L1 Muon Trigger Rates at High Luminosity ($L=10^{34}$ cm^{-2} s^{-1})

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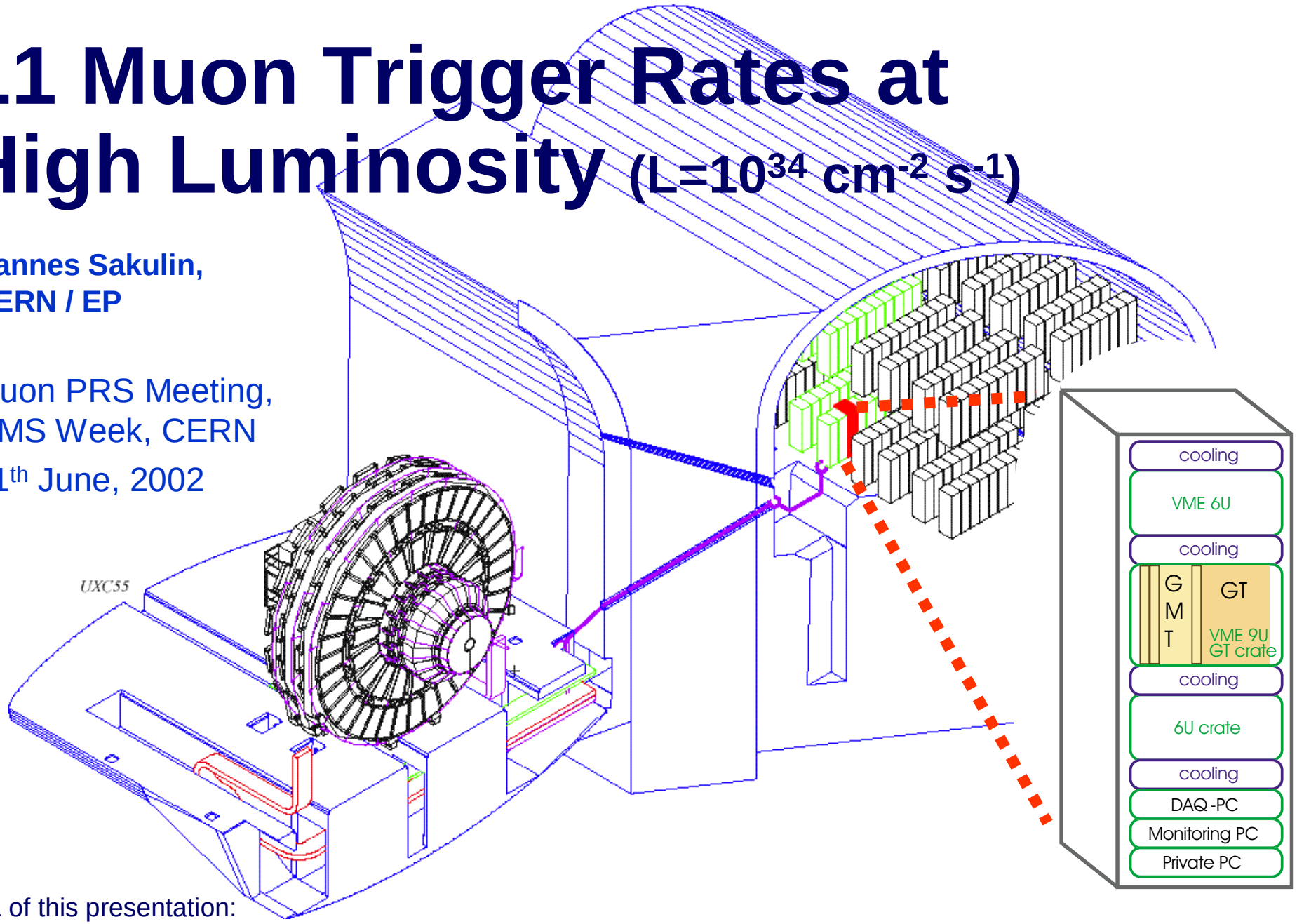
CERN / EP

Muon PRS Meeting,
CMS Week, CERN

11th June, 2002



URL of this presentation:
http://wwwhephy.oeaw.ac.at/p3w/cms/trigger/globalMuonTrigger/trans/L1Mu-CMSWeek11Jun2002.pdf

Outline

- First look at Level-1 results with 2002 production high luminosity $L=10^{34}$ cm^{-2} s^{-1}
- Single muon trigger rates
- Di-muon trigger rates
  - ⇨ contributions from real di-muons, noise & ghosts, pile-up
- Combined single and di-muon trigger rates
- Preliminary optimization of L1 Working Point
  - ⇨ DAQ rate: **100 kHz** **75 kHz**
    safety factor 3: 33.3 kHz 25 kHz
    ¼ for muon: 8.3 kHz 6.3 kHz

2002 Production & Samples

- Monte Carlo production (Pythia 6.158)
  - ⇨ improved weighting of heavy flavor processes
  - ⇨ improved relative normalization of pt10 and pt4 samples
  - ⇨ consistent with production in b/τ group
- CMSIM 125
- ORCA 6.1.1
  - ⇨ digitization for LHC Luminosities L = 10^{34} $cm^{-2}s^{-1}$ and L = $2x10^{33}$ $cm^{-2}s^{-1}$
- Analysis
  - ⇨ assume L1 Trigger only up to $|\eta| < 2.1$

Sample	L_{int} / nb^{-1}	Events in luminosity
MB1mu_pt1	0.0246	150483
MB1mu_pt4	0.9908	255732
MB1mu_pt10	11.4315	86914
W_1mu	3081.	50000
Z/γ* -> 1mu	2262.	50000

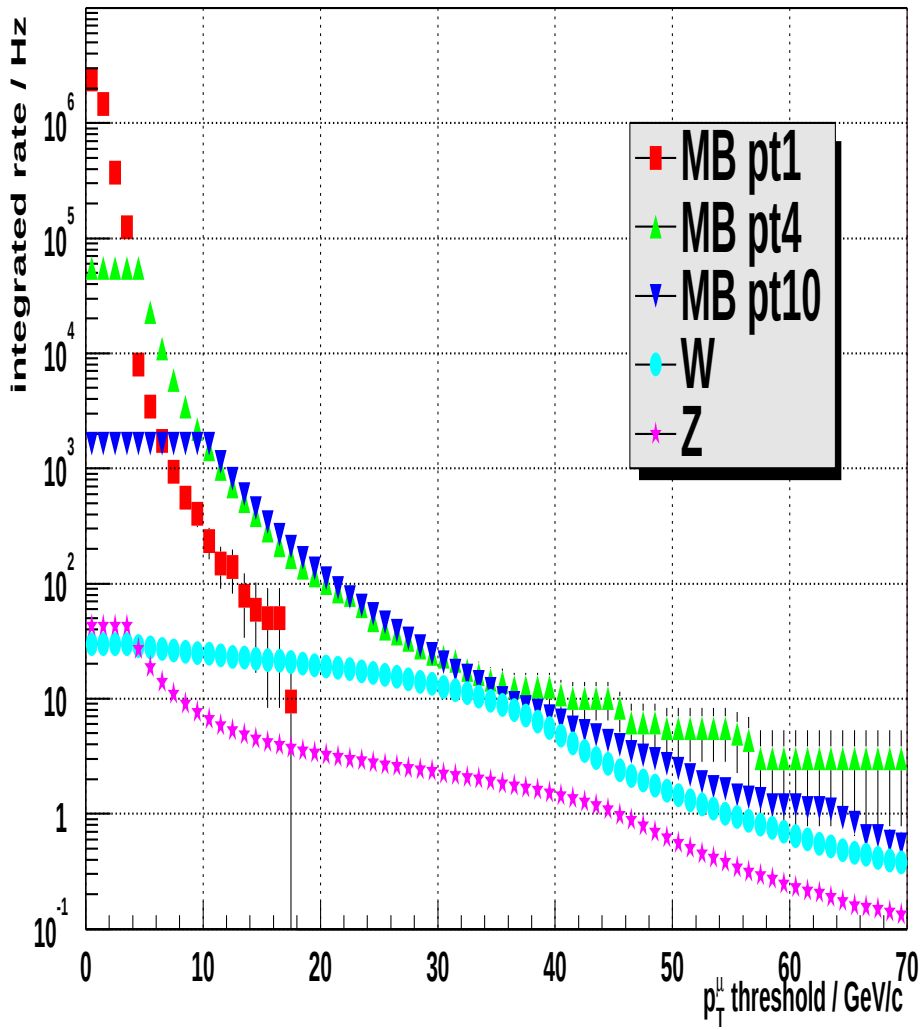
+additional signal samples

many thanks to all the people involved in the production!

