Un primo sguardo al mixing del B con tag di Top

Franco, Martino, Mia, Paolo R., Stefano 20/11/2013

- Introduzione
- Statistica aspettata
- Primi studi del segnale tt

Introduzione

Franco, 24/9/2013

- Decadimenti semileptonici del top $t\bar{t}$, $t \to l b \nu$, $\bar{t} \to \bar{b} X$
  - l tagga il flavor di entrambi i jet da b alla produzione

- Arxiv 1212.4611: test a 3σ dell'anomalia di D0 con 50 fb^{-1} a 14 TeV
- Per il momento: misura della probabilita` di mixing integrata

- Interessi:
  - Analisi originale
  - Confronto di $\chi(mt)$ con $\chi(mZ)$: test di fattorizzazione QCD
  - Possibilita` di studiare lo spettro dei leptoni per la misura padovana "standard" del mixing

Statistica aspettata

Mia

- Analisi CMS con top semileptonico, dati 2012, per esempio
  CMS PAS TOP-13-008 (W helicity):
  - 200 K evts dopo la selezione
  - 50% con W->μ, altrettanti W->e
  - ε HLT(μ)=62%, ε HLT(e)=53%
  - ε leptoni da b ~40%

} 230 K top quarks
9 K eventi b->μ
con tag di top

- Da aggiungere "altrettanti" b->e (+ le cascate b->c->l)
- Stima ~ 15 K evts (2012), ma le cascate possono aiutare
  - δχ~0.0025 senza contare fondi e diluizione dovuta all'assegnazione del leptone al top giusto
- L'asimmetria deve aspettare il RunII [ora avremmo δAsl~1.3%...]
  - Isidori: δAsl~0.15% con 50 fb^{-1} a 14 TeV (?)

Trigger

Mia

- Al momento stiamo usando:
  - Trigger: HLT_Mu17_Mu8
  - Pattuple prodotte da Stefano e Rootople da Paolo
- Per il futuro :
- W->μν
  - HLT_IsoMu24 OR HLT_IsoMu24_eta2p1 OR HLT_Mu17_Mu8
- W->eν
  - HLT_Ele27_WP80 OR HLT_Mu8_Ele17_CaloIdT_CaloIsoVL_TrkIdVL_TrkIsoVL OR HLT_Ele25_CaloIdVT_CaloIsoVL_TrkIdVL_TrkIsoT_TriCentralPFNoPUJet30
- Cross triggers:
  - HLT_Mu8_Ele17_CaloIdT_CaloIsoVL_TrkIdVL_TrkIsoVL OR HLT_Mu17_Ele8_CaloIdT_CaloIsoVL_TrkIdVL_TrkIsoVL

Impostazione dell'Analisi

- Problematiche (parzialmente correlate tra loro):
  - Separazione eventi tt dal fondo (Paolo)
  - Studio del segnale (Martino):
    - Identificazione del leptone da t->W->(τ)->l per il tag
    - Identificazione del leptone da t->b->(c)->l e assegnazione al top giusto
  - Separazione b->l da b->c->l (Franco)
  - Definizione della Likelihood per il fit e estrazione del risultato (Ptrel o altre variabili discriminanti) (Tutti)

Primi studi sul segnale tt

Martino
Paolo

Studio fatto su MC tt con un solo t->lX

(L= 469 fb^{-1}, 2.06*10^6 leptoni t->W->l gen., 1.71*10^6 reco)

Eziologia dei leptoni nel segnale tt

Classi correlate con il top

S1: t->W->l, t->W->τ->l

S2: t->b->l, t->b->c->l

B1: t->W->c->l, t->W->leggeri->l, t->b->leggeri->l

Classi non correlate con il top

B2: b->l, b->c->l (3.5% degli S2, diluiscono il campione)

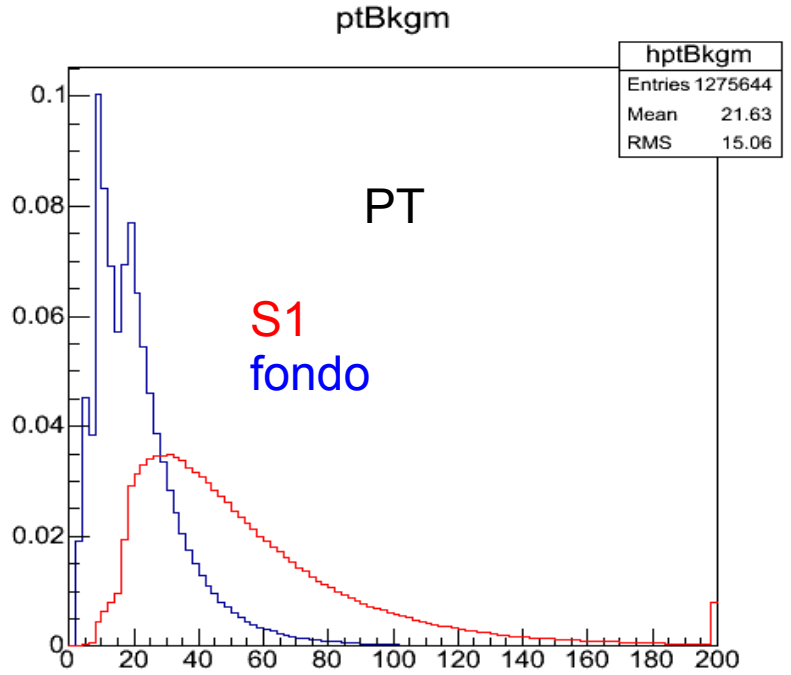
B3: c->l, leggeri->l

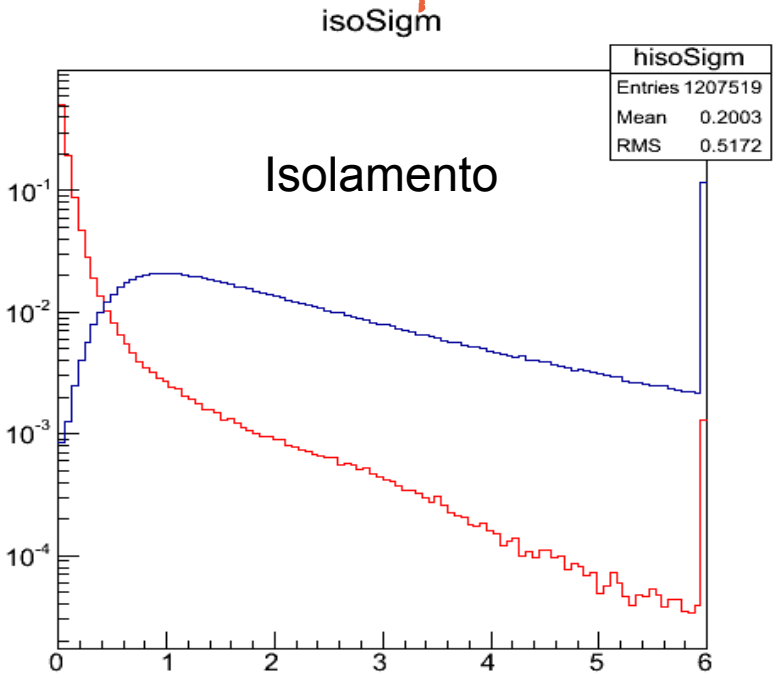
Studio per la separazione di Si dal resto

