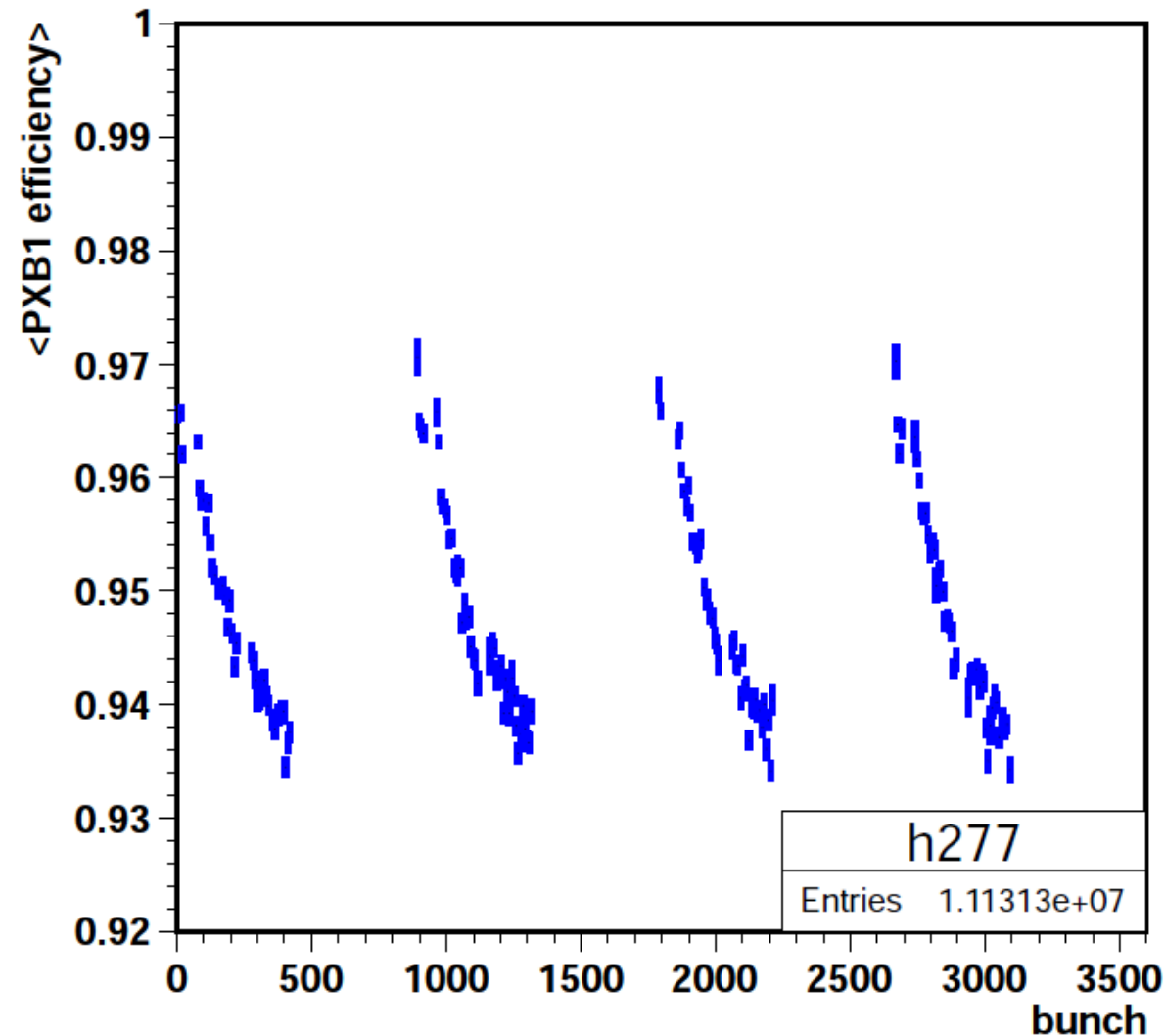# Barrel pixel dynamic inefficiency at PU 18

