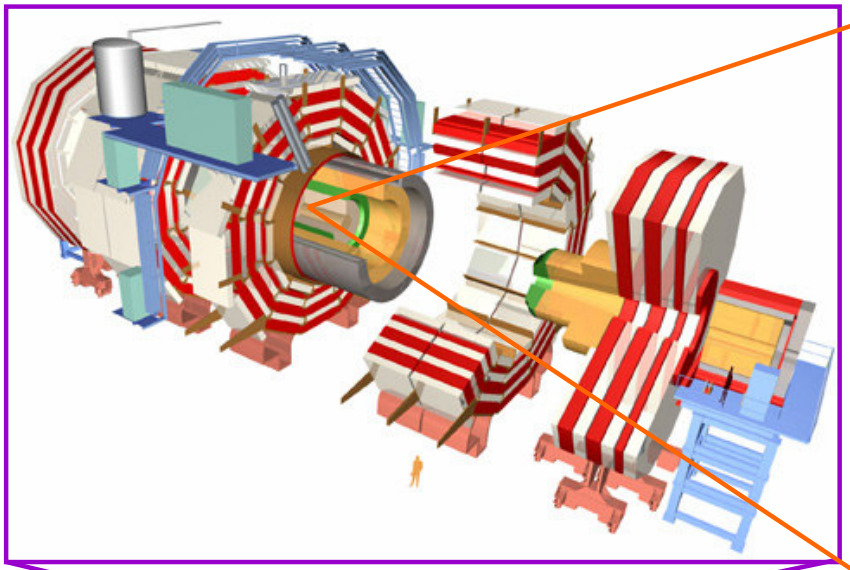
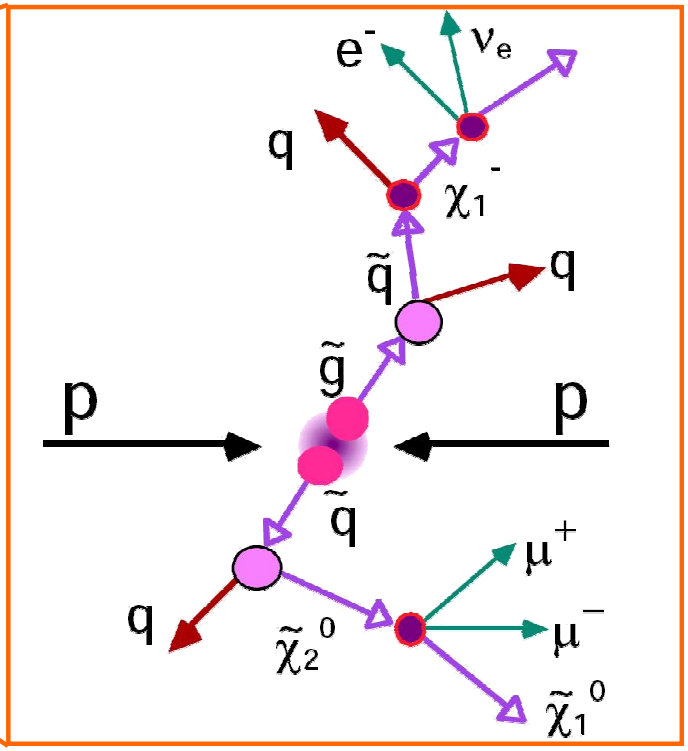
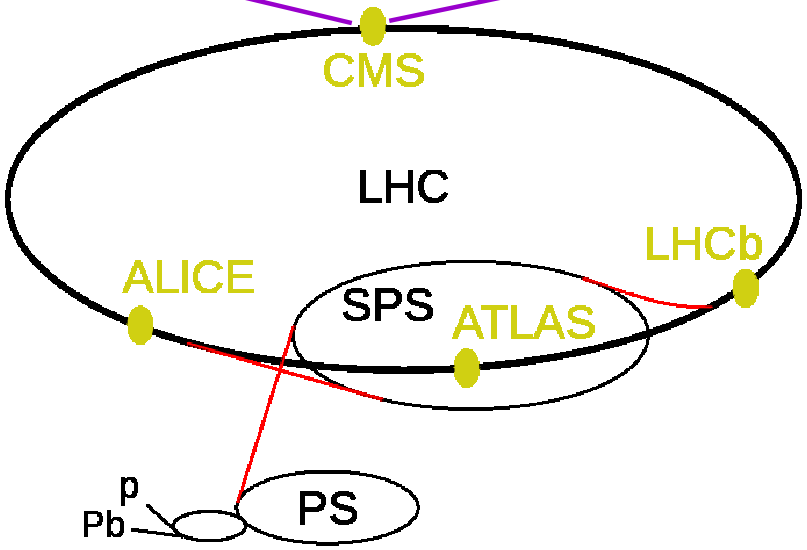
Statusreport : SUSY μ + Jets + MET







Outline :

- Infrastructure
- MuonID
- Data-driven Background Estimation

Infrastructure (I)

RWTH AACHEN
Phys. Inst. III A

Current People :

- ✓ Daniel Teyssier (PostDoc)
- ✓ new: Walter Bender (PhD)
- ✓ new: CM (PostDoc)

Advice from :

- ✓ Thomas Hebbeker
- ✓ Markus Merschmeyer
- ✓ Arnd Meyer

Former Members :

x Clemens Zeidler [SUSY Scans -> SUSY Parameter determination]
x Holger Pieta [Cut based analysis + BDT, Coding, now MUSiC]

References :

- Diploma Thesis Holger Pieta
- CMS AN-2008/034 (together with MUSiC)

Aim :
Resume our SUSY activities
-> improve our analysis, study and implement new techniques
(data-driven methods, systematic uncertainties, ...)

Infrastructure (II)

Analysis will be done in CMSSW_2_x_y using

Summer08/Fall08/(newer) samples in PAT

➔ In principle completely „new" analysis wrt previous analysis

- new center-of-mass energy of 10 TeV
- MADGRAPH <-> ALPGEN
- other triggers
- reco changed/improved

. . . .

→ Difficult (impossible) to compare numbers

Preselection

Preselection Cuts

Aachen-3A TWiki

There is **NO** trigger requirement. You have to do the trigger selection in the analysis, e.g. HLT_Mu[3,5,7,9,11,13,15] or HLT_IsoMu[9,11,13,15]. For the full table see triggers.txt.

Object	Cut Variable	Cut Value
Missing Transverse Energy	met	20 GeV
Jets	jet_pt	20 GeV, 20 GeV, 20 GeV
	jet_eta	2.5, 2.5, 2.5
	jet_fem	0.9, 0.9, 0.9
Muons	muo_pt	20 GeV
	muo_eta	2.5
Electrons	ele_pt	20 GeV
	ele_eta	2.5