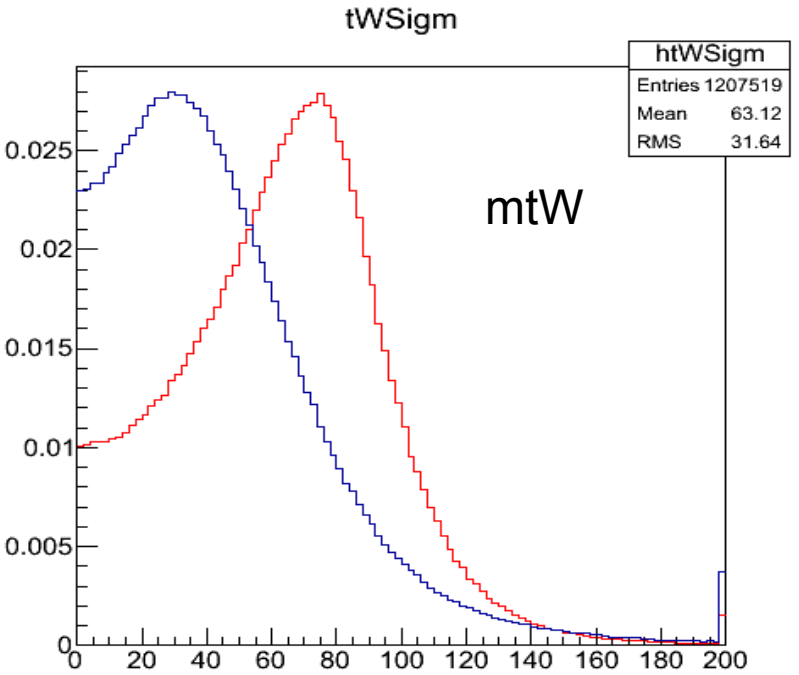
Martino

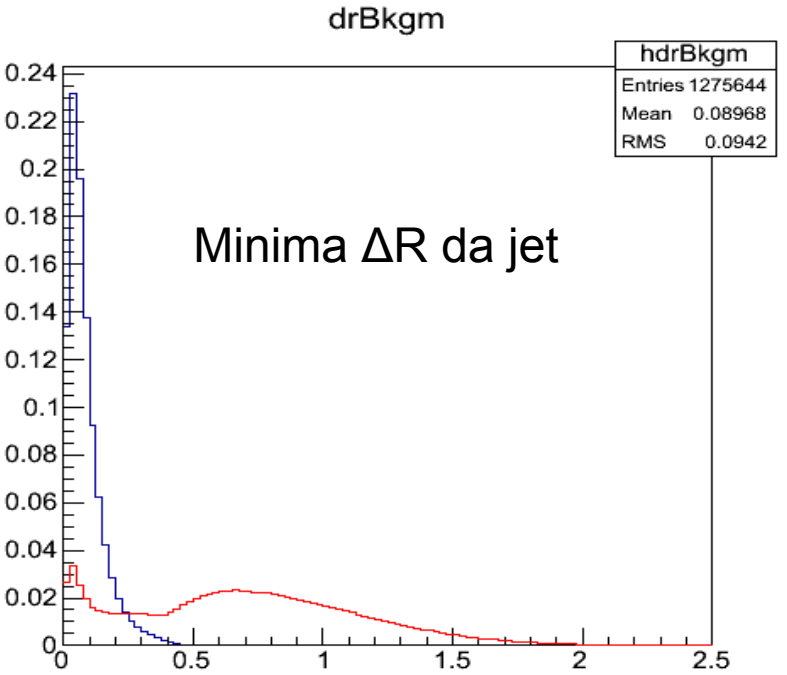
Muoni da decadimento semileptonico del top