Daniel Pitzl, DESY
CMS Pixel DPG 19.4.2012
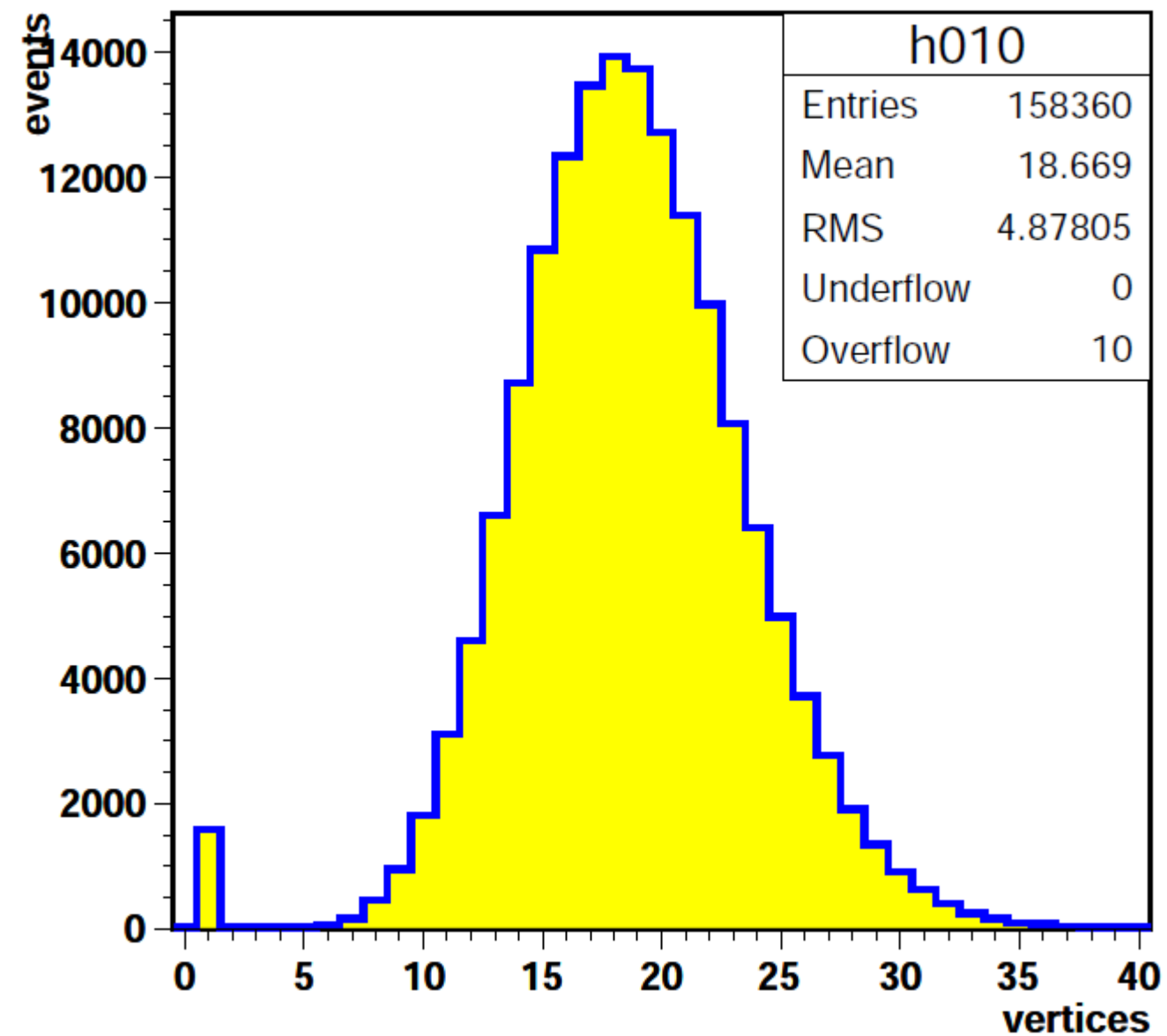
- Apr 2012 data
- Efficiency vs bunch