Generated rates, L=2x10^{33}cm^{-2}s^{-1}

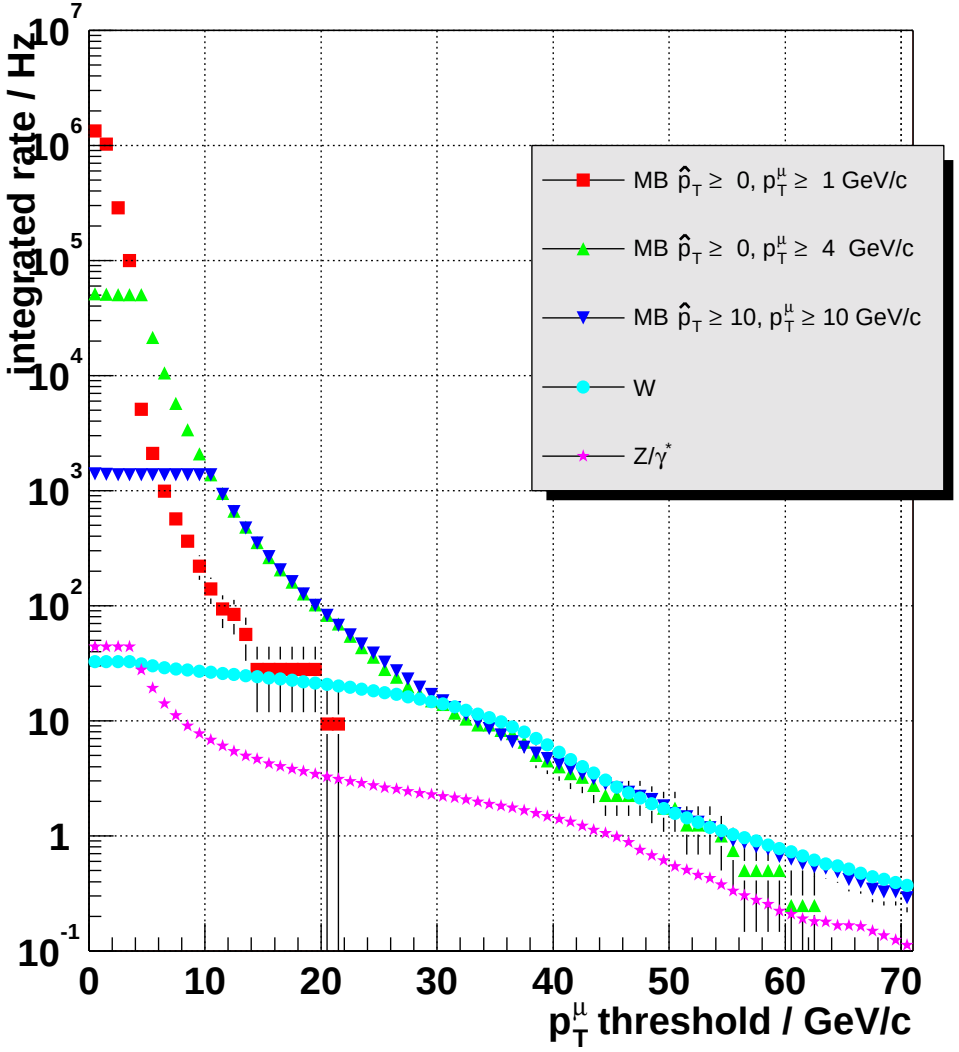
generated rates

Nov 2001



Generated Rates L=2x10^{33}cm^{-2}s^{-1}

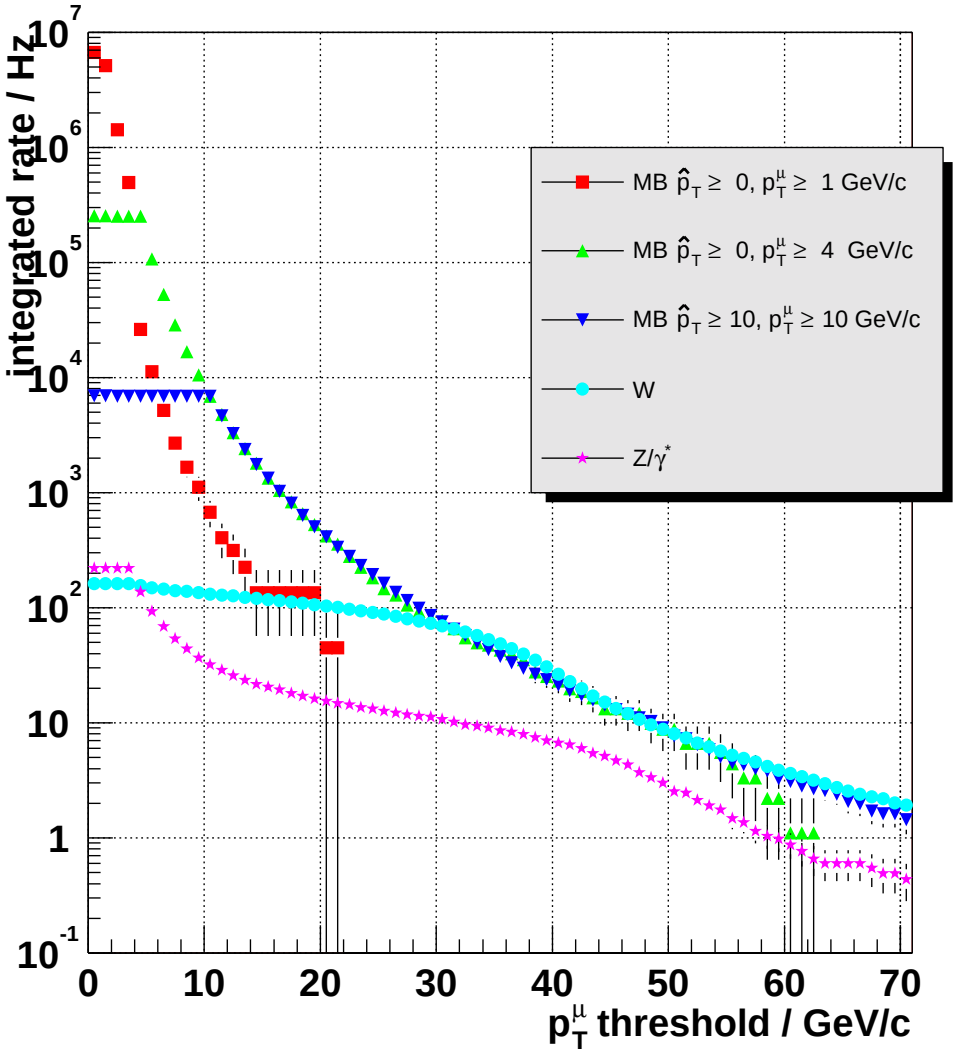
2002



Generated rates, L=10^{34}cm^{-2}s^{-1}

Generated Rates L=10^{34}cm^{-2}s^{-1}

2002

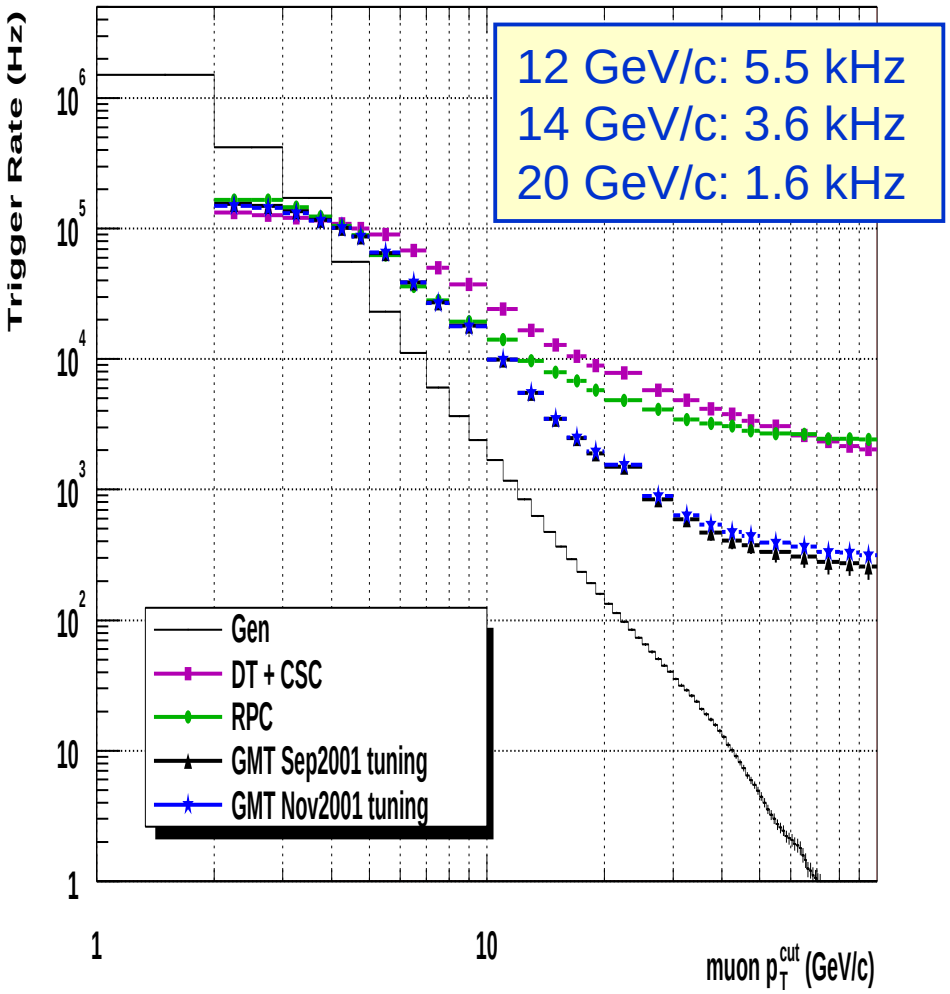


L1 single muon trigger rates $L=2x10^{33}cm^{-2}s^{-1}$

samples: pt1, pt4, pt10, W, Z

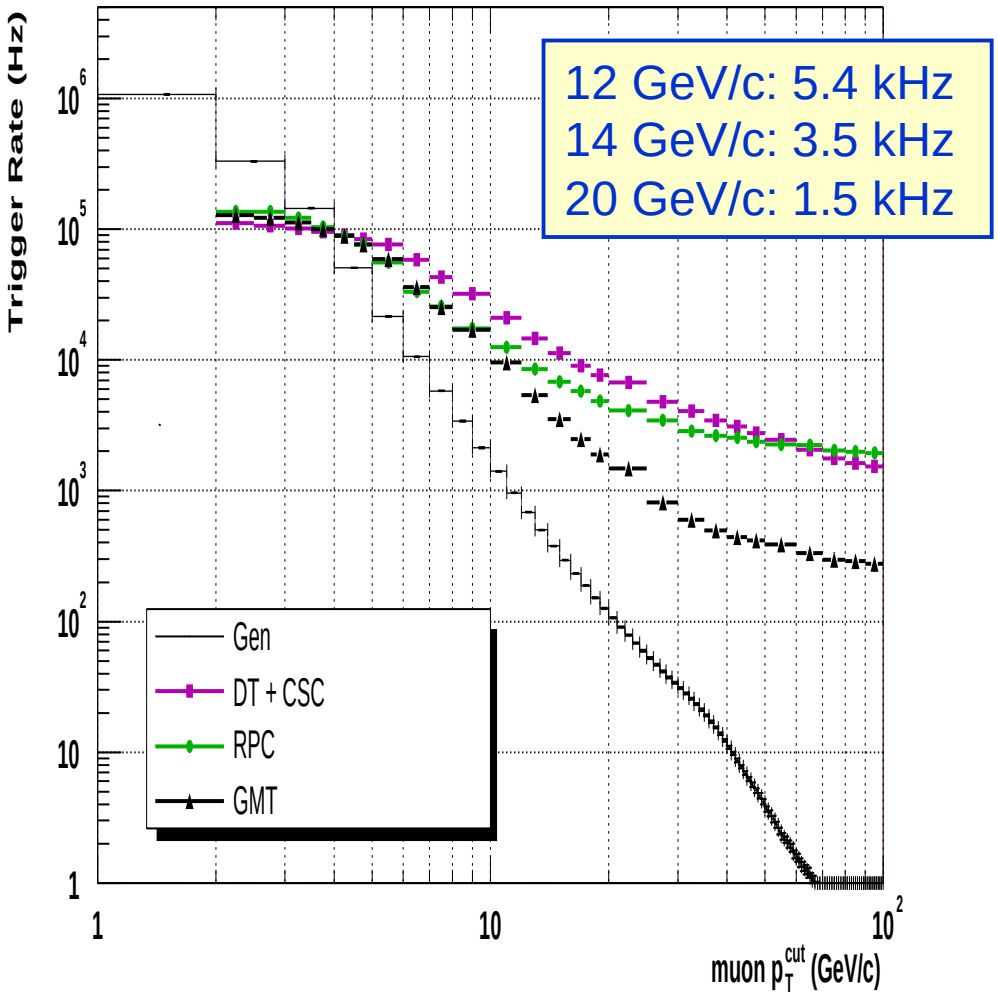
whole detector: $0 < |\eta| < 2.5$

Nov 2001



whole detector: $0 < |\eta| < 2.5$

