Brilcalc and 2010 data: solved

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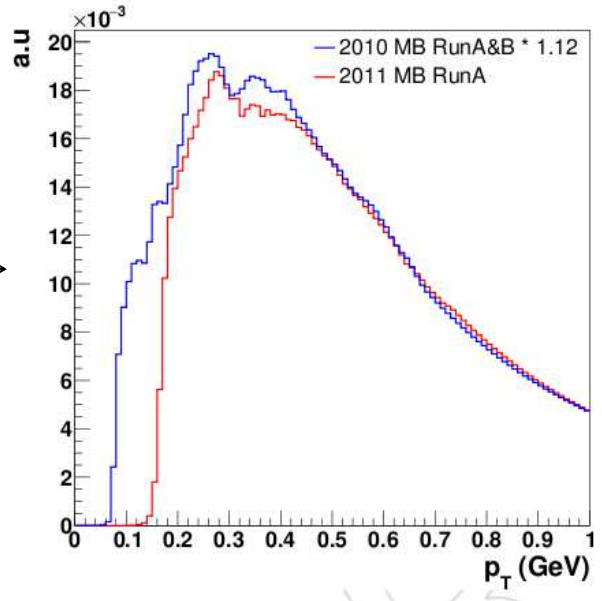
Excerpt from LUM POG meeting, 28.4.2020, + extensions

(feedback to/conclusion of issues raised on BRIL DPG and QCD meetings , 7. 4. and 9.4. 2020)

- **Why still study 2010 data?** **(available 100% as Open Data)**
  - **measure total charm and beauty cross sections as a function of sqrt(s) from Zerobias and MinimumBias events (analysis in BPH group) -> 0.9, 2.76, 5, 7, 8 and 13 TeV**
  - https://indico.cern.ch/event/880288/contributions/3713632/attachments/1972446/3281551/BPH_200120.pdf
- **Why Run 1?**
  - **measurements, e.g. at 7 TeV, can not be done on Run 2 data**
- **Why 2010 rather than 2011?**
  - **need special 2010 tracking to access "slow pions" from D* decays with p_T<200 MeV**
- **Why Brilcalc to calculate luminosity?**

  original tool, lumicalc, no longer available/supported



Brilcalc issues on 2010 data

All results refer to brilcalc on 2010 Runs A and B (legacy data), with Golden JSON

Cert 136033-149442 7TeV Apr21ReReco Collisions10 JSON v2.txt

Initial diagnosis: Working fine for unprescaled triggers in Run B, problems for many others

Thanks to great feedback from the BRIL and LUMI groups to the presentation on April 7, several issues could be identified more specifically and kindly fixed by Zhen Xie

1. HLT prescales turned out to be missing completely from boths Runs A and B.
-> Zhen kindly updated/reloaded the HLT prescale database.
-> fixed 2010 Run B and improved 2010 Run A.

2. Some runs in Run A were not accounted for e.g. in the muon triggers.
-> kindly solved by Zhen by recommending the --ignoremask flag.
-> fixed unprescaled triggers in Run A and improved prescaled ones (Run B remains the same)

3. Prescales were still missing for some triggers (including ZeroBias) for a subset of runs in Run A
-> Zhen kindly updated/reloaded the prescale database for these runs
-> all problems fixed in boths Runs A and B ☺

only remaining small issue: some of the HLT_L1Tech… triggers behaved erratically under all these changes and still do not give reasonable results
-> technical triggers presumably not meant to be used? Thus presumably **OK**.

Update of documentation to include recommendation of –ignoremask for 2010, and warning not to trust result for L1Tech triggers?

How did we check that results are OK?

- compare with previous records (from lumicalc) which use the legacy processing

E.g. (Run A+B, prescaled)	**CMS-FSQ-15-003**	**Brilcalc**	**(+-4%)**
HLT_Jet15U (heavily prescaled)	**26.7 nb^{-1}**	**26.7 nb^{-1}**	
HLT_DoubleJet15U_ForwardBackward (mildly prescaled)	**5.36 pb^{-1}**	**5.368 pb^{-1}**	

- all unprescaled triggers now have the same luminosity for Run A (3.13 pb^{-1}) and Run B (31.88 pb^{-1})

- measure average HLT_Zerobias prescale from overlap with unprescaled trigger: (see AN-18-284)

-> measure prescaled luminosity

		events	av. prescale	unpr.. lumi	**eff. lumi**	**Brilcalc**
e.g. HLT_DoubleMu3 & HLT_Zerobias	Run A:	36/ 317949	= 1/ 8832	3.13 pb^{-1}/8832	= 0.354 nb^{-1}	0.364 nb^{-1}
---------- : HLT_DoubleMu3	Run B:	44/6221623	= 1/141400	31.88 pb^{-1}/141400	= 0.226 nb^{-1}	0.245 nb^{-1}
				Run A+B:	**0.580 nb^{-1}**	**0.609 nb^{-1}**

similar, consistent, numbers also from other combinations of prescaled and unprescaled triggers

-> evaluation of luminosities and prescales by Brilcalc now OK!