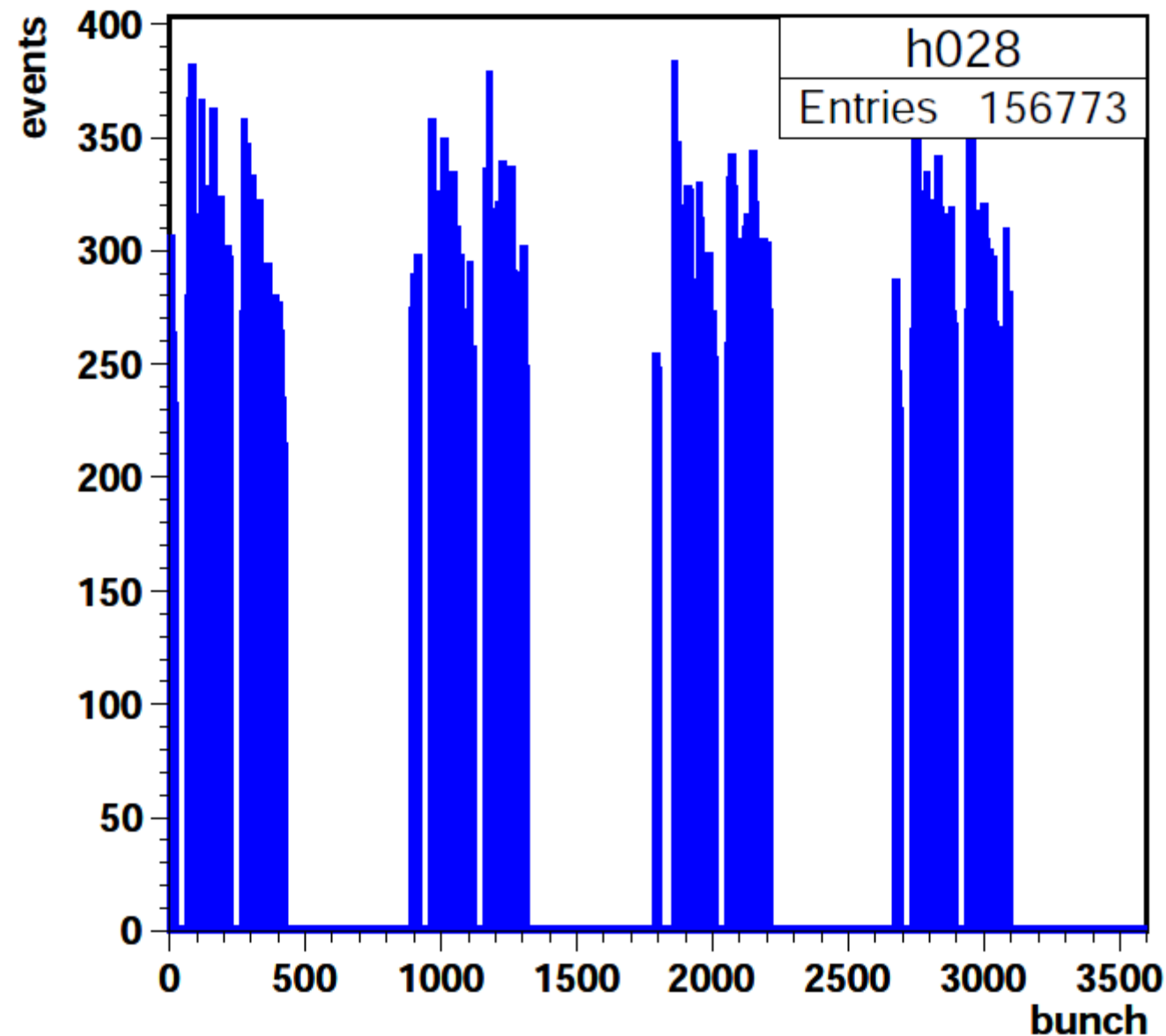# Data

- Apr 2012, fill 2497

  ‣ 50 ns spacing, 624 bunches

- Jet stream, PromptReco, AOD

- Use hits on tracks (`HitPattern`) in CMSSW_5_2_3

  ‣ 'efficiency' = 'availability of hits on tracks'

