L1 μ trigger rates and performance in ORCA 8.13

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CMS PRS/μ meeting

L1 μ rate calculations

- Progress preparing the production of weighted samples too slow
- July: Sridhara Dasu produced 10M plain min. bias events at Wisconsin - sufficient statistics to estimate L1 rates to 10%-20% up to any reasonable p_T threshold
- August-September: Jorge Troconiz produced GMT root trees from them with **ORCA 8.7.3** (directly at Wisconsin - difficult conditions)
- First results shown by Slava Valuev at CMS week on 20 September

L1 μ rate calculations

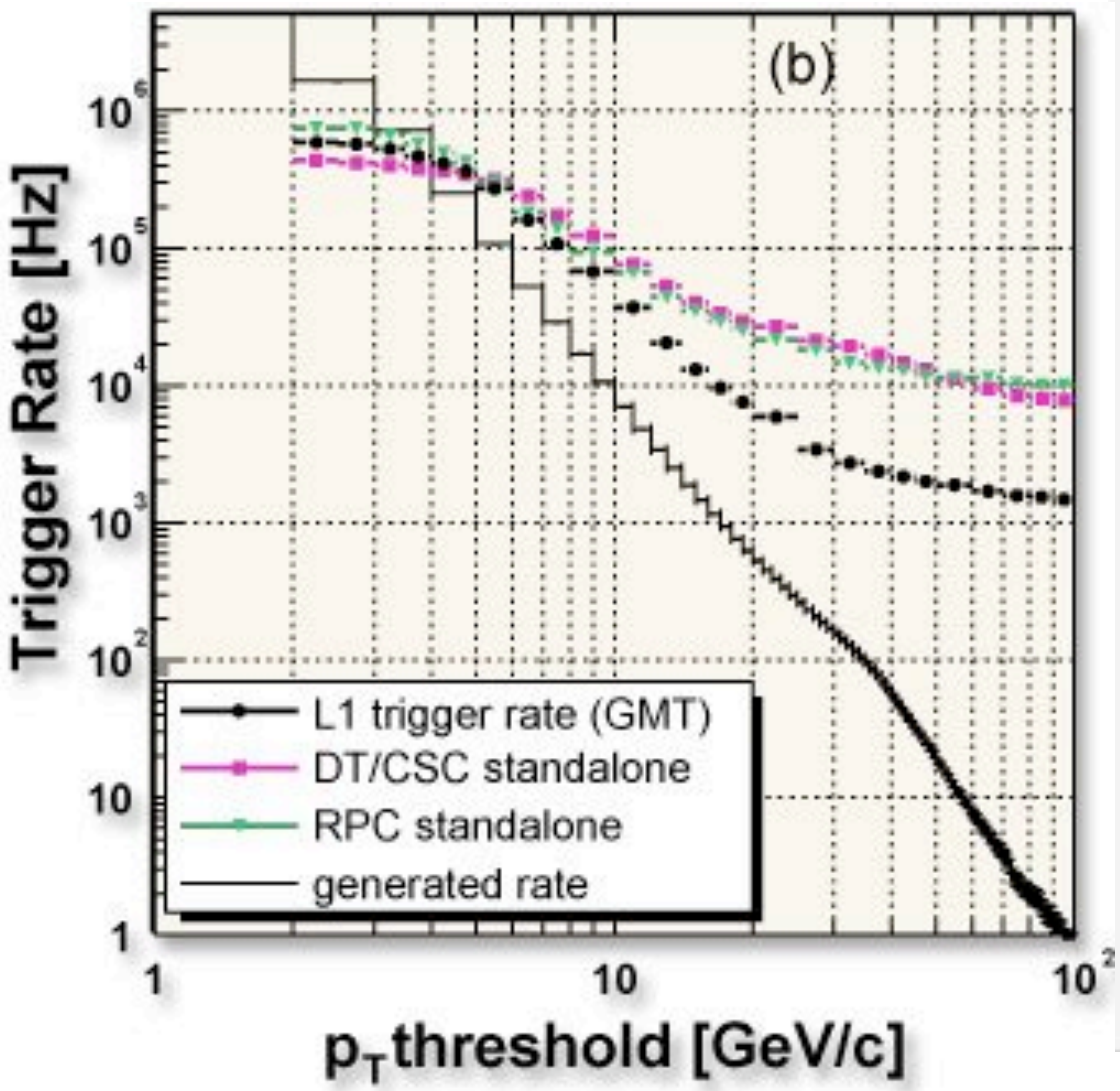
- Rates are calculated from trigger probabilities analytically (Hannes: CMS Note 2002/042)
- No need for real pile-up:
  - Its effect has been shown to be small with μ's (e.g. Hannes' thesis)
  - Care has to be taken not to recount same μ's
- Progress since CMS week:
  - All 10M events used
  - DTTF ghosts appropriately accounted for

Method

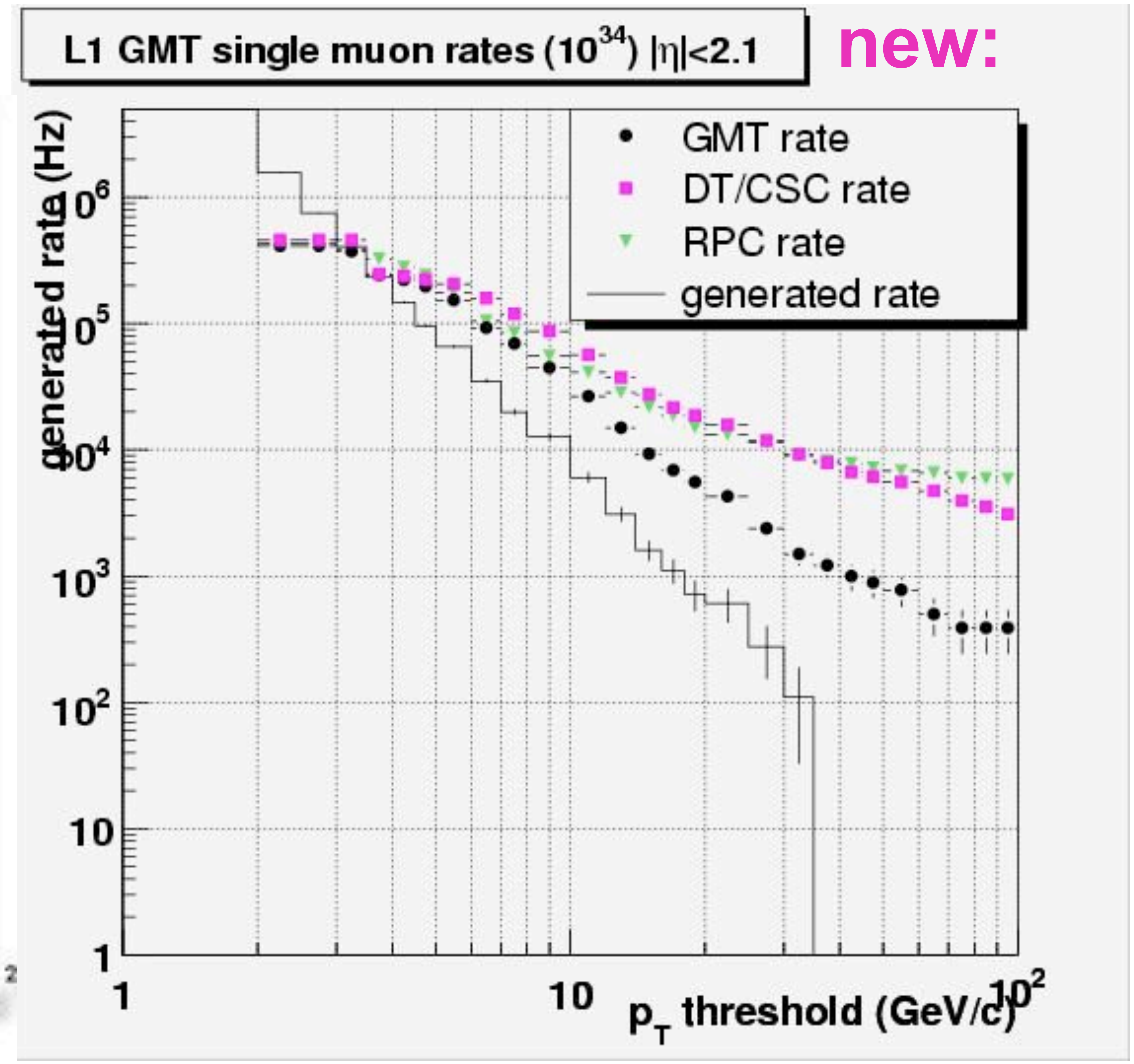
- Using effective BX rate of 32 MHz
- Using average number of interactions per BX:
  - 3.5 for $L=2x10^{33}$
  - 17.3 for $L=10^{34}$
- Accept quality bits $Q_{GMT} \geq 4$ for single muons and $Q_{GMT}=3$ or ≥ 5 for dimuons
- Each bunch crossing is considered as a separate event (DTTF ghosts)
- In dimuon rates, probabilities of exactly 1 muon above threshold are combined to take into account pile-up analytically

