

PAT Muons

MC truth, Fake Rates e dintorni

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Sommario:

- ➔ Contesto
- ➔ Selettori al lavoro
- ➔ Studi sulla fake rate / muon reconstruction

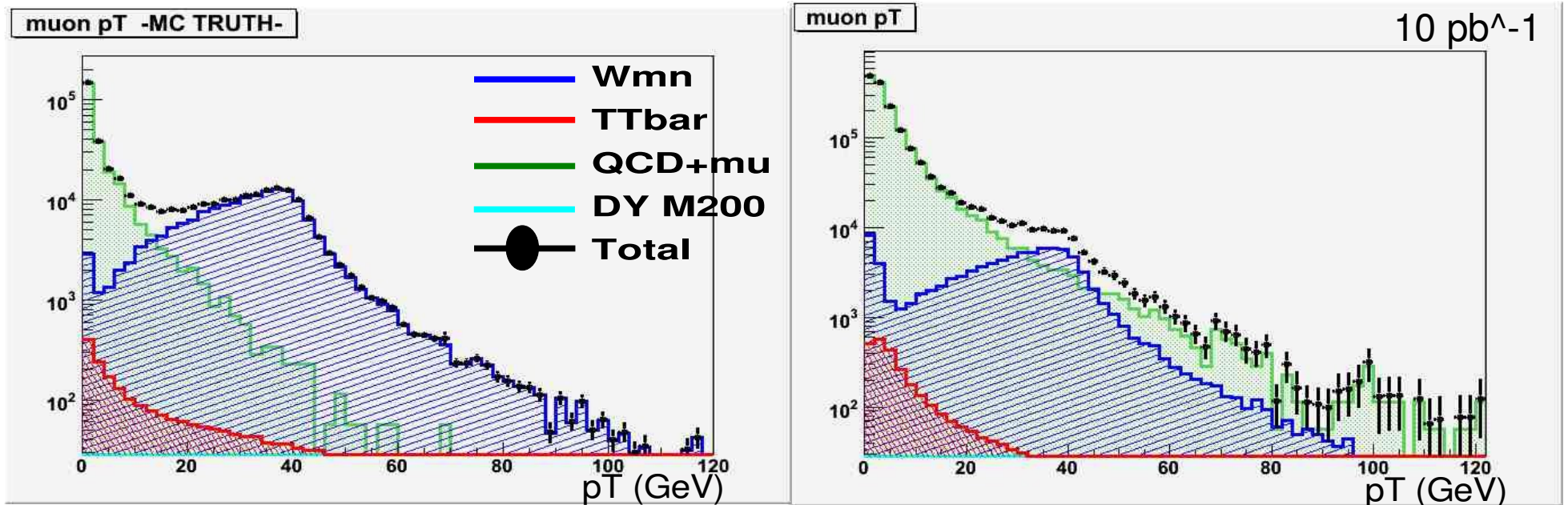
Contesto

Esercizi sui sample Zmm, Wmn, TTbar, QCDEnriched80to170

(v. talk http://cms.pd.infn.it/software/meetings/2008_10_07/NonSoloPAT.pdf)

Pratica sull'utilizzo di tools quali:

- pattificazione (L0/L1, cut on selections, iso, settings etc)
- CandidateModules (creazione di collezioni, selezioni @ cfg level)