Follow-up: calculation of luminosities for charm analysis

Zerobias triggers from Run A+B ZeroBias and Minimumbias datasets with Golden JSON: can use Brilcalc directly: 0.61 nb-1

use this to measure "effective cross section for reconstructed good quality primary vertices": 52.1 +- 2.1 mb

In turn, use this to determine luminosity for other triggers and datasets relevant for charm analysis from simple vertex counting:

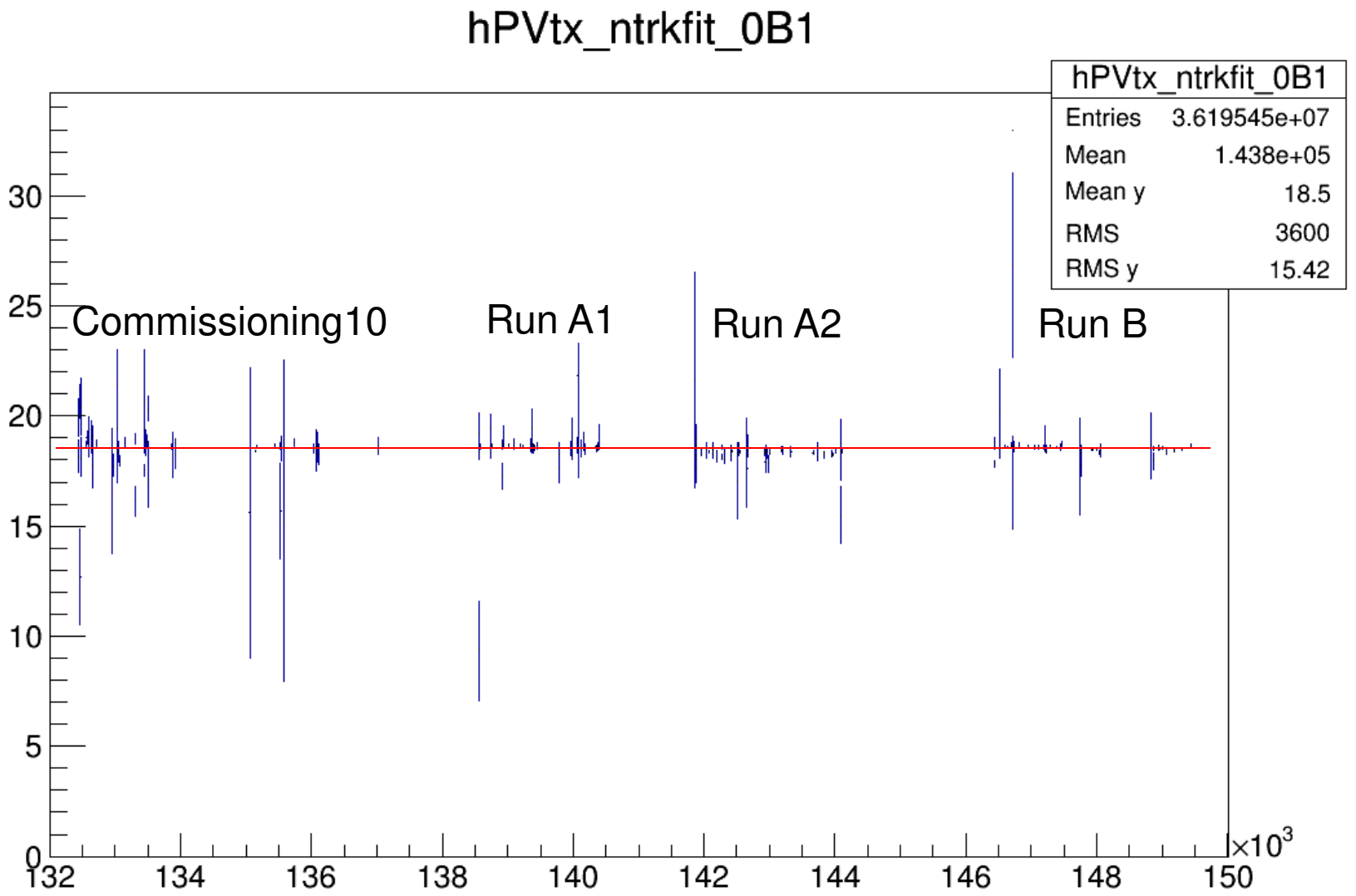
Other MinimumBias(like) triggers from Run A+B ZeroBias and MinimumBias datasets	0.39 nb-1
(MinimumBias trigger efficiency measured to be ~99%)	
ZeroBias and MinimumBias triggers from Commissioning10 Runs	0.63 nb-1
Next-to-Minimum Bias events (NMB, = pileup) from Run A+B MuOnia datasets with Golden JSON (mainly dimuon triggers)	0.47 nb-1
NMB from Mu and MuMonitor datasets, Run A+B, golden JSON (mainly single mu)	0.46 nb-1
NMB from EG, Electron and EGMonitor datasest, run A+B, golden JSON (single e)	0.44 nb-1
Sum:	3.00 nb-1