Scalini: soglie di trigger

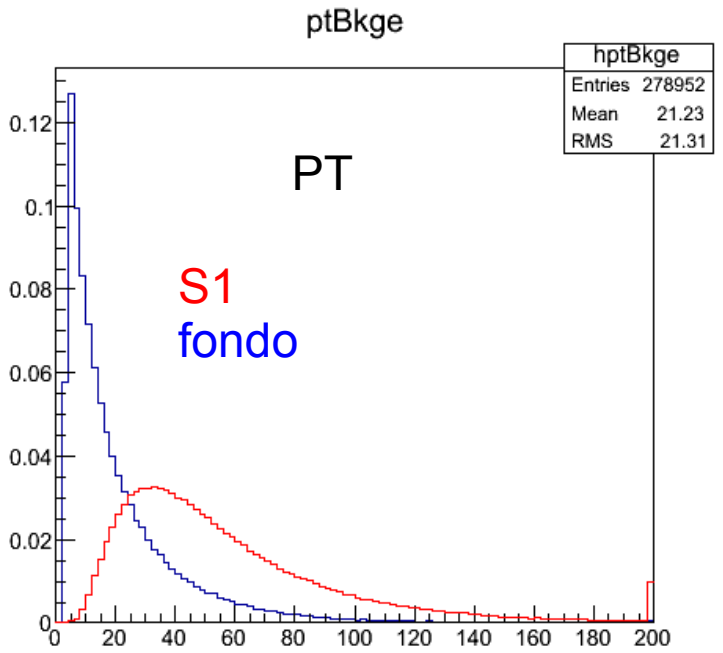


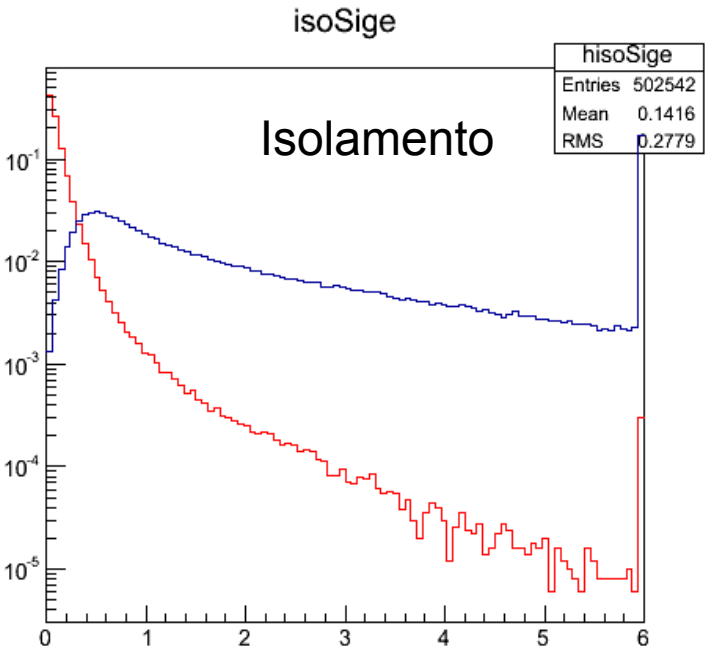


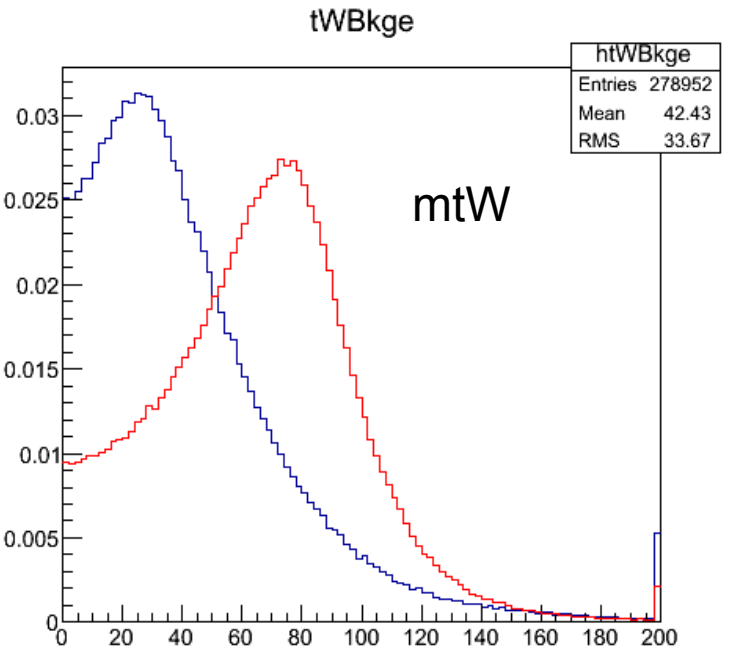


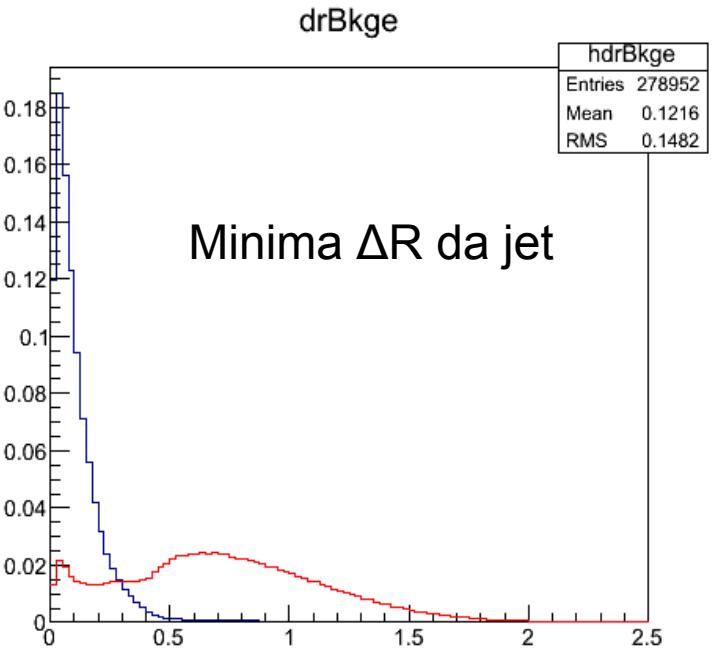


Elettroni da decadimento semileptonico del top

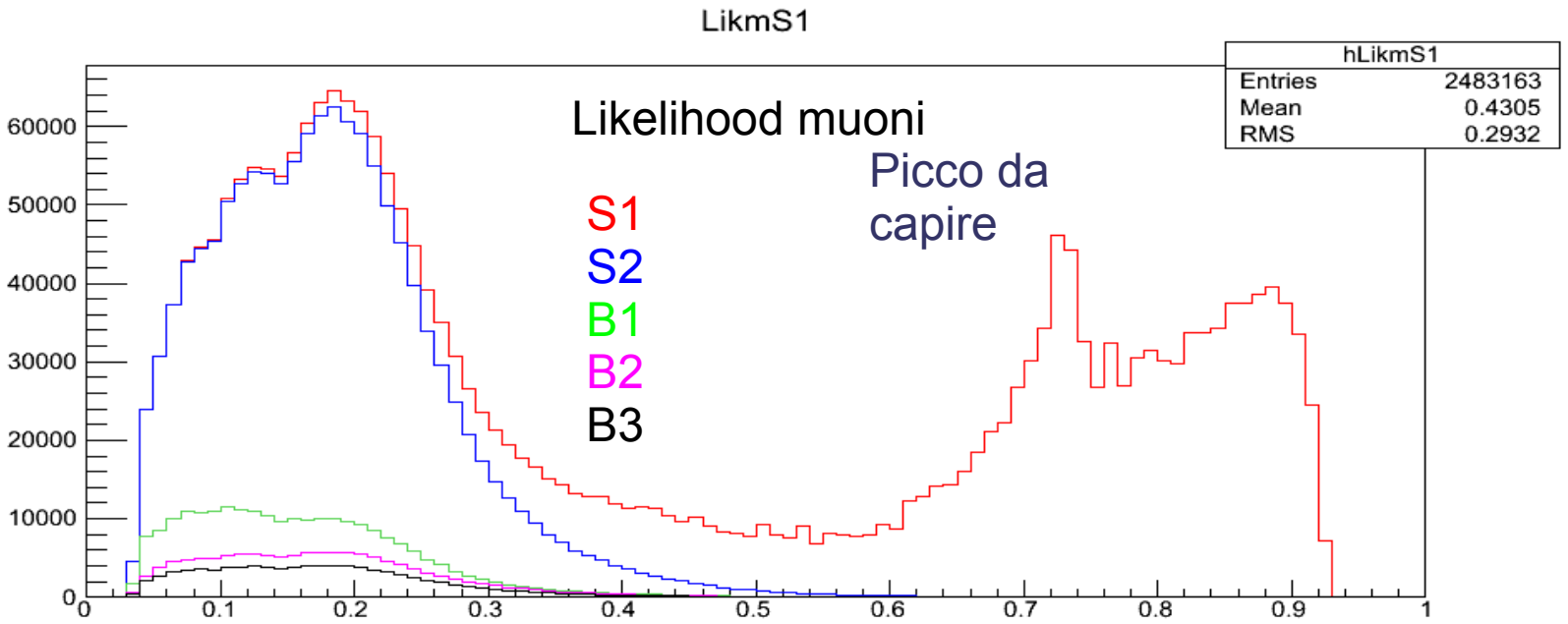


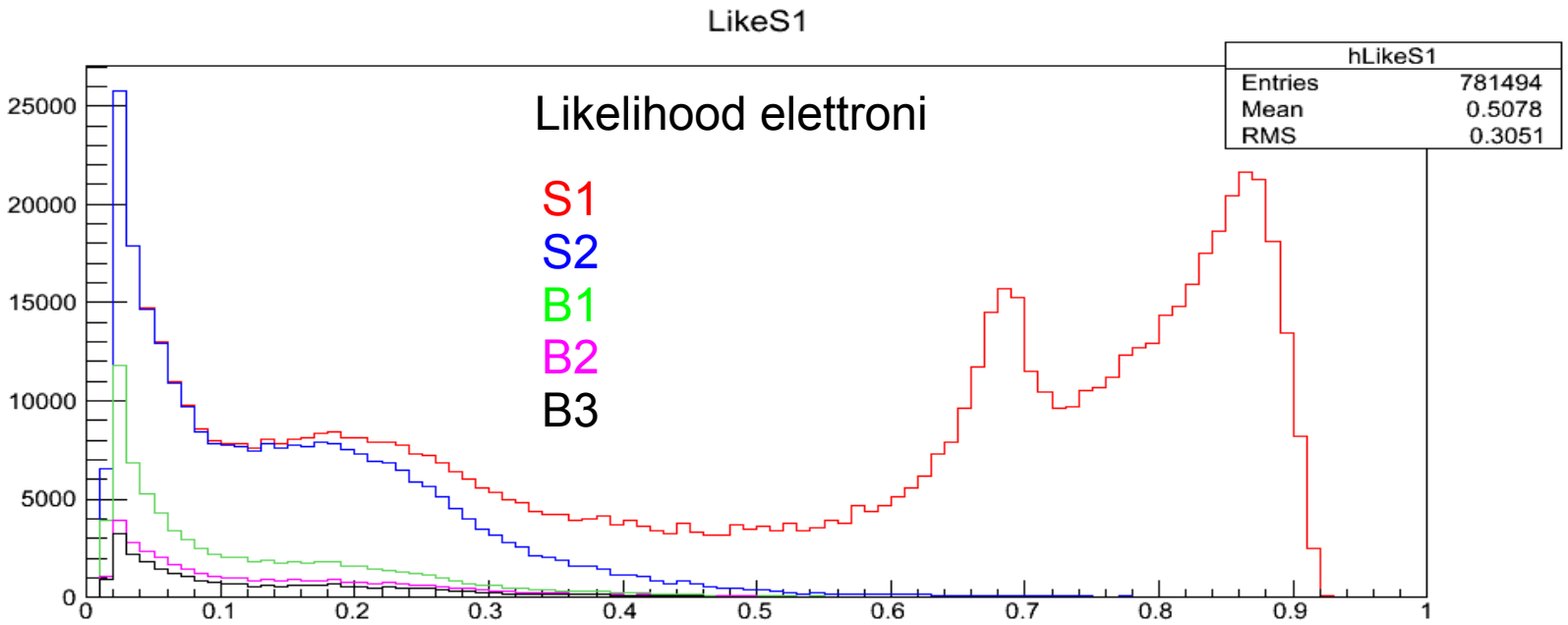




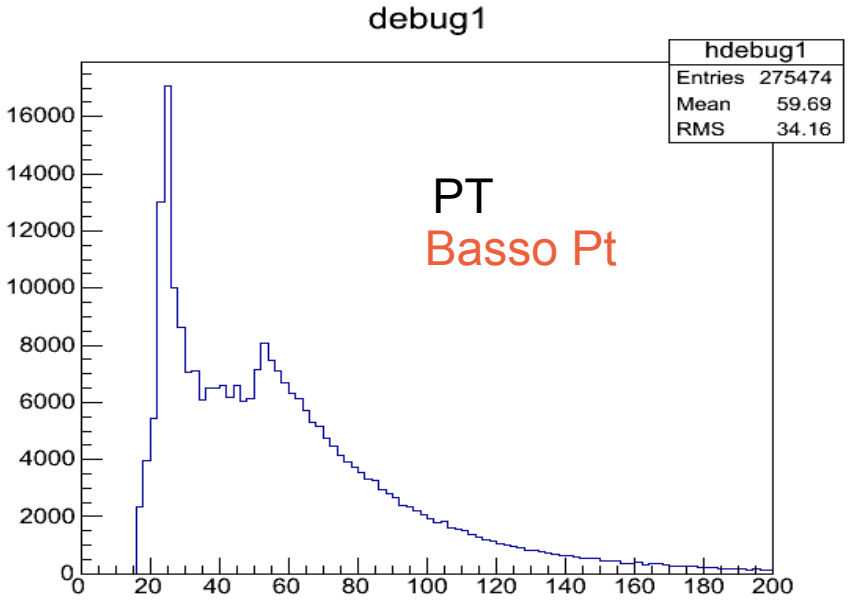


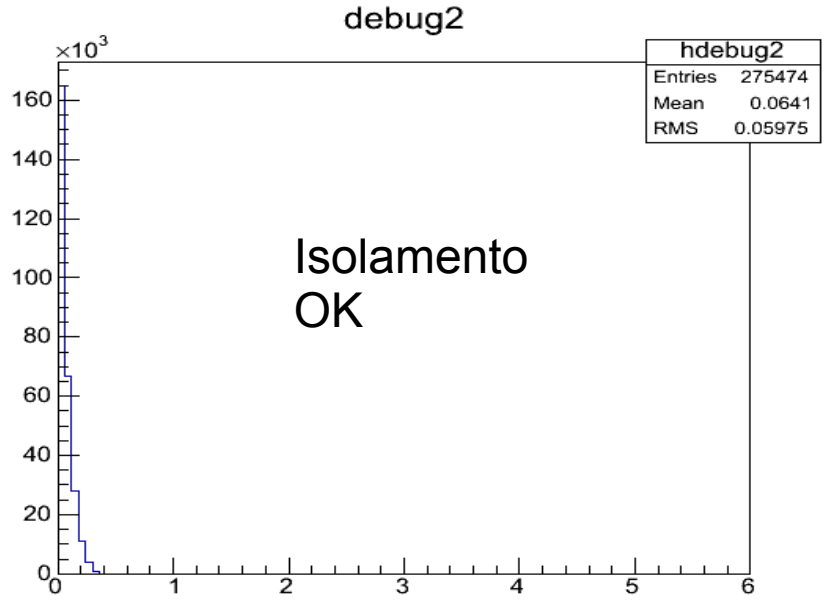
Likelihood ratio definito con le quattro variabili