2002



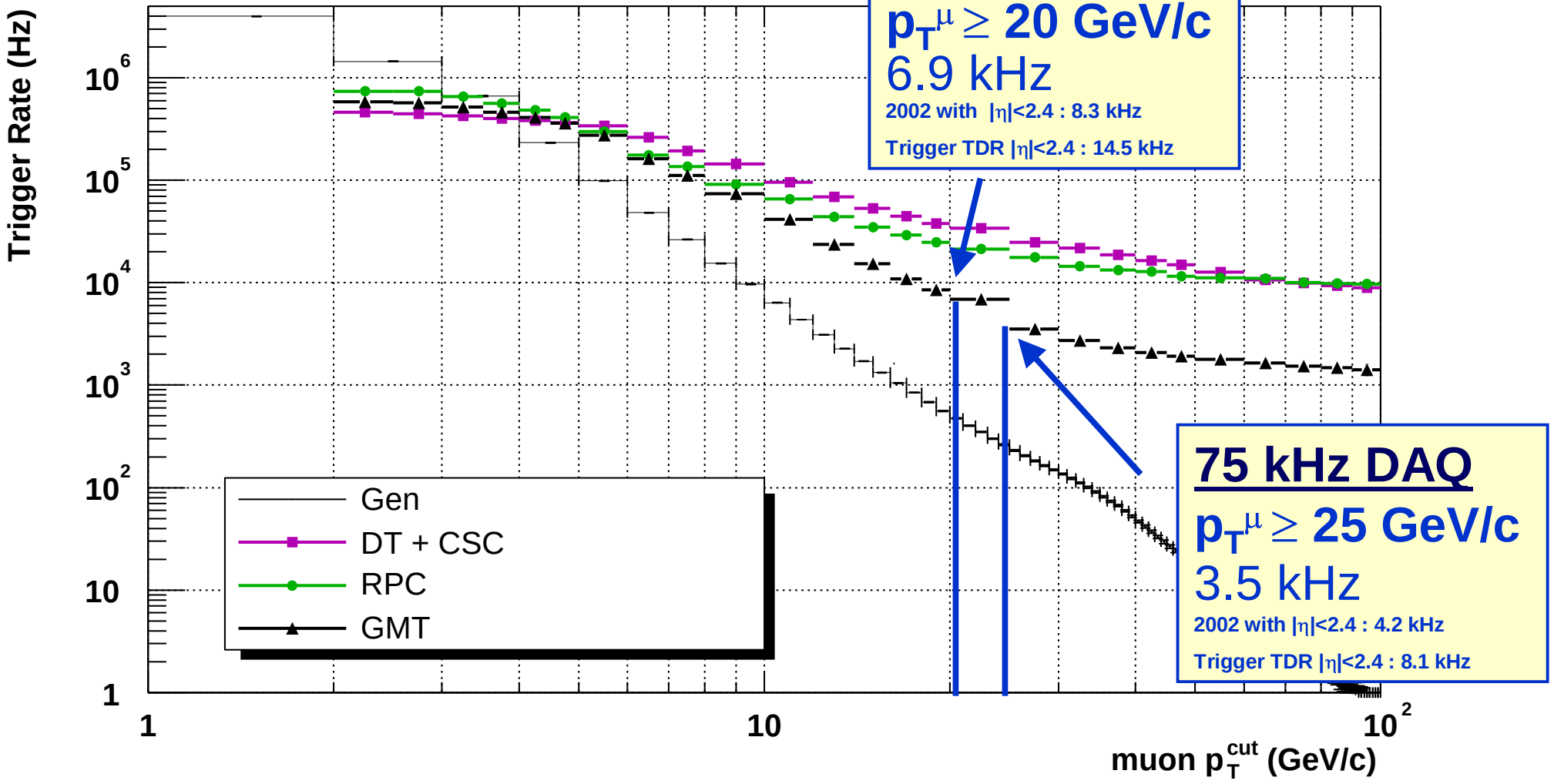
L1 single muon trigger rates, L = $10^{34}cm^{-2}s^{-1}$

samples: pt1, pt4, pt10, W, Z/γ^*

$|\eta| < 2.1$

$|\eta| < 2.1$

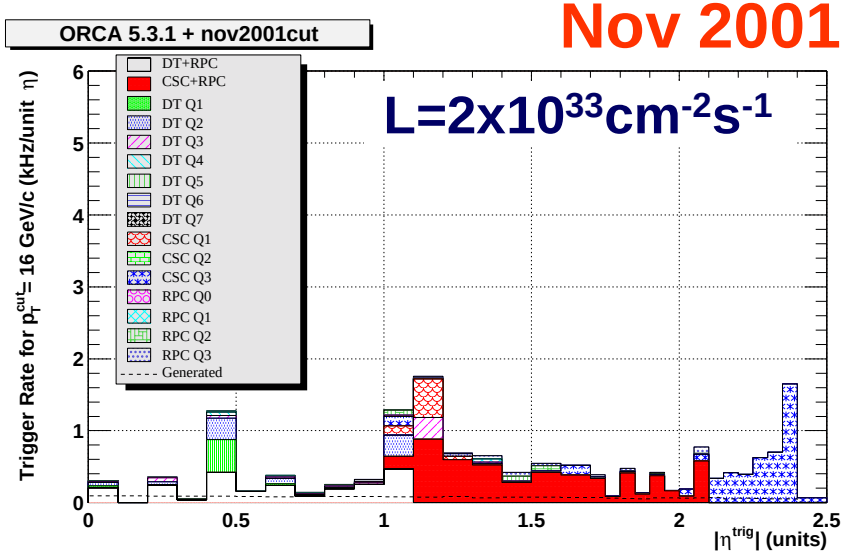
2002



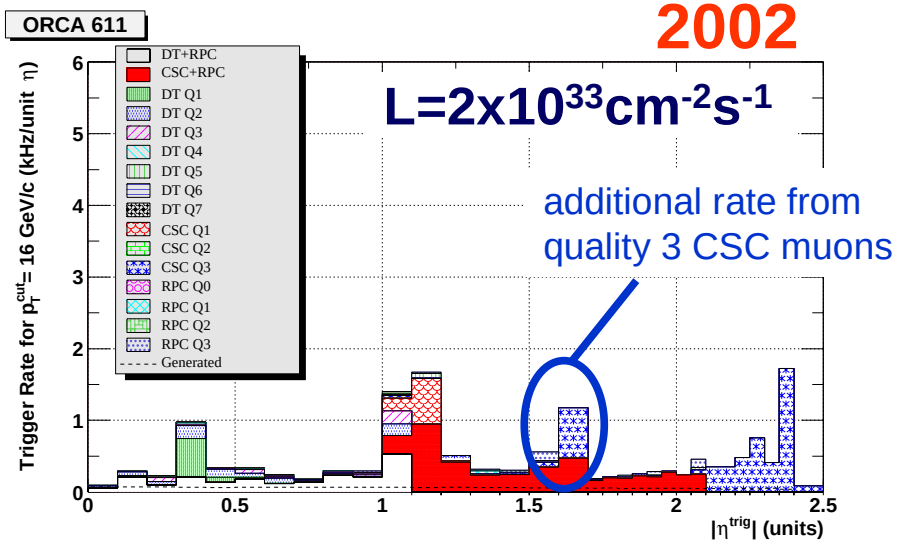
Single muon trigger rates and efficiency vs. η
L=2x10^{33}cm^{-2}s^{-1}

L1 single muon trigger rates (p_T > 16 GeV/c)

Nov 2001



2002



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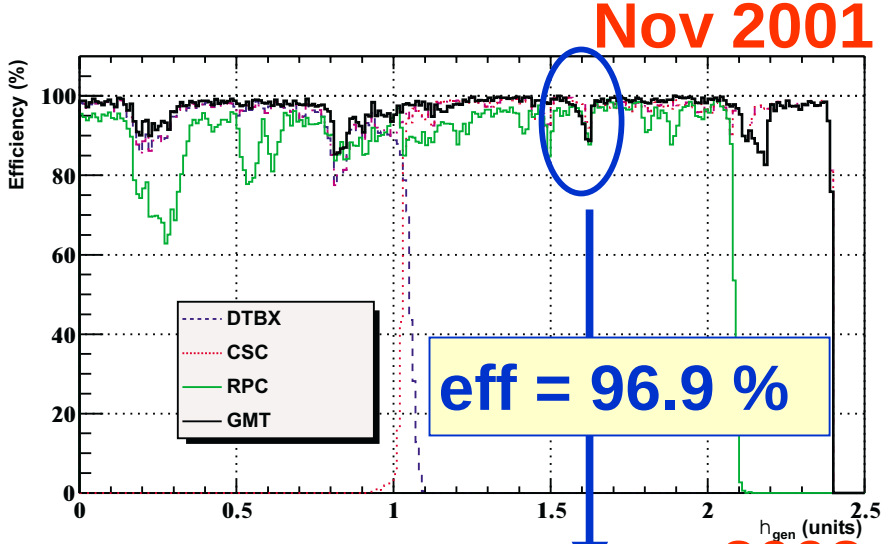
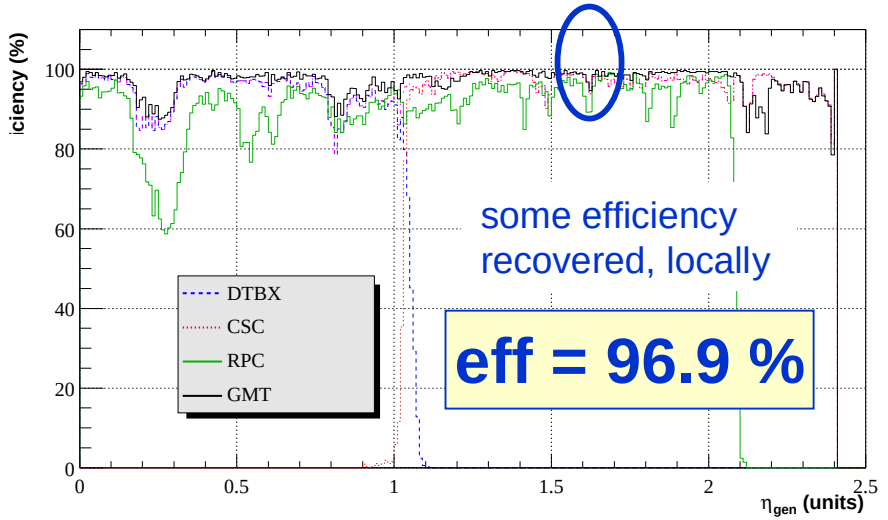