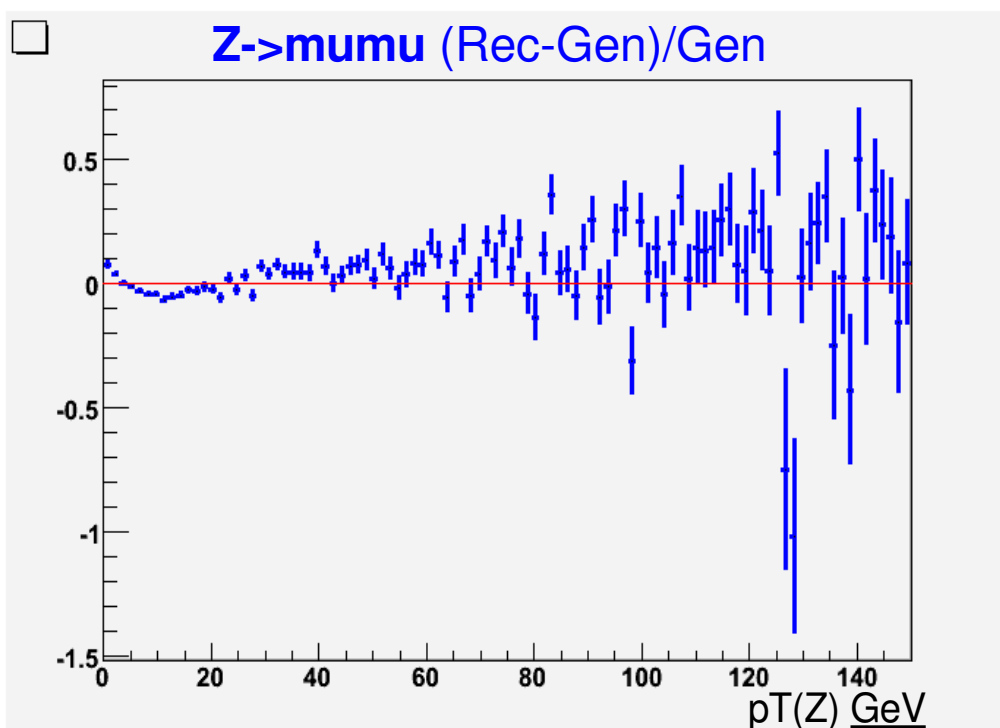


...l'uso dei **CandidateModules** in particolare

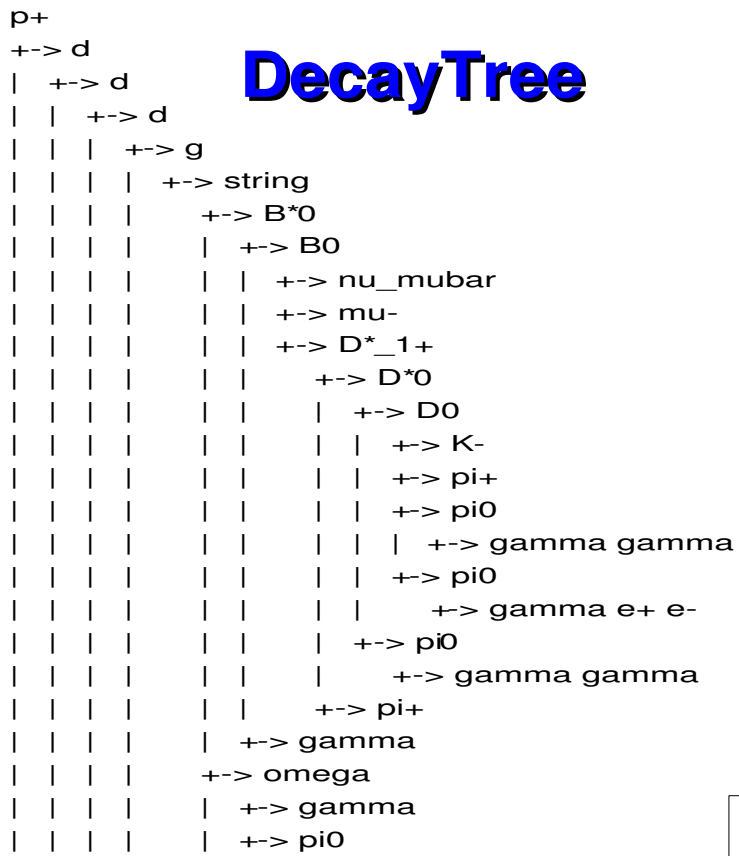
(<https://twiki.cern.ch/twiki/bin/view/CMS/SWGuideCandidateModules>)

e' particolarmente utile. Essi tra le altre cose permettono:

- ✓ Contare oggetti, ordinarli in pT...
- ✓ Creare o manipolare collezioni
- ✓ Calcolare masse invarianti
- ✓ Applicare selezioni
- ✓ Implementare l'associazione Gen-Rec ☹ (anche per oggetti composti)

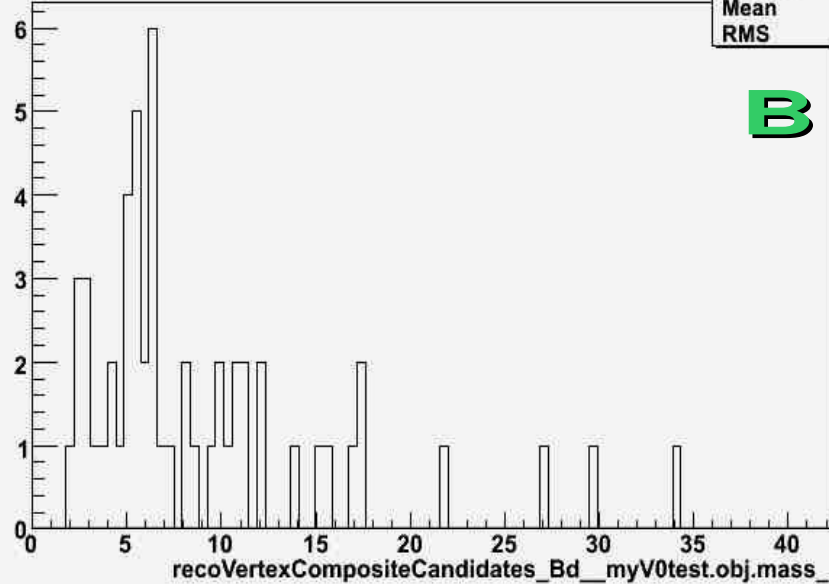


```
process.zCands = EDProducer(  
  "NamedCandViewShallowCloneCombiner",  
  decay = string("selectedMuons@+ selectedMuons@-"),  
  cut = string("20 < mass < 200"),  
  name = cms.string('zToMuMu'),  
  roles = cms.vstring('mu1', 'mu2') )
```