Comparison with DAQ TDR: 1μ

DAQ TDR:

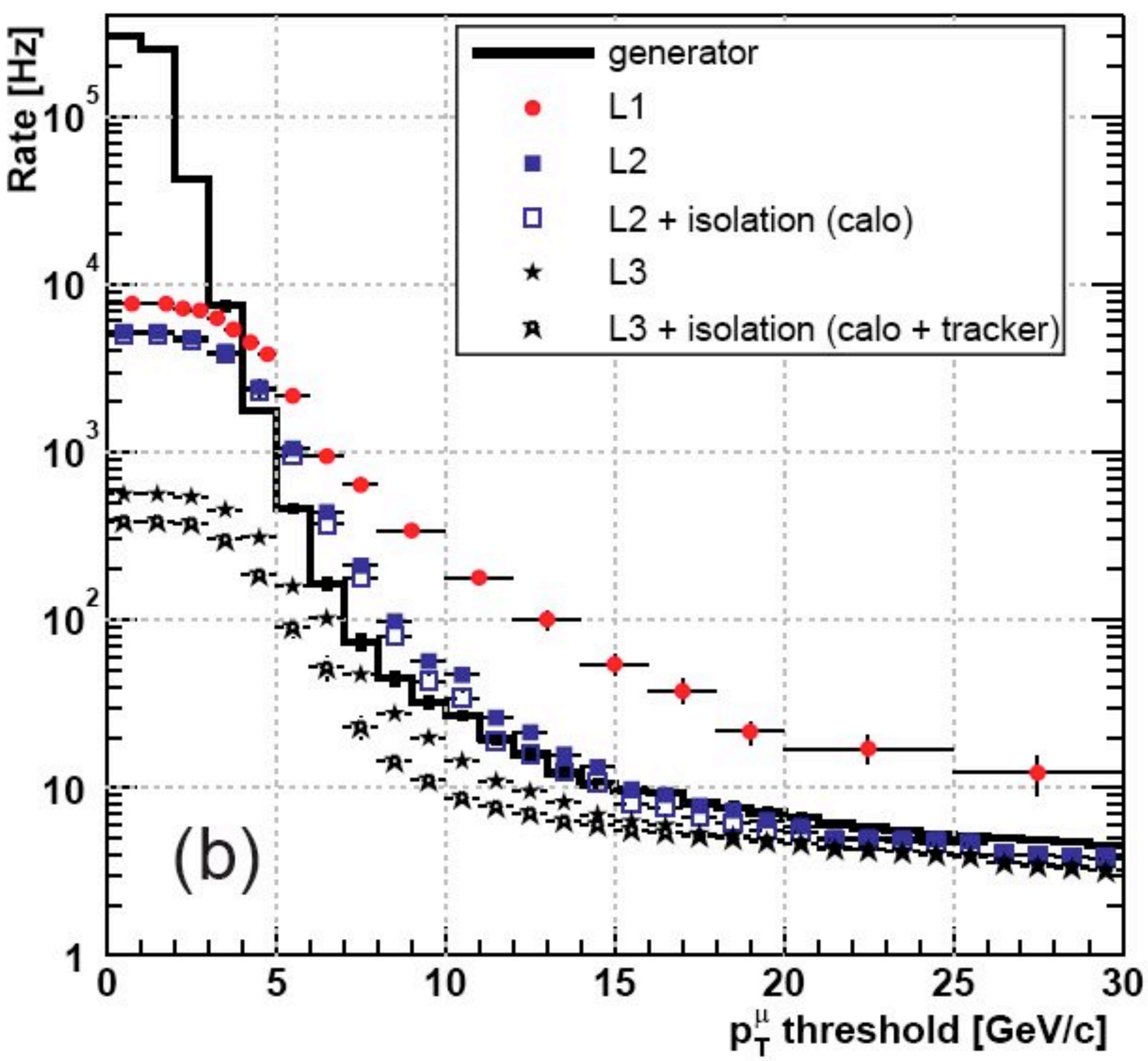


new:

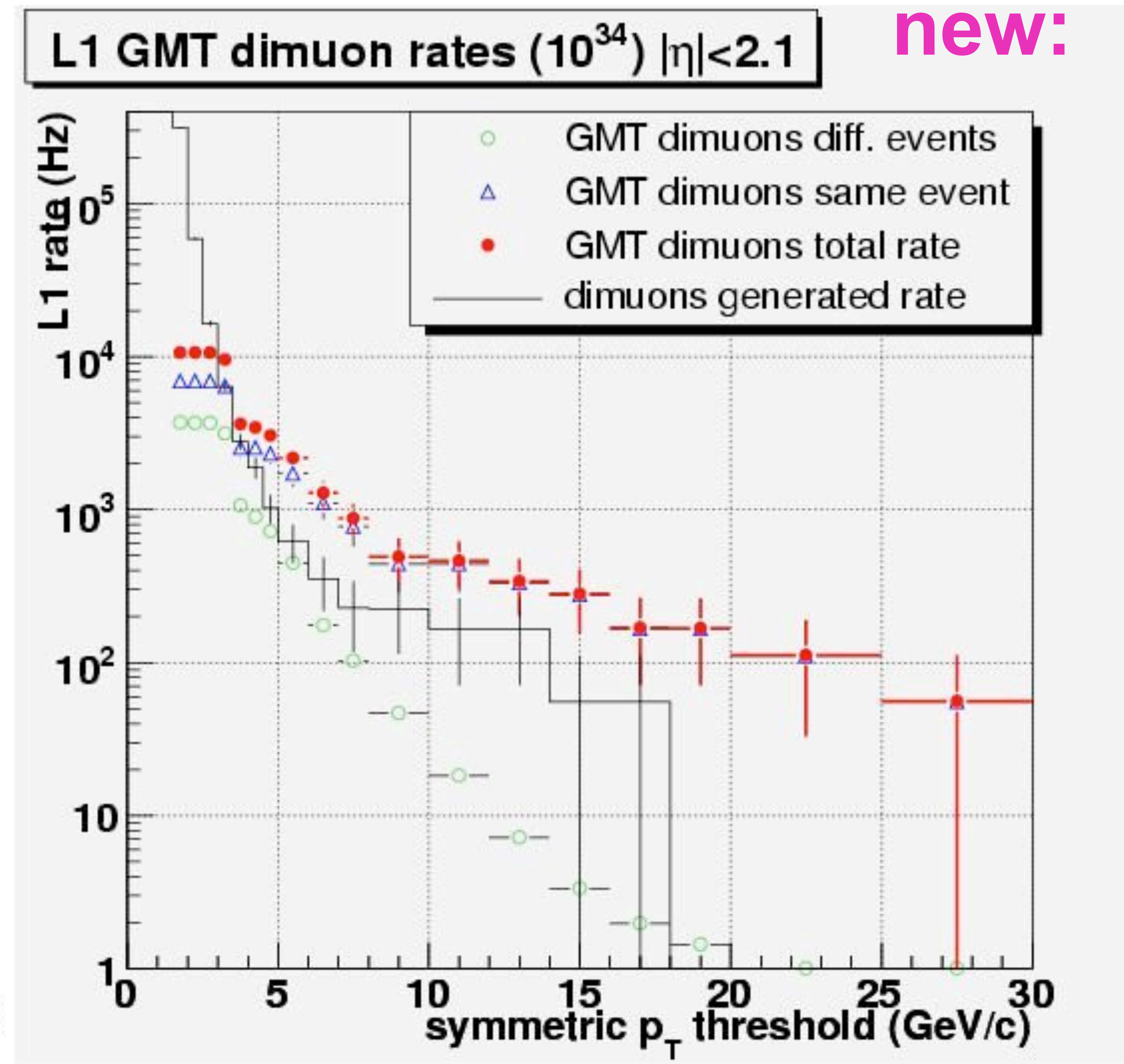


Comparison with DAQ TDR: 2μ

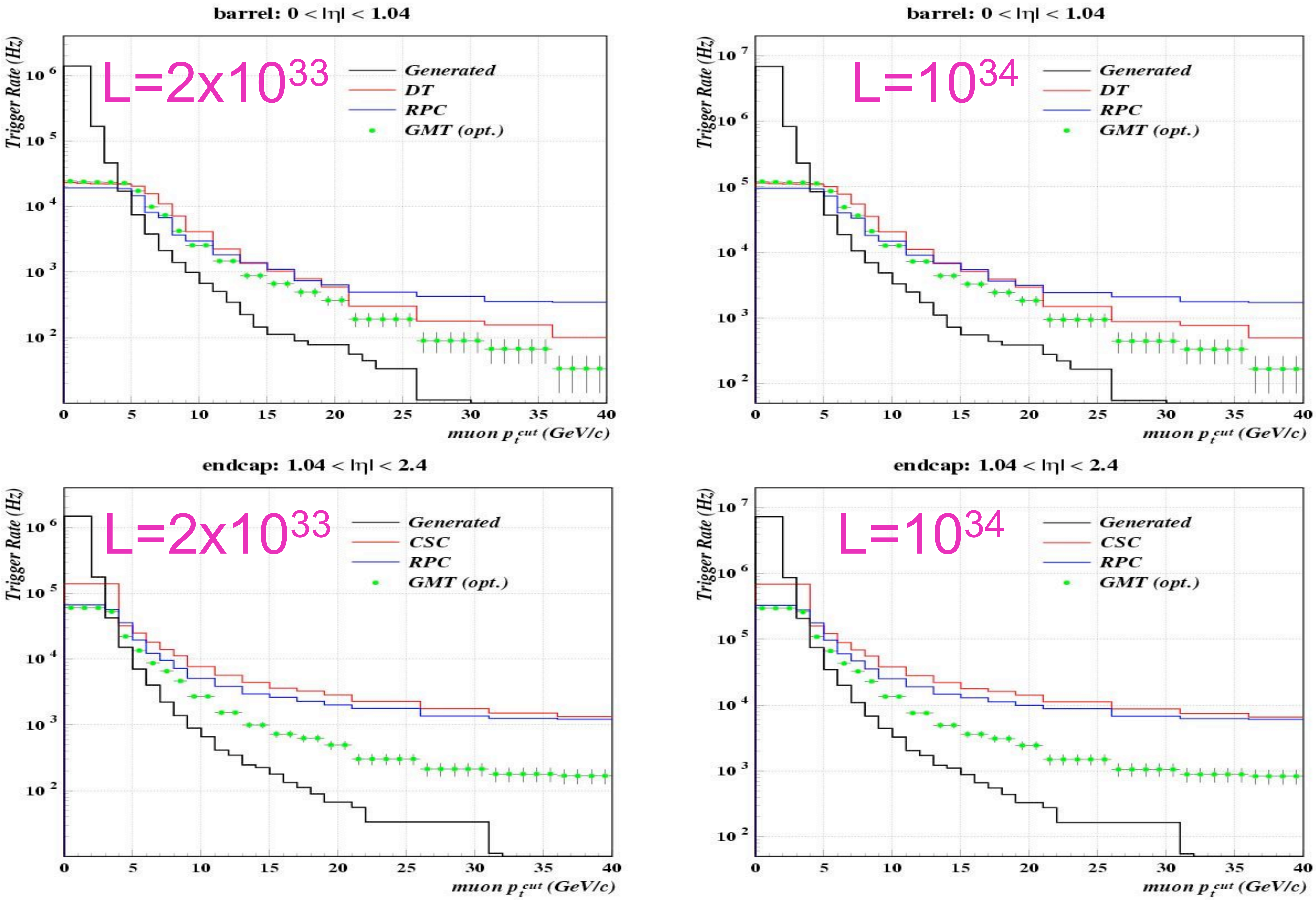
DAQ TDR:



new:



1μ rates barrel/endcaps

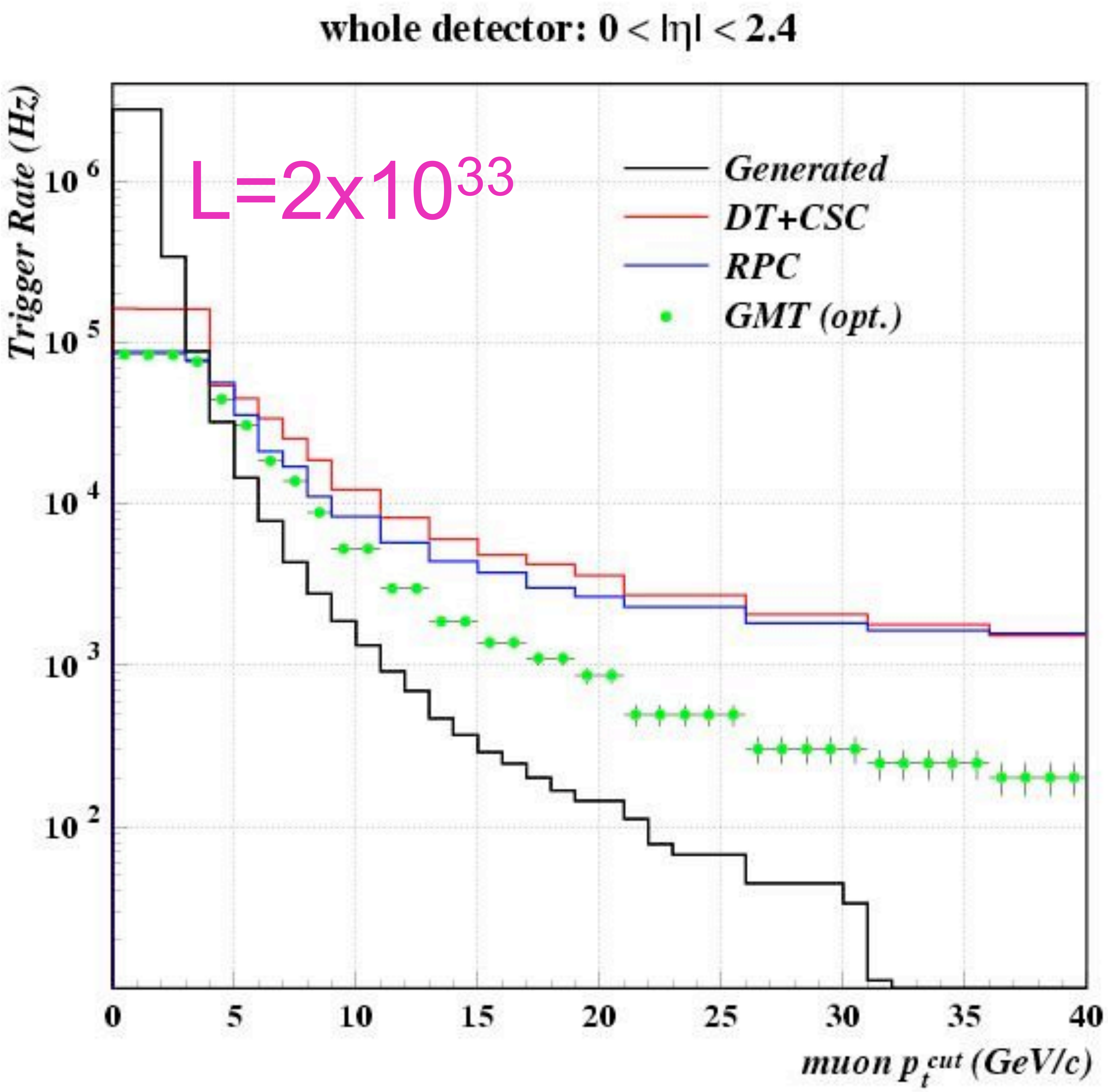


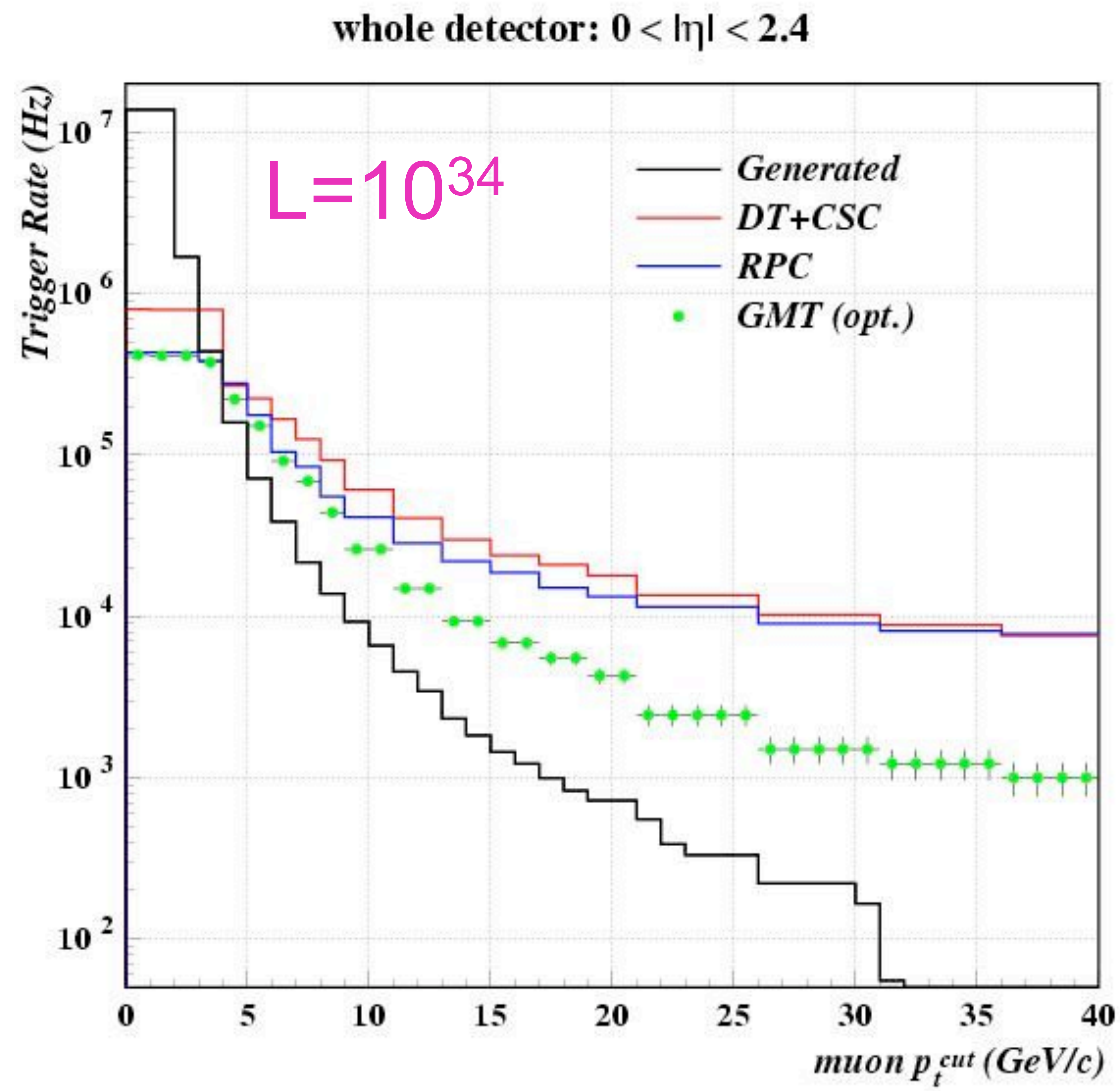
barrel

endcap

Plots by
Belen Lasanta,
Jorge Troconiz

1μ rates |η|<2.4

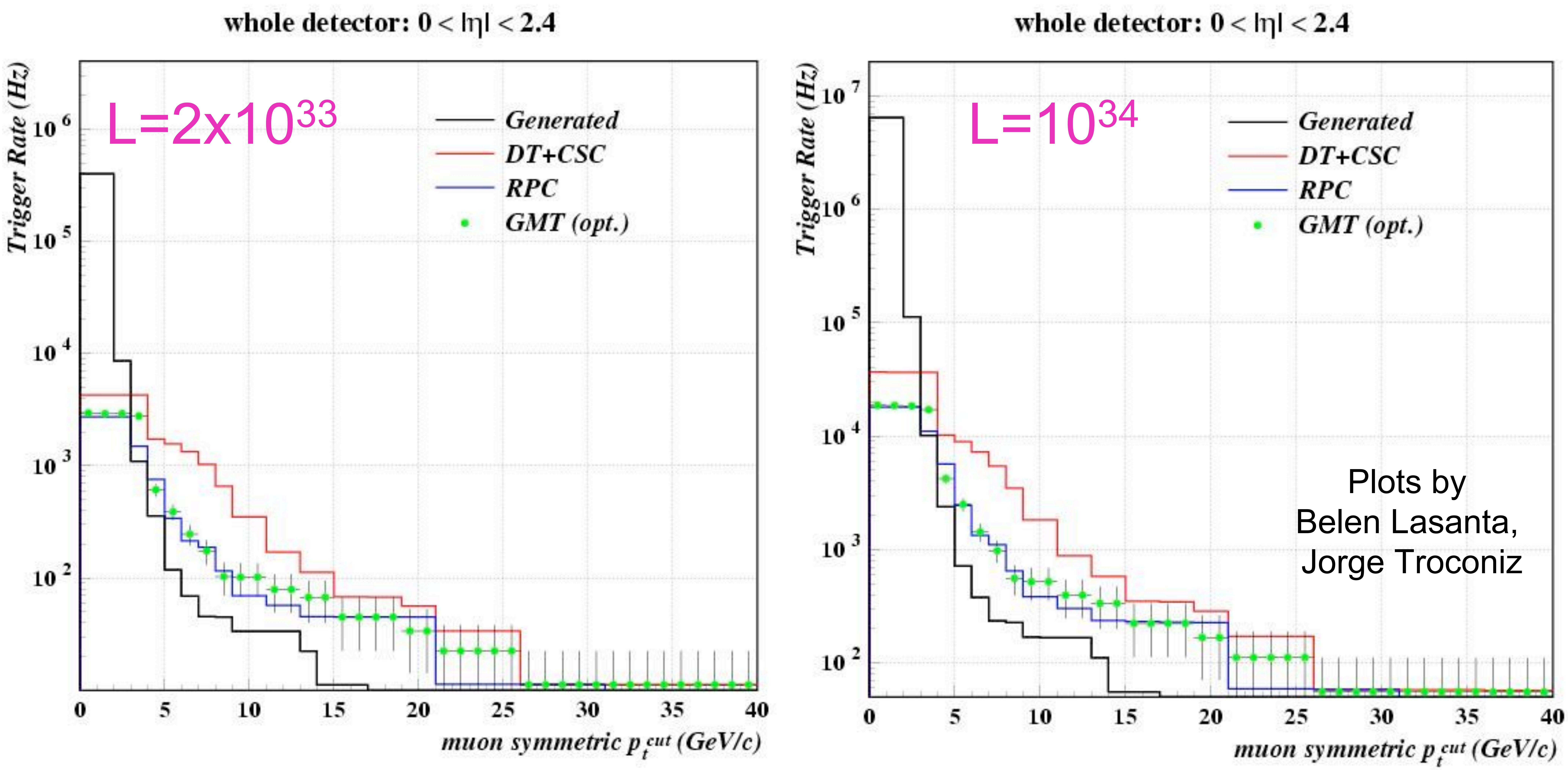




- No contribution from 2.1<|η|<2.4

Plots by Belen Lasanta, Jorge Troconiz

2μ rates |η|<2.4



- Contribution from $2.1<|\eta|<2.4$ only at $p_T<4$GeV

Numerical rate comparison

$L=2x10^{33}$	Single μ $p_T \geq 14$ GeV		Di μ $p_T \geq 3$ GeV		
	$\|\eta\|<2.1$	$\|\eta\|<2.4$	$\|\eta\|<2.1$	$\|\eta\|<2.4$	
DAQ-TDR	2.7		0.9		
new	1.8 ± 0.1	1.9 ± 0.1	1.4 ± 0.1	3.0 ± 0.2	kHz

$L=10^{34}$	Single μ $p_T \geq 20$ GeV		Di μ $p_T \geq 5$ GeV		
	$\|\eta\|<2.1$	$\|\eta\|<2.4$	$\|\eta\|<2.1$	$\|\eta\|<2.4$	
DAQ-TDR	6.2		1.7		
new	4.3 ± 0.5	4.3 ± 0.5	2.2 ± 0.3	2.3 ± 0.3	kHz