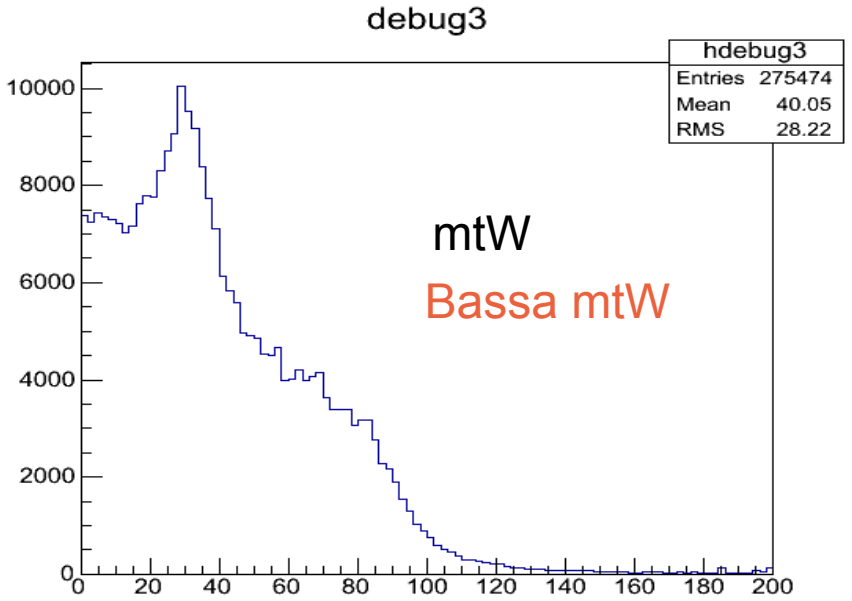


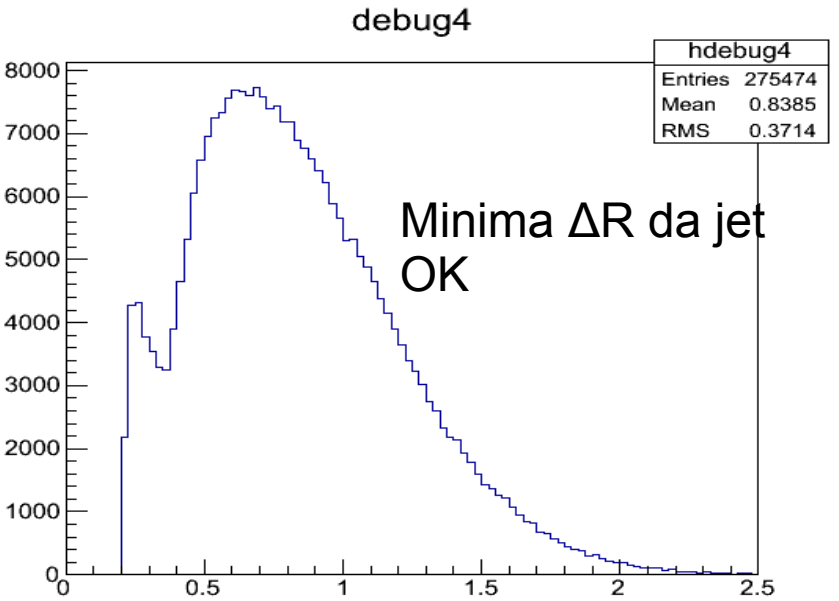


Picco nel segnale, non sono t->W->tau. In generazione non pare esserci nulla di patologico, da indagare ulterioremente...









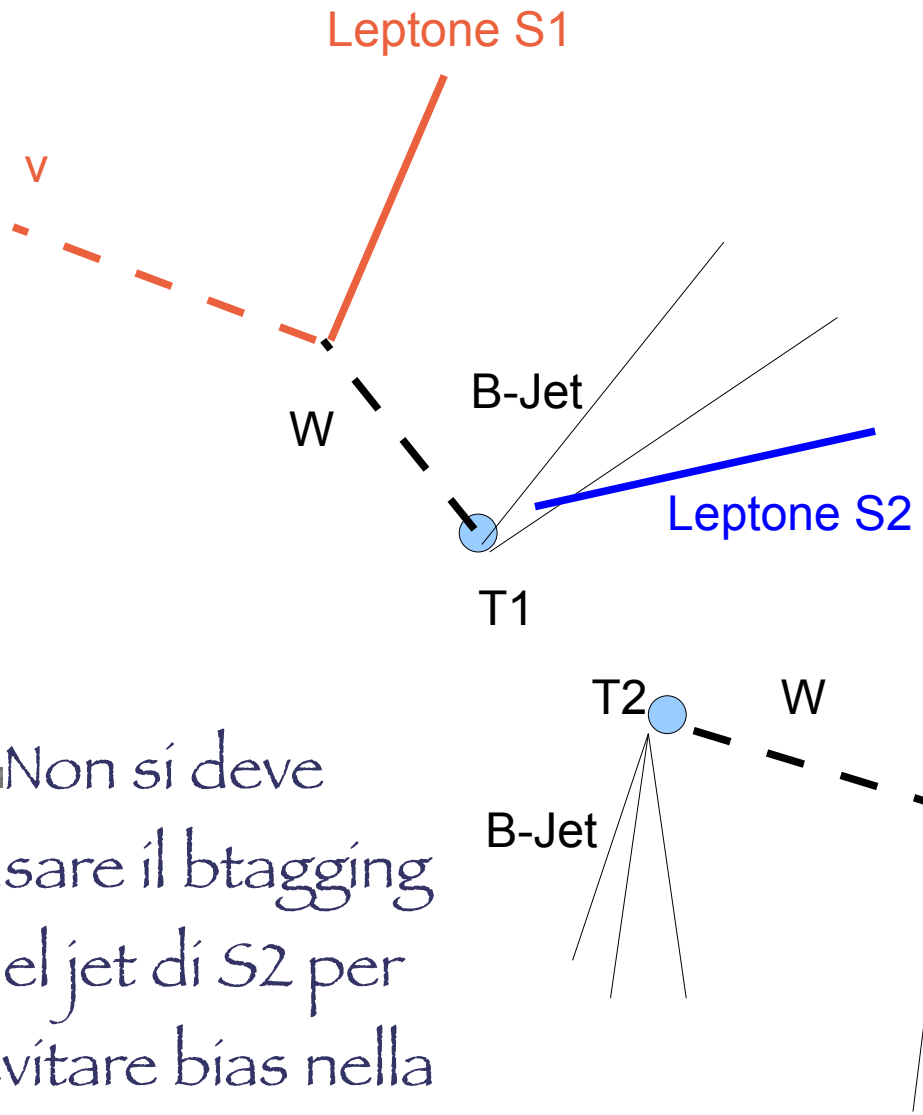
Studio per la separazione di S2 dal resto e scelta del top a cui associarlo

Martino

- Ottimizzo la separazione di S2 da un dato top (leptonico o adronico) da S2 dall'altro top, ossia considero fondo solo i leptoni S2 dall'altro top e non considero le classi B1, B2, B3 nella definizione della likelihood

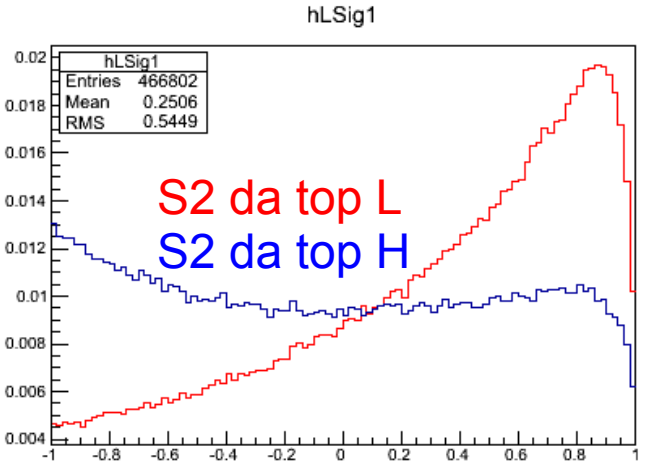
- In questo modo ottengo una separazione migliore che considerando nel fondo anche le classi B1, B2 e B3

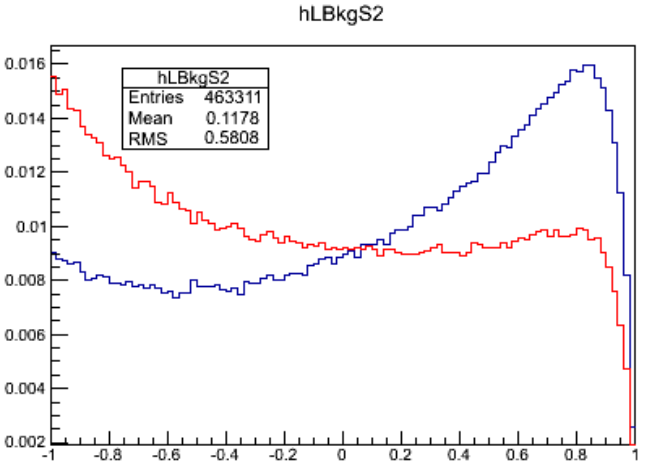
Schema del decadimento



- Il mixing si ottiene dalla correlazione di carica tra il leptone S1 e il leptone S2.
- S2 deve essere assegnato a uno dei due B-jets usando informazioni cinematiche e angolari
- Non si deve usare il btagging nel jet di S2 per evitare bias nella misura del mixing
- I due jets del W->jj possono essere selezionati con un anti-btagging

