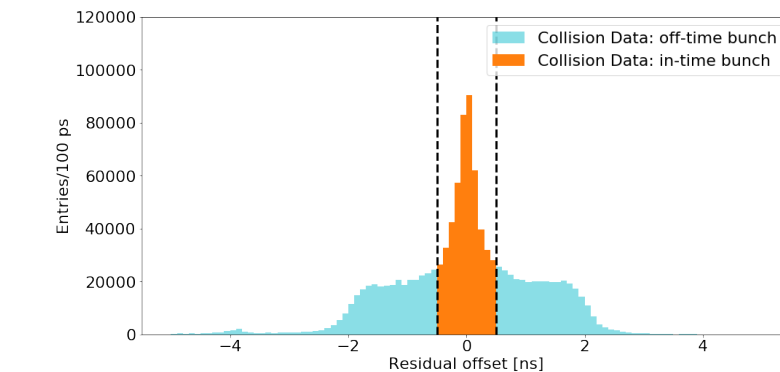
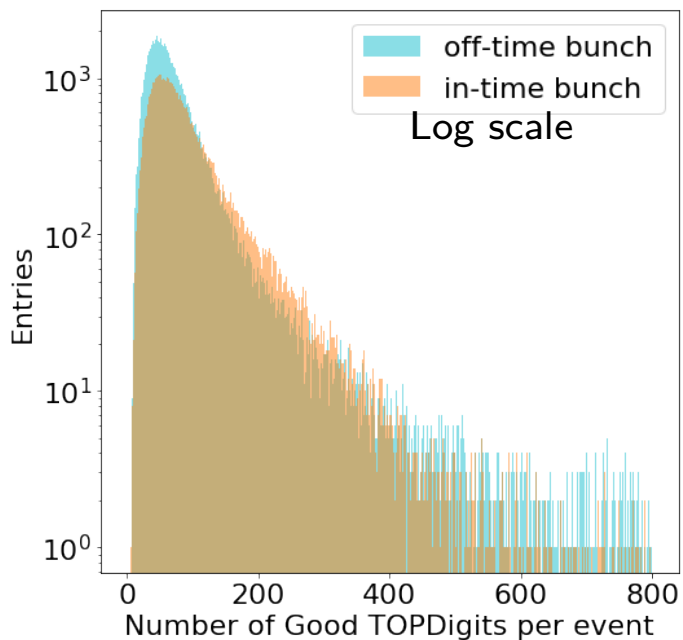
Bunch finder: number of TOPDigits



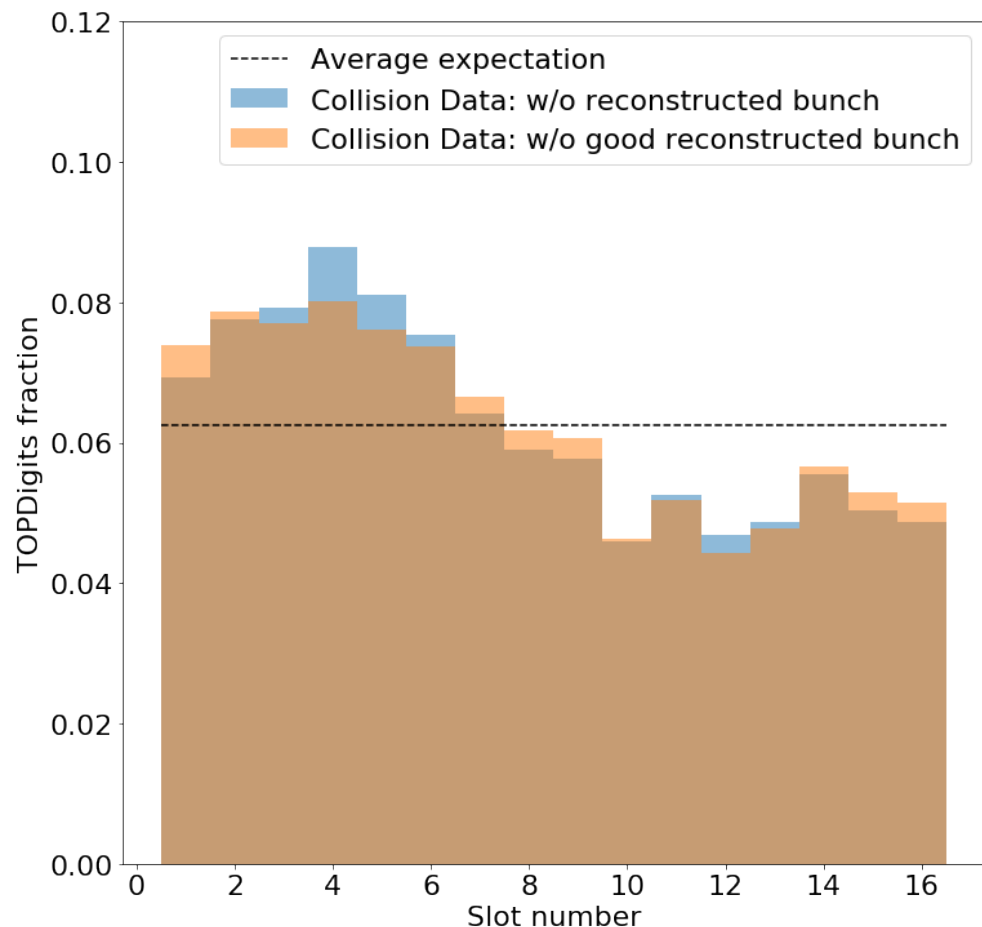
Events with or without a valid bunch being found are rather different

Bunch finder: in-time VS off-time

For the events with a valid bunch, we can check the number of hits as function of the time offset. Not sure about the message to take from these results: off-time events have less occupancy?