8.35 fb⁻¹

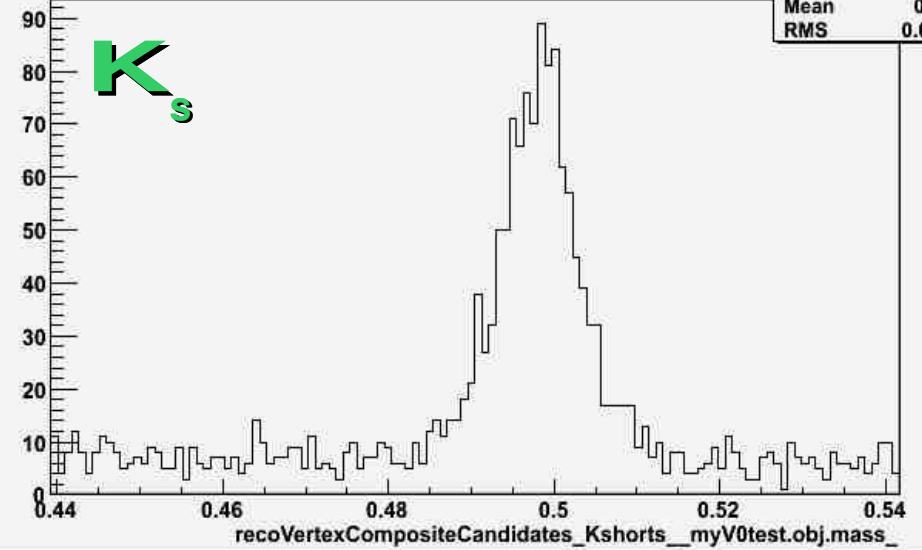
recoVertexCompositeCandidates_Bd_myV0test.obj.mass_



htemp	
Entries	58
Mean	9.101
RMS	6.813

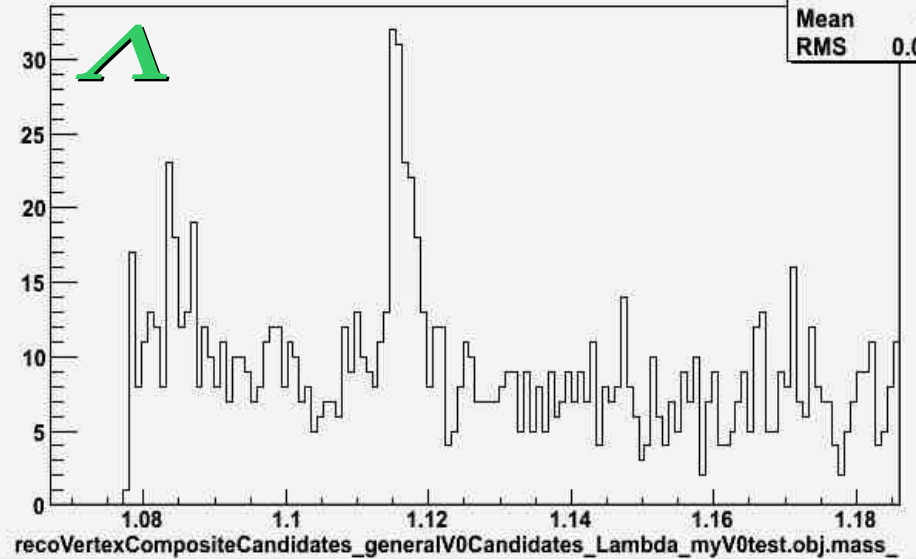
B

recoVertexCompositeCandidates_Kshorts_myV0test.obj.mass_



htemp	
Entries	2093
Mean	0.4938
RMS	0.02083

recoVertexCompositeCandidates_generalV0Candidates_Lambda_myV0test.obj.mass_



htemp	
Entries	2875
Mean	1.126
RMS	0.03108

QCDDiJetPt80to120/IDEAL_V11_redigi_v1

CandidateCombiner

Sull' associazione Gen – Rec

Goal: studi su efficienza
e Fake Rates per analisi correlate

linee guida: [CMS AN-2008/098](#) sulla Muon ID
e lavori piu' recenti di C.Campagnari, J.Ribnik;

In teoria da un po' ci sono le PAT ufficiali:

fondi da QCD, di-jet, BtoJpsiMuMu, DymumuM200, SUSY, Gravitoni, LeptoQuarks...

→ <https://hypernews.cern.ch/HyperNews/CMS/get/skims/50.html>,

→ <http://mthomas.web.cern.ch/mthomas/rereco/Summer08ProductionPATrereco.html>

PERO'...

L'associazione Rec-Gen e' fatta a livello di config. file

- E' un by-product della PATtificazione
- E' configurabile (DRmax, stessa carica, multiple match., status, etc)
- Il default forza l'ID della particella generata ad essere un mu
 - non adatto a questo tipo di studi
 - PATtificazione privata con criterio di associazione rilassato
- ✓ **QCDEnriched80to180**
- ✓ **QCDdijets**
- ✓ Aggiunta anche la simulazione dei decay-in-flight
(routine privata di K. Ulmert ...*work in progress*...)