2002



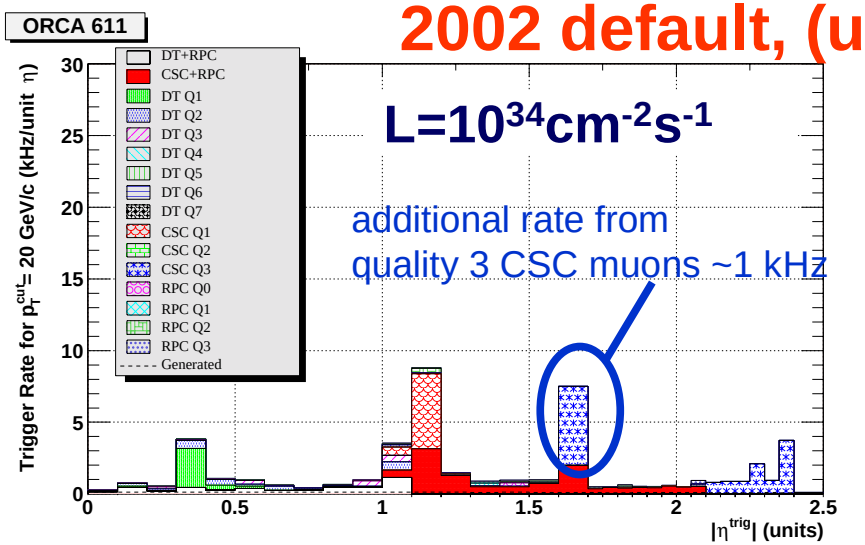
L1 efficiency

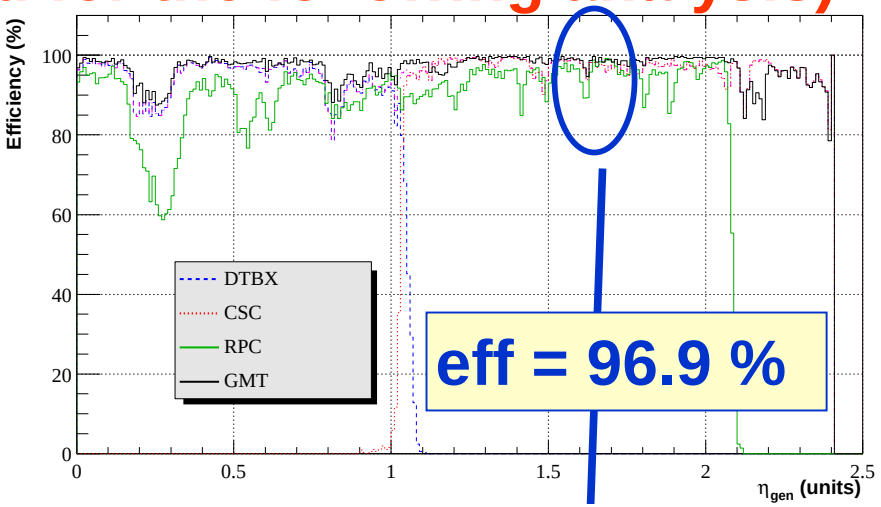
η → (*)efficiency to find muon of any p_T in flat p_T sample

Single muon trigger rates and efficiency vs. η
L = 10^{34}cm^{-2}s^{-1}

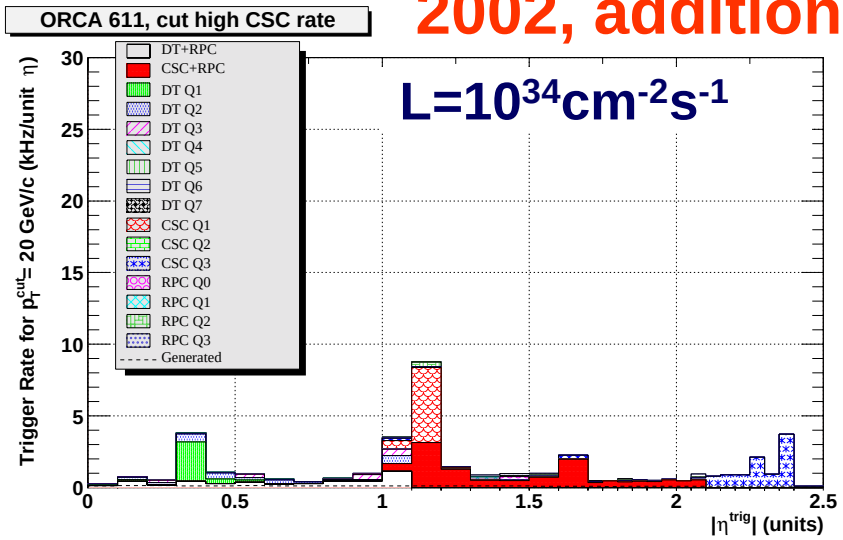
L1 single muon trigger rates (p_T > 20 GeV/c)

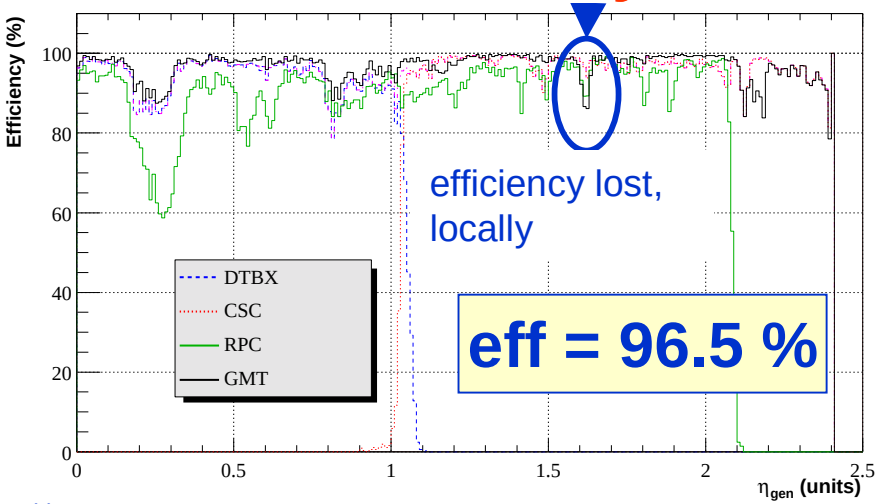
2002 default, (used for the following analysis)





2002, additional rate can be cut rate by GMT





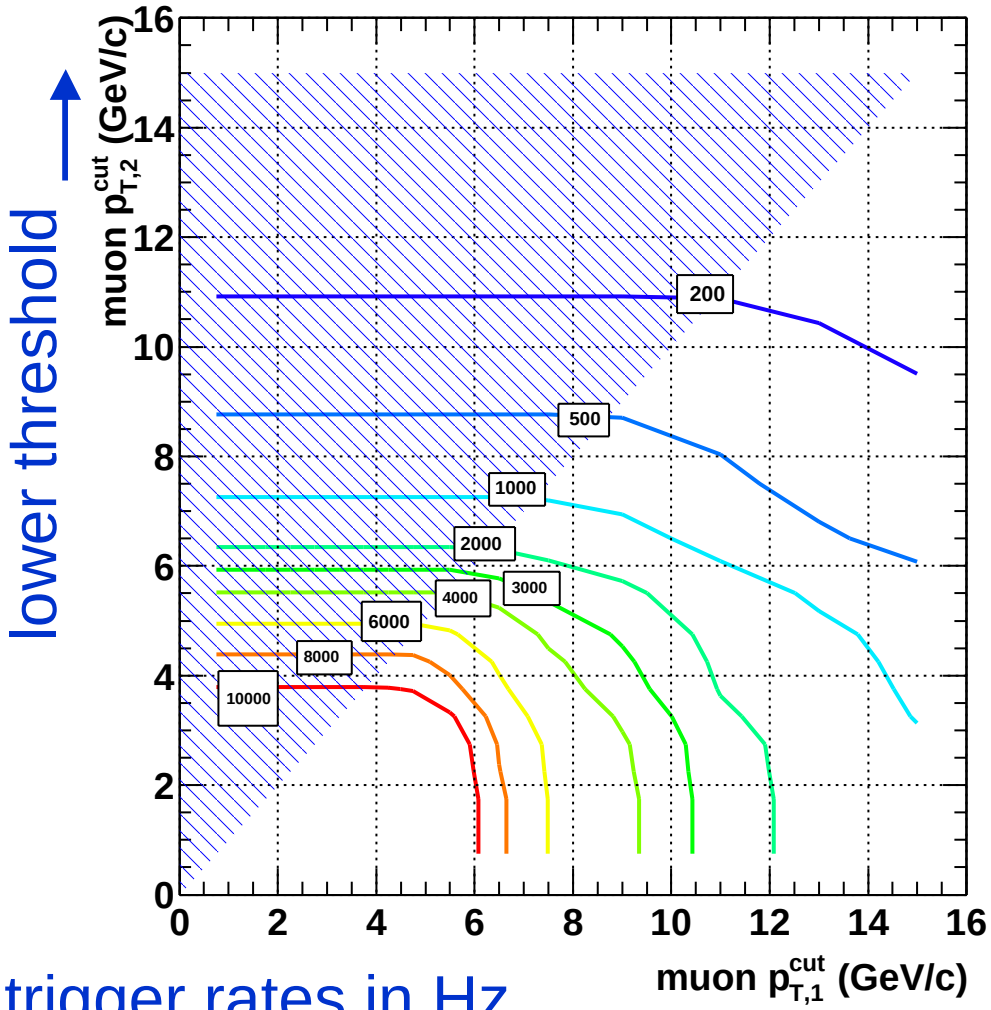
L1 efficiency

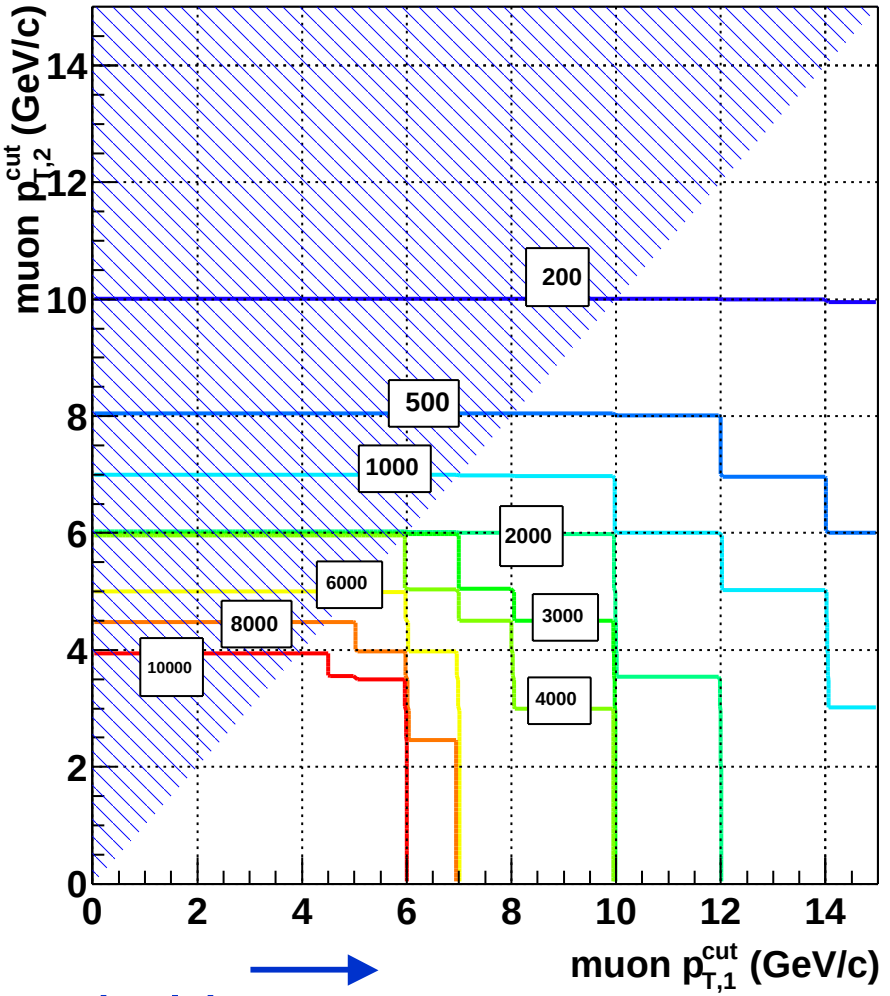
η → (*)efficiency to find muon of any p_T in flat p_T sample