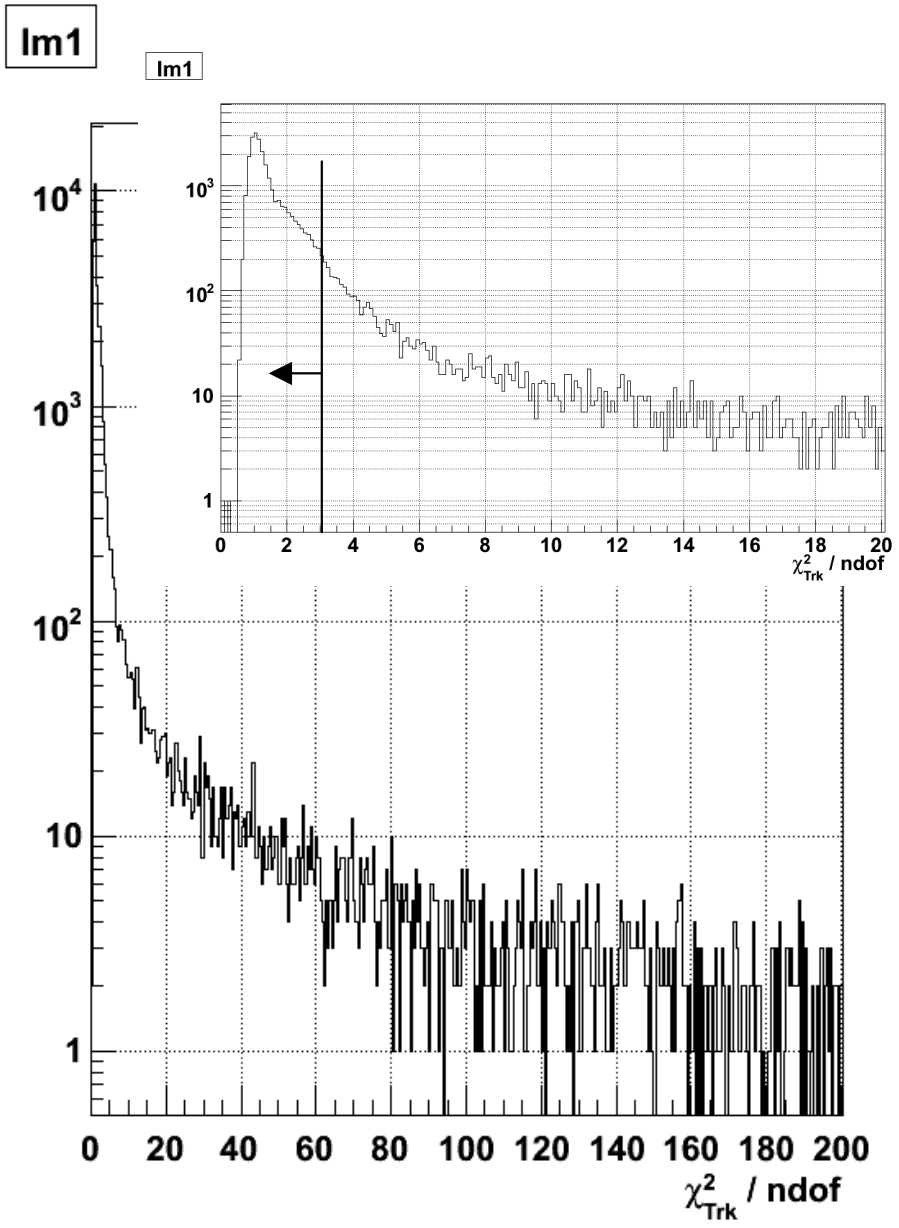
selectedLayer1Muons

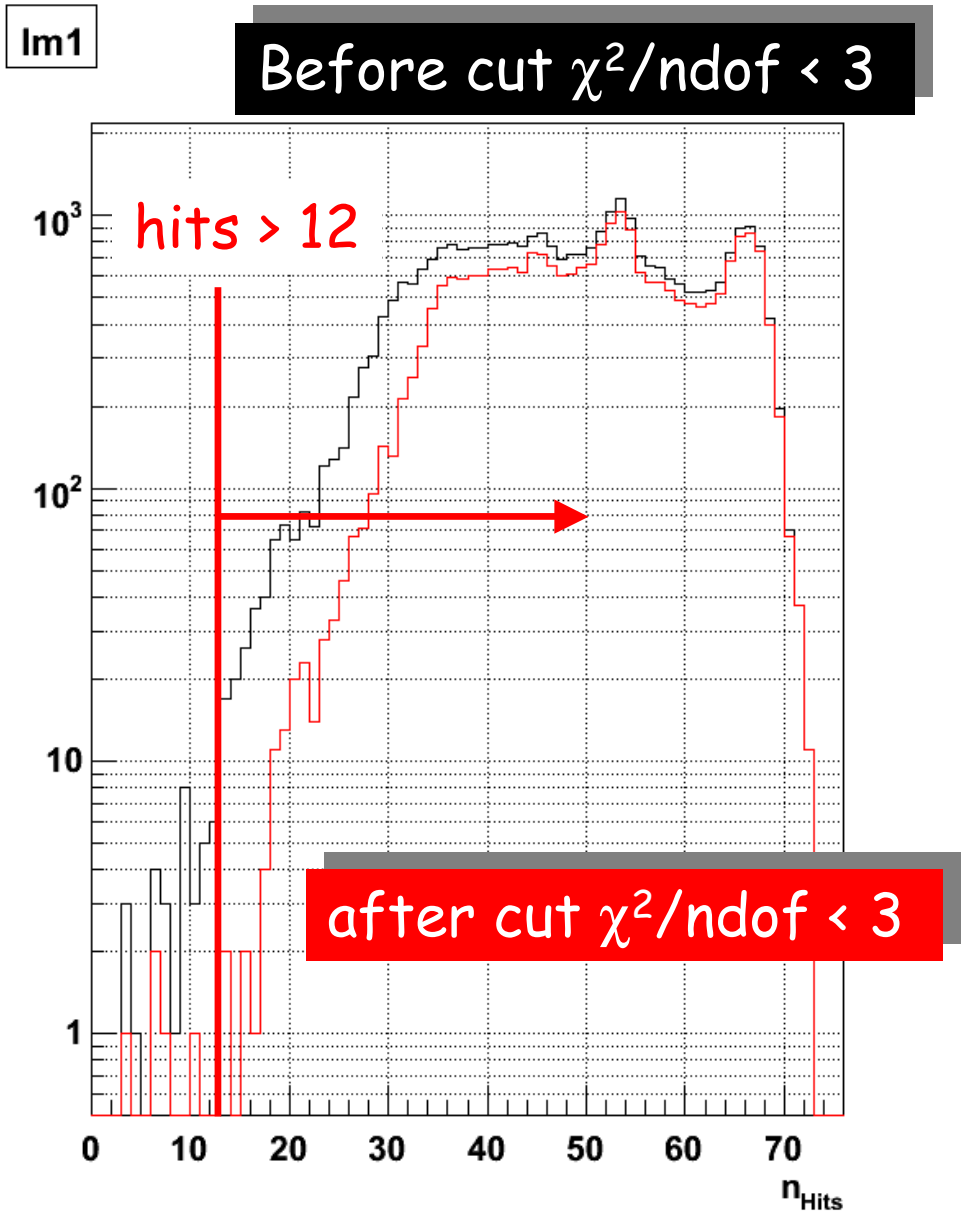
(no electrons required, just filled)

MuonID : χ^2/ndof < 3.
hits > 12
TrkIso < 6.

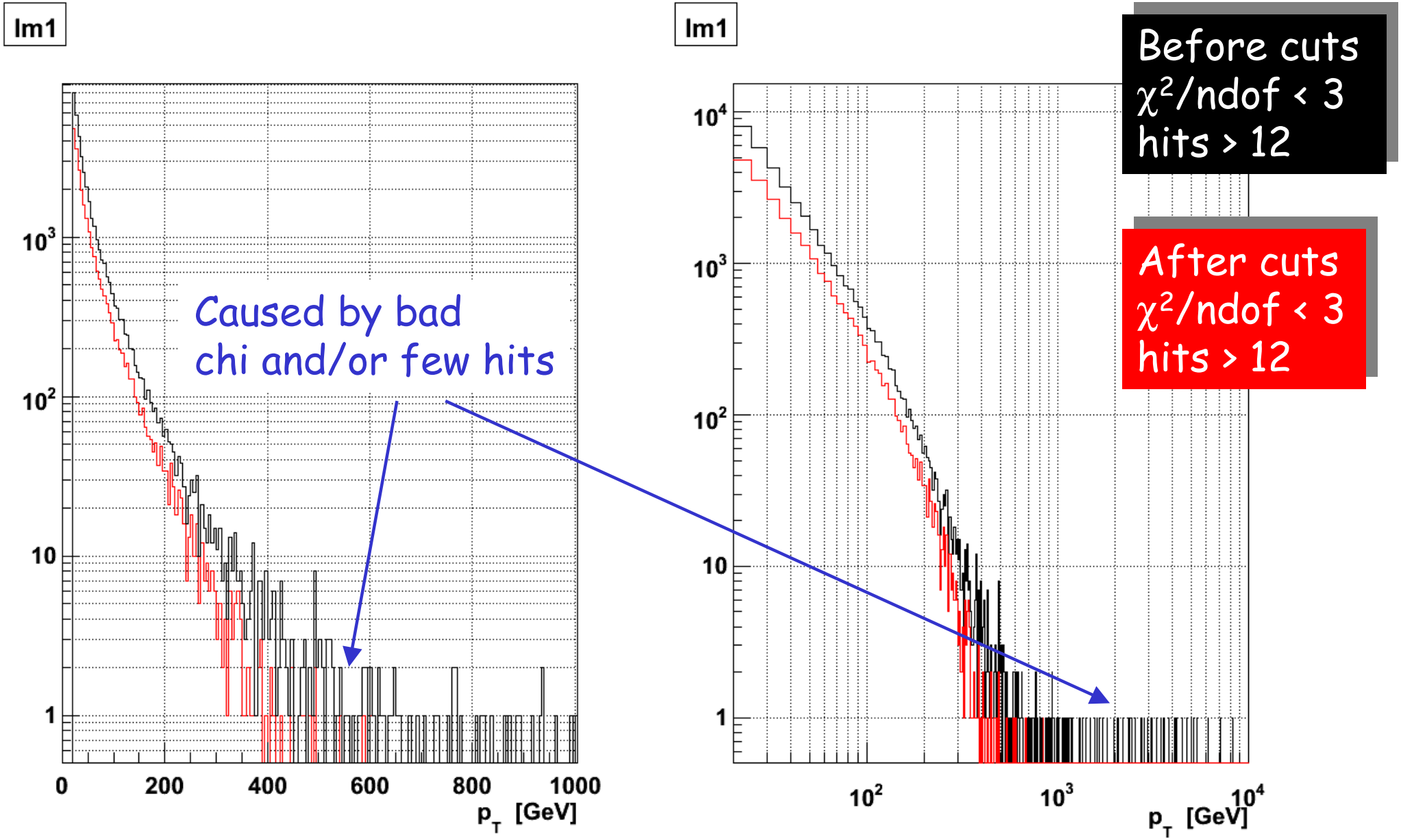
Still valid for CMSSW_2_x_y ?

SelectedLayer1Muons (I)





SelectedLayer1Muons (II)



Definitions

selectedLayer1Muons

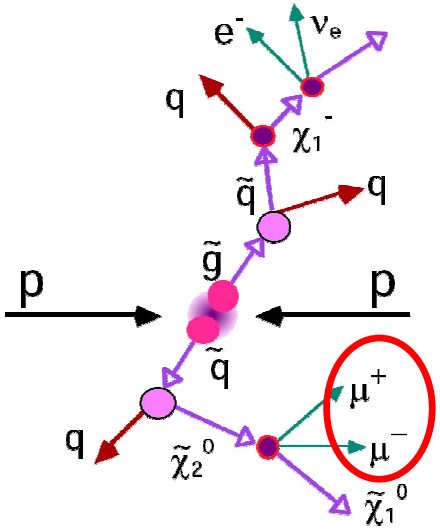
„Loose" : track chi and hits

Truthl ?
(stable truth muon)

No truthl ?
(stable truth muon)

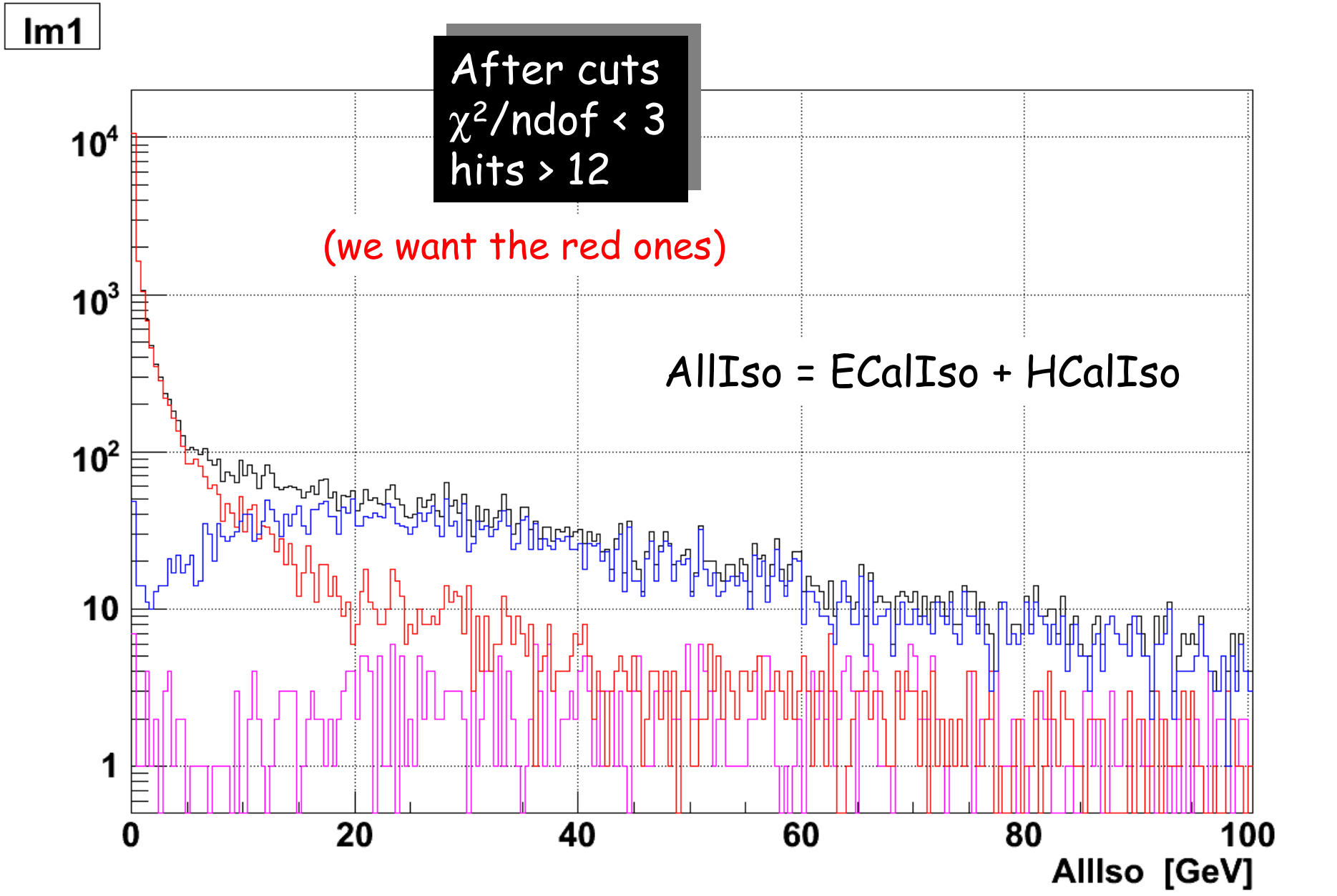
Prompt ?
(in decay chain of hard interaction)

Non-prompt ?
(in decay chain of hadrons)