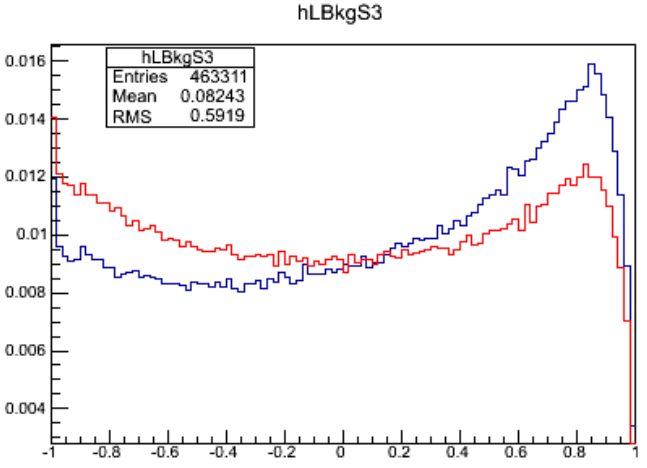
Angolo Ltop-Lb

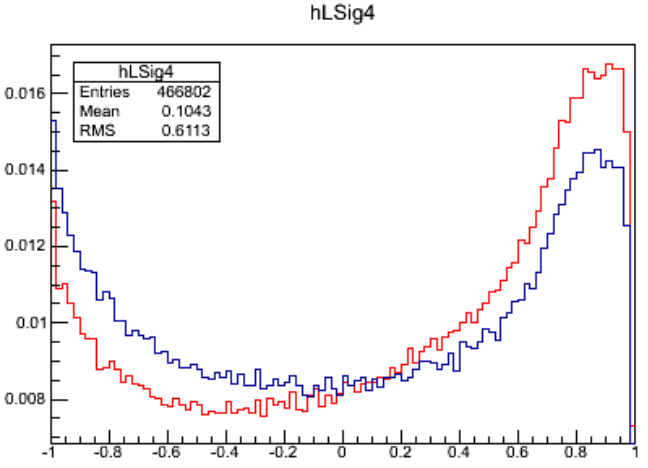




Angolo Jantibtag-Lb

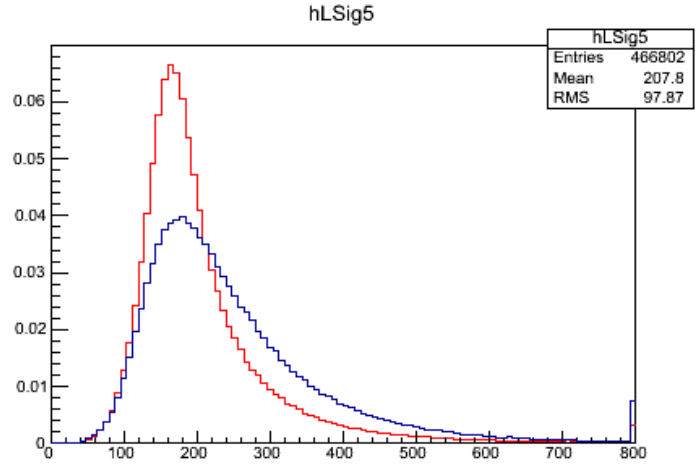
Angolo Ltop-Jetbtag no L

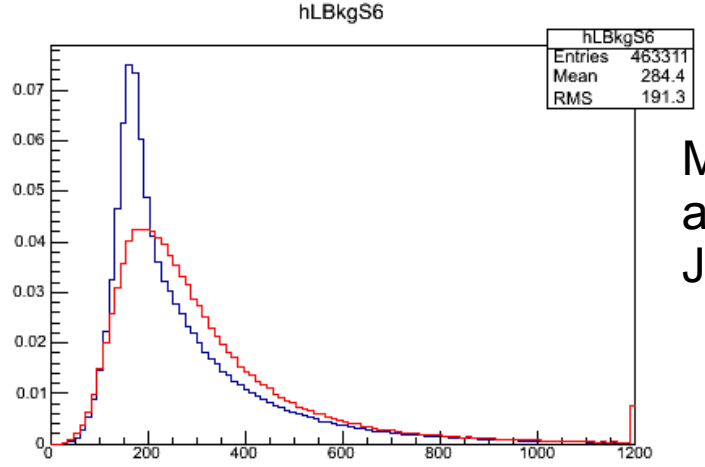




Angolo Jantibtag-Jetbtag no L

Massa Top semi leptonico cn Jet leptone



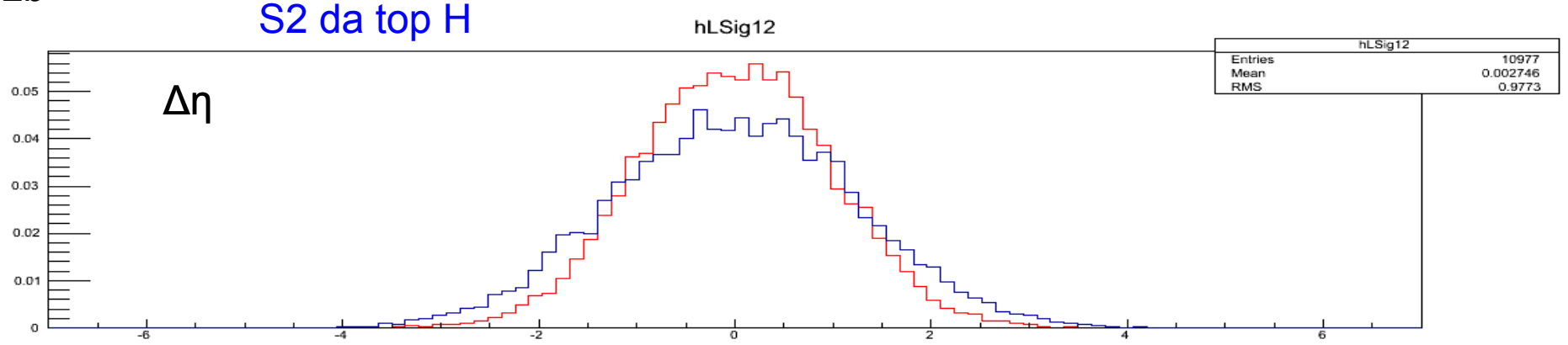


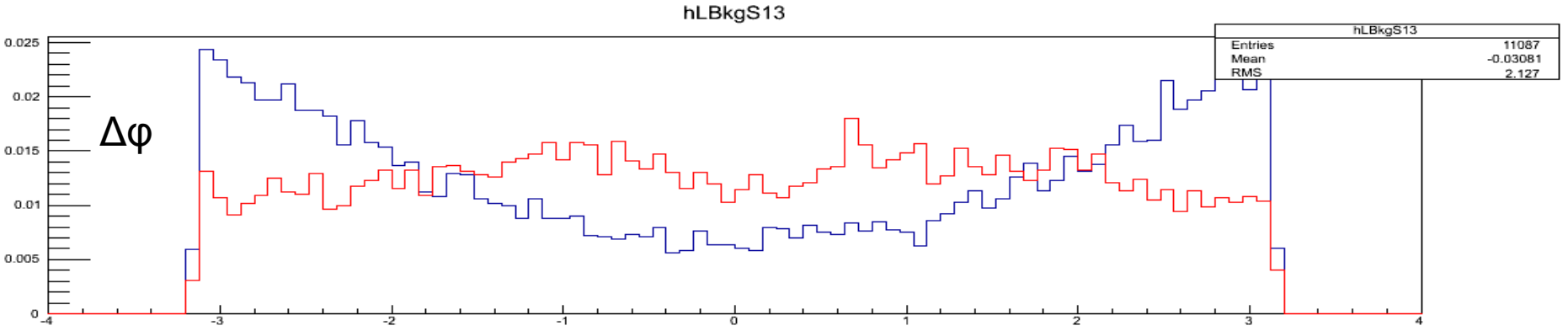
Massa Top adronico con Jet leptone

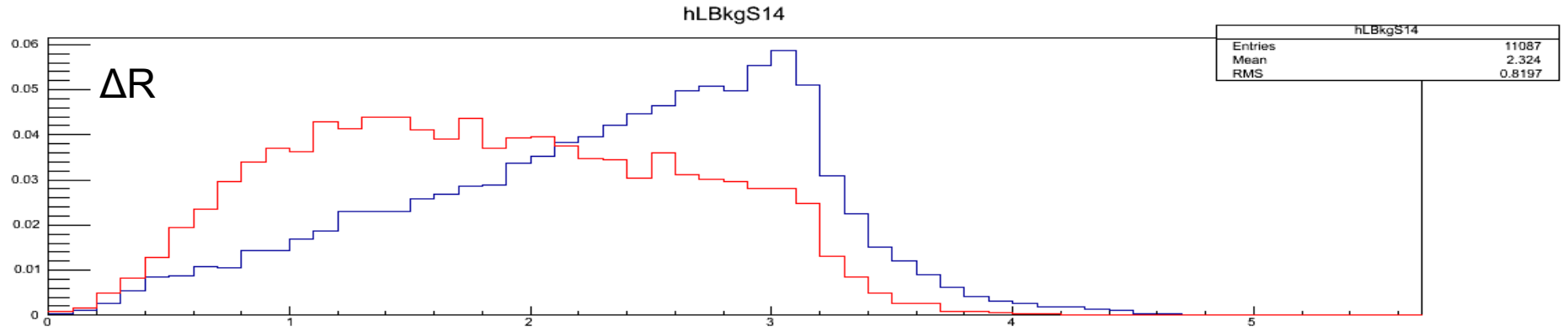
Altre variabili non usate per il momento