Occupancy per slot VS bunch offset



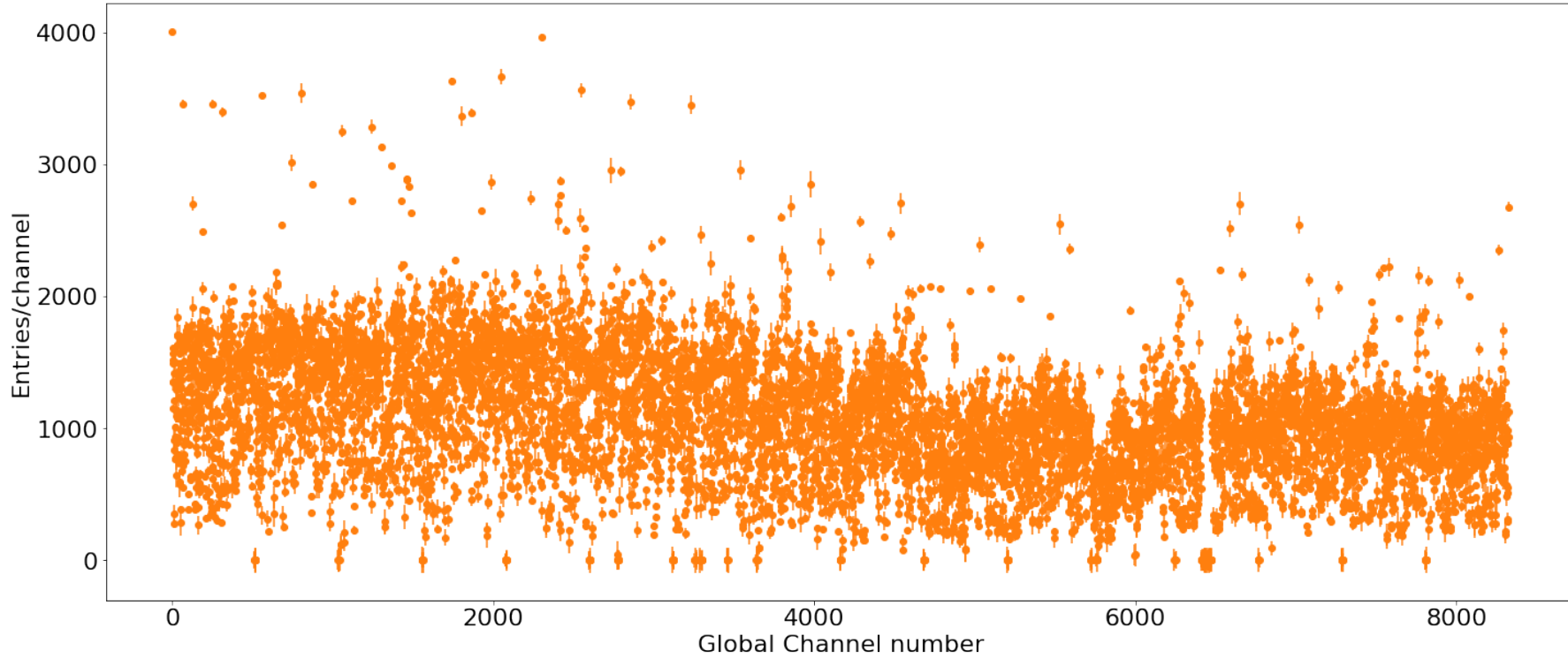
The off-time background is slightly more asymmetrically distributed.

Touschek/beam gas signature?

Watch out! The “expectation” line do not take into account the asymmetry induced by the beam crossing angle