offline primary vertices: pile up

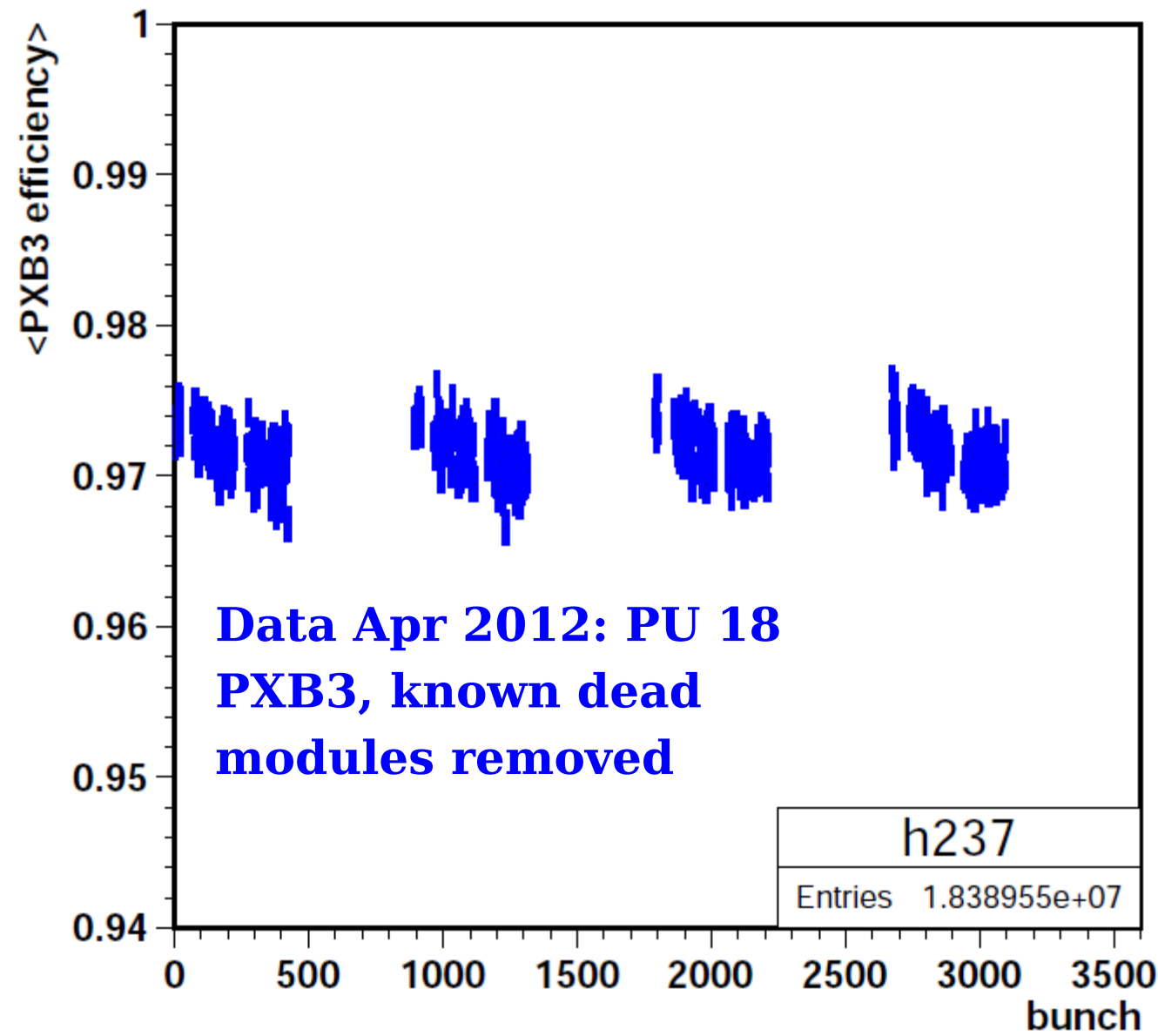| h010	
Entries	158360
Mean	18.669
RMS	4.87805
Underflow	0
Overflow	10

- Fill 2497 (2.5h)

- Mean number of CMS reconstructed vertices in this sample is 18.7

Bunch pattern fill 2497

- LHC:
  - 26'659 m
  - 89 us / turn
  - space for 3564 bunches at 25 ns.