→ Primi risultati su:

- Associazione muoni ricostruiti-truth
- Distribuzioni in p_T , η di mu veri e 'fake'
- Fake Rate VS p_T , η

$$\text{Fake Rate } (\pi, K) = \frac{\#(\text{mu rec as a } \pi, K)}{\#(\text{True } \pi, K)}$$

Altri tools muonici utili: i **Global Selectors**

```
AllGlobalMuons,          // checks isGlobalMuon flag
AllStandAloneMuons,      // checks isStandAloneMuon flag
AllTrackerMuons,         // checks isTrackerMuon flag
TrackerMuonArbitrated,   // resolve ambiguity of sharing segments
AllArbitrated,           // all muons with the tracker muon arbitrated
GlobalMuonPromptTight,   // global muons with tighter fit requirements
TMLastStationLoose,      // penetration depth loose selector
TMLastStationTight,      // penetration depth tight selector
TM2DCompatibilityLoose,  // likelihood based loose selector
TM2DCompatibilityTight, // likelihood based tight selector
TMOneStationLoose,       // require one well matched segment
TMOneStationTight,       // require one well matched segment
TMLastStationOptimizedLowPtLoose, // combination of TMLastStation and TMOneStation
TMLastStationOptimizedLowPtTight // combination of TMLastStation and TMOneStation
(...)
```

Tracker Muon One/Last Station Algorithms

- Almeno un (DUE) segmenti matchati con l'estrapolazione della Si track
- Un segmento well-matched** nella (I'ULTIMA) stazione attraversata* dall'estrap. della Si track

* almeno 3 multiple scattering σ e almeno

3 cm lontano dal bordo della camera piu' vicino

** well-matched : =

$|\Delta X| < \text{Max}(3\sigma X, 3 \text{ cm})$ (TMLastStationLoose and TMLastStationTight)

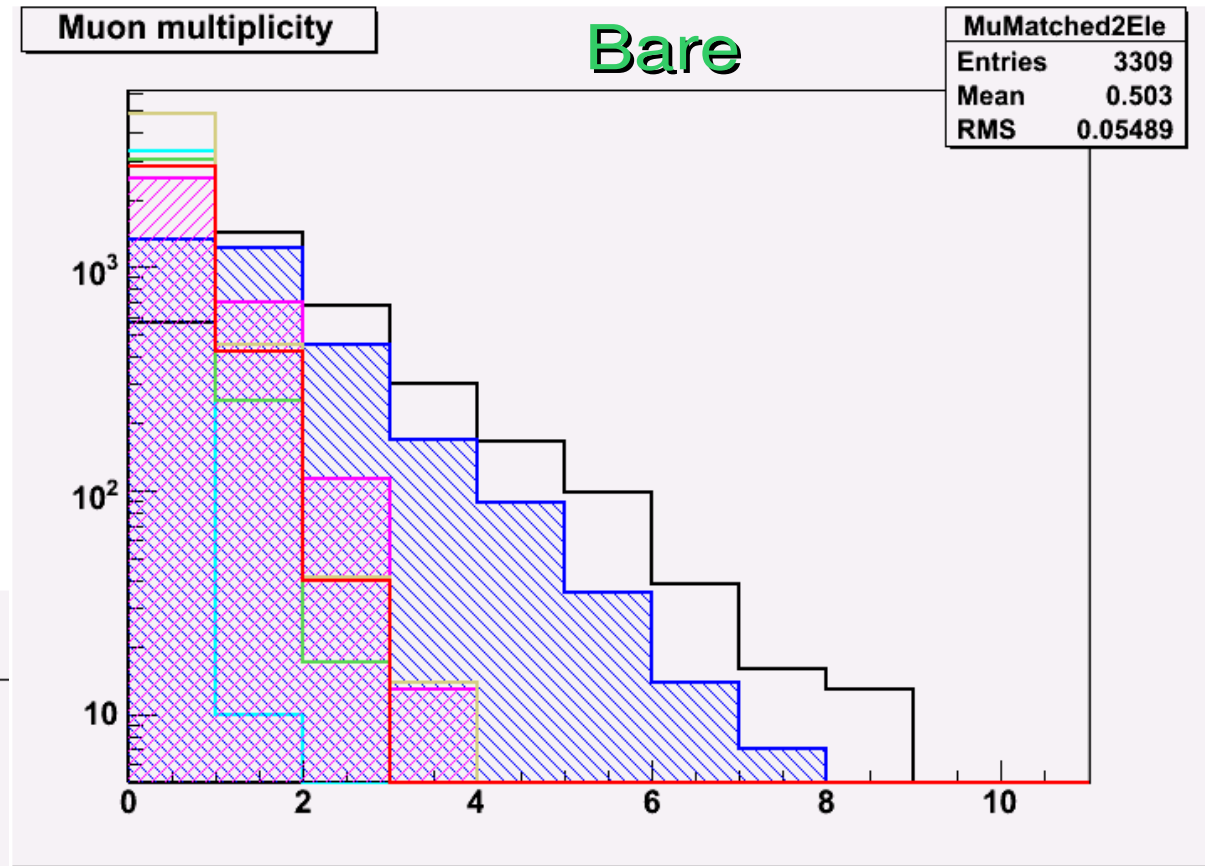
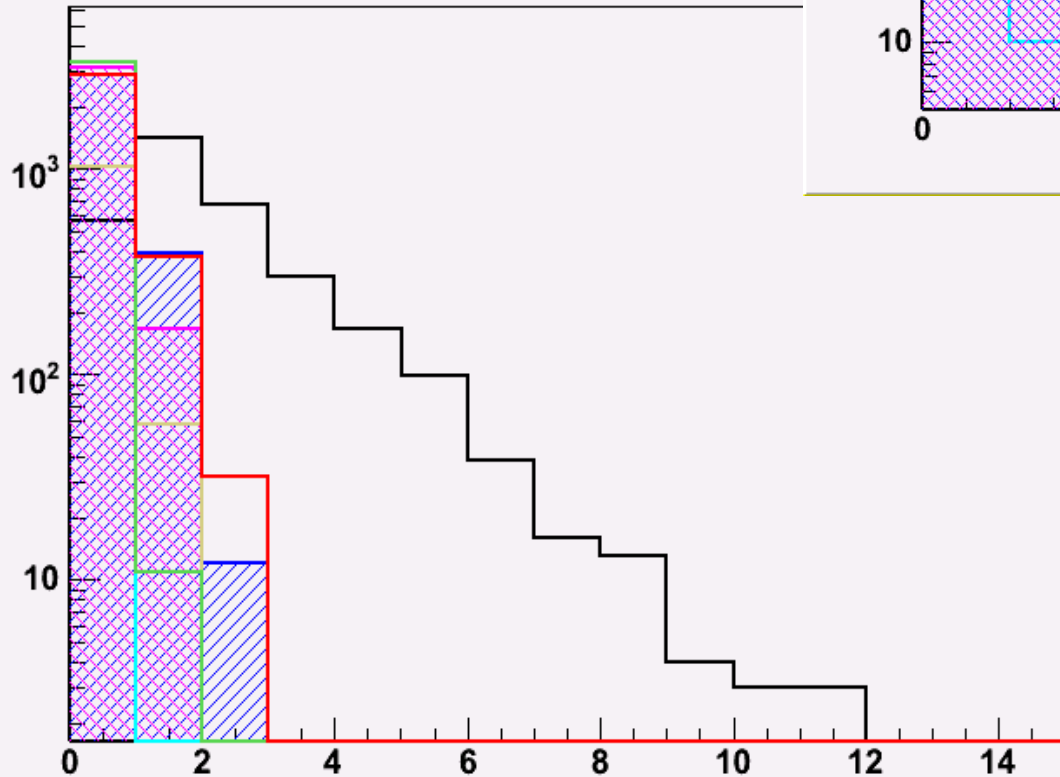
$|\Delta Y| < \text{Max}(3\sigma Y, 3 \text{ cm})$ (TMLastStationTight)