- Statistical precision fully sufficient up to much higher thresholds

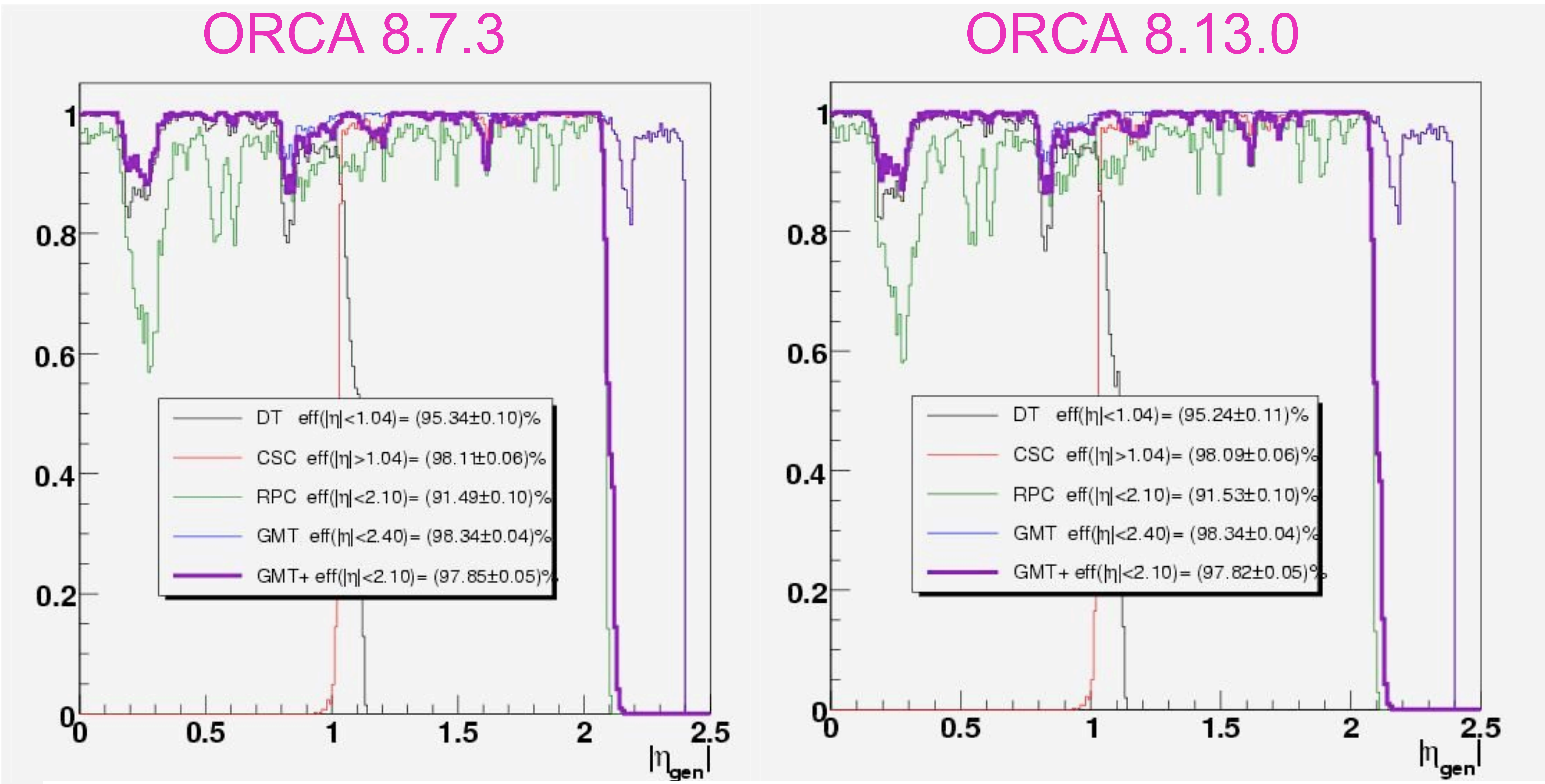
Comments on rates

- Single muon rates seem to be better than at DAQ-TDR at all p_T-thresholds:
  - Generated rates agree
  - All trigger components better - just normalisation?
- Dimuon rates slightly higher (by ~30%) at nominal thresholds - seems to be a result of higher generated rates
- In dimuon rates at high p_T-thresholds, generated and measured rates are much higher than in DAQ TDR
- Agreement in all points with Belen/Jorge, some differences with Sridhara (see his talk at Fermilab 6 Oct - e.g. 1μ at high luminosity)

Performance check with ORCA 8.13.0

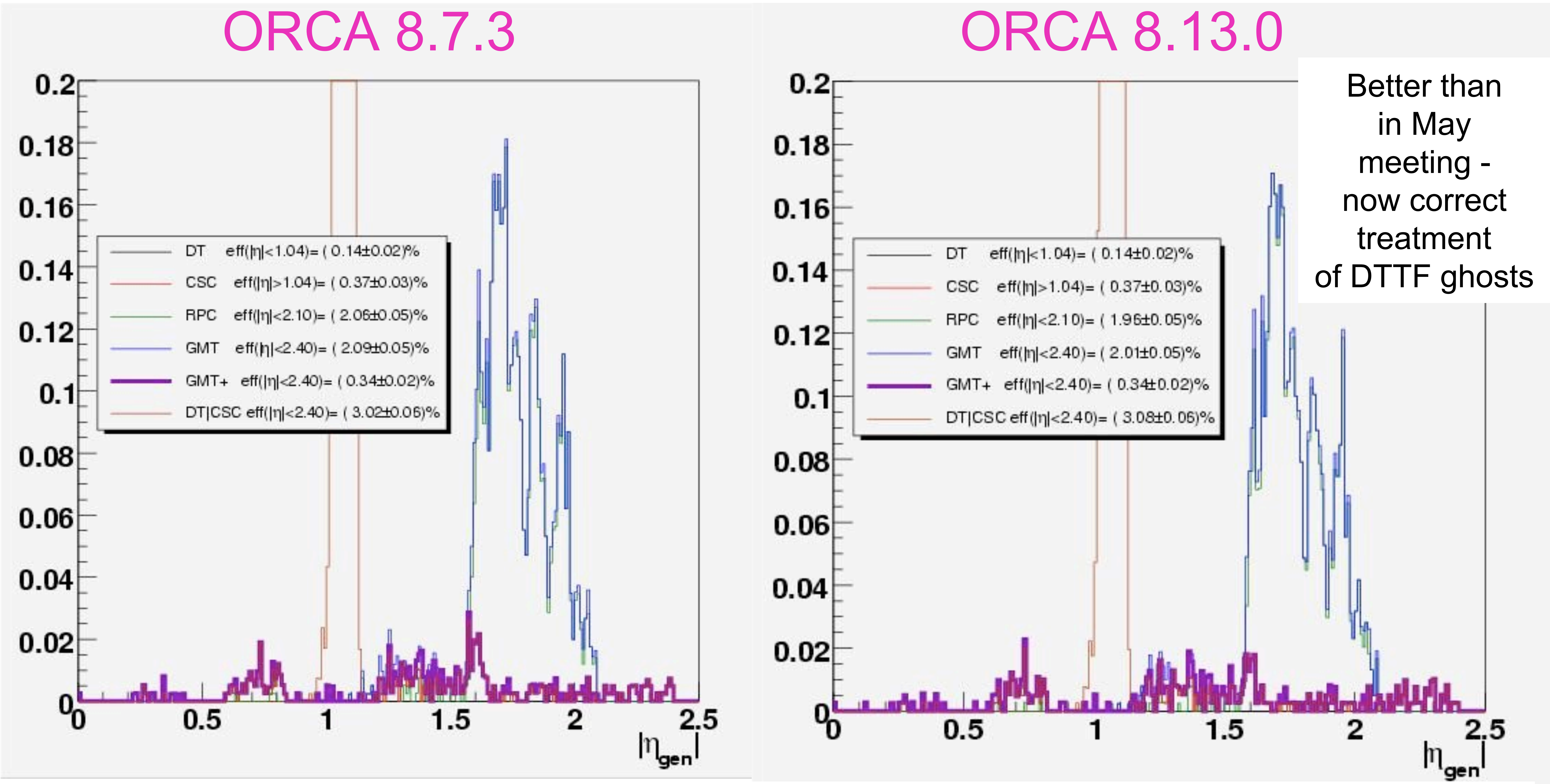
- Last performance check presented in PRS/μ meeting on May 24 (ORCA 8.8.0)
- Now compare ORCA 8.13.0 with ORCA 8.7.3
- Using single muons with $5<p_T<100$ GeV generated with OSCAR 3.6.0
- Main change after 8.7.3: upgrade of the CSC-TF code