Angolo
Ltop-Lb

S2 da top L
S2 da top H

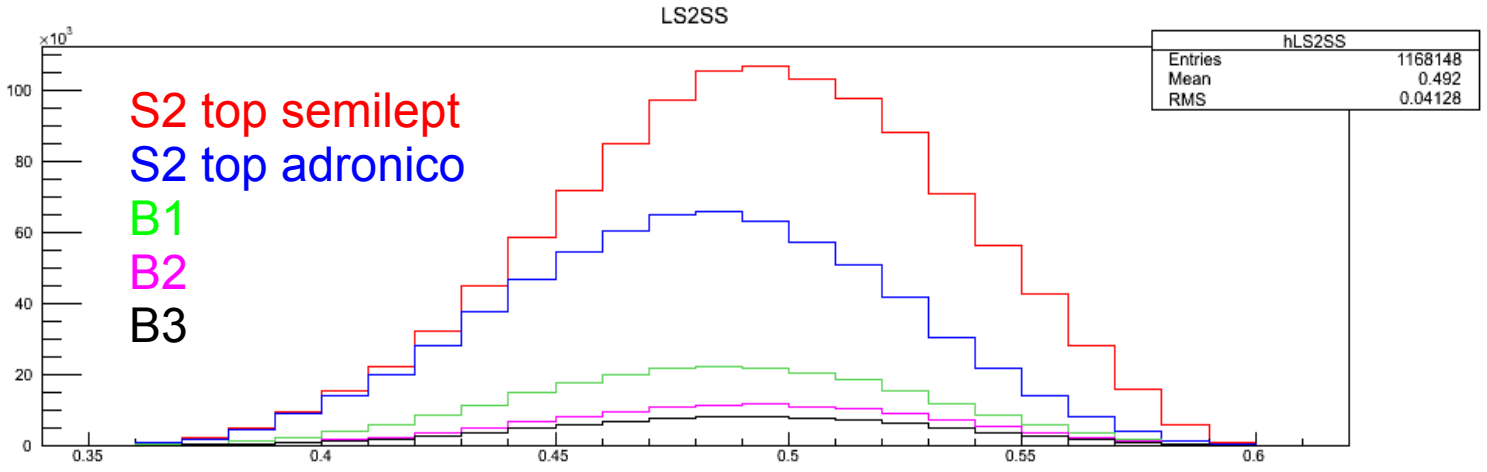






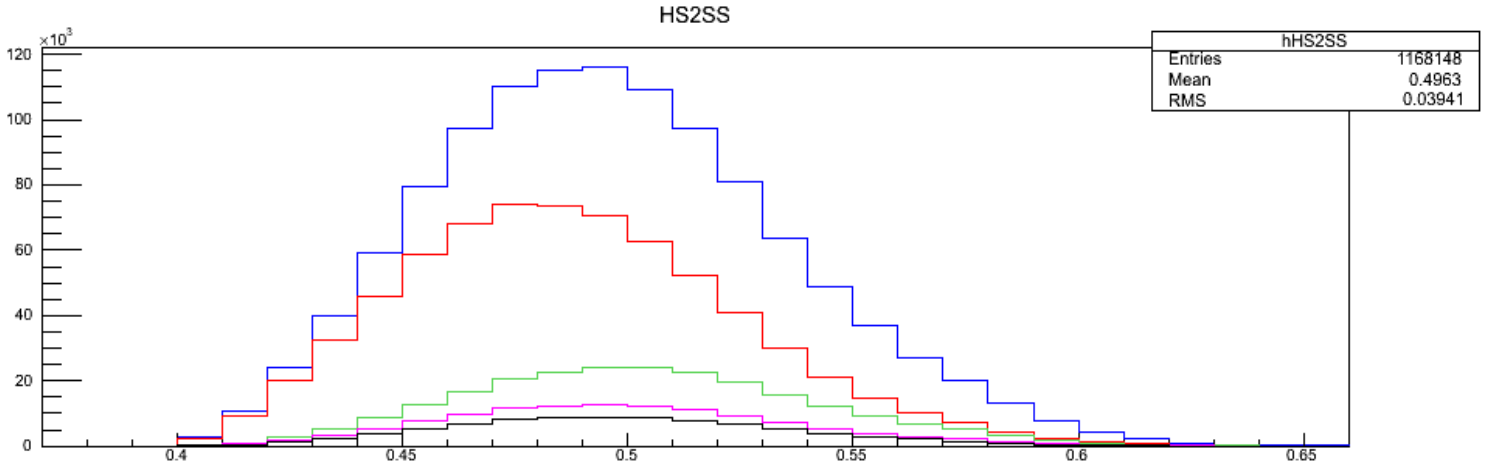
Likelihood S2 da top semileptonico

LL

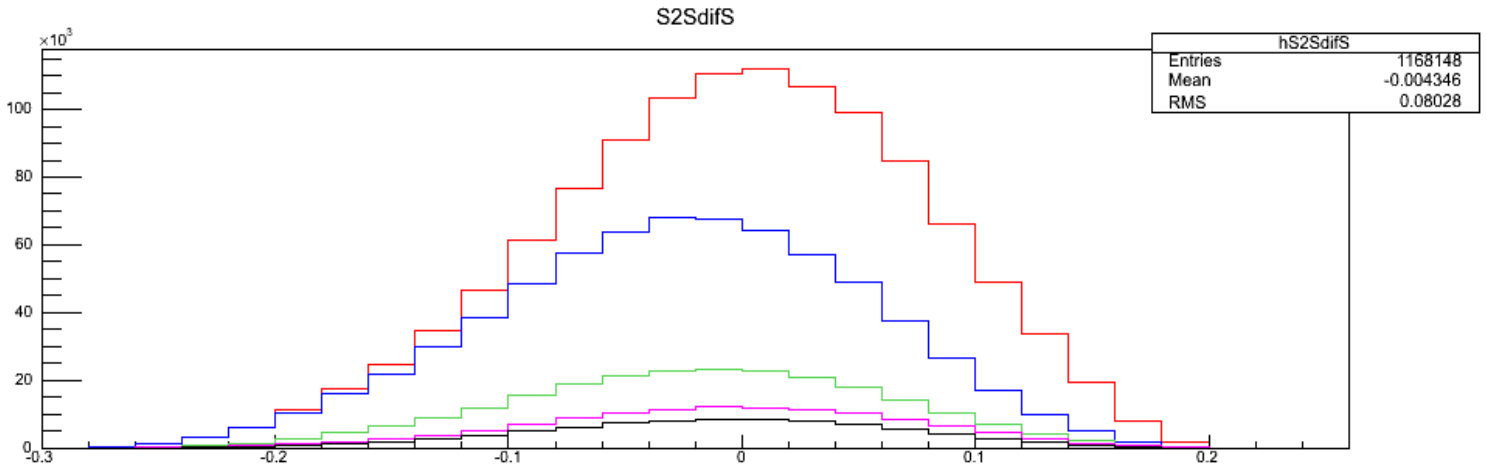


Likelihood S2 da top adronico

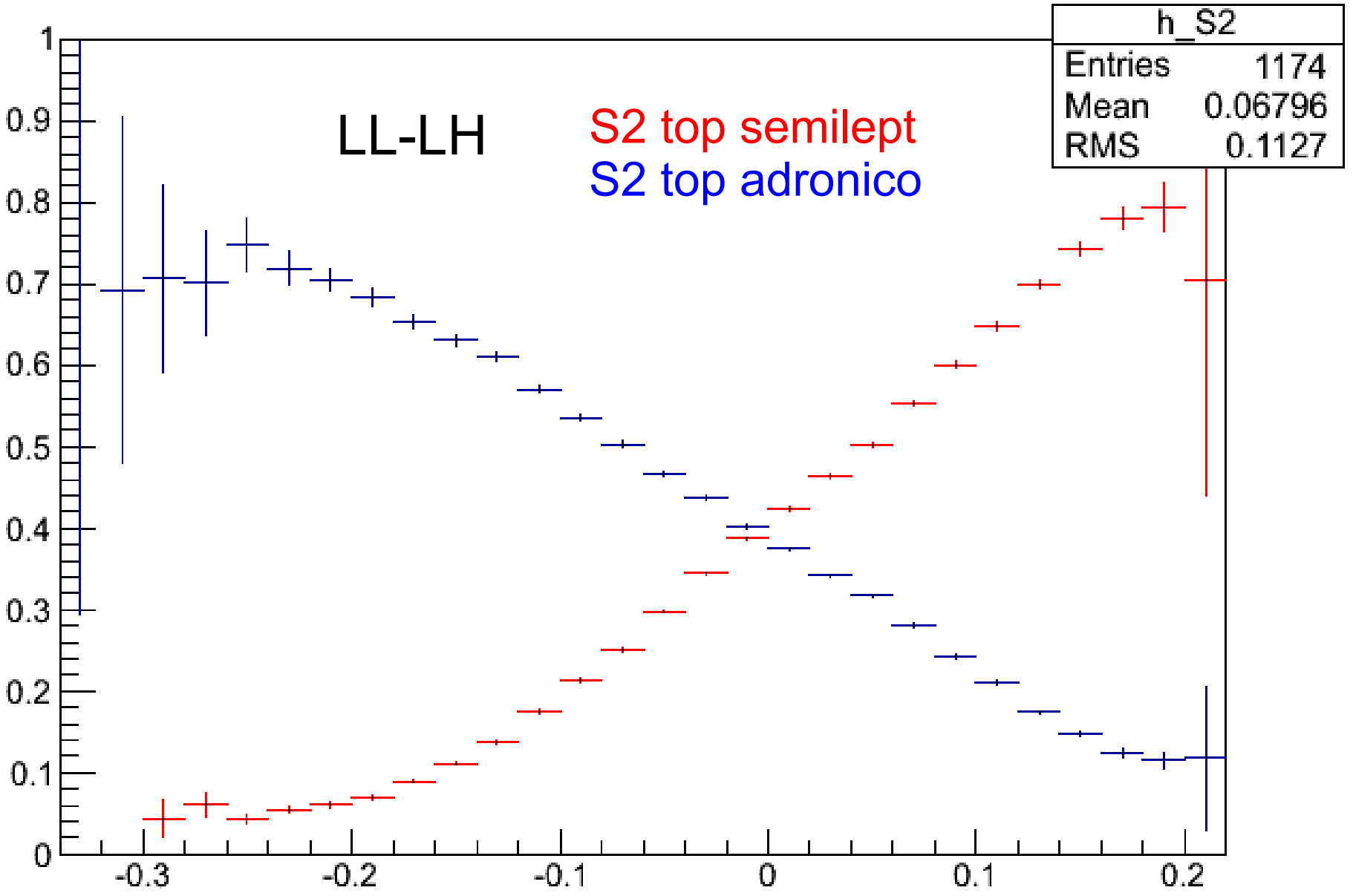
LH



LL-LH



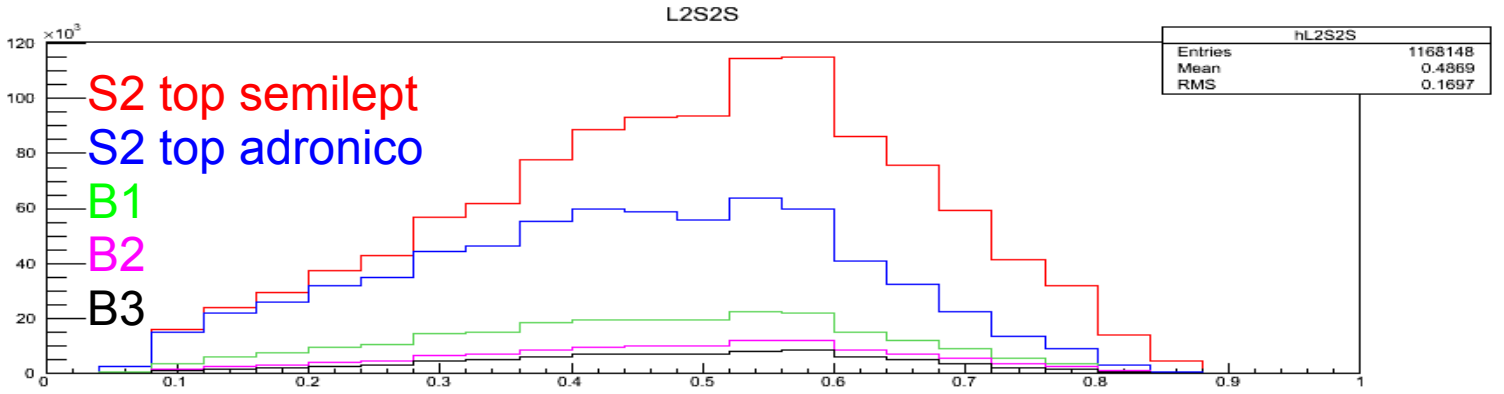
Frazioni vs Likelihood



Likelihood combinata da LL e LH

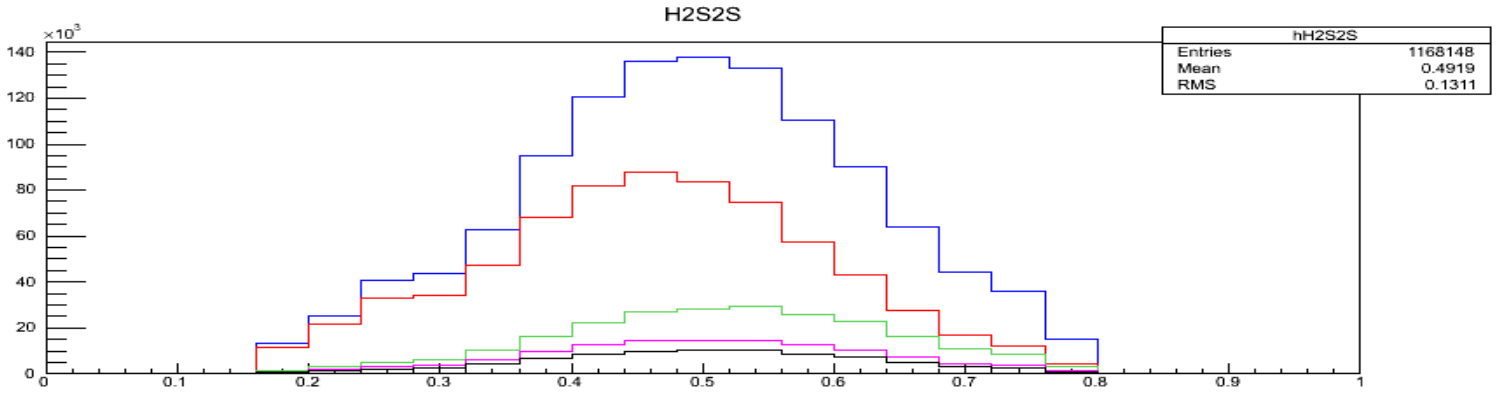
S2 da top semileptonico

L

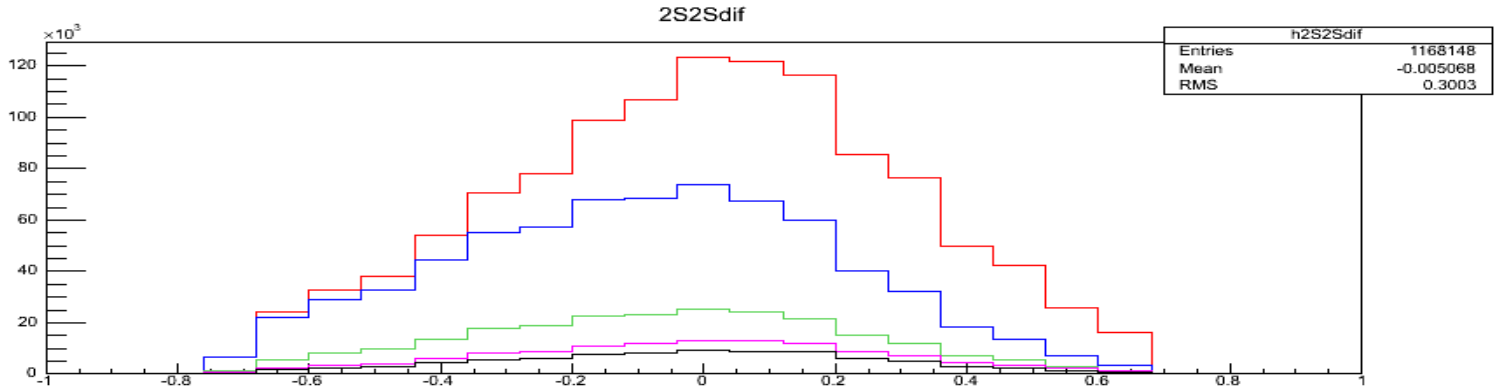


S2 da top adronico