Backup

control plots for various trigger/pileup selections

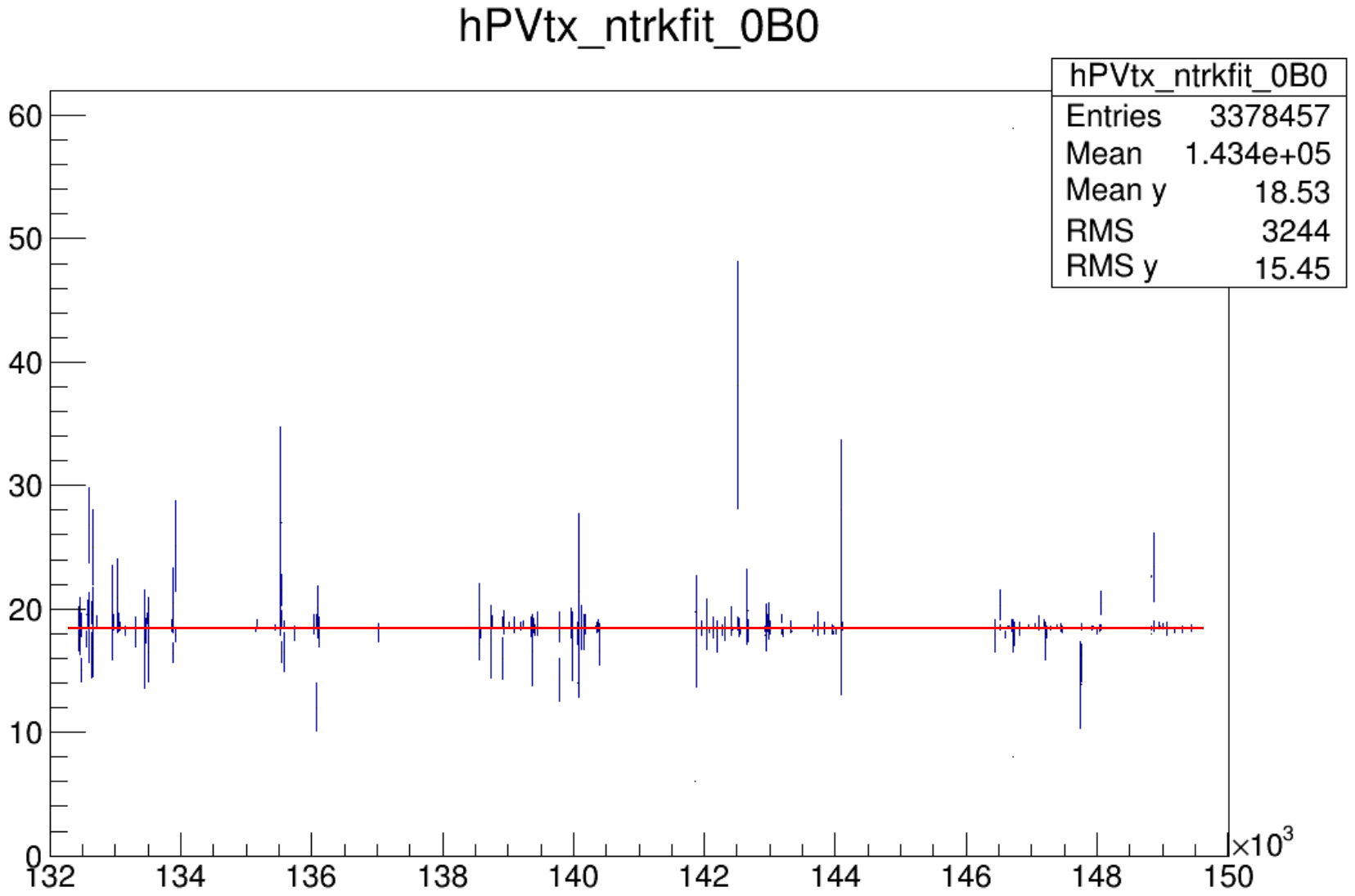
Trigger and vertex stability

average vertex track multiplicity vs. Run number, HLT_Zerobias triggers



Trigger and vertex stability

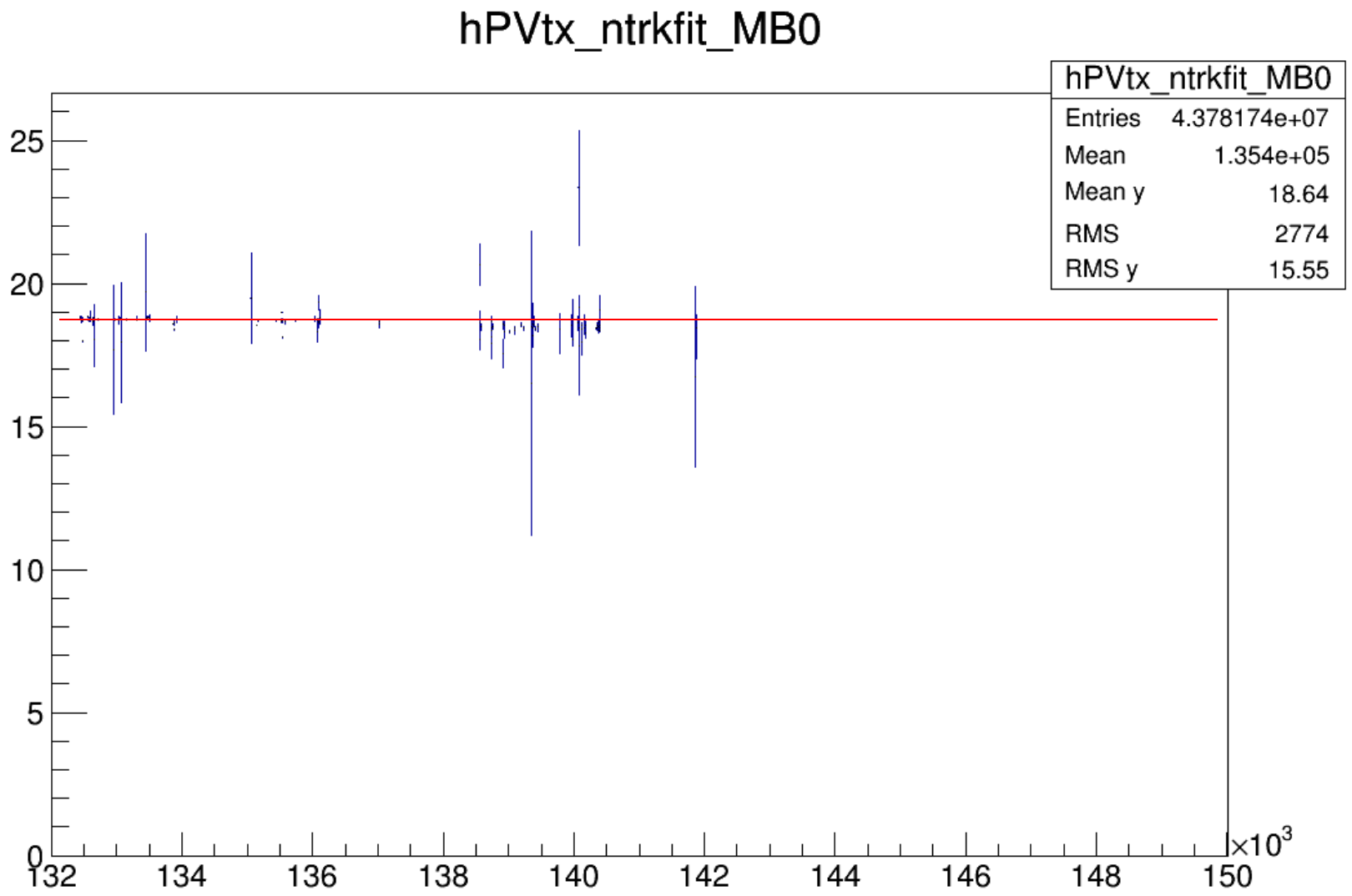
average vertex track multiplicity vs. Run number, HLT_BPTX triggers