One+Last=Opt

Molteplicita' delle associazioni

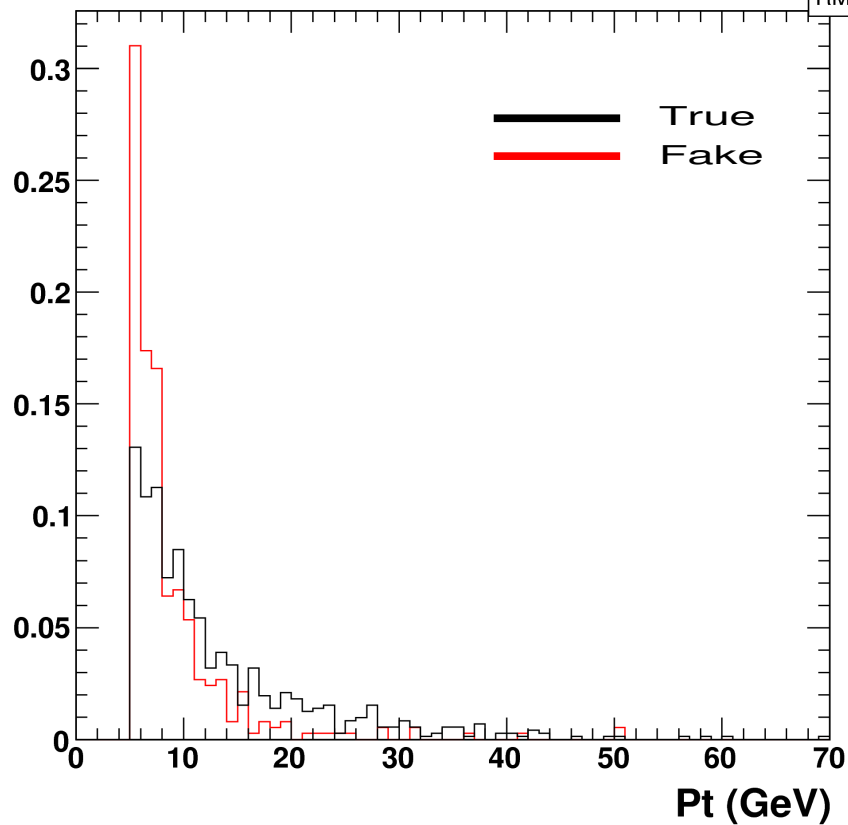
- **Kaons**
- **Pions**
- **true Mu**
- **Protons**
- **Electrons**
- **none**
- **Total**