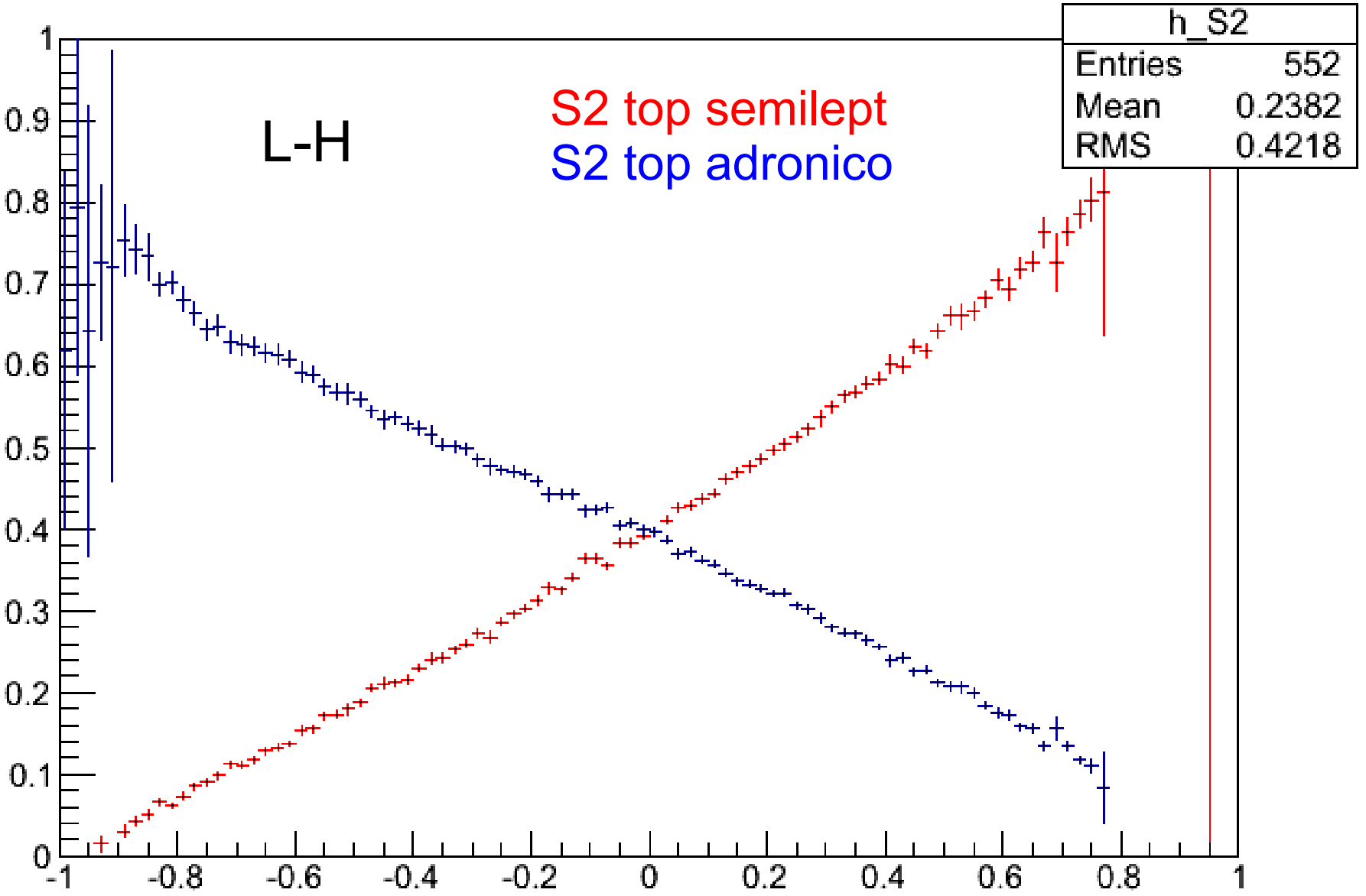
H



L-H



Frazioni vs Likelihood combinata

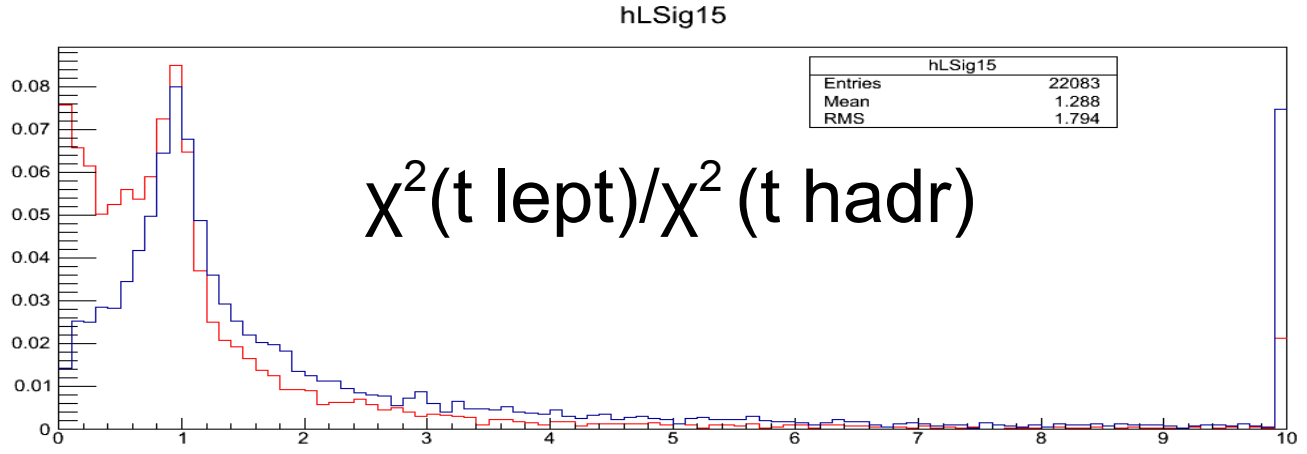


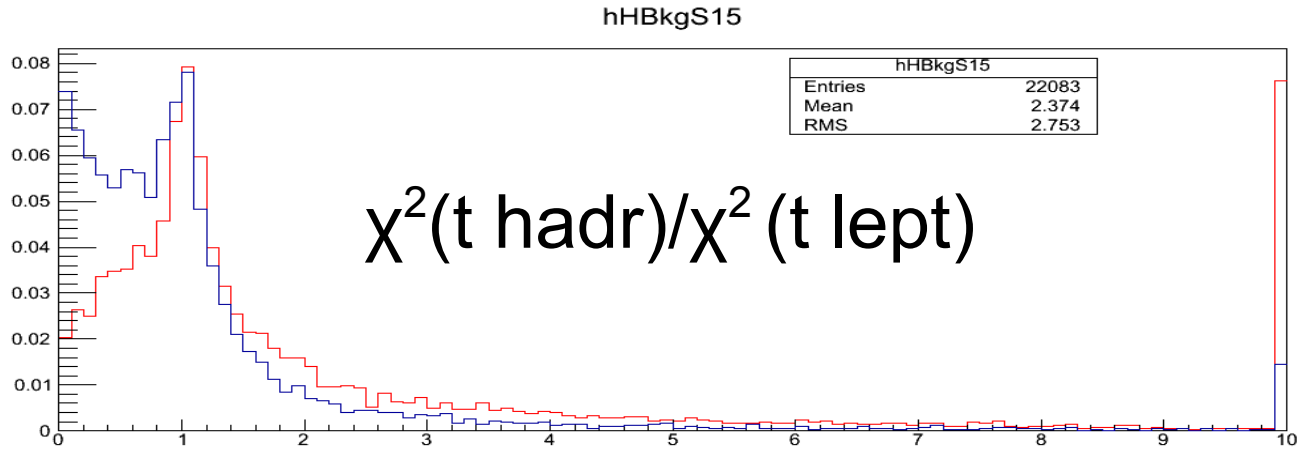
Prossimi passi

- Segnale tt (Martino)
  - Studiare un fit cinematico per migliorare l'assegnazione dei leptoni della categoria S2 al top giusto
  - Definire il migliore discriminante multivariato da utilizzare (likelihood ratio non ottimale per variabili correlate).
- Separazione segnale da fondo (Paolo R.)
  - Richiedere due leptoni a alto Pt e un jet btaggato senza leptoni per ridurre i fondi (per esempio W+c)