- fill 2497:
  - 624 bunches filled in 12 trains
  - 4 long gaps: **~11 µs**

Pixel barrel layer 3 efficiency

Data Apr 2012: PU 18 PXB3, known dead modules removed

| h237	
Entries	1.838955e+07

- Efficiency for layer 3:
  - ‣ z-gaps taken out
  - ‣ **known** dead or bad modules **are taken out.**

- Hit in PXB1 or PXB2 required.

- Mean efficiency is 97.2%.

- Dynamic degradation: at most -0.3%.

Pixel barrel layer 2 efficiency

Data Apr 2012: PU 18 PXB2, known dead modules removed

h227	
Entries	1.906494e+07
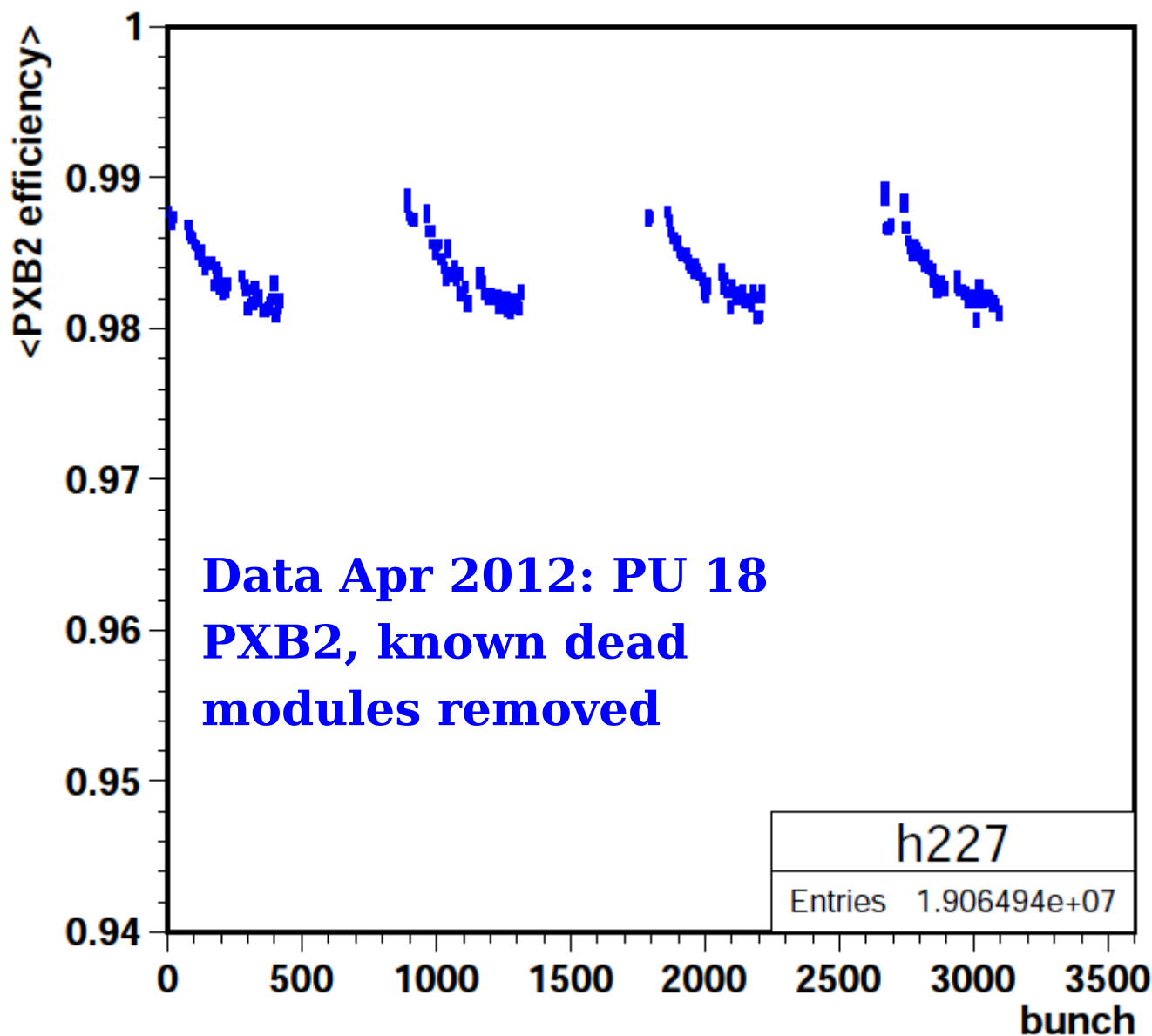
- Efficiency = (tracks with hit in PXB2) / (tracks through PXB2 – z-gaps – dead modules)
  - ‣ z-gaps taken out,
  - ‣ dead or bad modules **are taken out.**