Whole detector occupancy

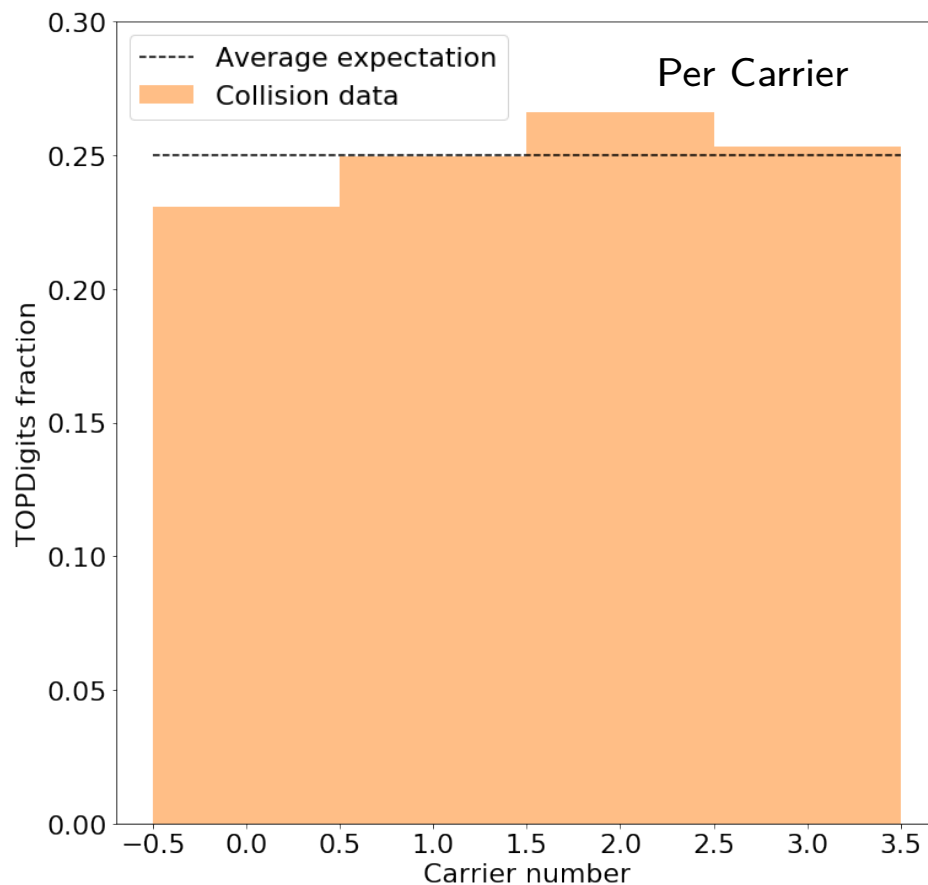
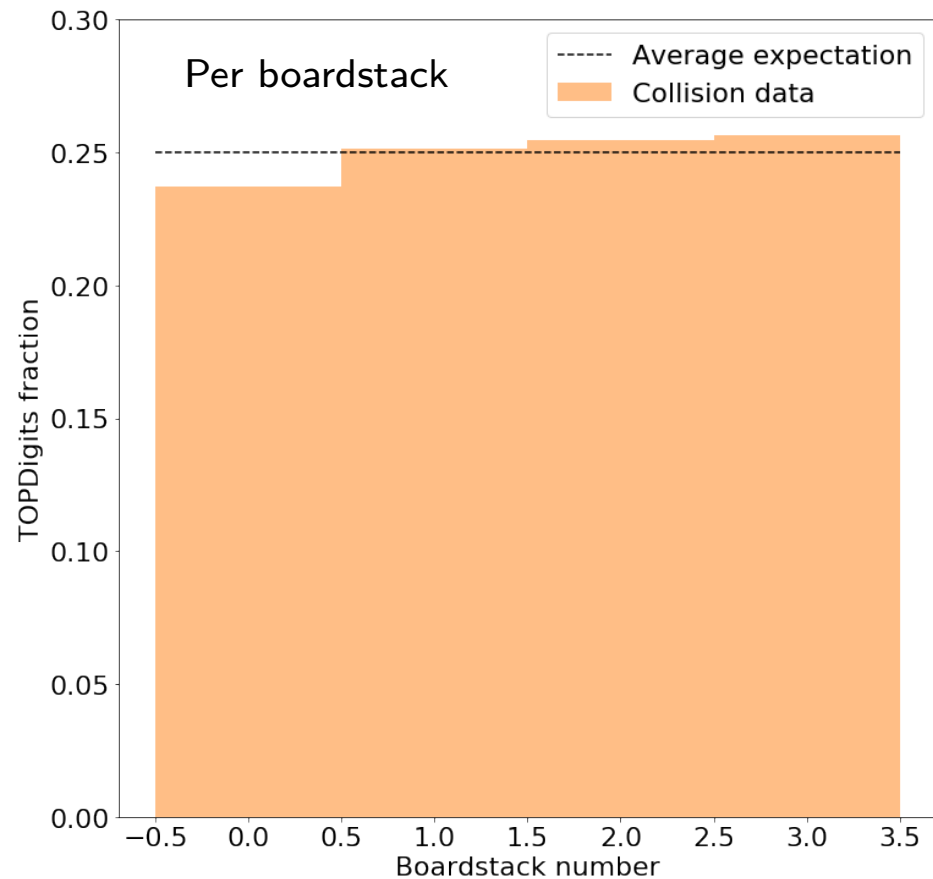
Selecting only in-time digits