Trigger and vertex stability

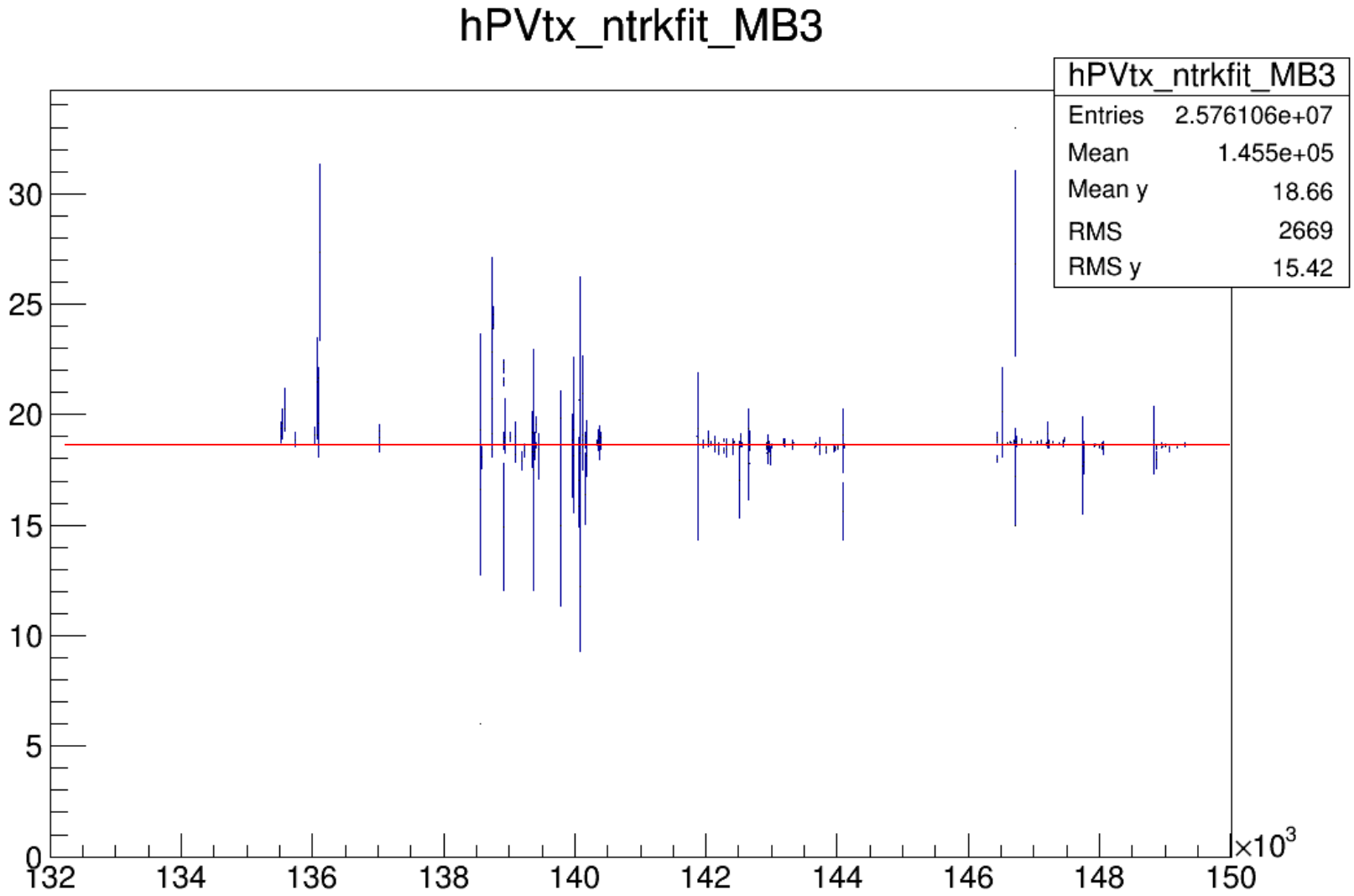
average vertex track multiplicity vs. Run number,