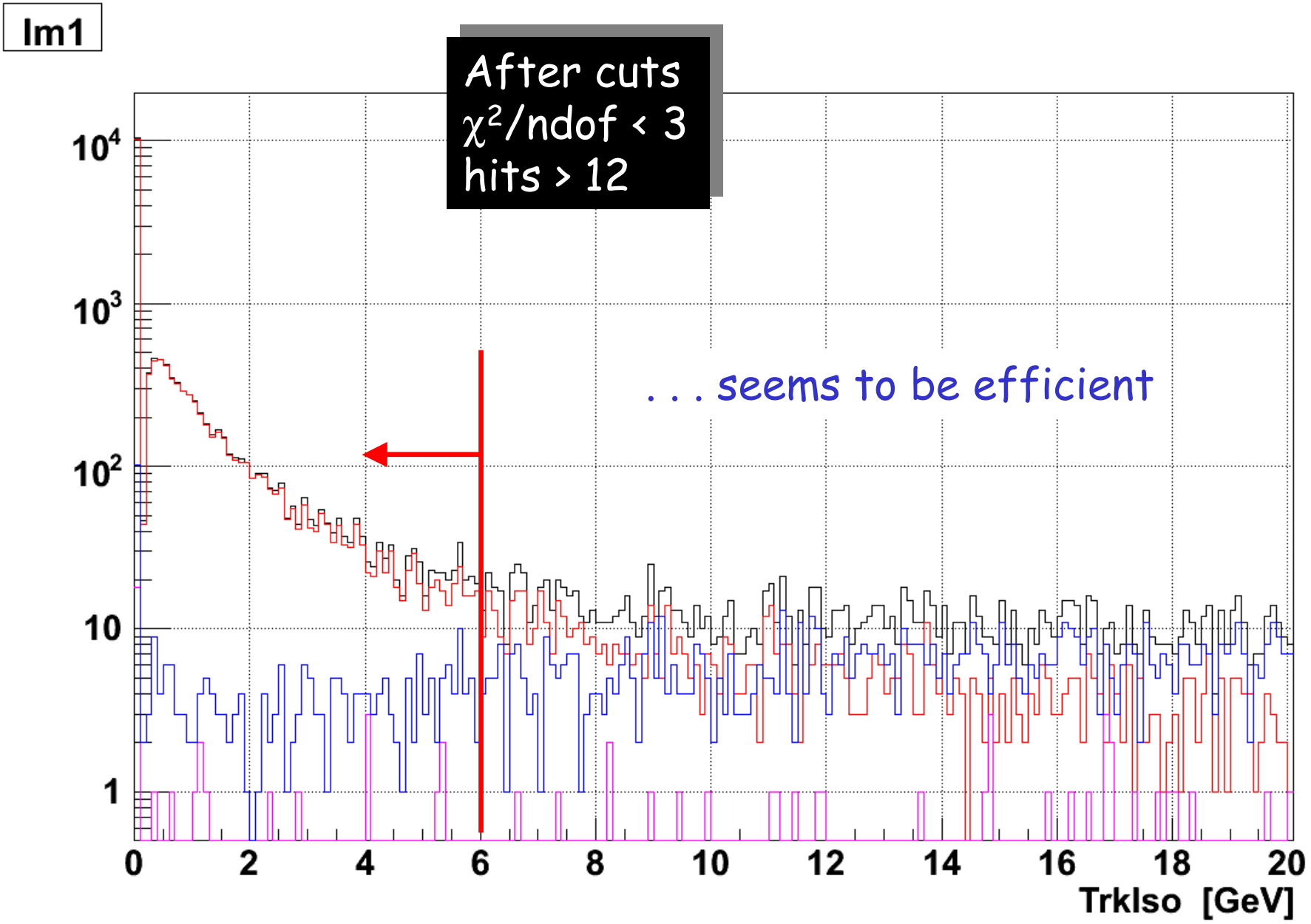


Are we efficiently selecting prompt muons ?

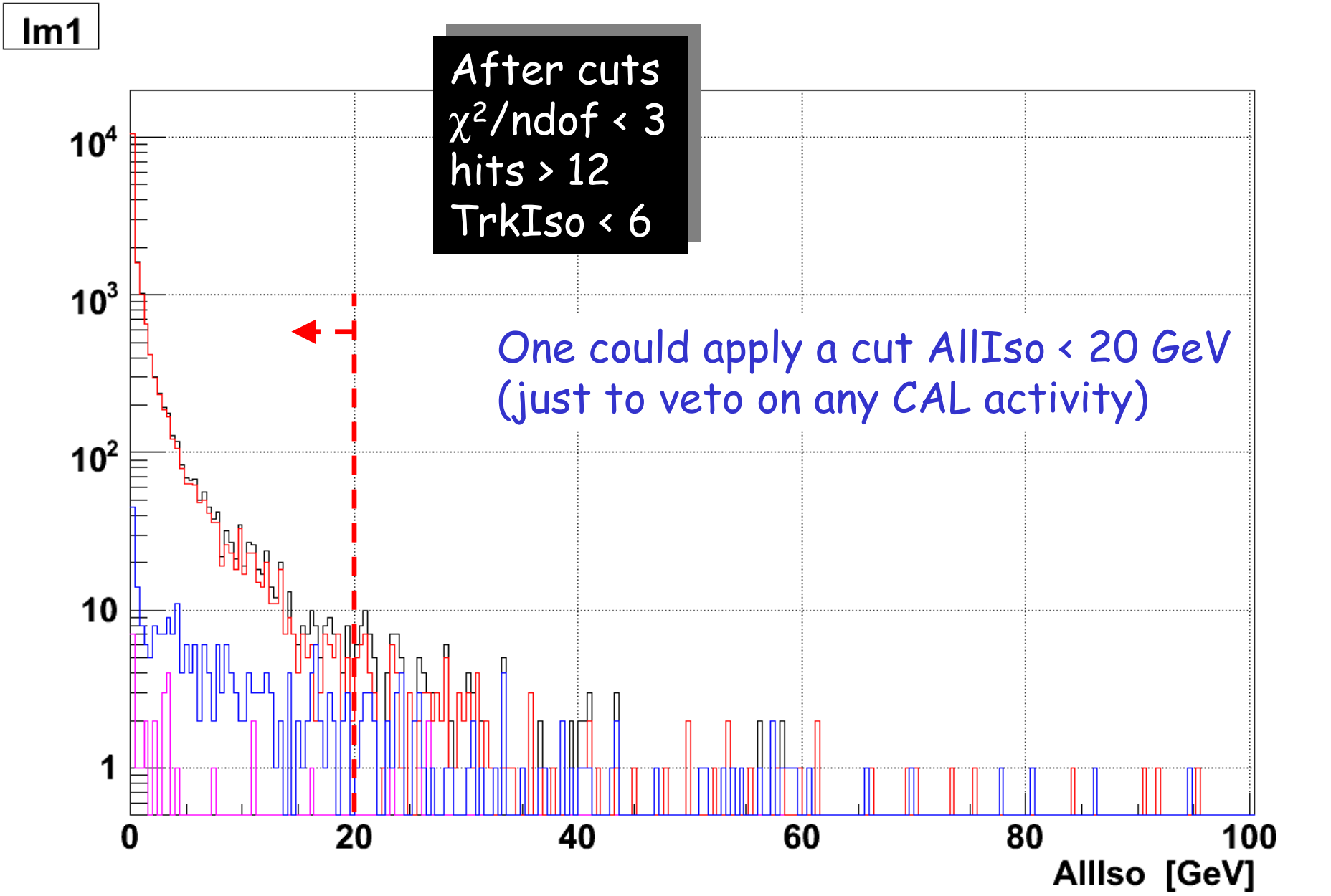
Loose MuonID (I)



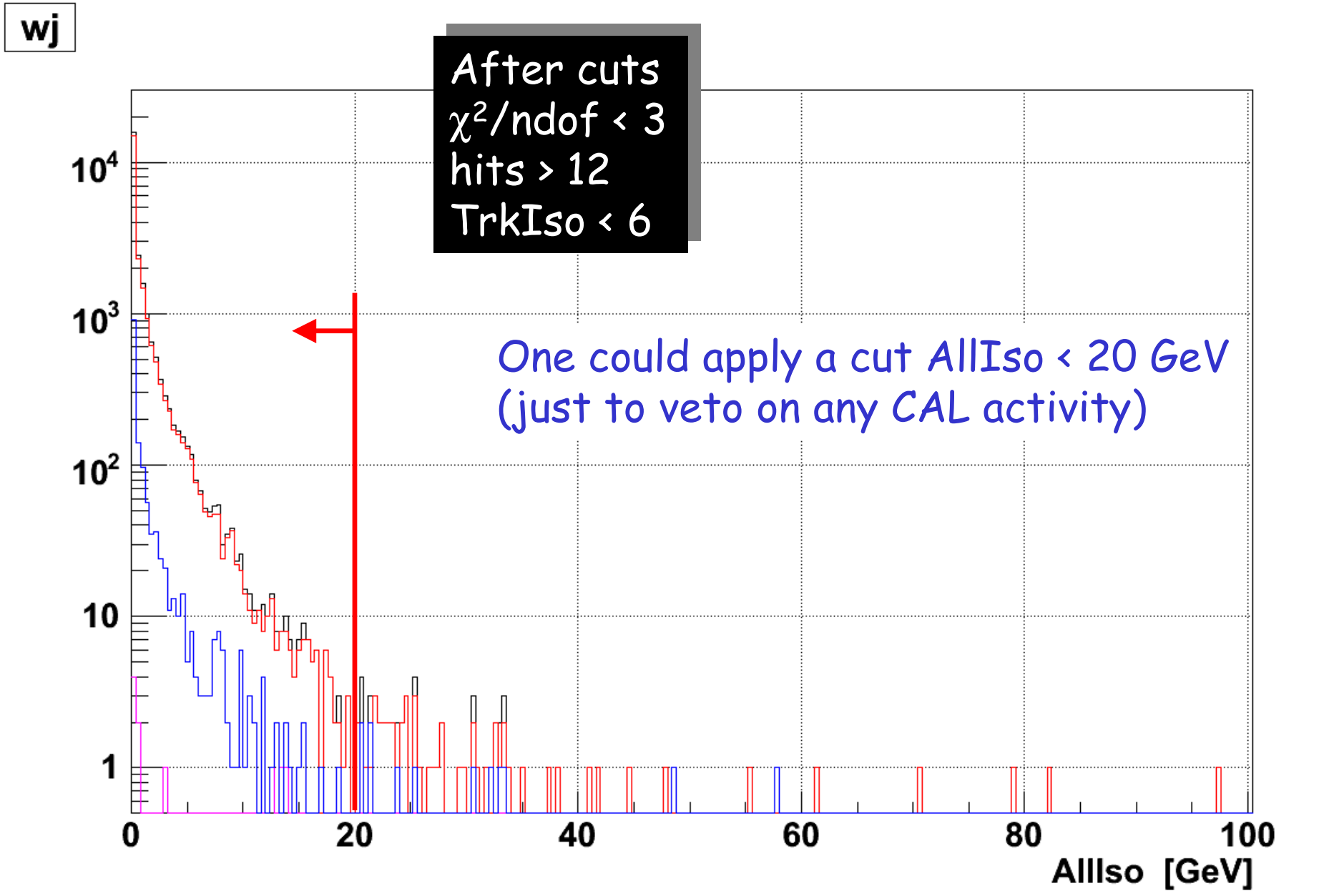
Loose MuonID (II)