Inclusive L1 di-muon trigger rates, L = 10^{34}cm^{-2}s^{-1}

samples: pt1, pt4, pt10, W, Z; contribution from PU added analytically

interpolated $|\eta| < 2.1$ **L1 binning**



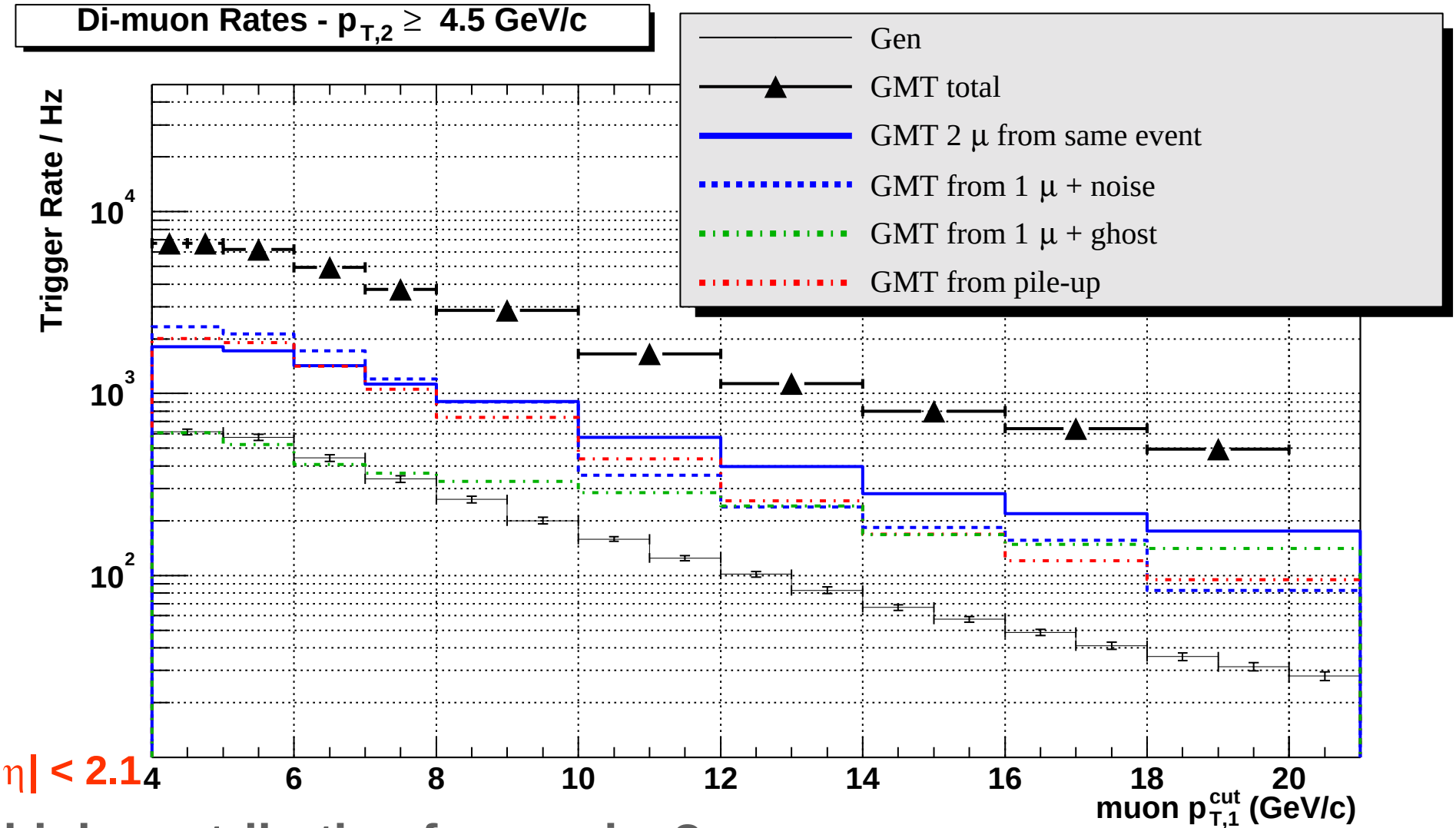


trigger rates in Hz

higher threshold

L1 di-muon trigger rates, $p_{T,2} \geq 4.5$ GeV/c

samples: pt1, pt4, pt10, W, Z; contribution from PU added analytically



$|\eta| < 2.1$

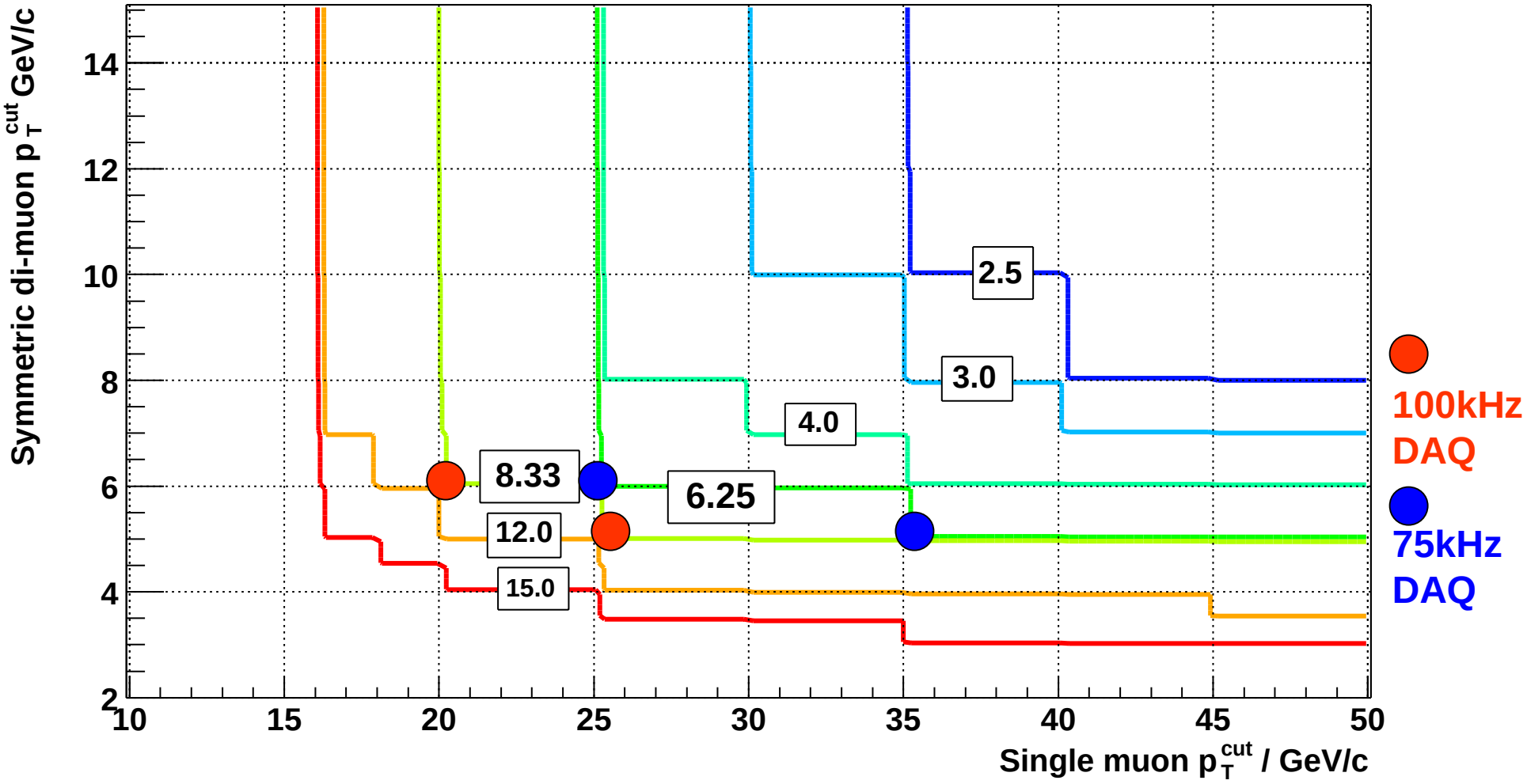
high contribution form noise? (need further studies)

L1 single & di-muon trigger rates

symmetric di-muon cut

L1 single and di-muon trigger rates

|η| < 2.1 trigger rates in kHz



Preliminary optimization of working point

- **Bandwidth splitting**

⇨DAQ rate:	**100 kHz**	**75 kHz**
safety factor 3:	33.3 kHz	25 kHz
¼ for muon:	**8.33 kHz**	**6.25 kHz**

- **Three benchmark channels**

$W \rightarrow 1\mu + X$

$p_T^{\mu} > 3$ GeV/c, $|\eta|<2.5$

σ = 185 nb

$Z \rightarrow 2\mu$

m_Z=81..101 GeV/c

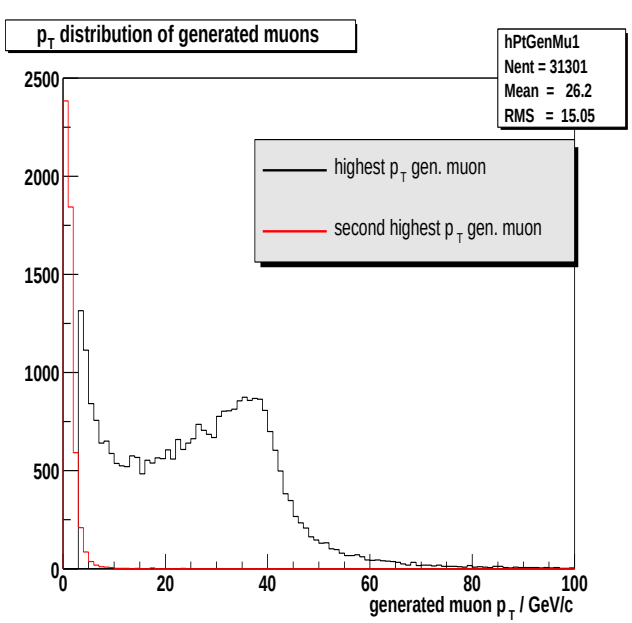
σ = 1.74 nb

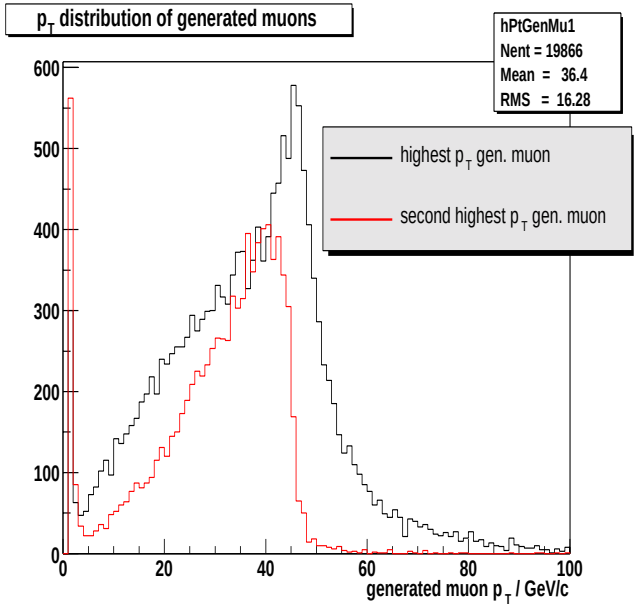
$B_s^0 \rightarrow J/\psi\,\phi \rightarrow \mu^+\mu^-\,K^+K^-$