TMLastStationOptimizedLowPtTight



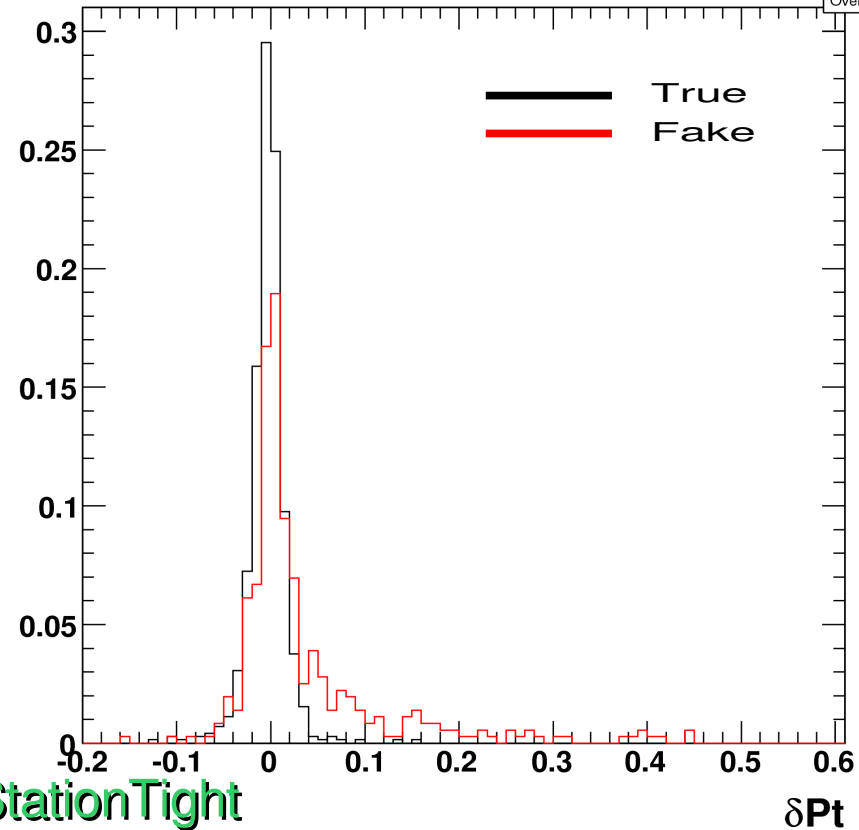
Nel campione di di-jet:
 il 9% assoc. a veri muoni
 il 18% a K
 il 61% a pi
 Con il selettore
 TMLastStationOptimizedLowPtTight
 40% a veri muoni
 il 15% a K
 il 38% a pi

Pt for real and fake muons {Pt>5GeV}



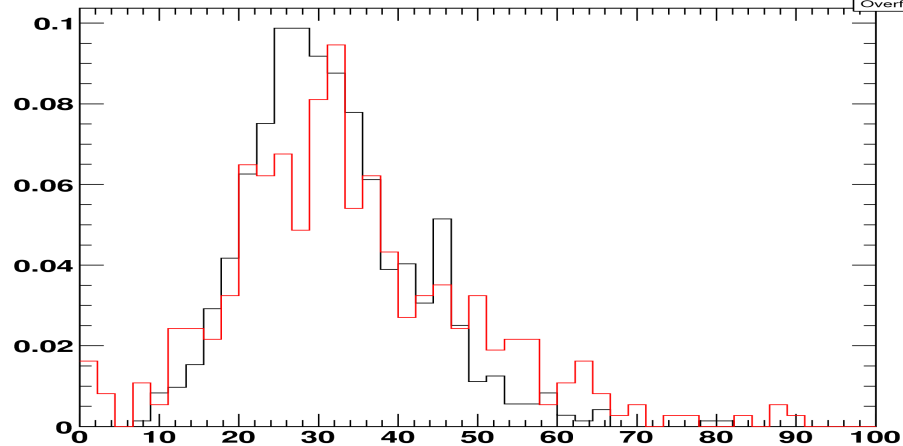
Pt_real	
Entries	719
Mean	13.13
RMS	9.028