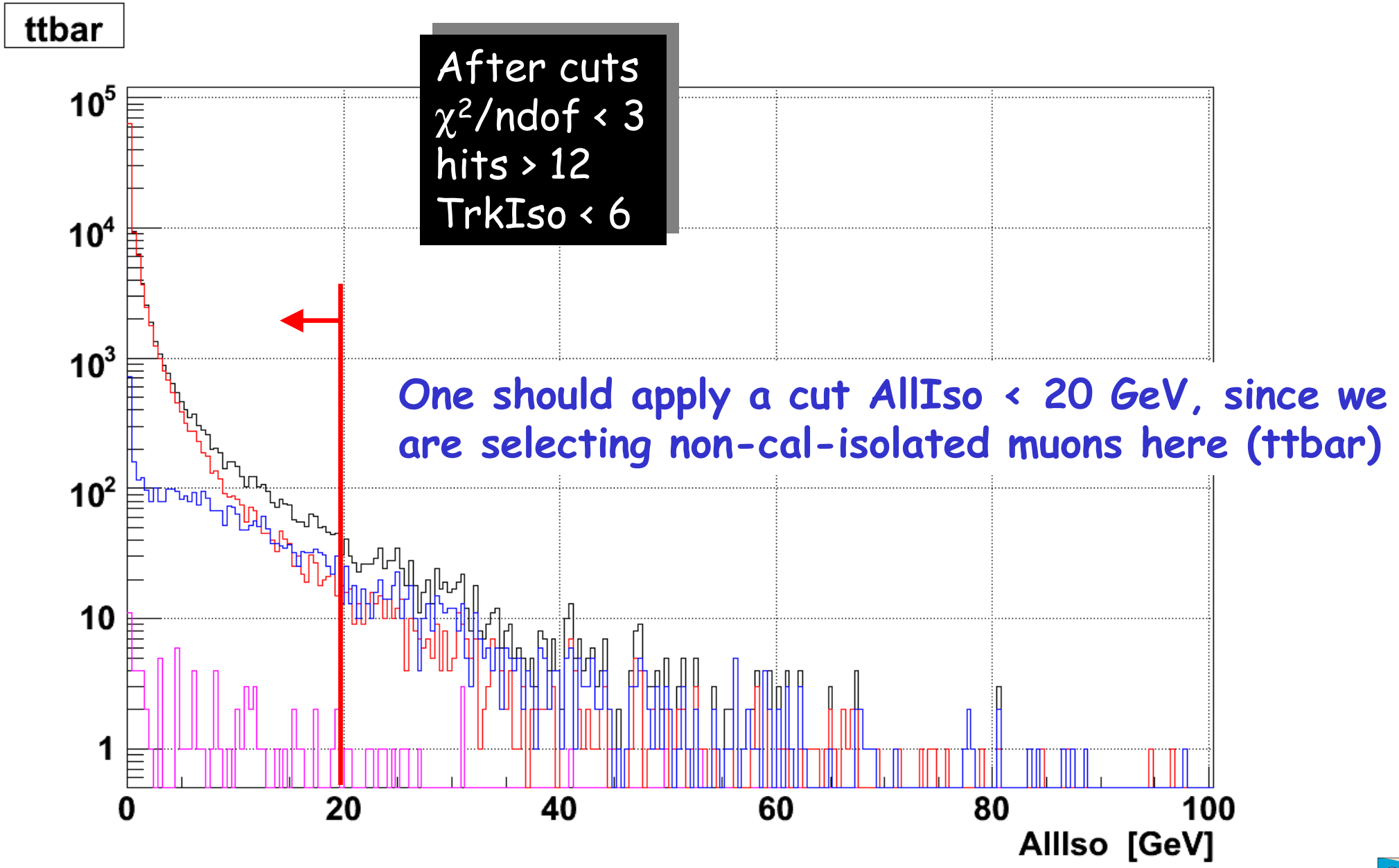
Final MuonID (I)



Final MuonID (II)



Final MuonID (III)



Summary MuonID

Cuts from CMSSW_1 are also applicable in CMSSW_2

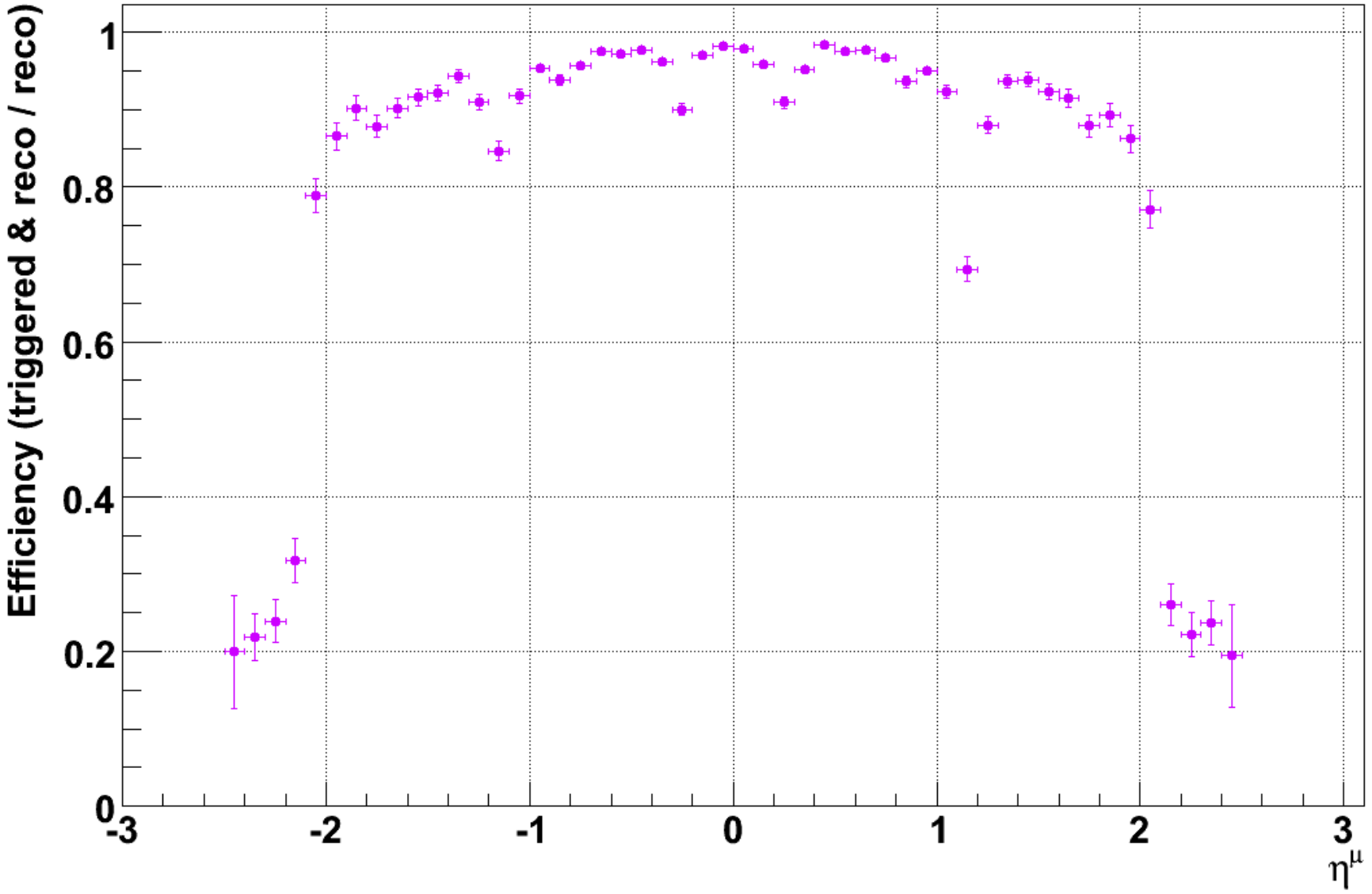
I would suggest to cut on AllIso in addition to TrkIso

χ^2/ndof < 3
hits > 12
TrkIso < 6 GeV
AllIso < 20 GeV

Trigger Efficiency

LM1

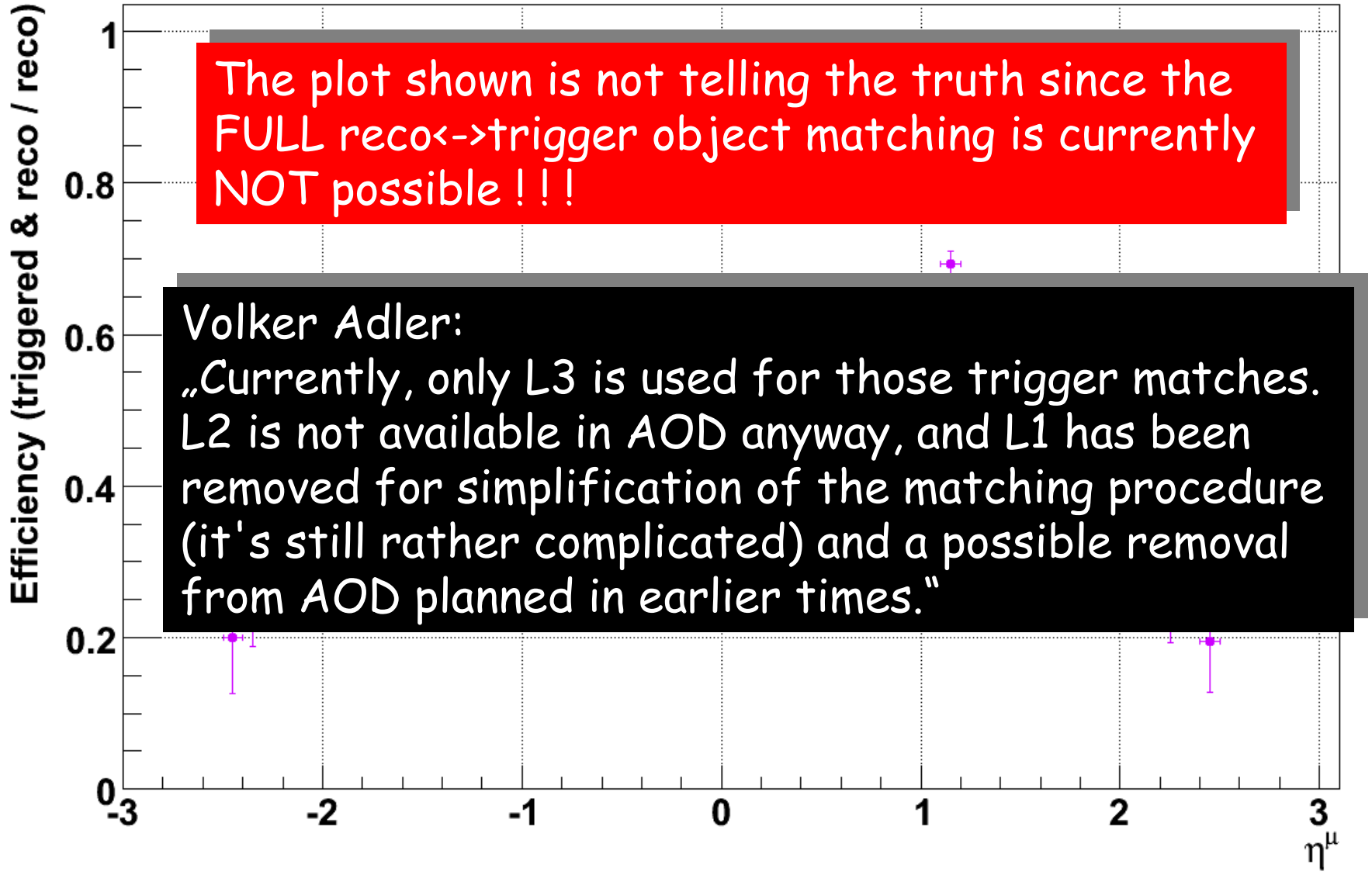
Tried to study trigger efficiencies



Trigger Efficiency

LM1

Tried to study trigger efficiencies



The plot shown is not telling the truth since the FULL reco<->trigger object matching is currently NOT possible ! ! !