HLT_L1_BscMinBiasOR_BptxPlusORMinus triggers



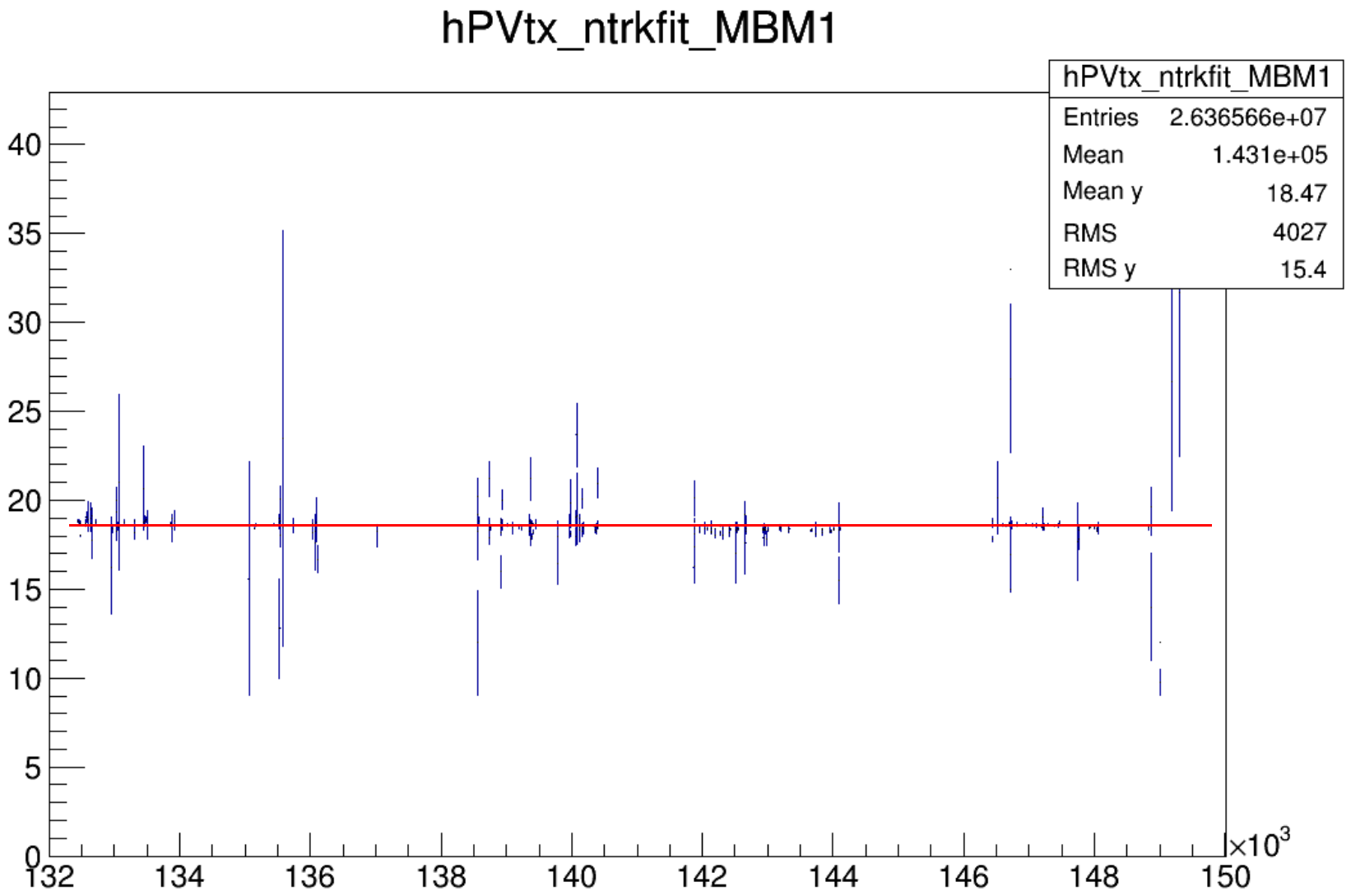
Trigger and vertex stability

average vertex track multiplicity vs. Run number, HLT_L1Tech_HCAL_HF triggers



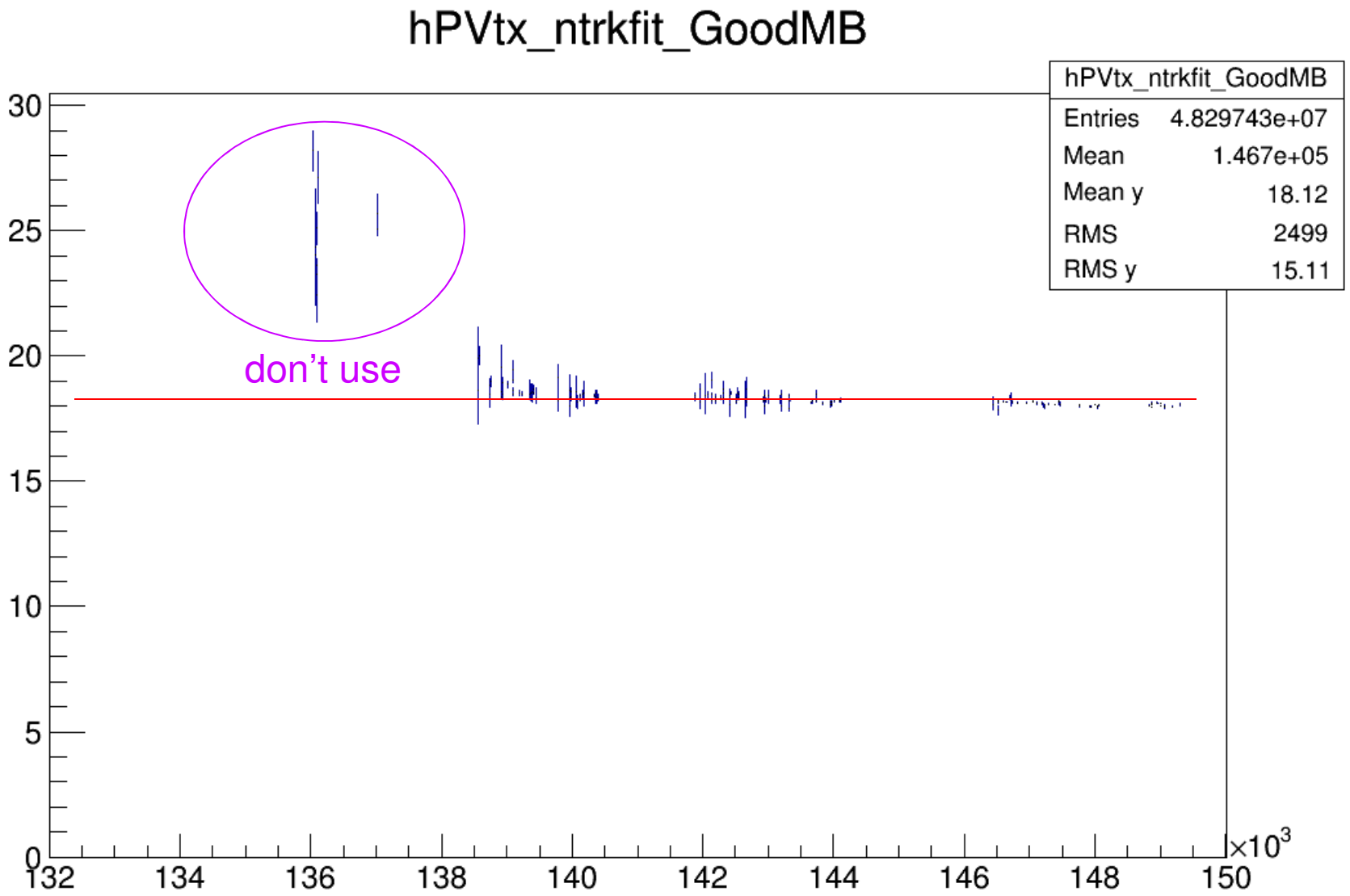