- Hit in PXB1 required.

- Mean efficiency is 98.4%.

- Dynamic inefficiency: about -0.6%.
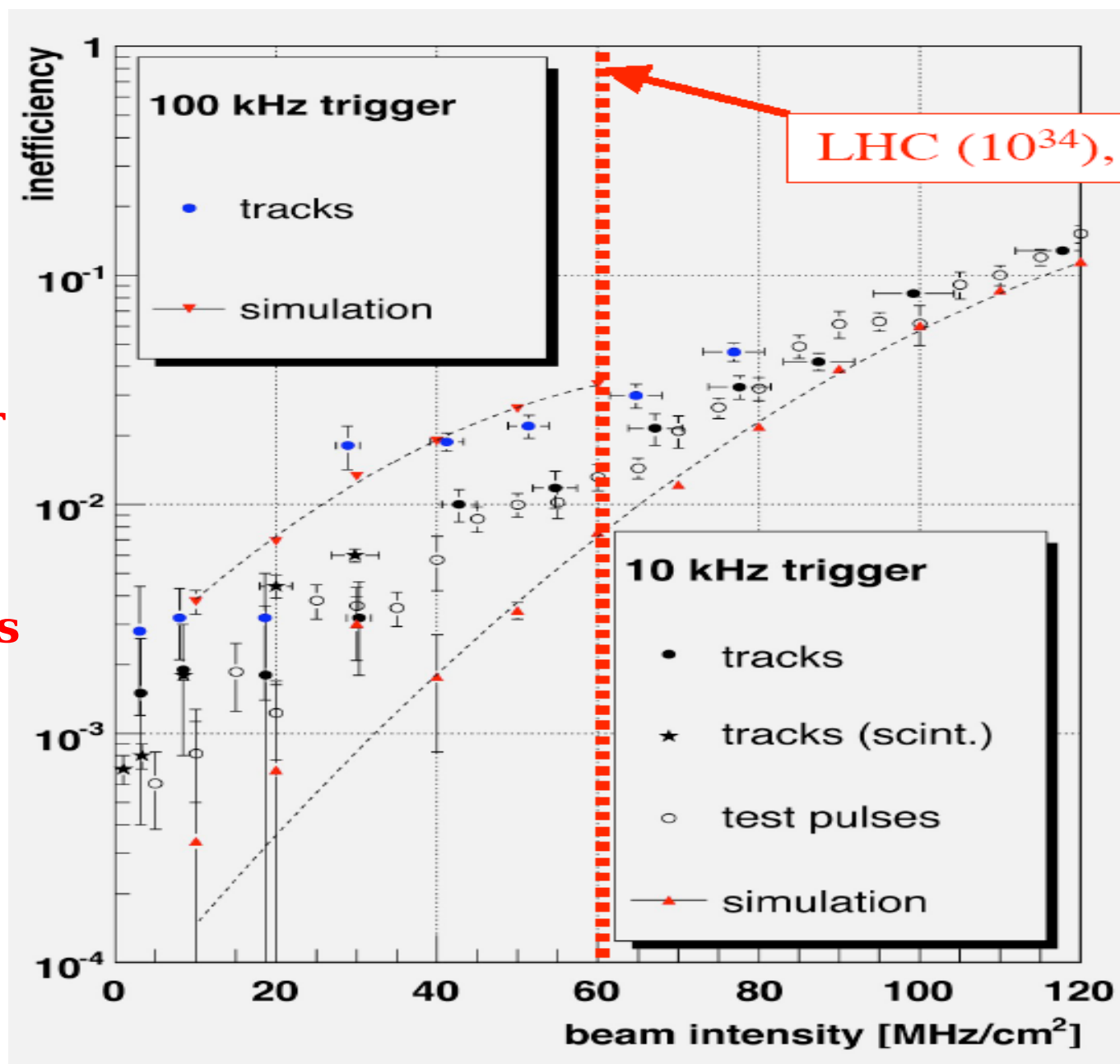