Volker Adler:
„Currently, only L3 is used for those trigger matches. L2 is not available in AOD anyway, and L1 has been removed for simplification of the matching procedure (it's still rather complicated) and a possible removal from AOD planned in earlier times."

Data-driven Background Estimation

In addition to predictions from SM Monte Carlo we want (need?) to estimate backgrounds from real data

Basic method :
Extrapolation from ***control*** into ***signal*** region

- **QCD background** : „ABCD method"
  Daniel Teyssier
- **ttbar** : „top box" (== kinematic fit)
  Walter Bender
- **W+jets + ttbar: mT method**
  CM

Main problems/difficulties :
- signal contribution in control region
- systematics of the method
- method relies on Monte Carlo

Analysis Cuts

1 muon with : $p_T > 20$ GeV, $|\eta| < 2.5$, $\chi^2/ndof < 3$, hits > 12, TrkIso < 6

3 jets with : $p_T > 50$ GeV, $|\eta| < 2.5$, fem < 0.9

Missing transverse energy > 100 GeV

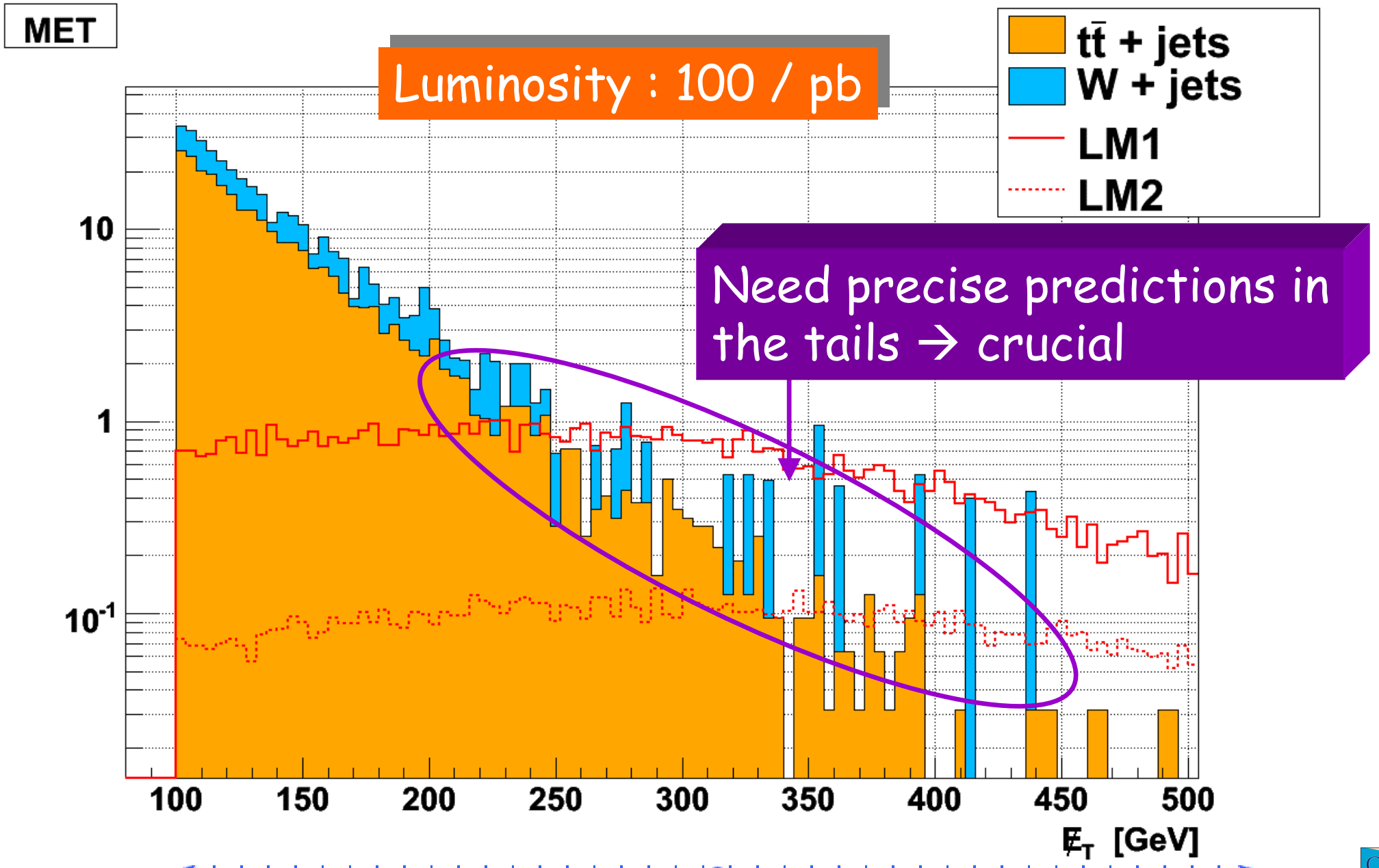
#Events that survive the cuts (not scaled to xs)

1M	ttbar,	xs = 310 pb	8429
10M	W+jets,	xs = 40 nb	257
200k	LM1	xs = 16 pb	9077
200k	LM2	xs = 2.4 pb	9595

Statistics !

(LM1 : highest XS from benchmark points)

MET - Distribution



mT - Method

Goal : Want to use **MET distribution** for final cut

Problem : Tails from W+jets, ttbar, suffer from statistics
Monte Carlo ? → better try to predict in addition from data

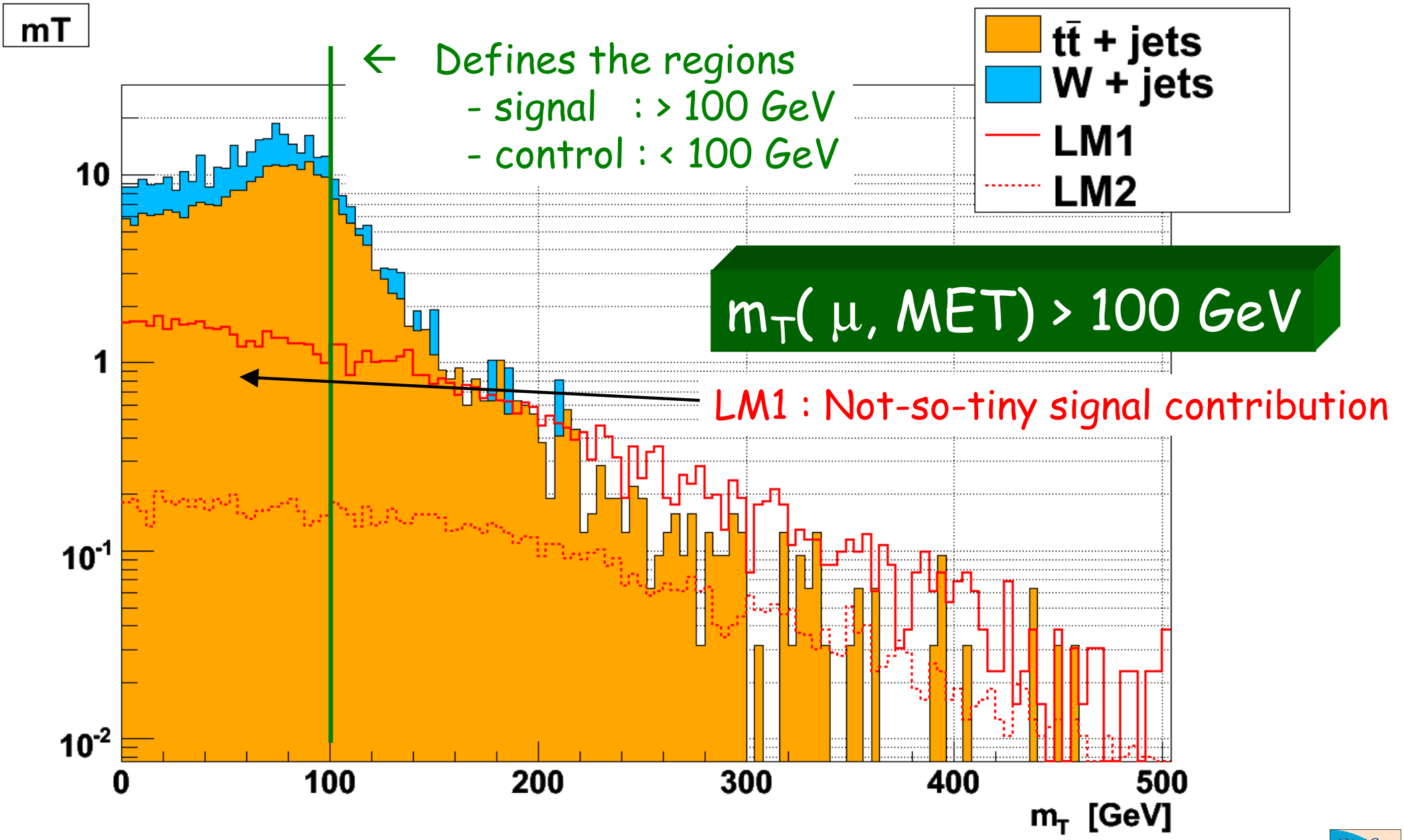
Solution : Estimate W+jets + ttbar ***simultaneuosly*** in control region and extrapolate into signal region (-> high MET)

Method :
(1) Check if MET depends on mT
(2) Check if enough statistics remains from control region
(3) Check normalization
(4) Check extrapolation method for ttbar & W + jets
(5) Correct for signal contamination in control region