Trigger and vertex stability

average vertex track multiplicity vs. Run number, HLT_L1Tech_HCAL_HF triggers



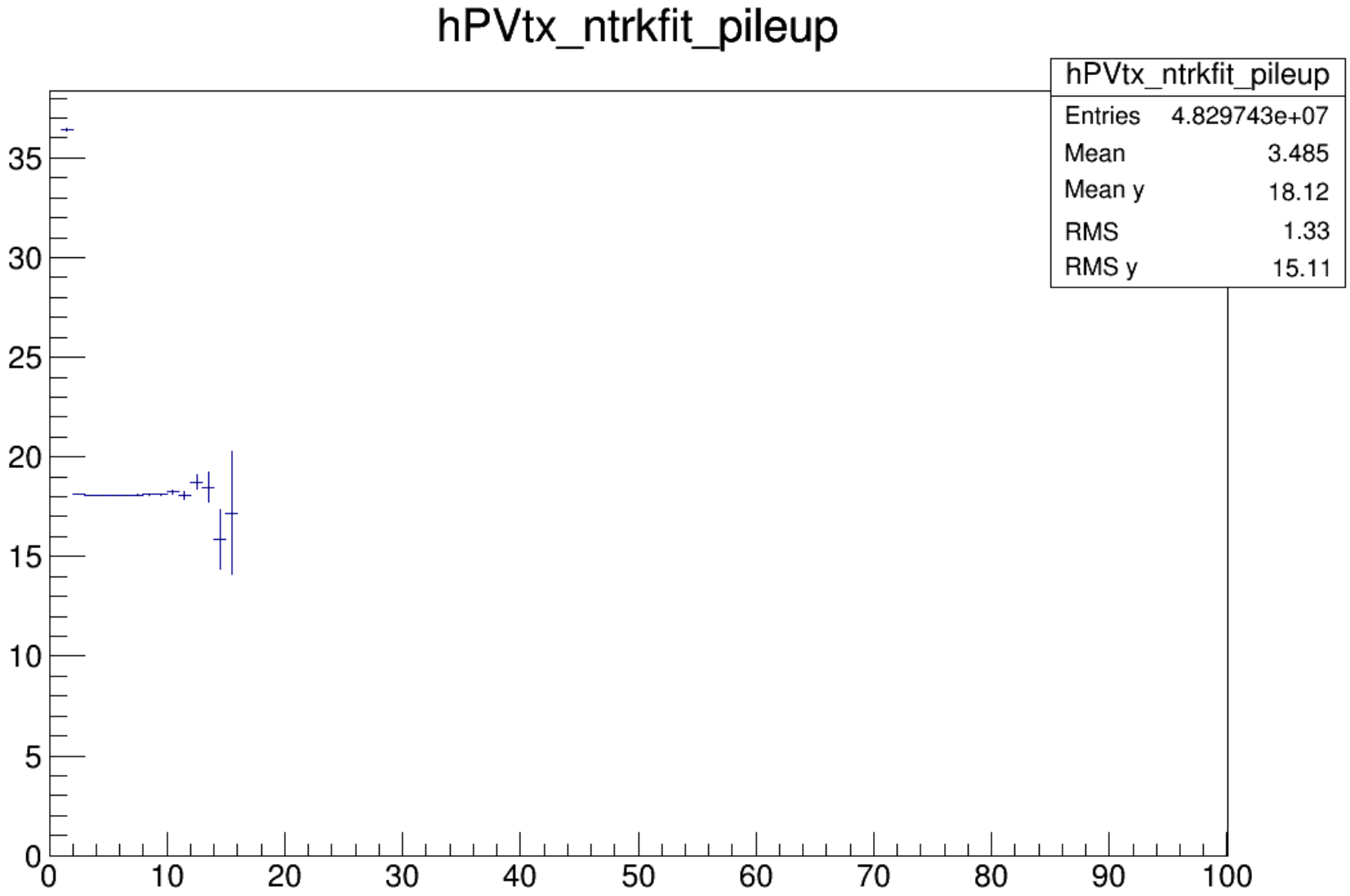
Trigger and vertex stability