Mild asymmetry as expected

More occupancy plots

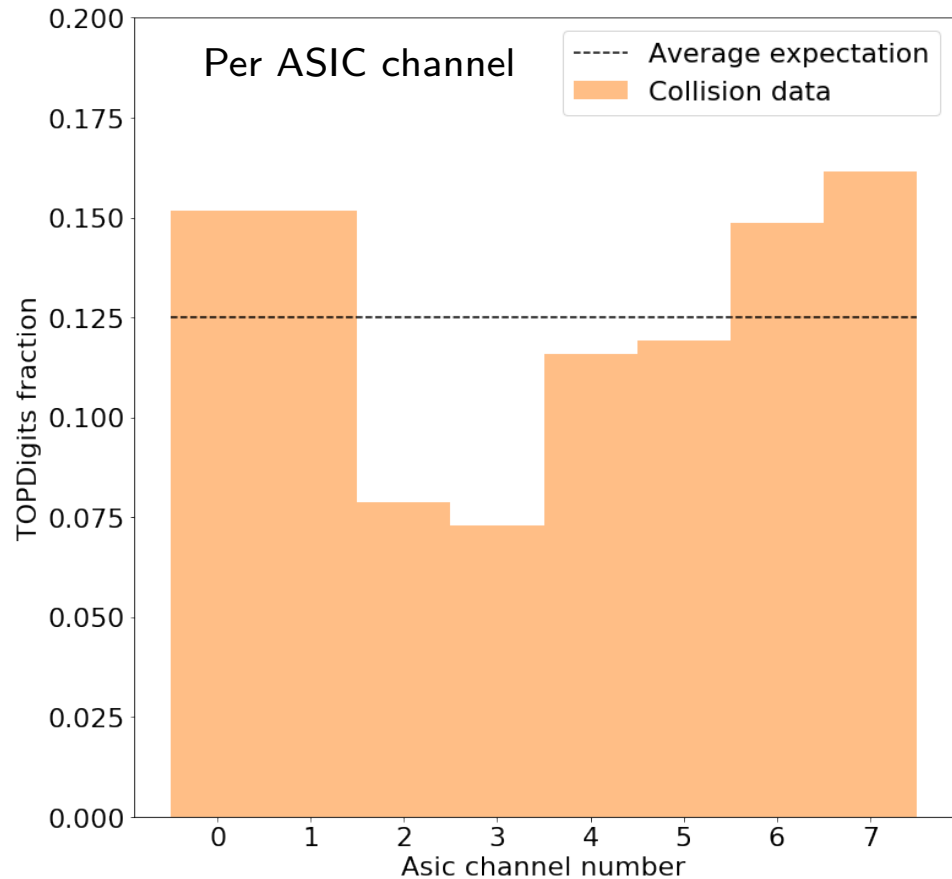
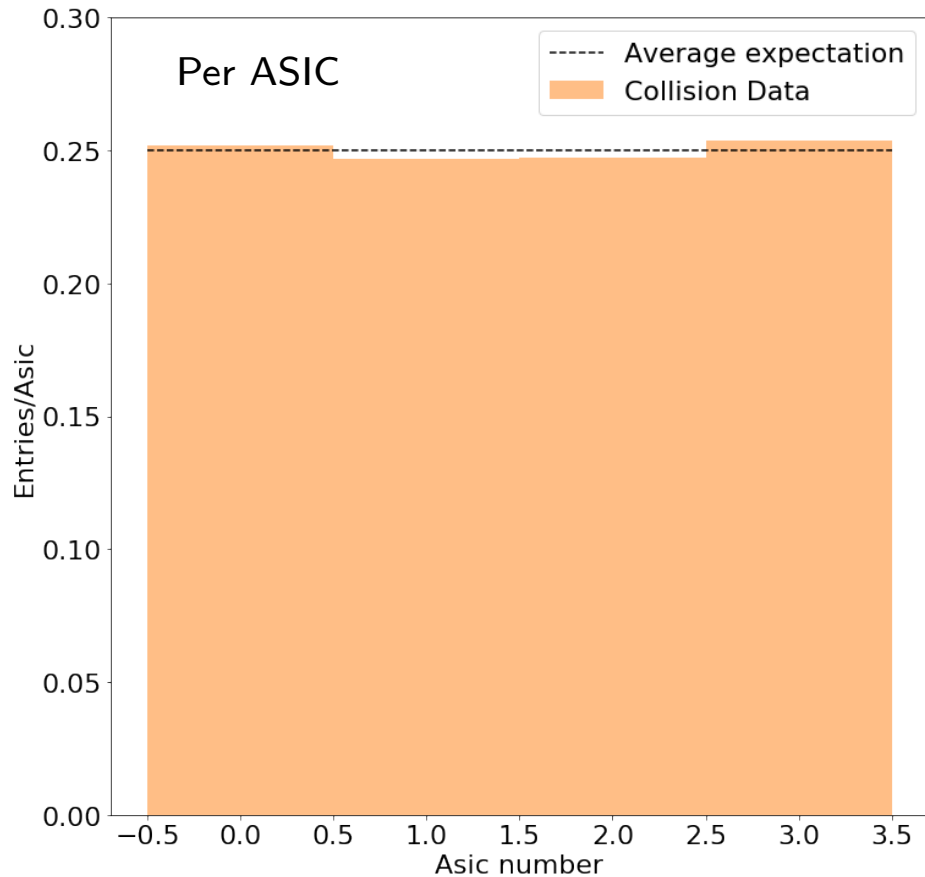
Selecting only in-time digits, integrating over all the slots