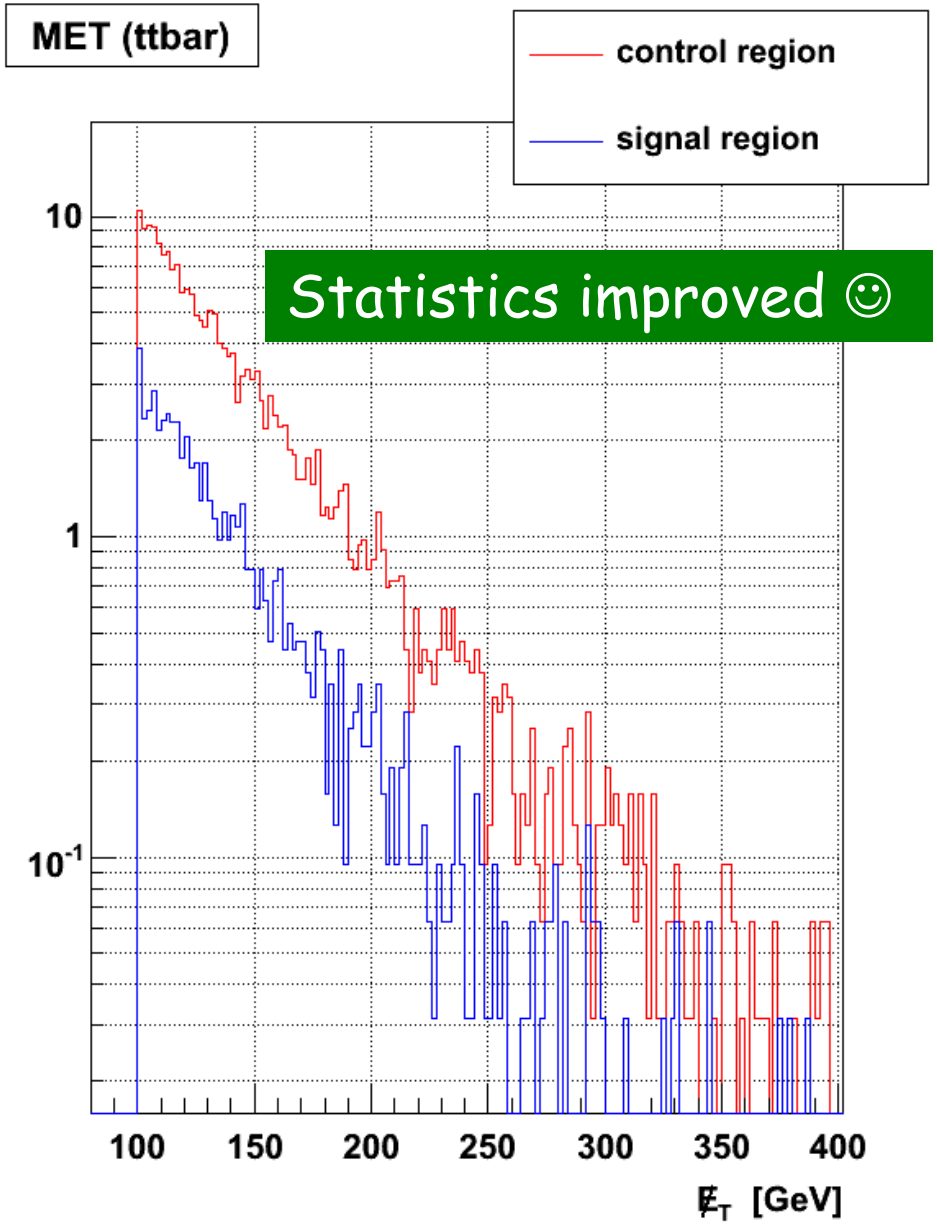
I assume that there is no QCD background left.
The very few events surviving the cuts will be estimated by Daniel's ABCD method.