average vertex track multiplicity vs. Run number, pileup from (di)muon triggers



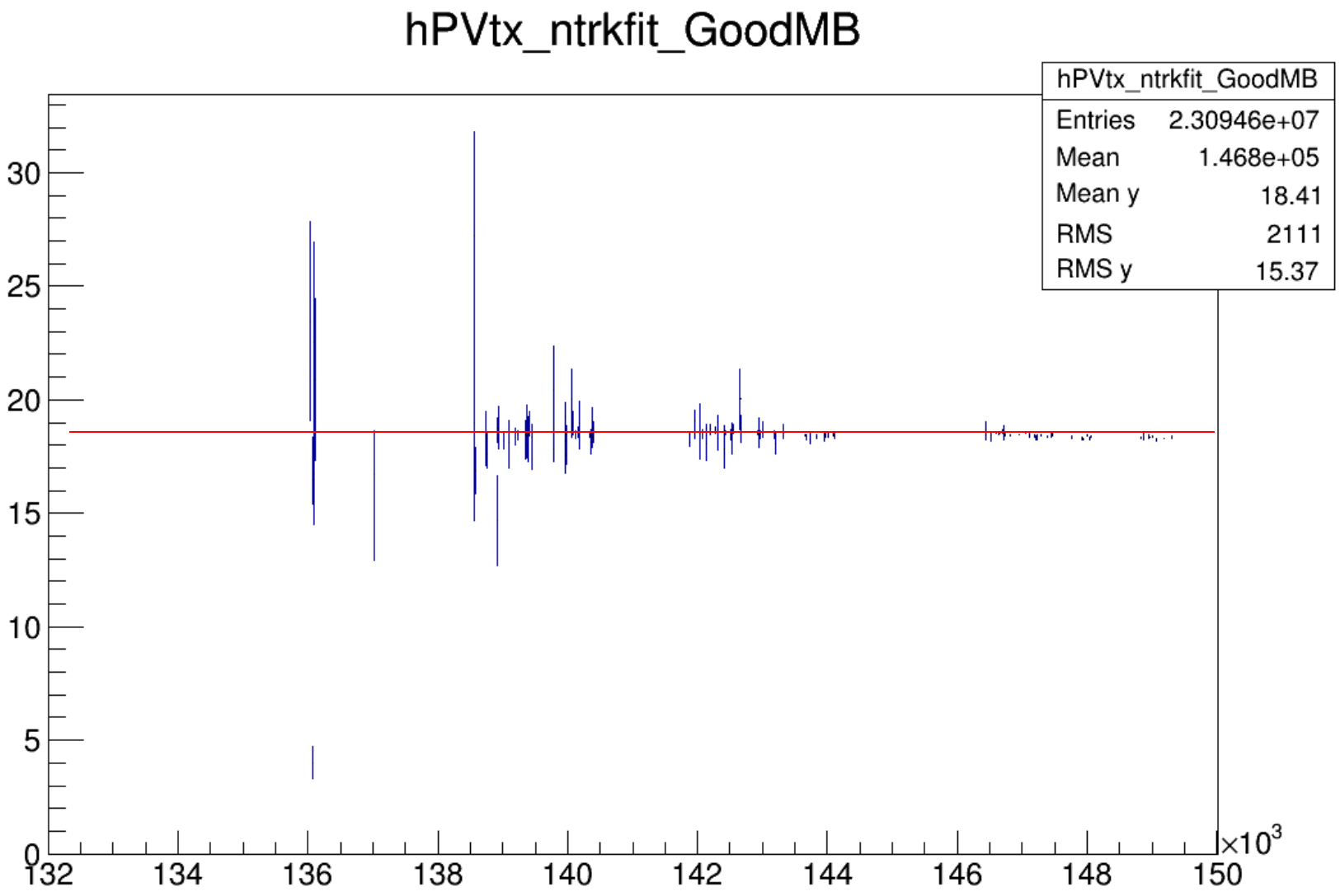
Trigger and vertex stability

average vertex track multiplicity vs. vertex multiplicity, pileup from (di)muon triggers