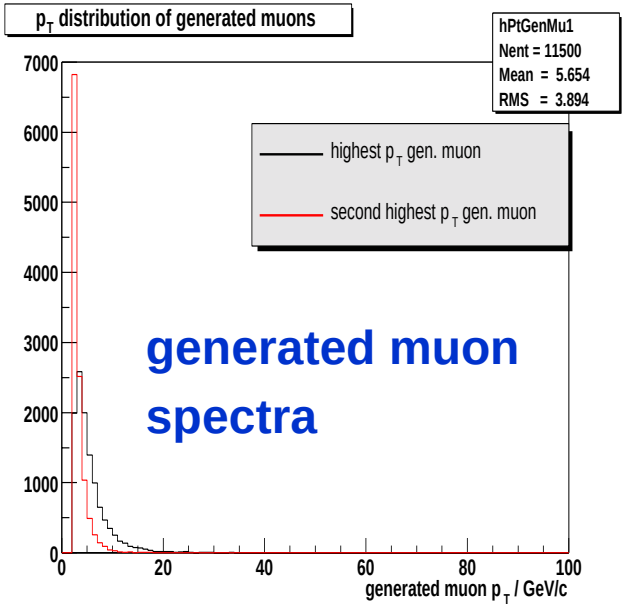
$p_T^{\mu} > 2$ GeV/c, $|\eta|<2.4$

$p_T^{K} > 0.5$ GeV/c, $|\eta|<2.4$

σ = 0.1 nb

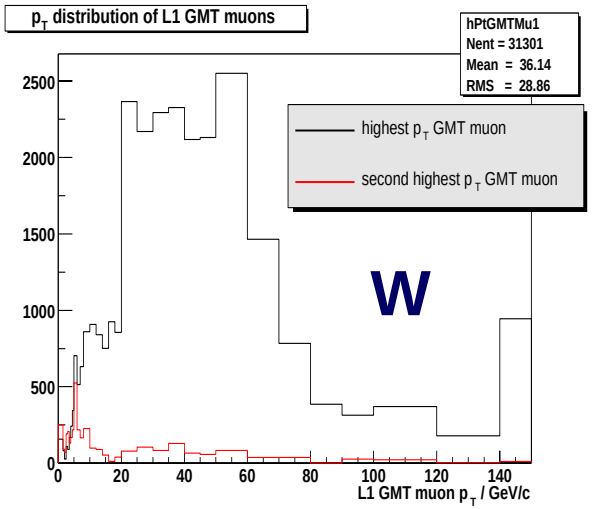


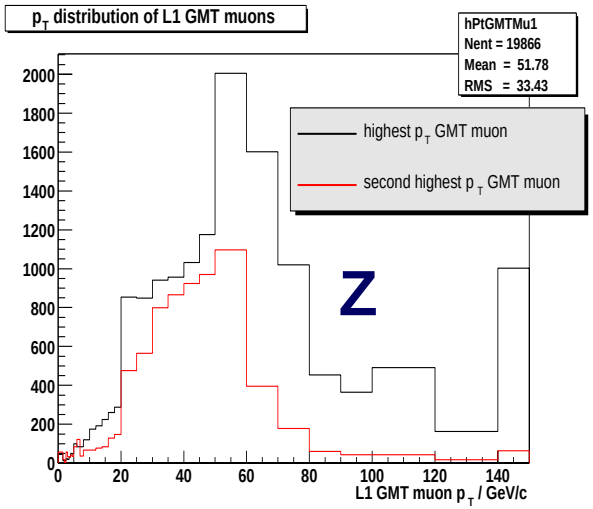


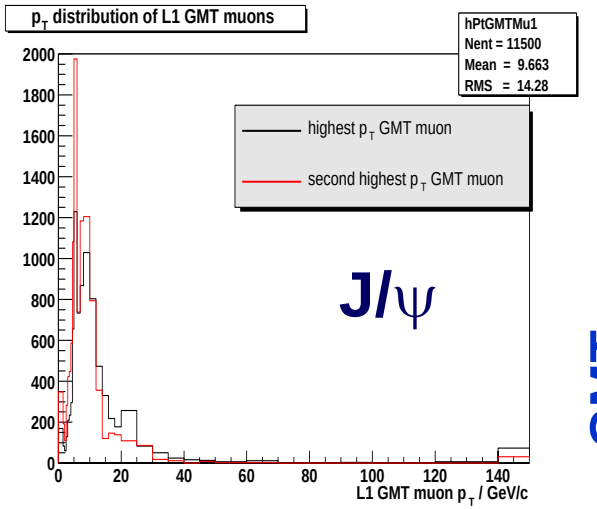


generated muon spectra

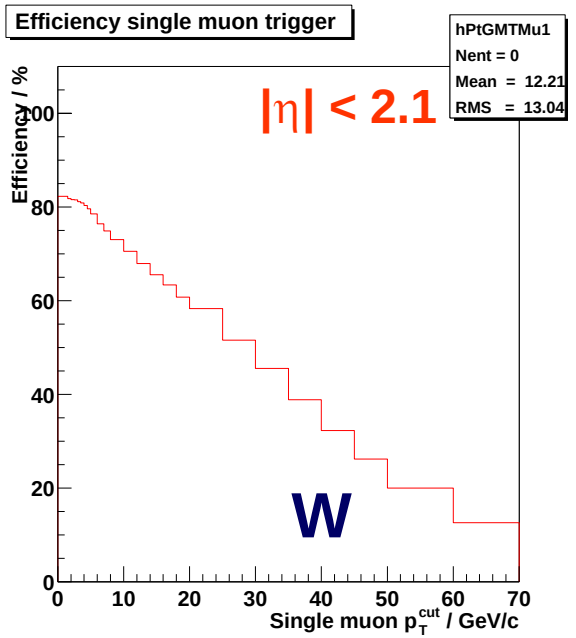
Preliminary optimization of working point Samples