More occupancy plots

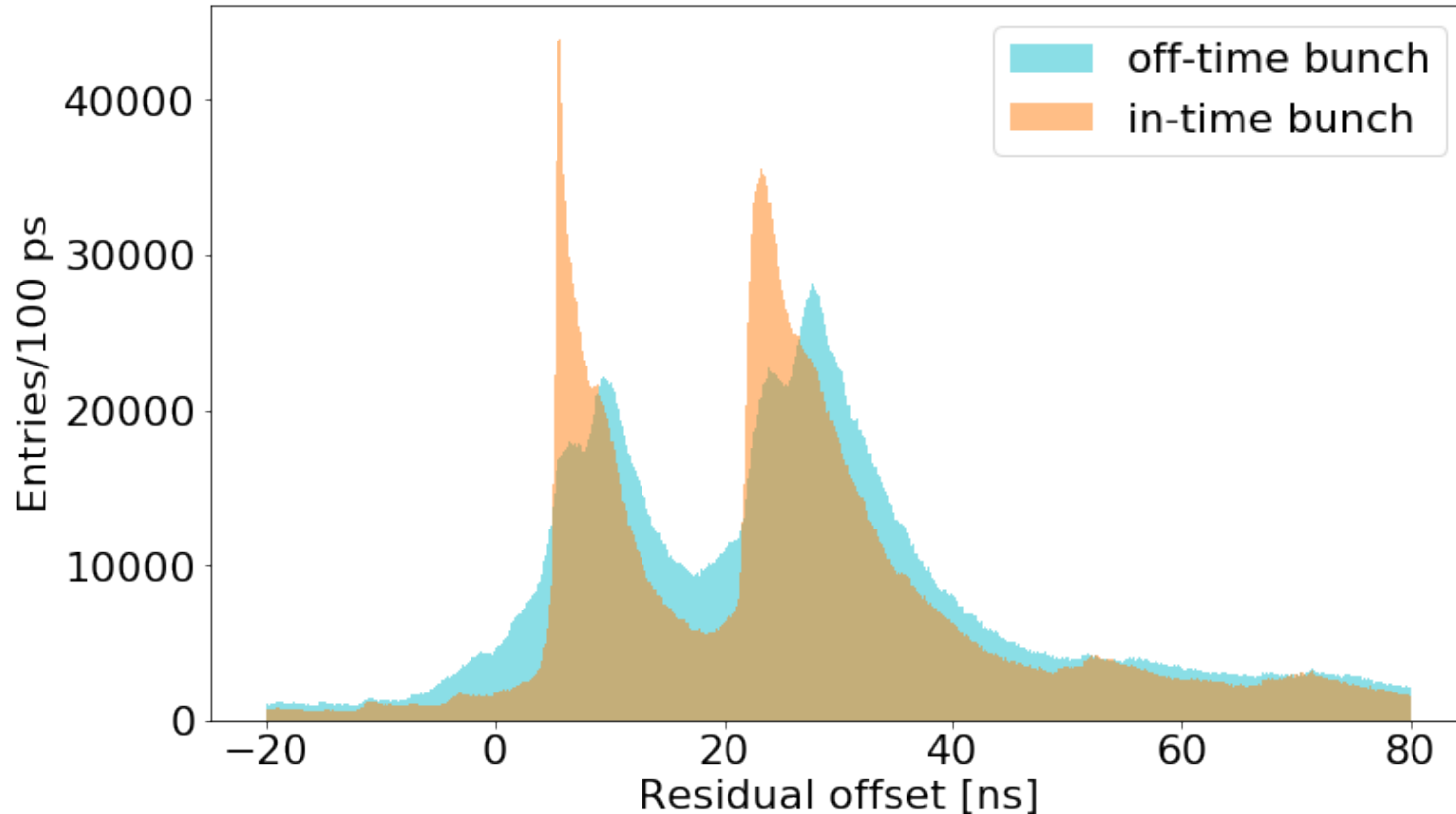
Selecting only in-time digits, integrating over all the slots

→ Why is the occupancy across the asic channel number no flat?