Efficiency



- ➢ Efficiency unchanged

Ghost probability

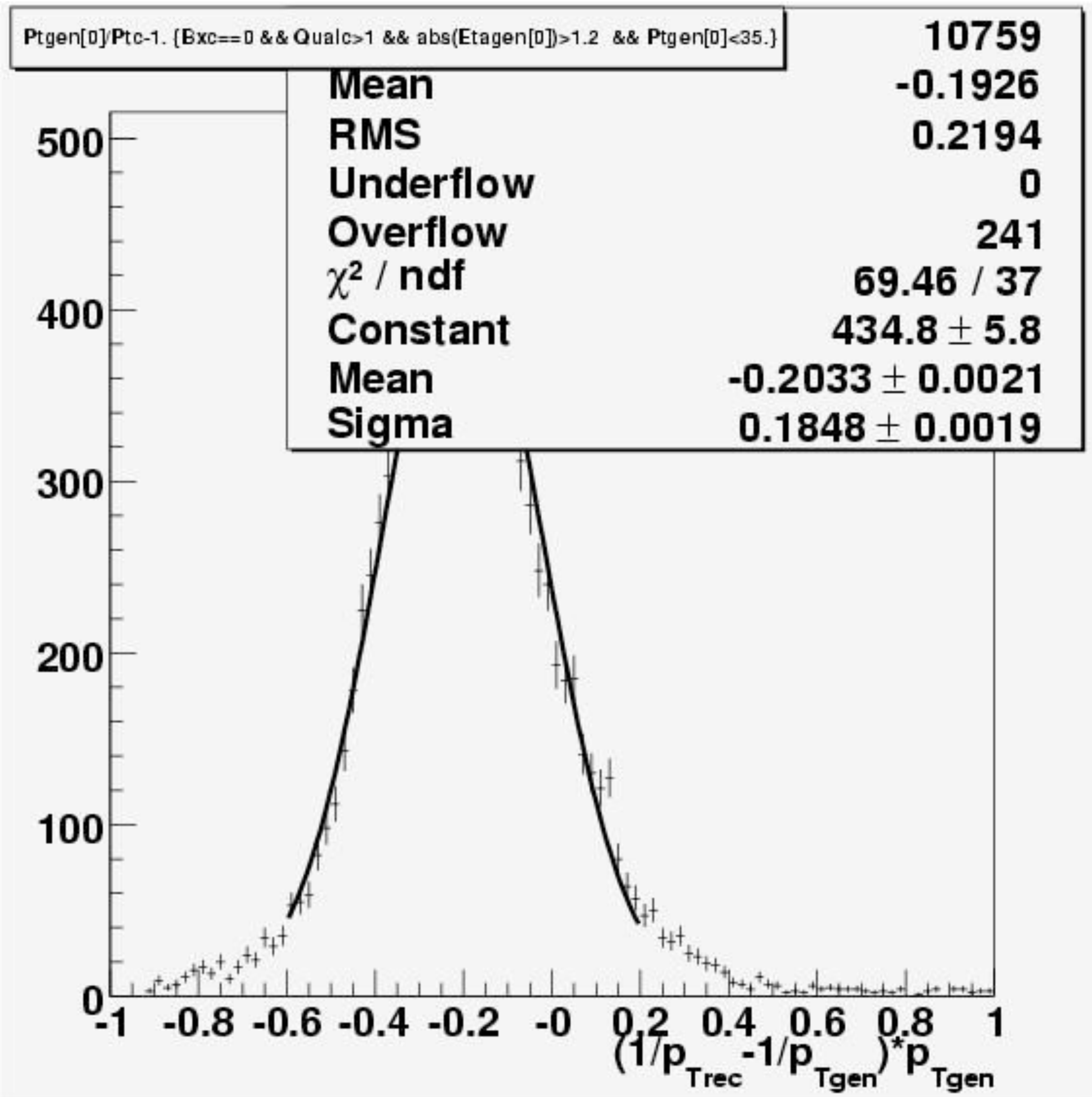


Better than in May meeting - now correct treatment of DTTF ghosts

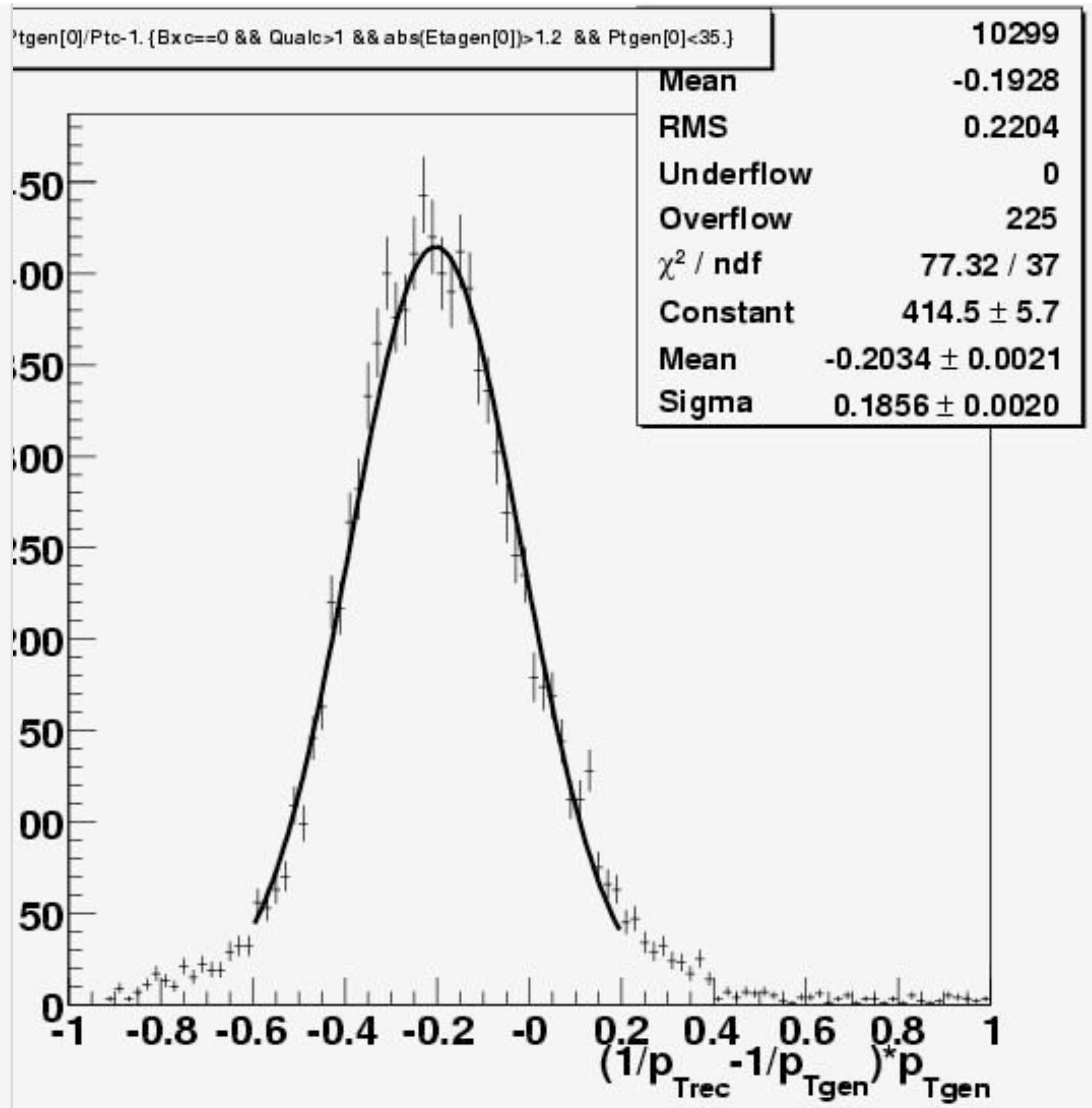
- ➢ Ghost probability the same

CSCTF p_T resolution

ORCA 8.7.3



ORCA 8.13.0



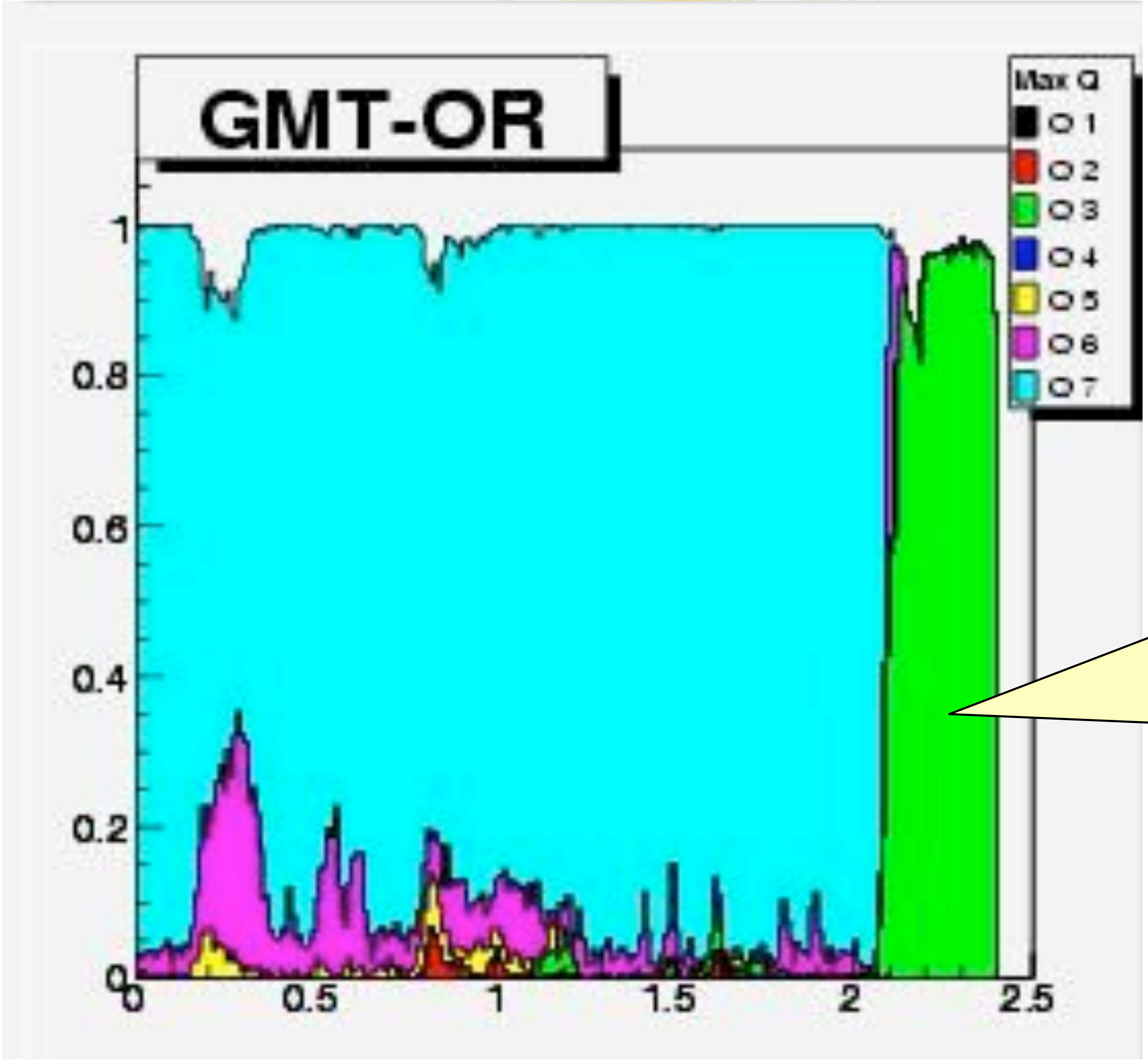
- Also CSC TF p_T resolution the same

Conclusions

- L1 muon trigger rates have been recalculated for PTDR
- The differences wrt. to DAQ TDR are small - no surprises