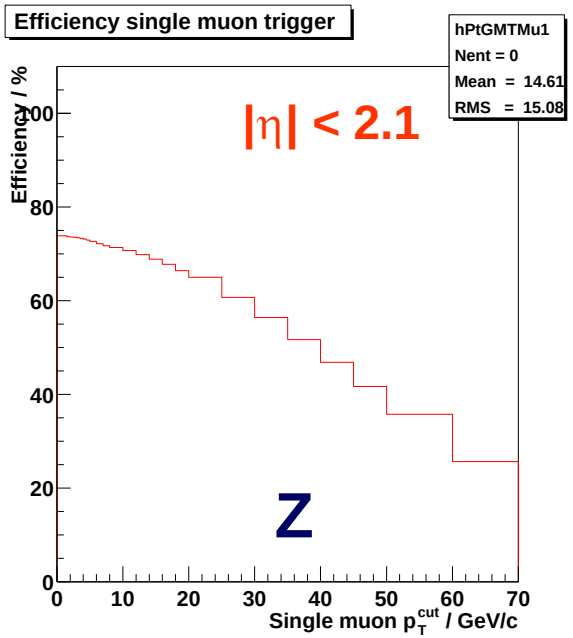


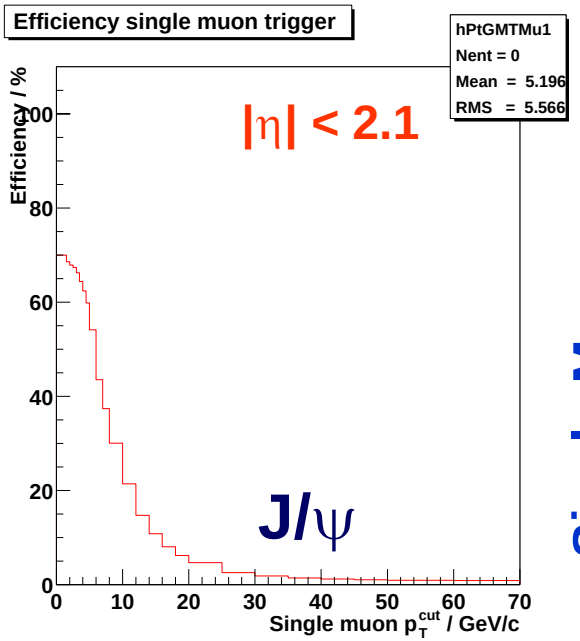




GMT muon spectrum



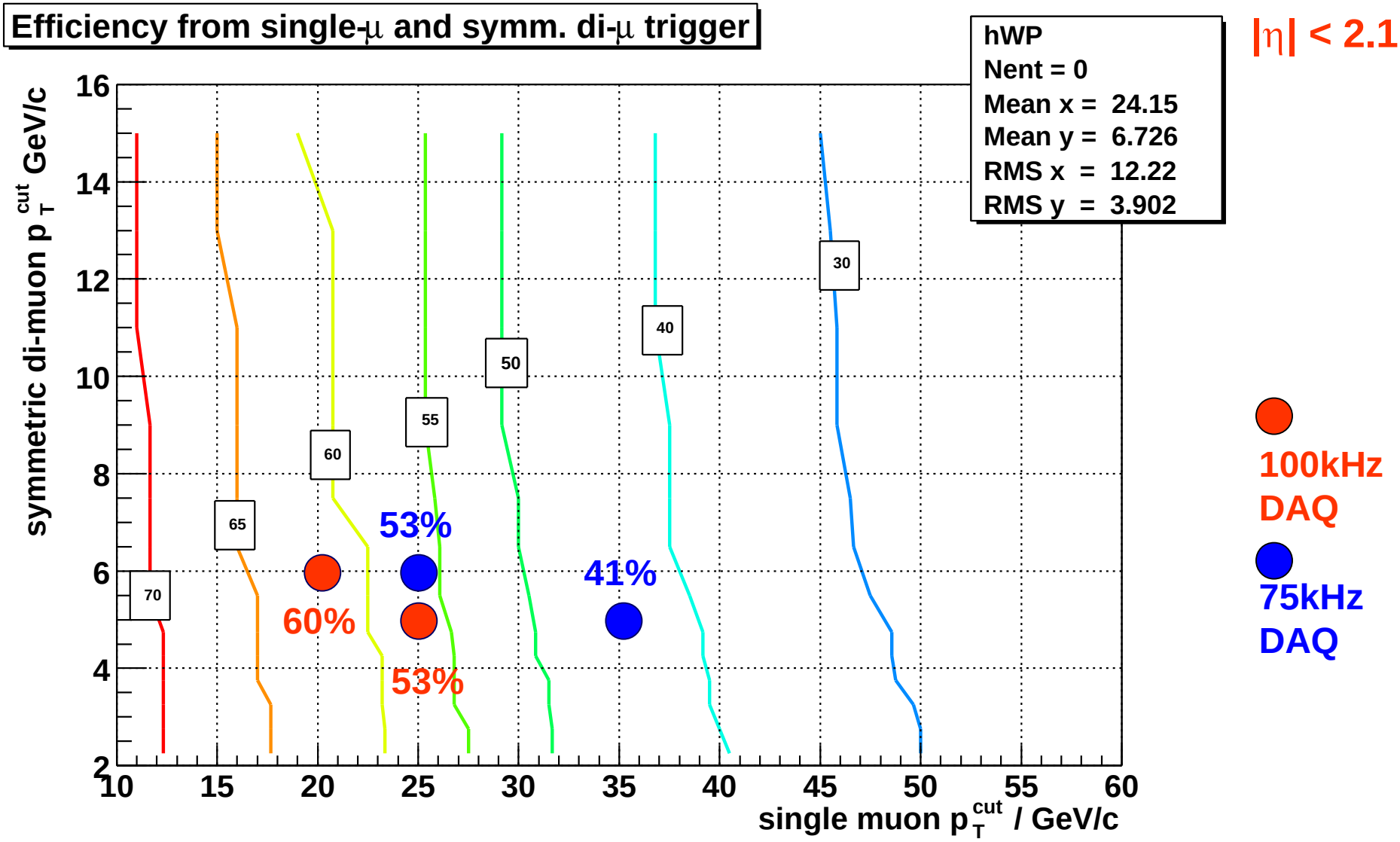




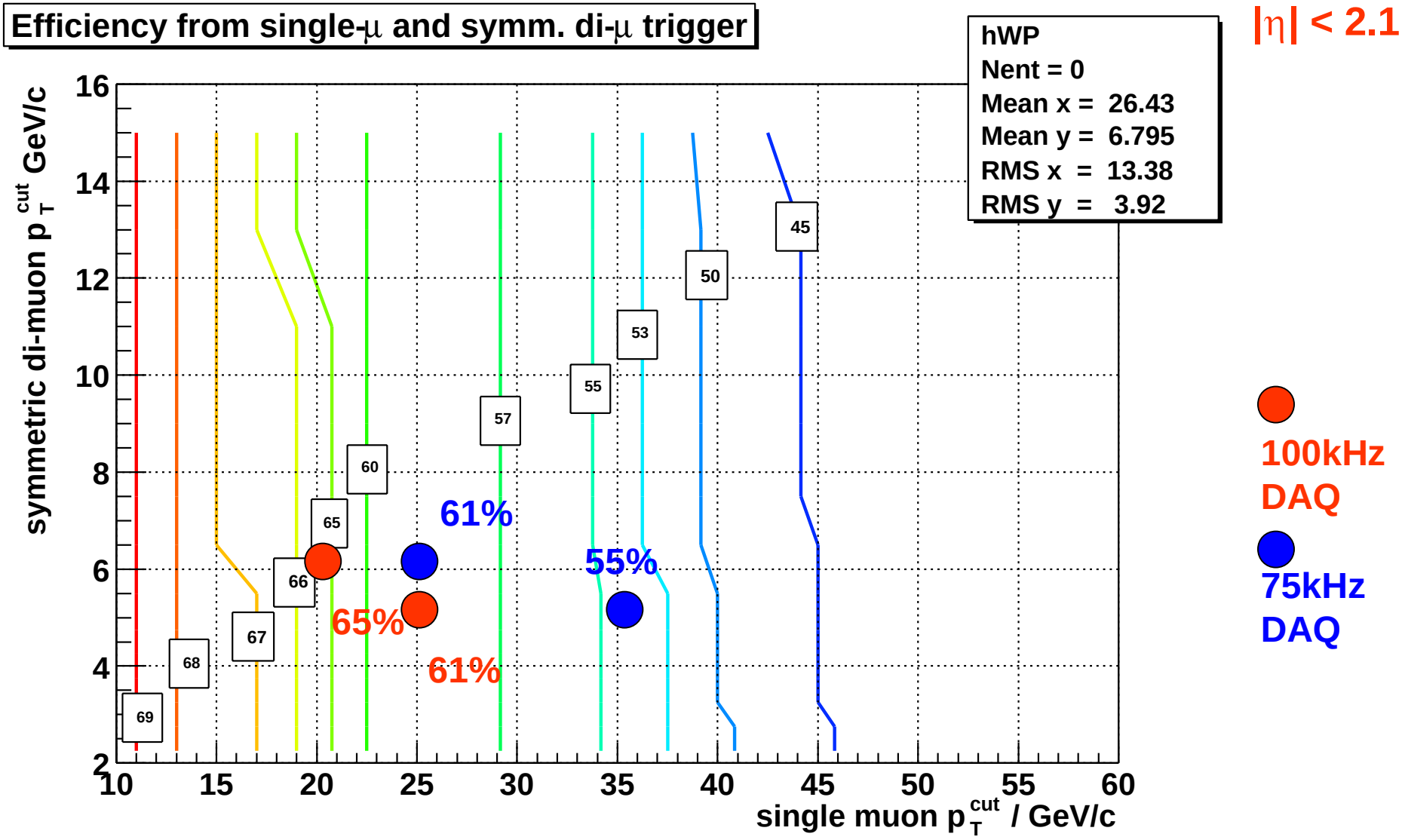
Single Muon Trigger Efficiency

W Efficiency

Efficiency from single-μ and symm. di-μ trigger

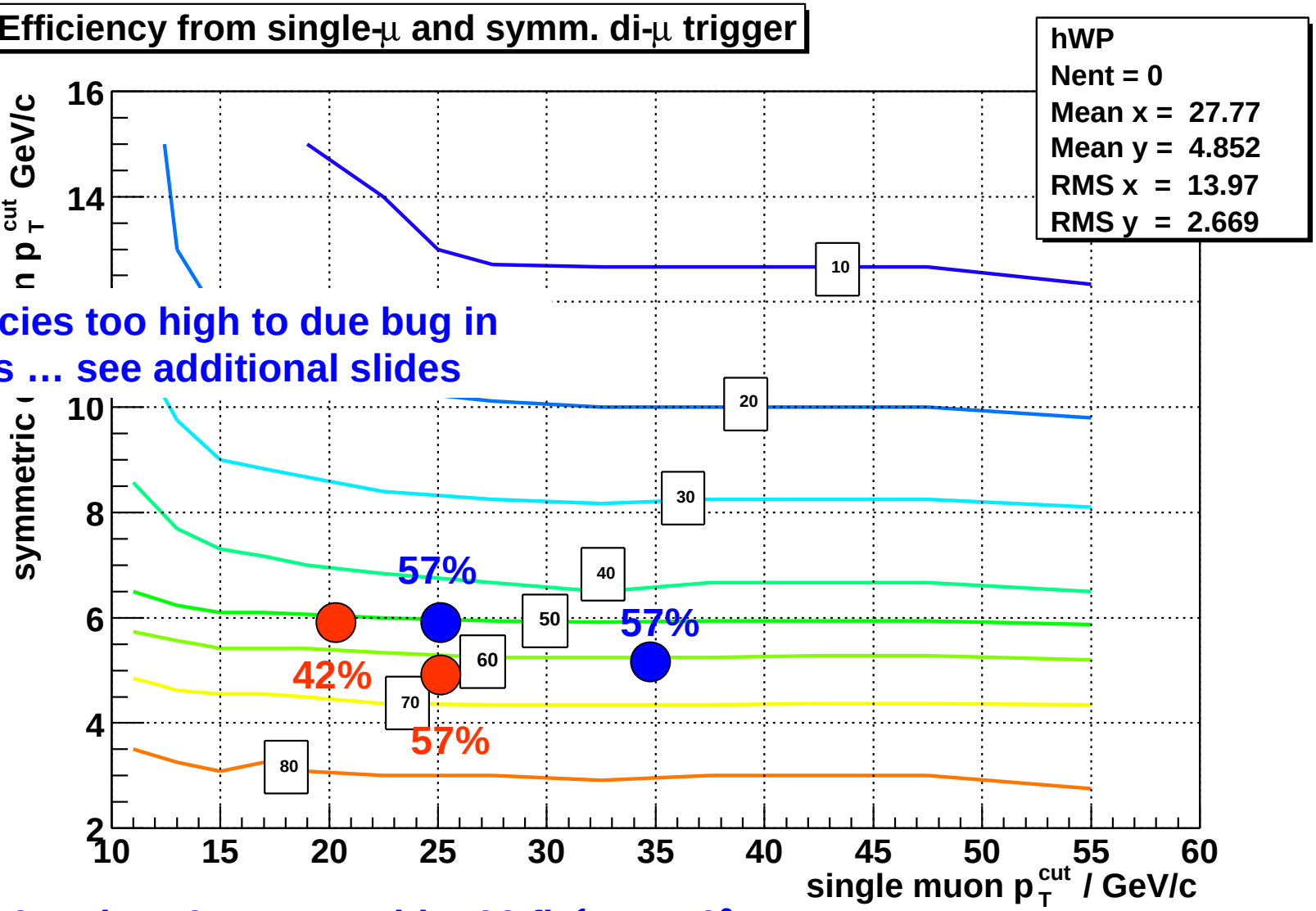


Z Efficiency



J/ψ Efficiency

Efficiency from single-μ and symm. di-μ trigger



$|\eta| < 2.1$

efficiencies too high to due bug in analysis … see additional slides

100kHz DAQ

75kHz DAQ

50 % @ 0.1 nb ⇒ 0.5 Hz, with 100 fb^{-1} : 5x10^6 events at L1

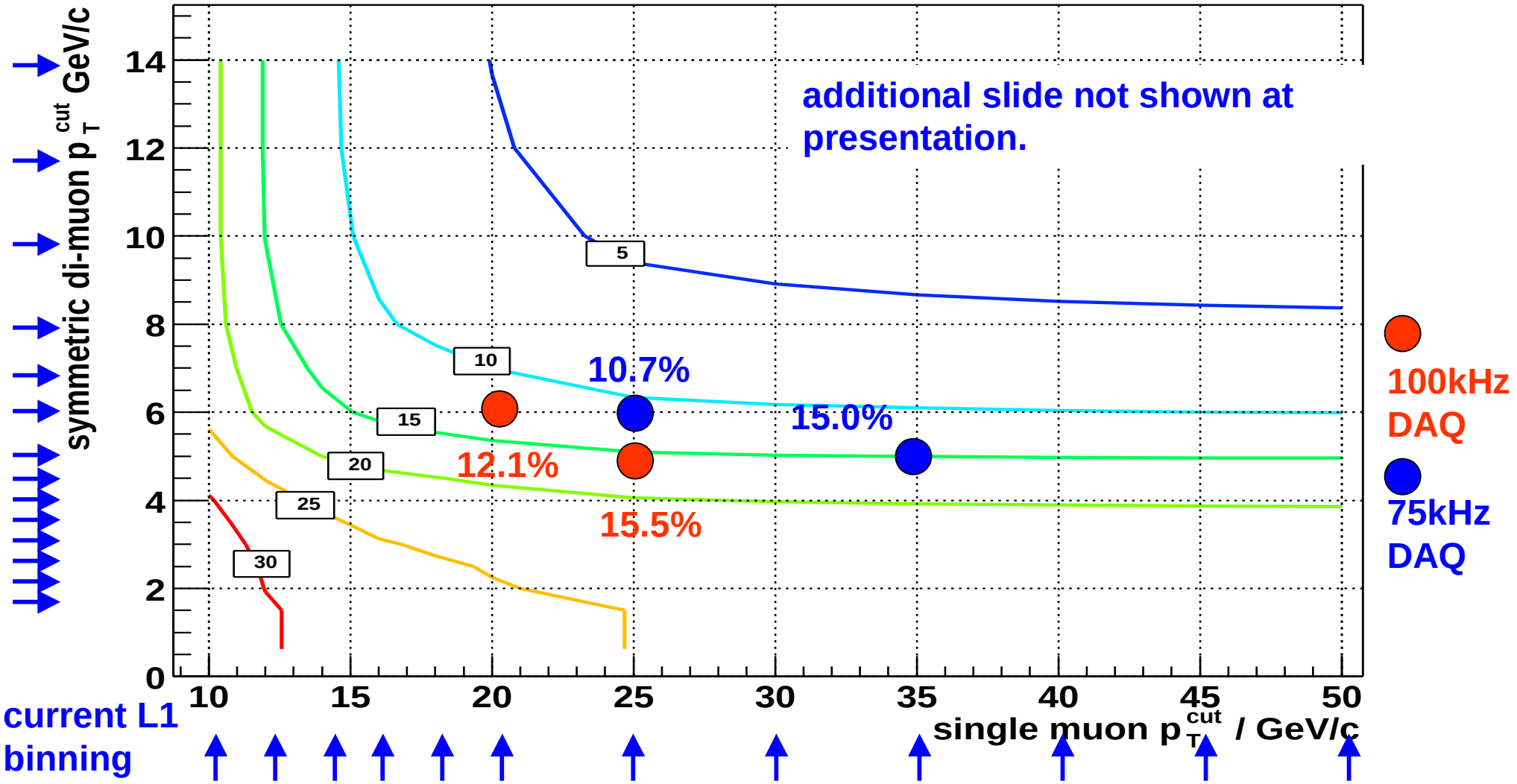
Conclusion

- First results for L1 with 2002 production
  - ⇨ trigger rates at low luminosity agree with previous production
  - ⇨ new trigger rates with high luminosity
- Single muon trigger rates
  - ⇨ need to understand new contribution at $|\eta|=1.6$ (noise ?)
- Di-muon trigger rates