Calibration validation: Digit Time

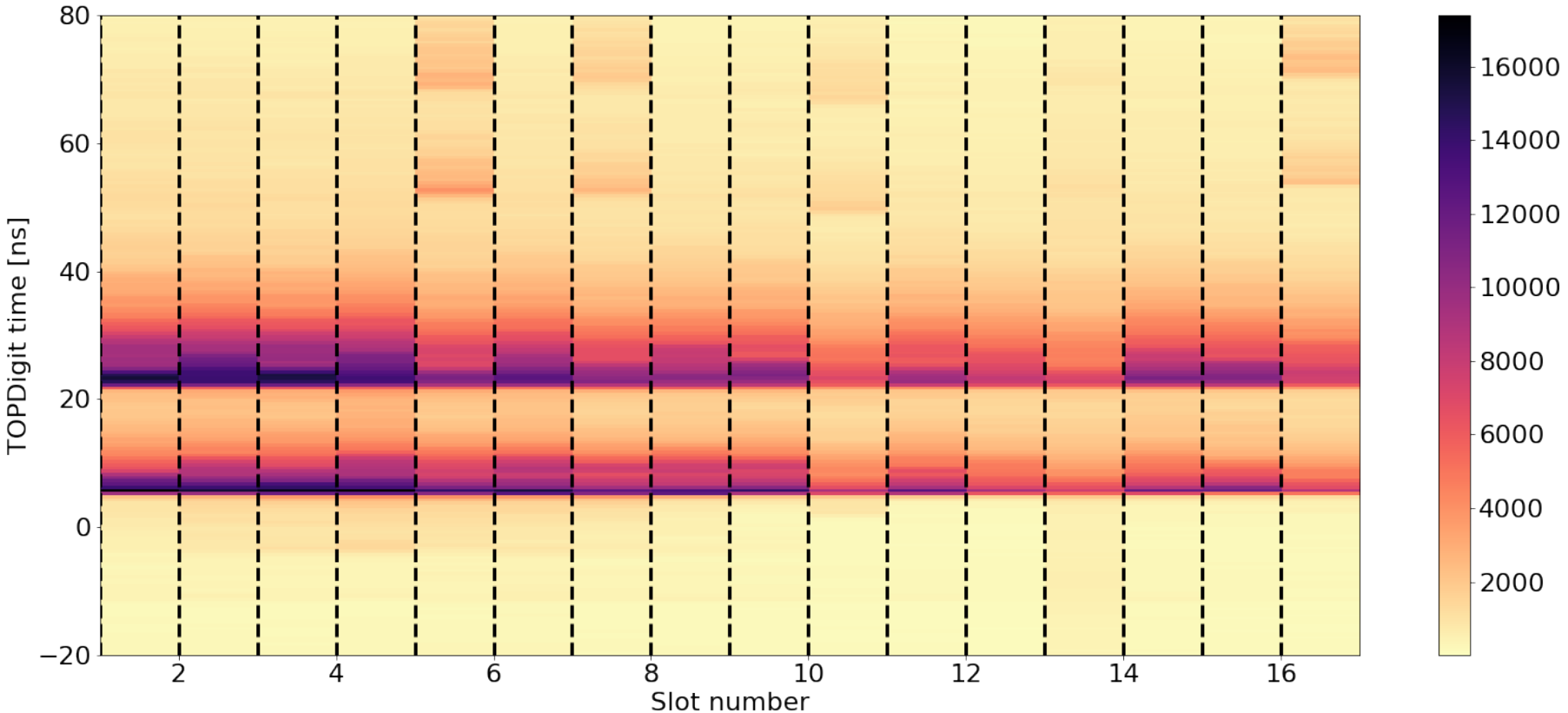
- Direct and reflected peak
- on-time and off-time samples behave quite differently