δPt for real and fake muons {Pt>5GeV}



DeltaPt_real	
Entries	719
Mean	-0.003496
RMS	0.02066
Underflow	1
Overflow	0

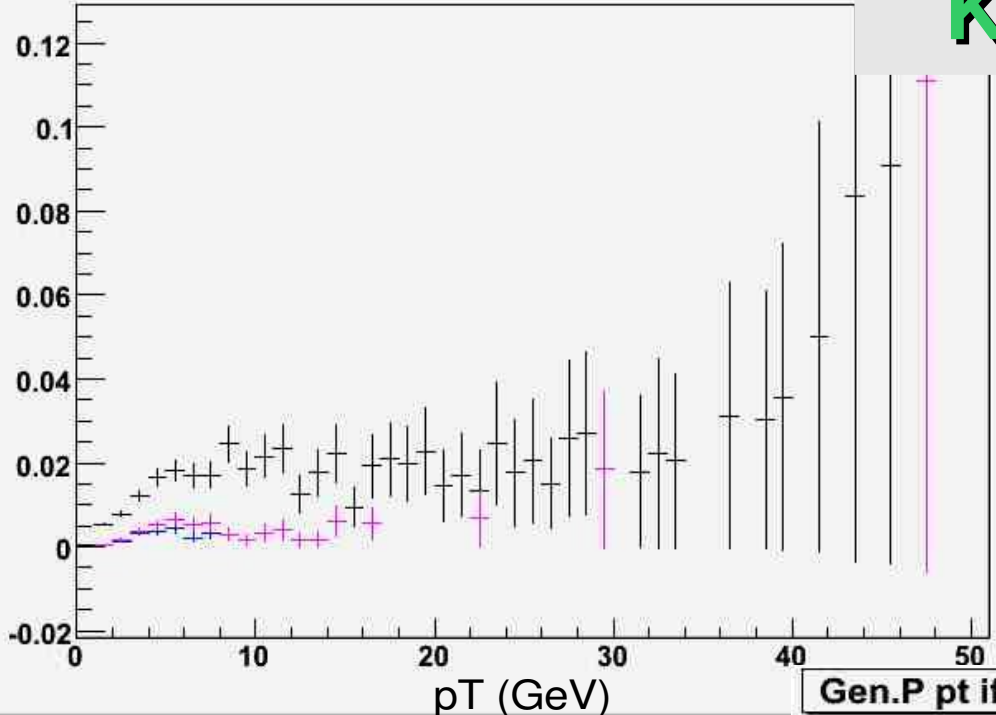
χ^2 for real and fake muons {Pt>5GeV}



Chi2_real	
Entries	719
Mean	31.67
RMS	10.45
Underflow	0
Overflow	0

QCDEnriched

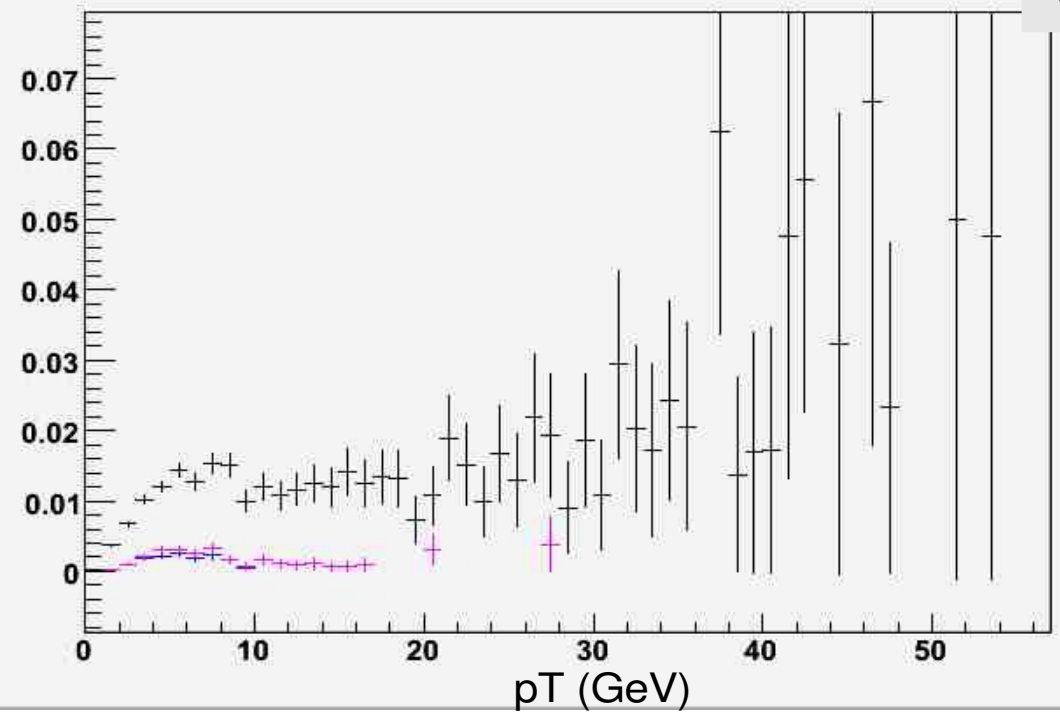
Gen.P pt if K



K

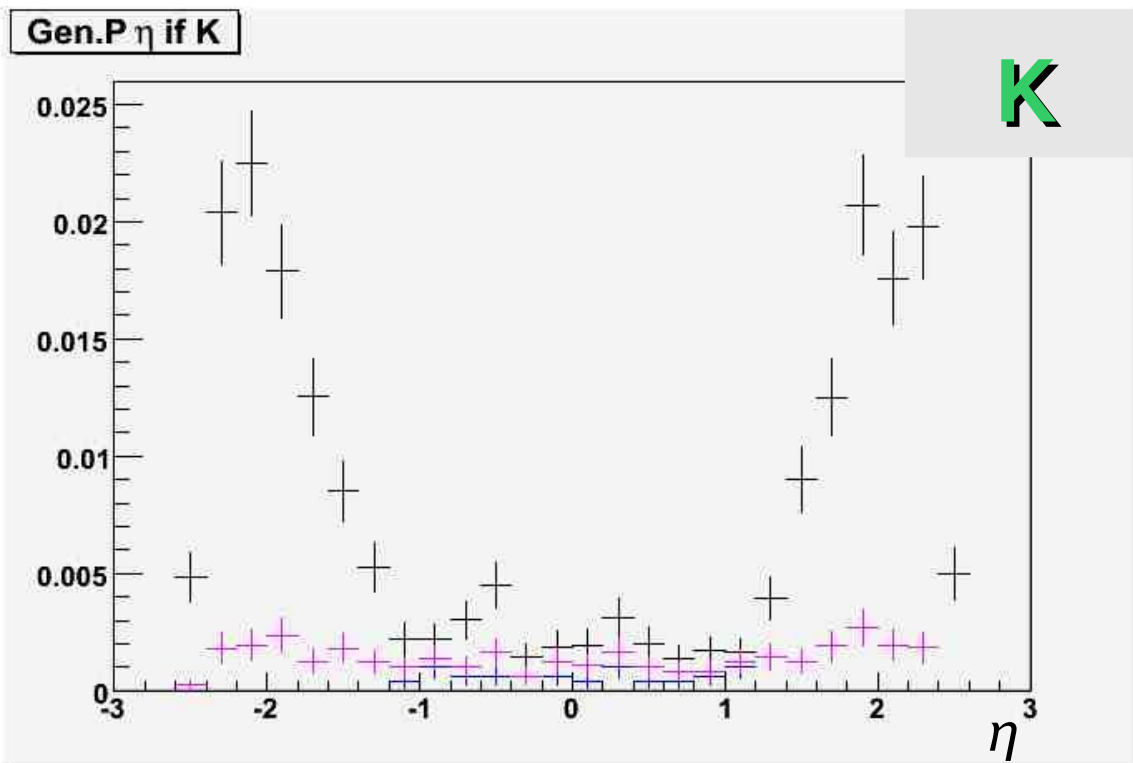
- No selector
- TMLastStationTight,
- TMLastStationOptimizedLowPtTight