  - ⇨ need to understand rate from noise
- Special production of mix sample for triggers from pile-up
  - ⇨ 90% of analysis jobs (for L1 only) finished, by yesterday
  - ⇨ thanks to production team and Vincenzo
  - ⇨ no time to analyze, yet
- Optimization of L1 Working Point (very preliminary)
  - ⇨ W and Z both triggered well by single muon trigger
  - ⇨ high efficiency (and yield) on J/ψ possible at high luminosity

J/ψ Efficiency corrected

Combined efficiency from single- μ and symmetric di- μ trigger

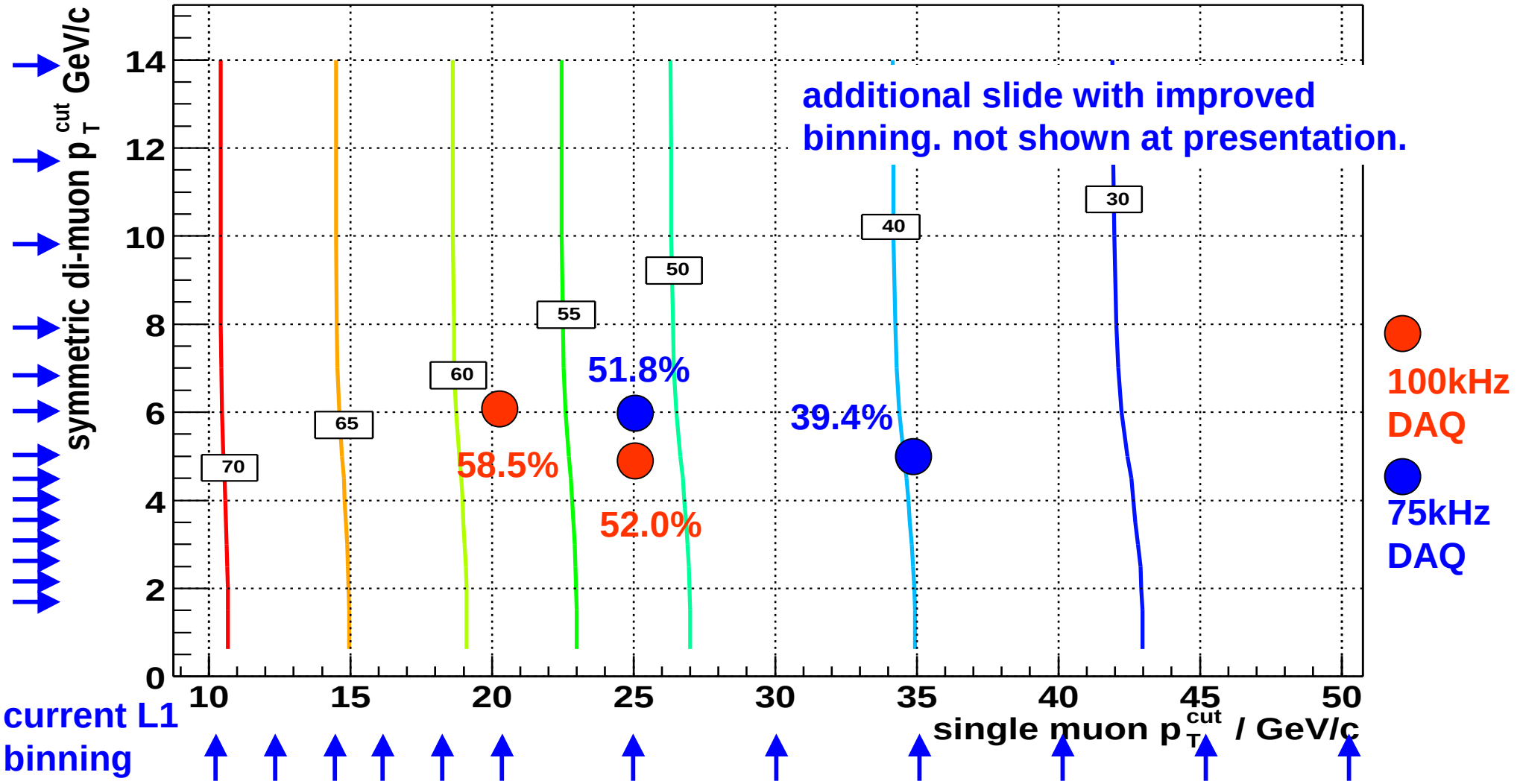
$|\eta| < 2.1$



W Efficiency corrected

Combined efficiency from single- μ and symmetric di- μ trigger

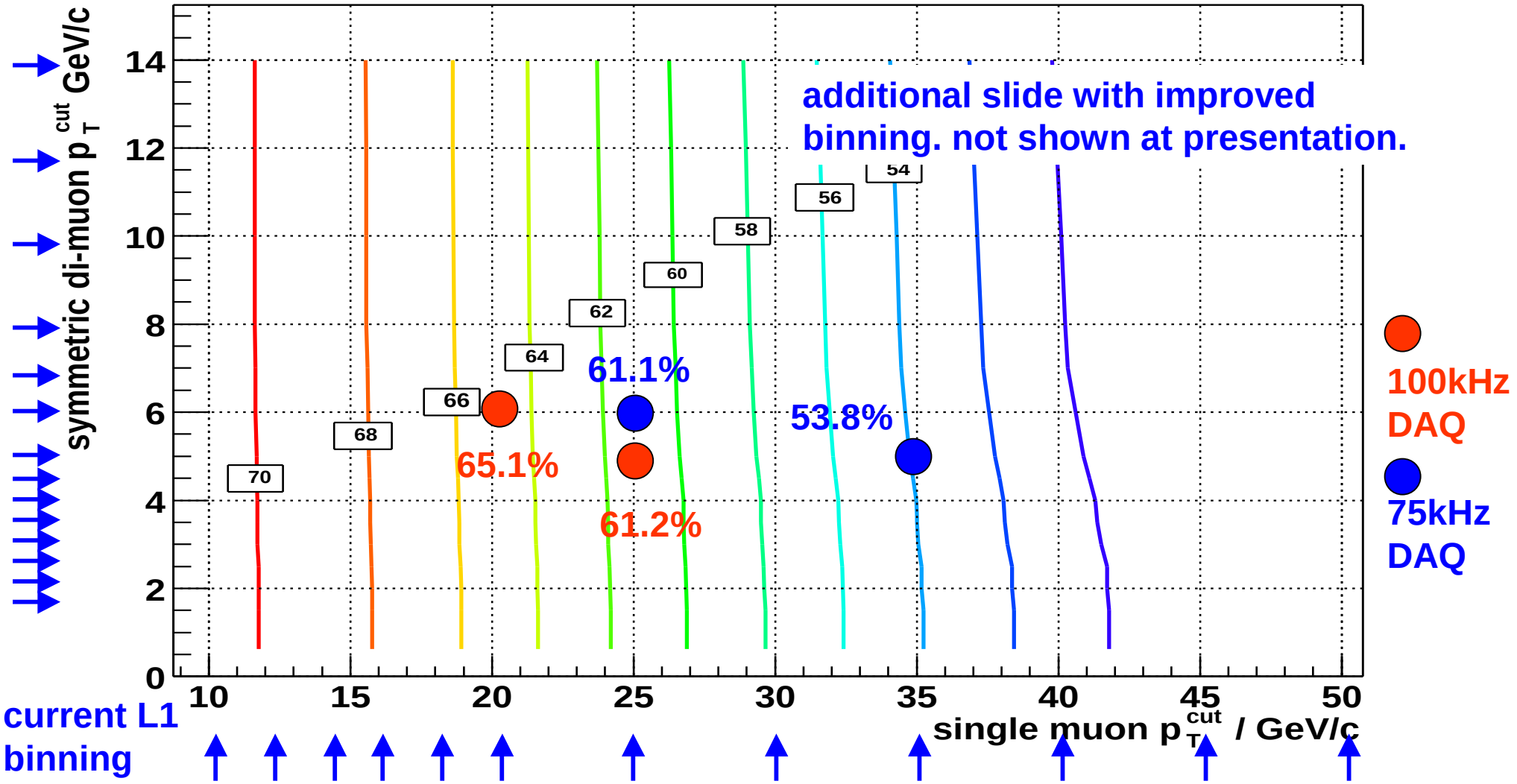
$|\eta| < 2.1$



Z Efficiency corrected

Combined efficiency from single- μ and symmetric di- μ trigger

|η| < 2.1



L1 single & di-muon trigger rates

symmetric di-muon cut

L1 single and di-muon combined trigger rates

$|\eta| < 2.1$ trigger rates in kHz