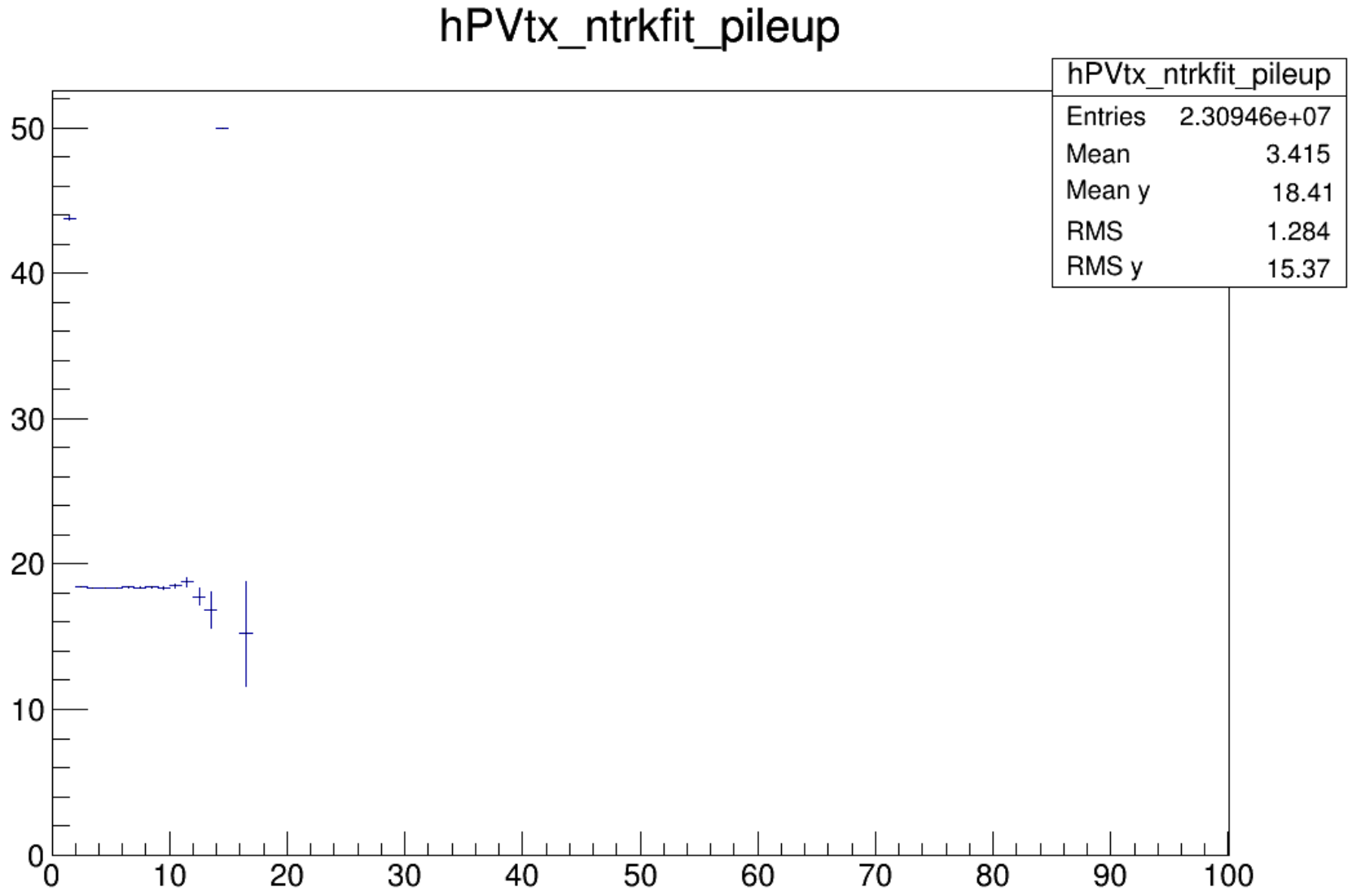
Trigger and vertex stability

average vertex track multiplicity vs. Run number, pileup from electron triggers



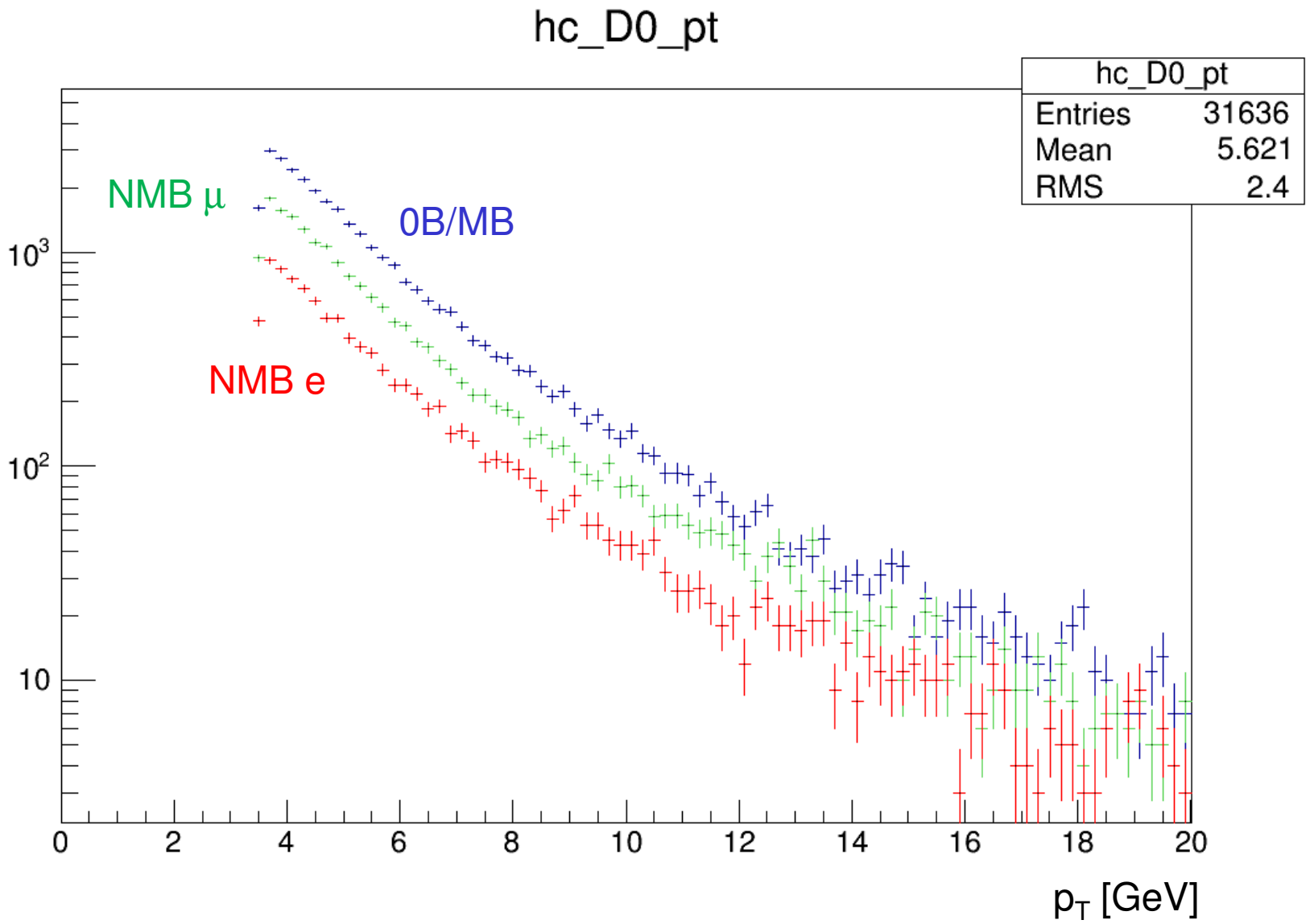
Trigger and vertex stability

average vertex track multiplicity vs. vertex multiplicity, pileup from electron triggers



Pileup (NMB) vs. Zero/Minimum Bias

p_T spectrum of D^0 candidates (mostly background) -> no bias!



Pileup (NMB) vs. Zero/Minimum Bias (earlier version)

D0_pt is a very sensitive value (candidates will be formed with trigger leptons if surviving)

0B/MB, muon, electron wrong!