Calibration validation: Digit Time VS slot

Integrating over all the channels in each slot

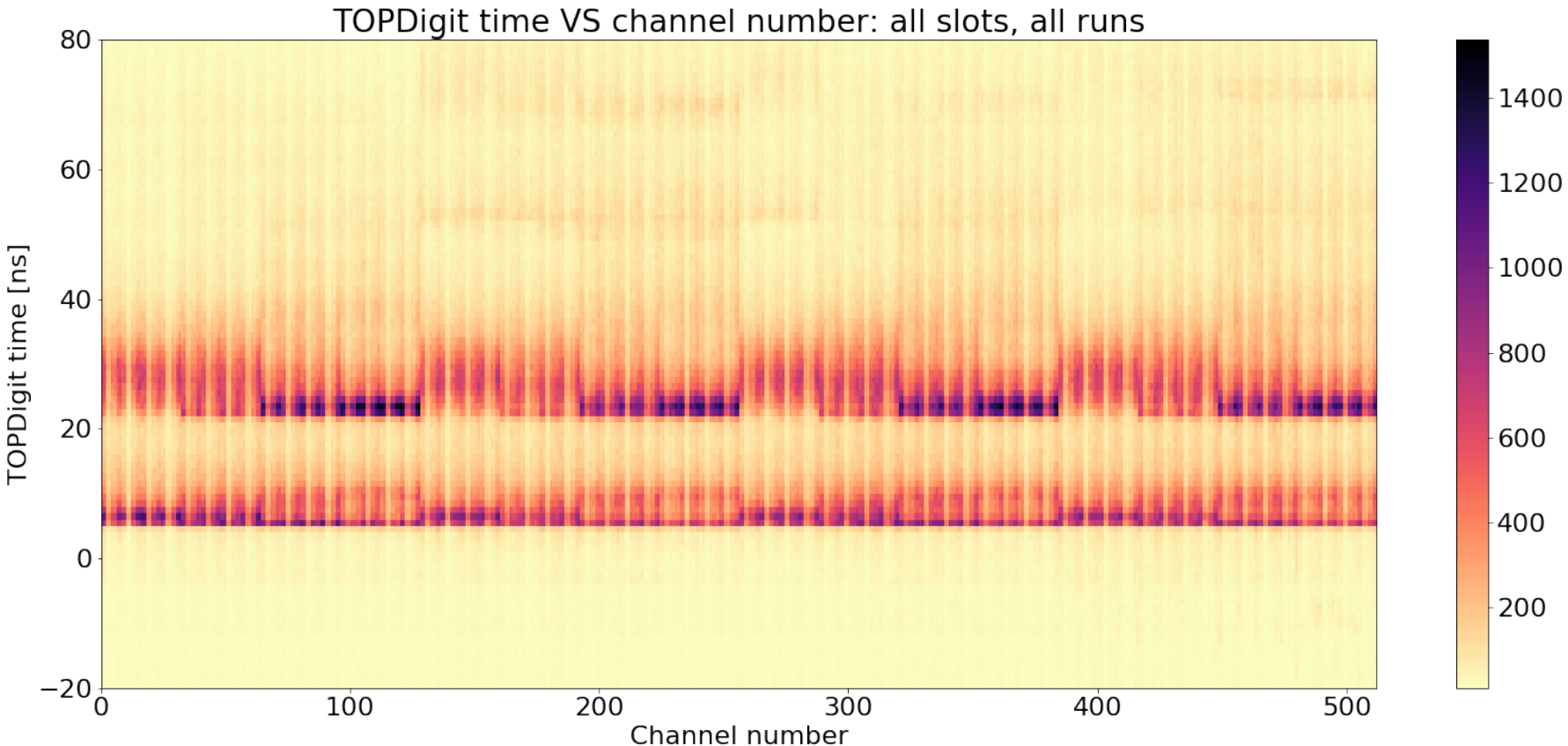
→ **ModuleT0 is ok!**



Calibration validation: Digit Time in each slot

Integrating over all the slots

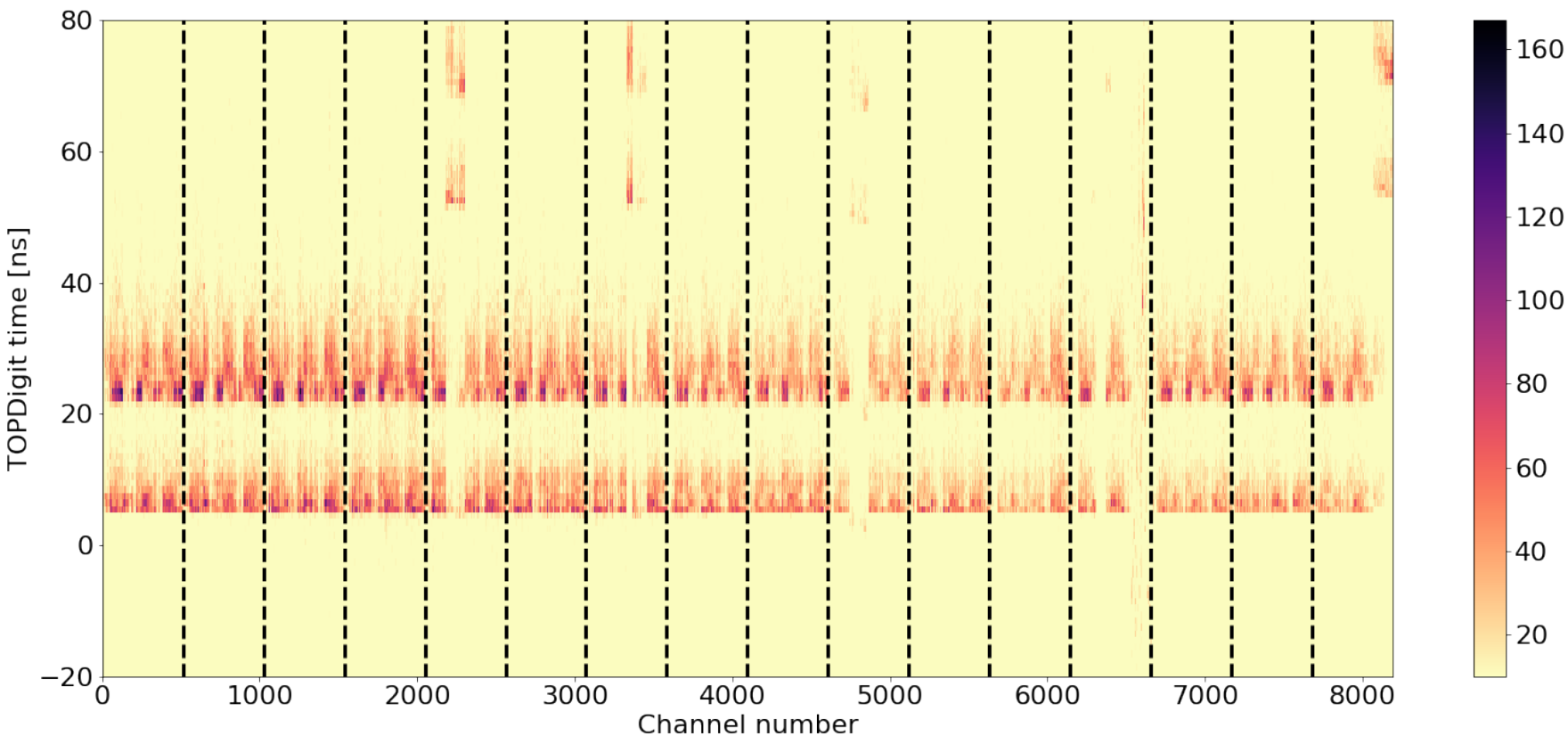
→ LocalT0 is ok!