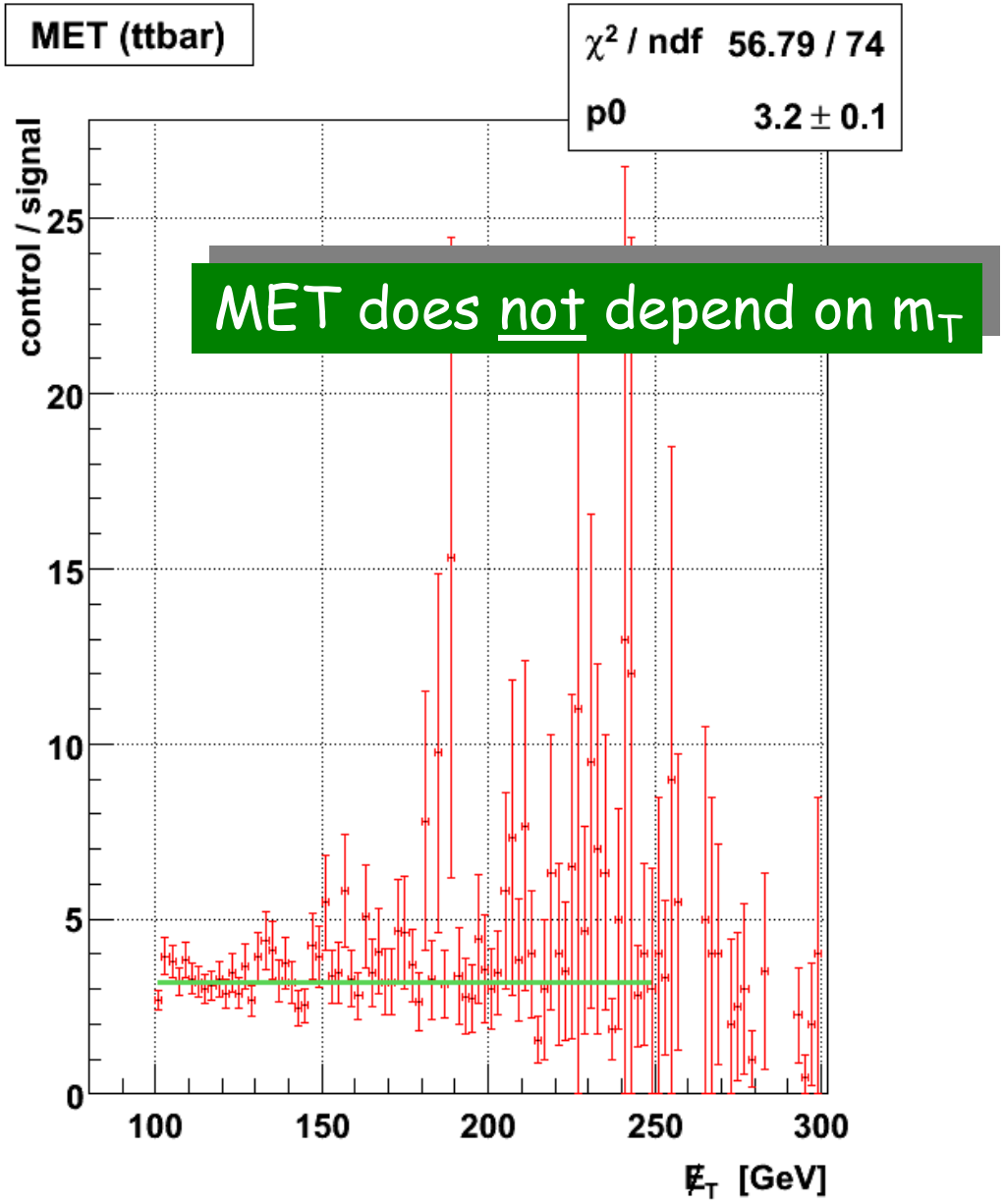
mT - Distribution

$$m_T = \sqrt{2 \not{E}_T p_T^{\mu} (1 - \cos \Delta\varphi)}$$

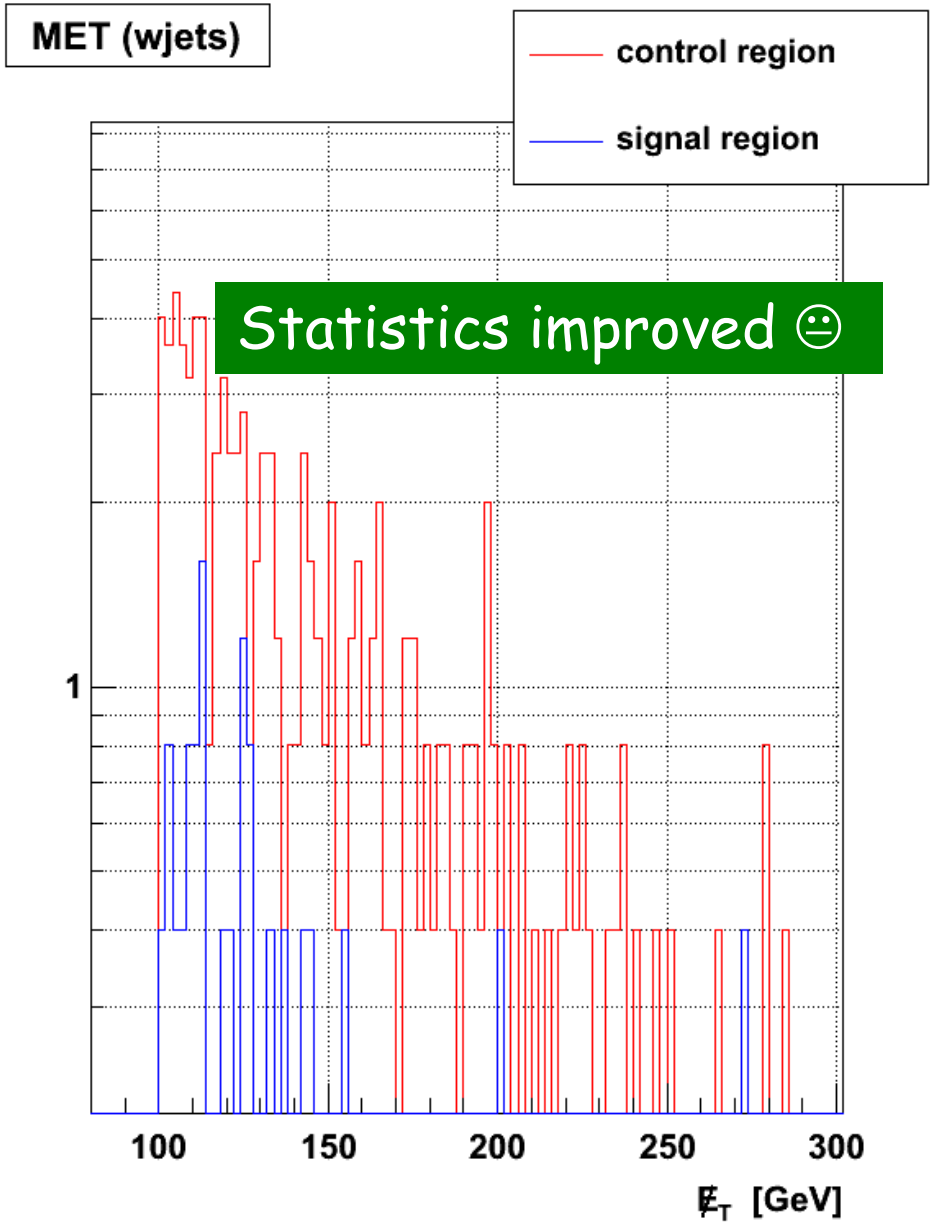


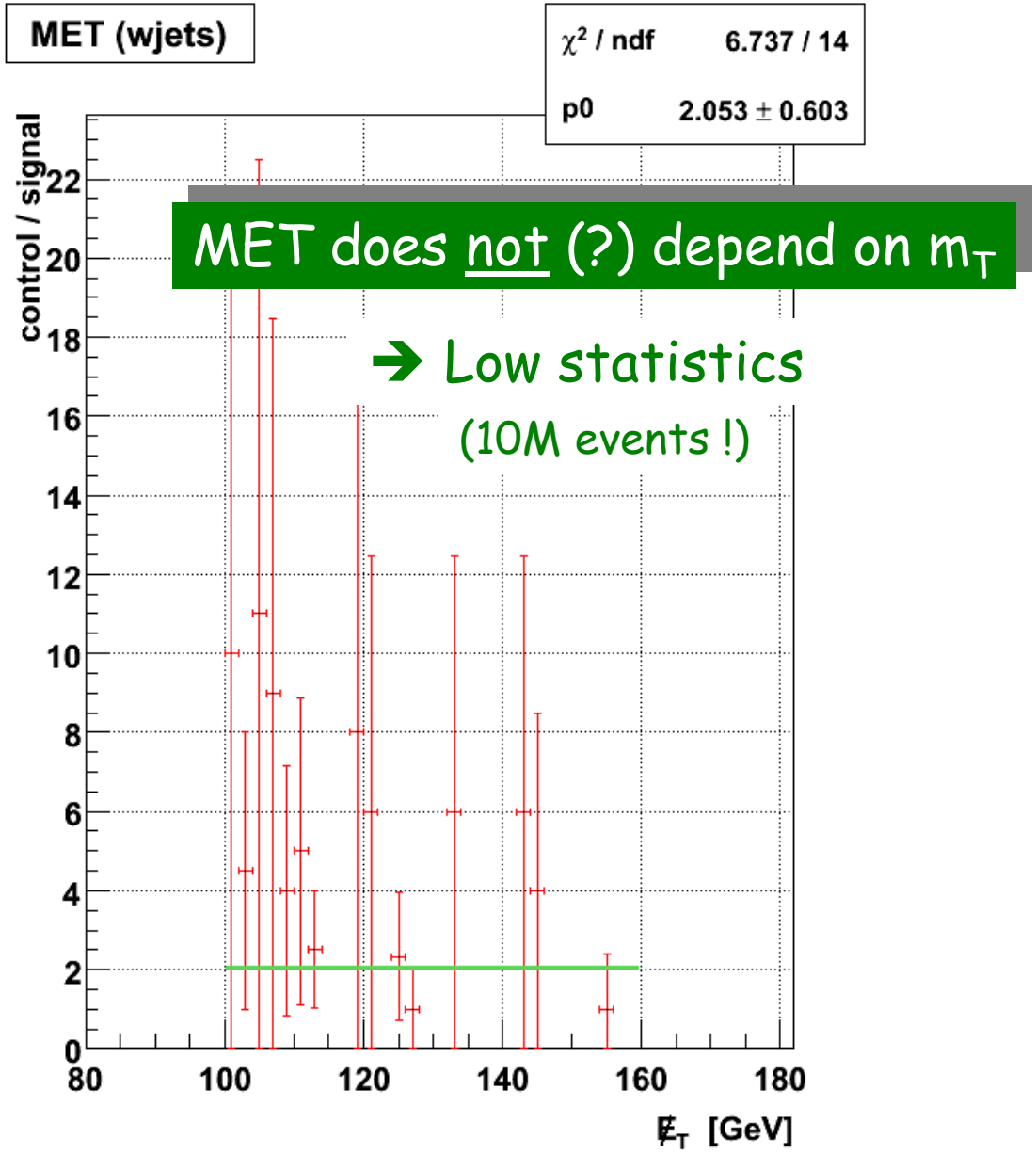
MET Dependency : ttbar



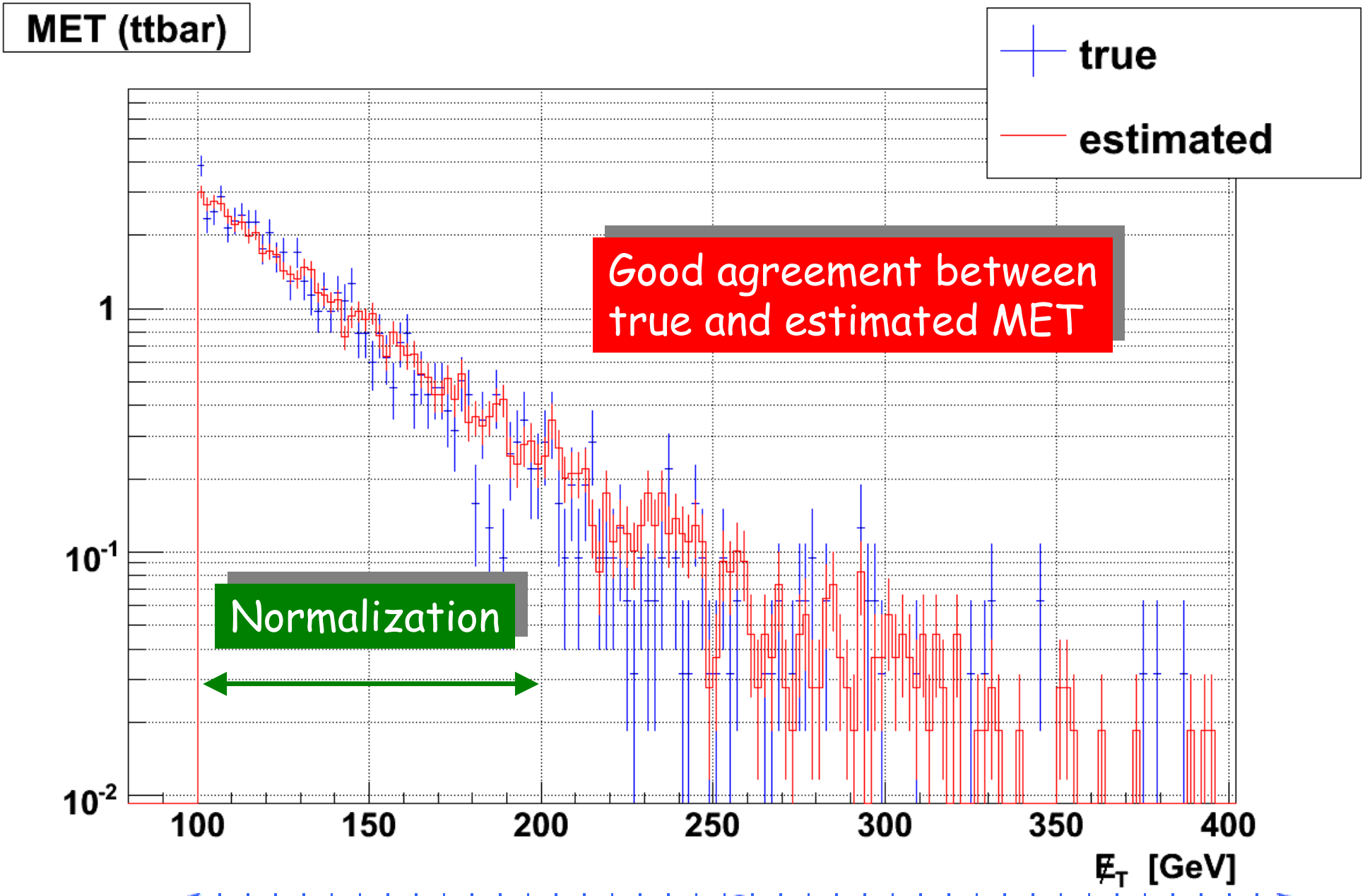


MET Dependency : W + jets

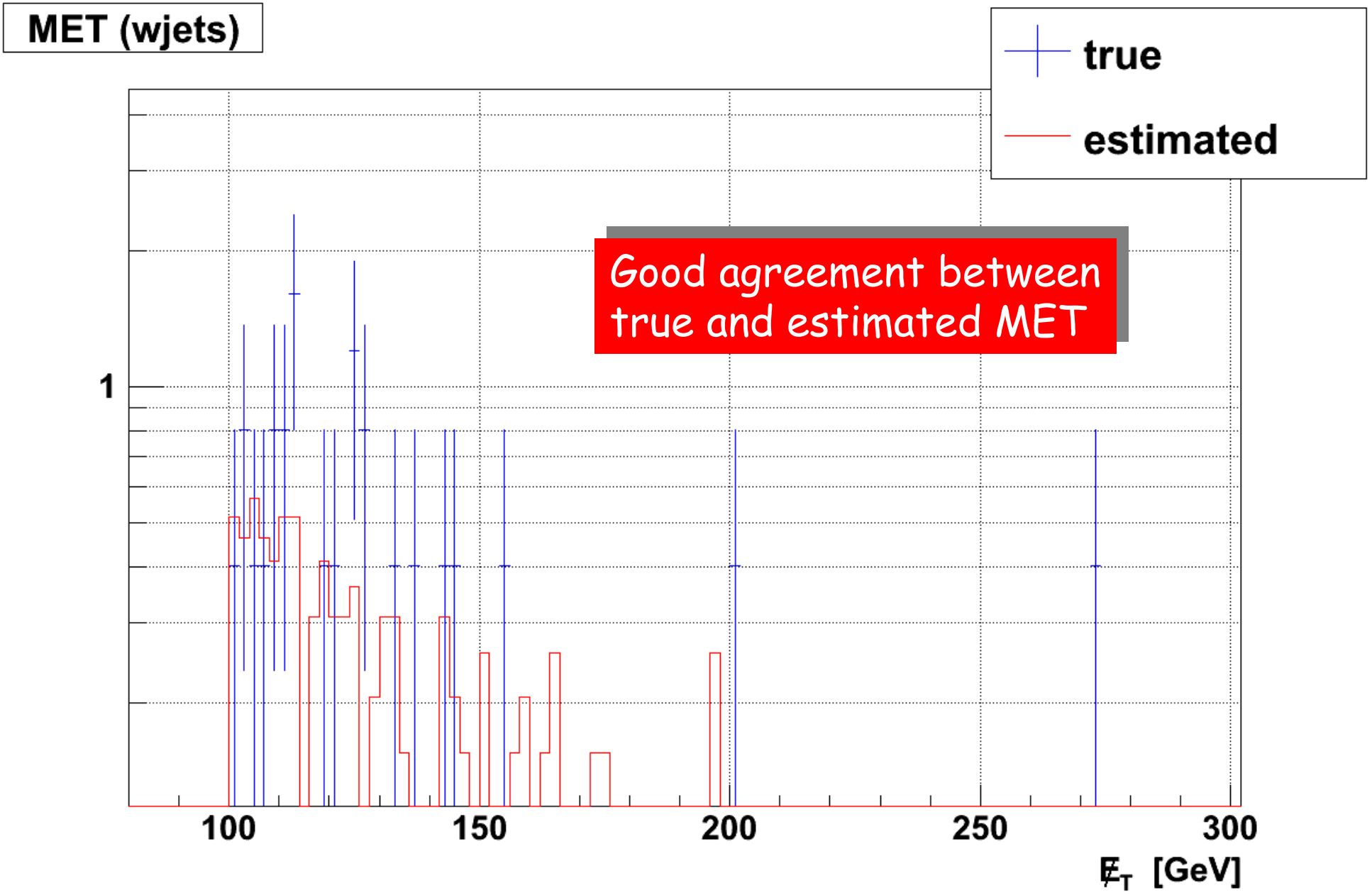




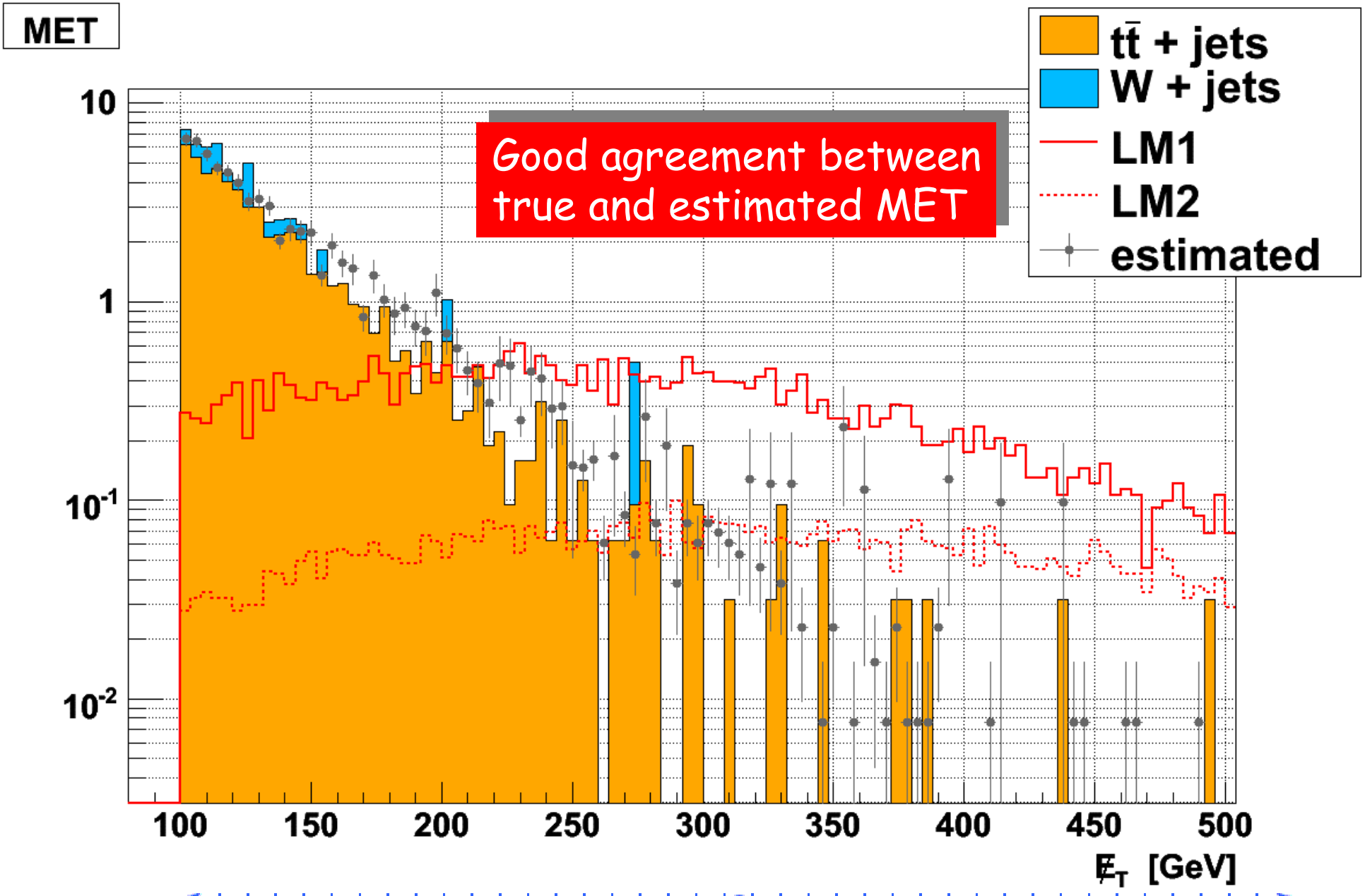
Normalization & Extrapolation : ttbar



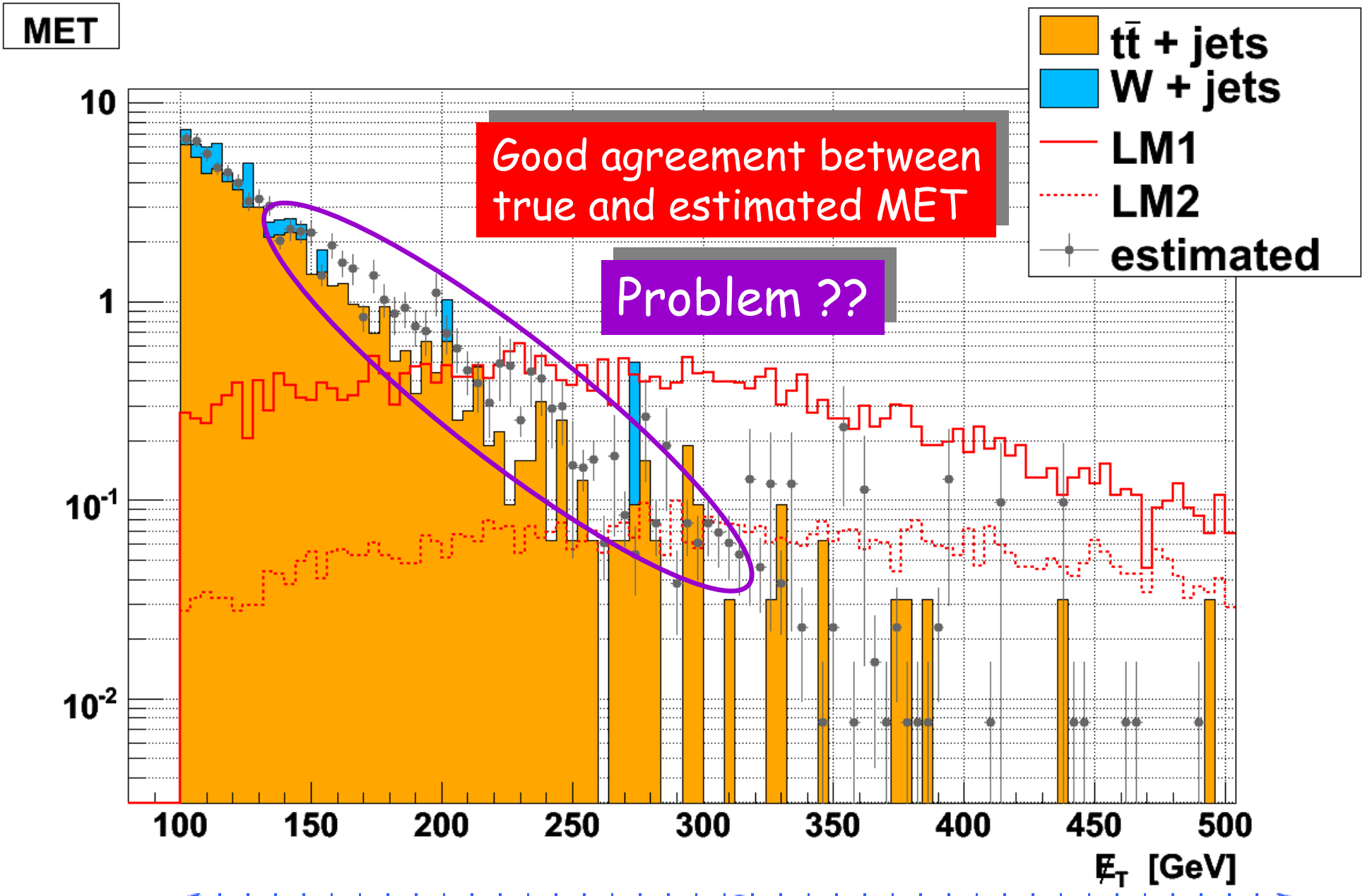