Gen.P pt if π



π

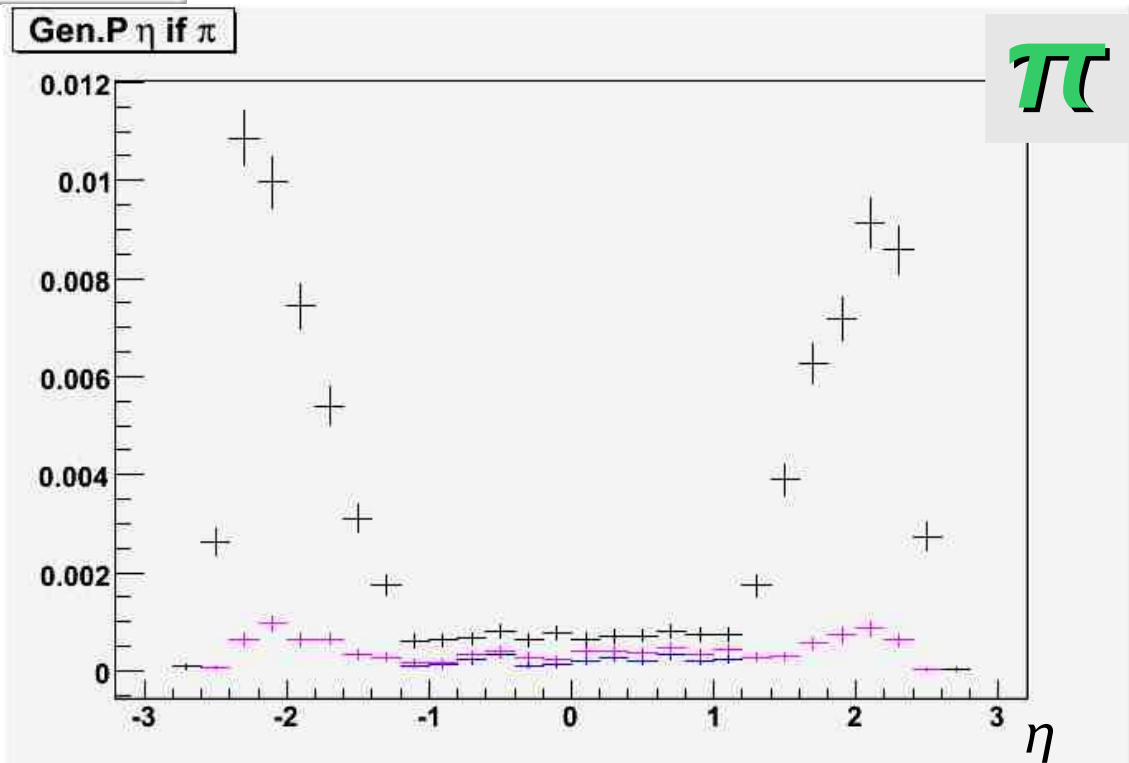
QCD di-jets



- No selector
- TMLastStationTight,
- TMLastStationOptimizedLowPtTight

Le inefficienze osservate
migliorano sensibilmente

QCD di-jets



Concludendo...

Sull'argomento c'e' parecchio da

- Impratichirsi
- capire
- da fare!

Goal: Efficienza di ricostruzione 'di segmento'

misurata sui cosmici del CRAFT

$\Delta r\varphi := d_{xy}$ (segm – punto medio estrap.)

Richiesta globale: $r\varphi$ hits > 3

$$\mathfrak{S} := \begin{cases} -20 < \Delta r\varphi < 40 \text{ } (\mu^+) \\ -40 < \Delta r\varphi < 20 \text{ } (\mu^-) \end{cases}$$

$$\#(\Delta r\varphi \in \mathfrak{S}) \Big|_{\text{CH}(X), [r\varphi \text{ hits} > 5]}$$

$$\varepsilon(\text{Ch } X) := \frac{\#(\Delta r\varphi \in \mathfrak{S}) \Big|_{\text{CH}(X), [r\varphi \text{ hits} > 5]}}{\#(\Delta r\varphi \in \mathfrak{S}) \Big|_{\text{CH}(X+1)} \textit{ if } \{ \text{Trigger}(\text{CH} \neq X) \geq 2 \} \cap \exists \{ \text{Glb. Mu}(\phi < 0) \} \cap \{ \text{Estrapolaz. } \exists \text{ nella Ch}(X \text{ et } X+1) \}}$$