Calibration validation: big picture

6 BS seem to be 48 ns off-sync or generically bad:

s05b, s07c, s10b, s13b, s13d, s16d



Conclusions

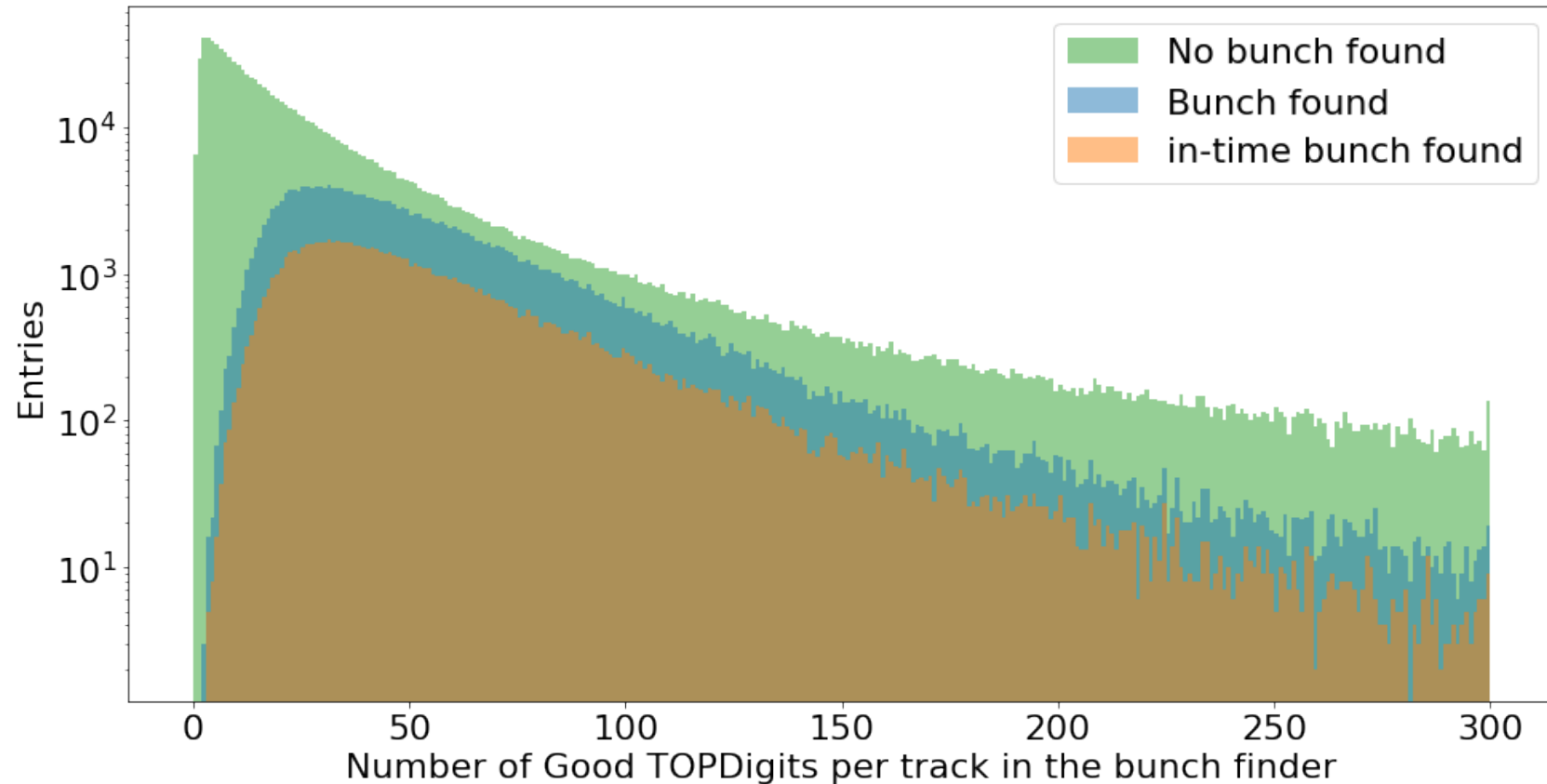
- **We can correct for the carrier-by-carrier offset offline**
 - TOP data are usable only after the first reprocessing
 - The TOP feedback will come few weeks after everybody else
- **We can determine a run-dependent CommonT0**
 - Same considerations as above
 - To avoid to have to wait for a further reprocessing, the commonT0 is derived on the data without the carrier shift correction. Works but it's not ideal
 - Quite large off-time background (beam gas or other sources)

**The calibration seem to be satisfactory for the reprocessed data, in the runs up to 1162.
A more quantitative analysis in preparation!**

Backup

Number of Digits VS bunch finder result

Number of digits per track in the bunch finder



Zoom on direct light