- Plots will be ready soon after some polishing
- No need to rerun with ORCA 8.13.0 - efficiencies, ghost probabilities and p_T resolutions are the same
- To do - study cross trigger rates and eventually, effects of misalignment

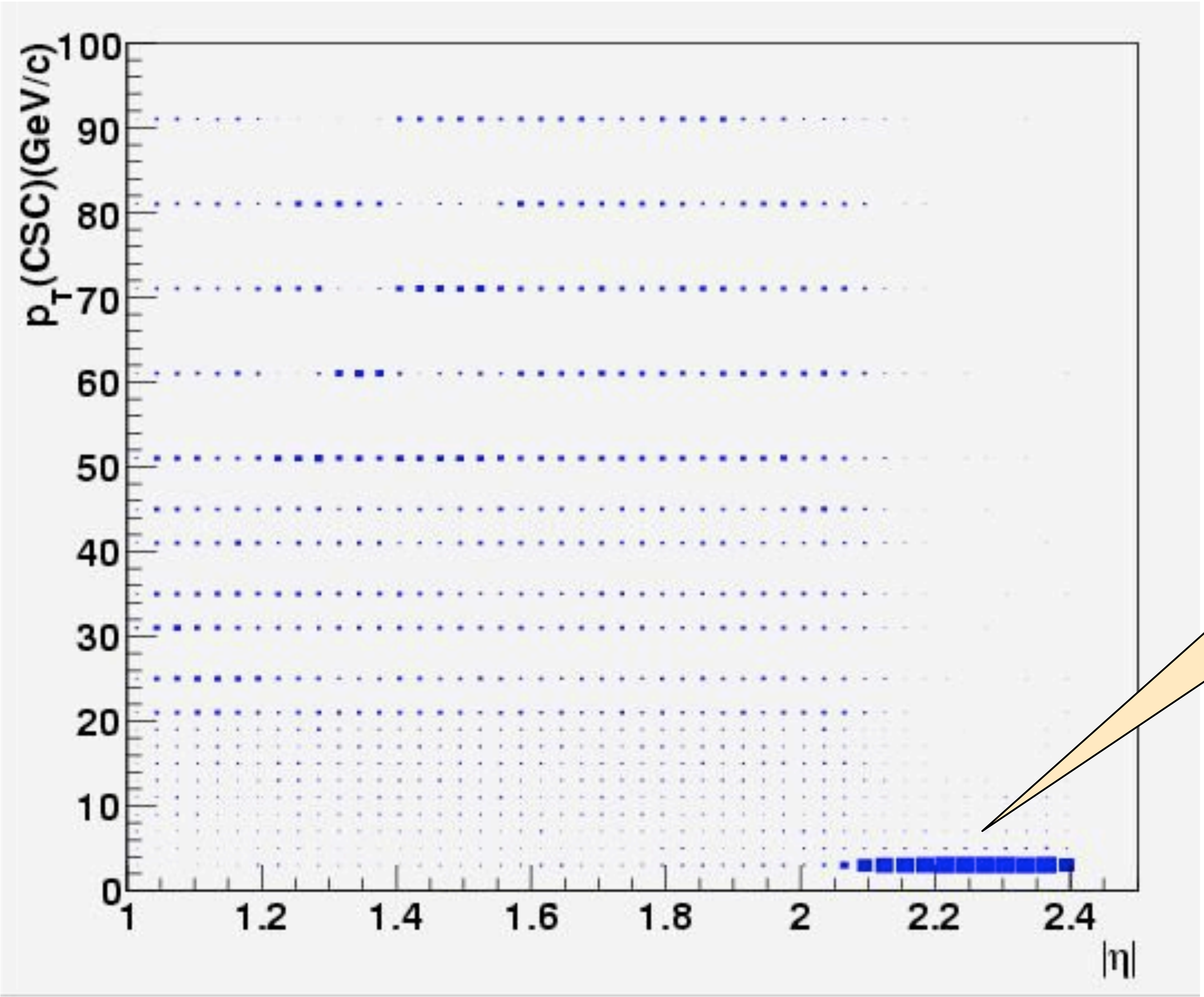
Spares

GMT quality assignment



Above |η|≈2.1
GMT assigns
quality=3,
that is:
accept only
in dimuons

pT measurement at |η|>2.1



Above |η|≈2.1 CSC trigger measures $p_T \approx 3$ GeV/c