Pixel barrel layer 1 efficiency
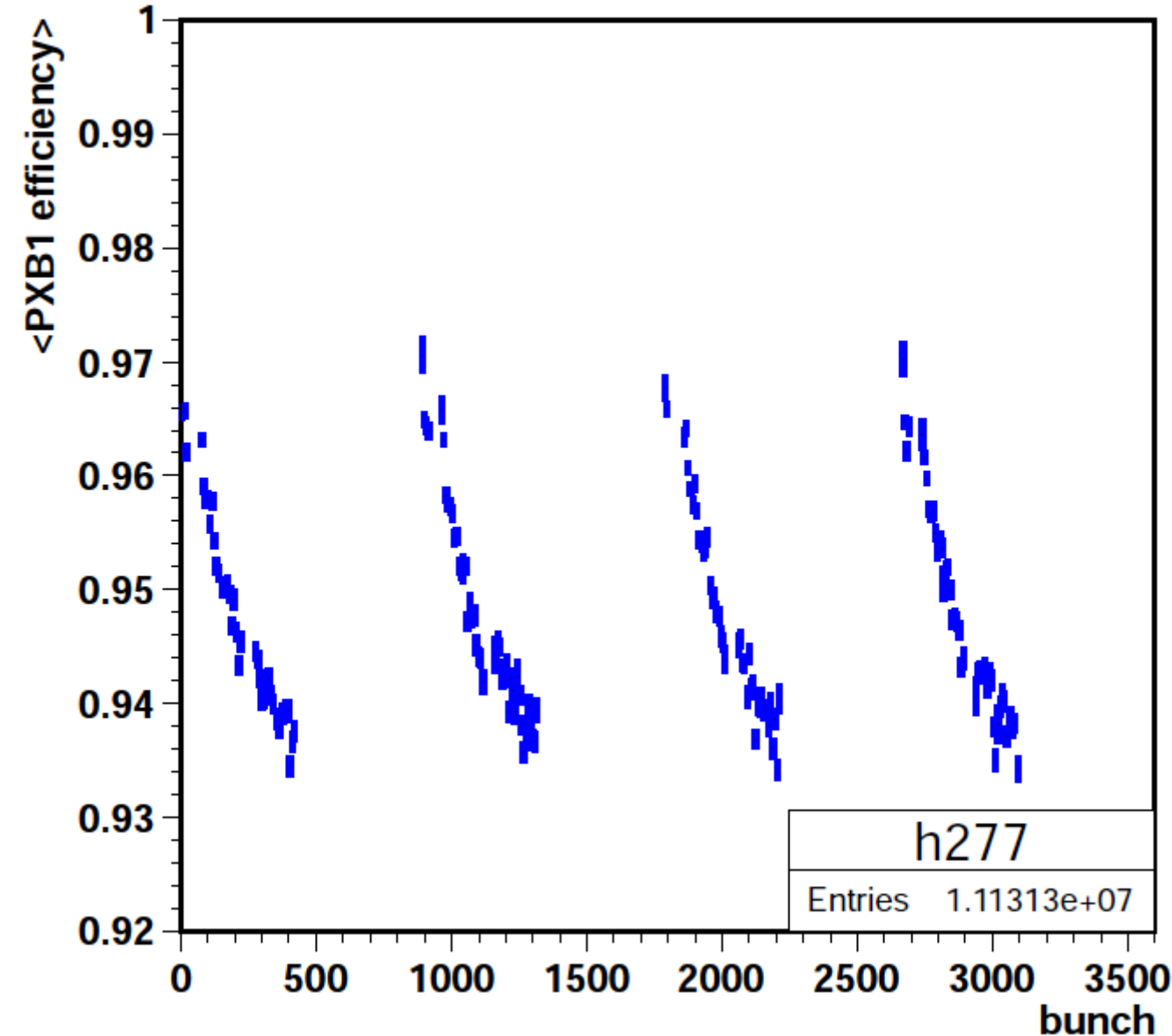
- Efficiency = (tracks with hit in PXB1) / (tracks through PXB1 – z-gaps)