Normalization & Extrapolation : W + jets



First Result



First Result

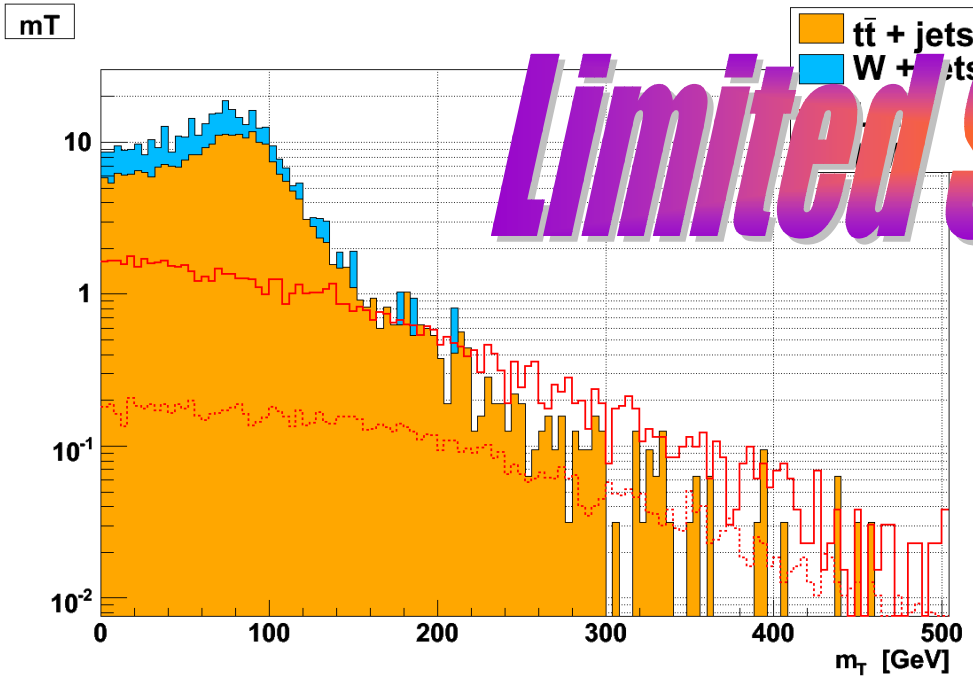


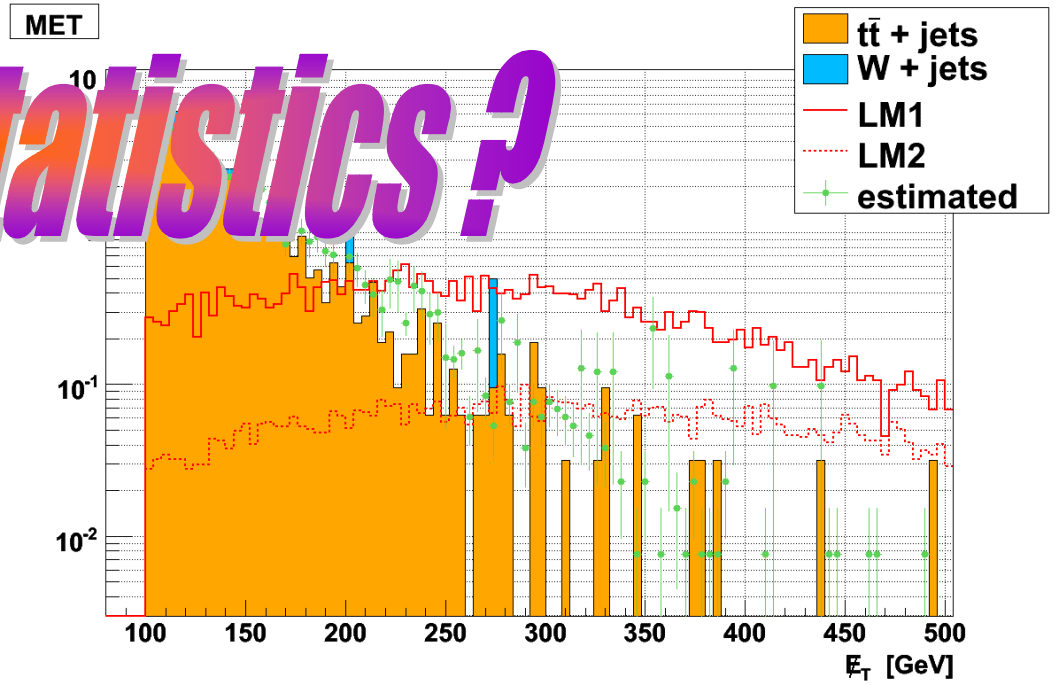
Composition

	m_T < 100 GeV		m_T > 100 GeV	
ttbar	186	70 %	54	84 %
W + jets	78	30 %	10	16 %
Sum	264		64	

→ Composition different in control and signal region (?)

Limited Statistics ?





Summary mT - Method

Method is working !

Next steps :
- include signal and correct for possible contamination
- further cross-checks
- separate ttbar from W+jets ?