  ‣ z-gaps taken out,

  ‣ one dead module taken out.

- Peak efficiency 96.8%.

- Dynamic inefficiency -3%.

Pixel ROC inefficiency

Apr 2012:
52 kHz trigger

$L_{avg} = 2.5 \cdot 10^{33}$
in 618 bunches
at 50 ns

$\simeq 1 \cdot 10^{34}$ **in**
2472 bunches
25 ns
$\simeq$ **design!**

PSI high rate test beam 2005

Data loss mechanisms

Present PSI46 readout chip simulated at LHC design luminosity

Pixel busy:
0.04% / 0.08% / 0.21%
pixel insensitiv until hit
transferred to data buffer
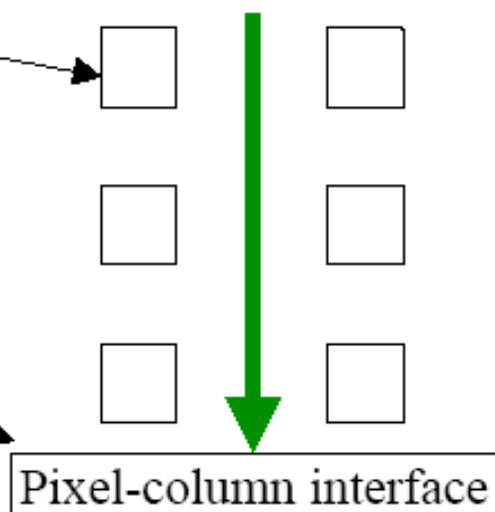(column drain mechanism)

Double column busy:
0.004% / 0.02% / 0.25%
Column drain transfers hits
from pixel to data buffer.
Maximum 3 pending column
drains requests accepted

Data Buffer full:
0.07% / 0.08% / 0.17%

Pixel-column interface

Timestamp Buffer full:
0 / 0.001% / 0.17%

Readout and double column reset:
0.7% / 1% / 3.0%
for 100kHz L1 trigger rate

Double column readout

- 1xLHC: $10^{34} cm^{-2} s^{-1}$
- 11 cm / 7 cm / 4 cm layer
- total data loss @ 100kHz L1A:
  - 0.8%
  - 1.2%
  - 3.8%

H.C. Kaestli, CMS Tracker upgrade workshop Feb 2007
http://indico.cern.ch/conferenceDisplay.py?confId=12094

Summary

- Dynamic inefficiency in PXB1 at PU 18 is about -3%

- Similar studies in Sep 2011 with PU 12 gave about -1%

- Similar studies on March 2011 with PU 5-6 gave about -0.5%

- PXB2 dynamic inefficiency is about -0.6 at PU 18

- Does it agree with simulation?

- Is the effect included in CMS simulation?

- Plot for TDR?