  - ....
- Separazione b->l da b->c->l (Franco)
  - Ptrel rispetto alla direzione del jet,...
- Definizione della Likelihood per il Fit

"Anteprima"

- Cerco di ricostrire W adronico, top adronico e top semileptonico
- Minimo χ^2 usando come errori le larghezze delle distribuzioni di mW, mT(lept) e mT(hadr).
- Non uso (ancora) l'errore su Pi e E dei jets.





Difficolta` principale: trovare i due jets del W, molte combinazioni.

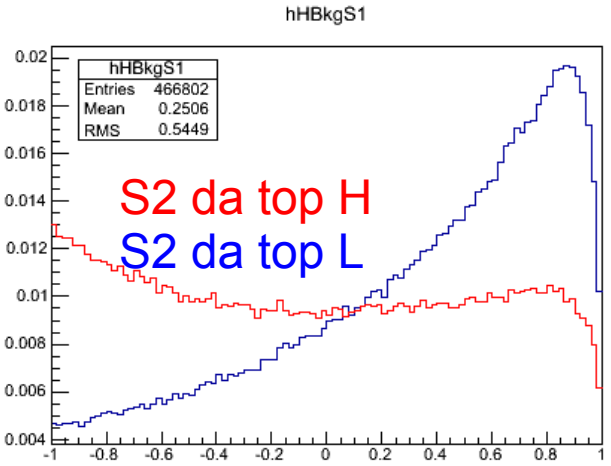
Rosso: leptone da top semileptonico

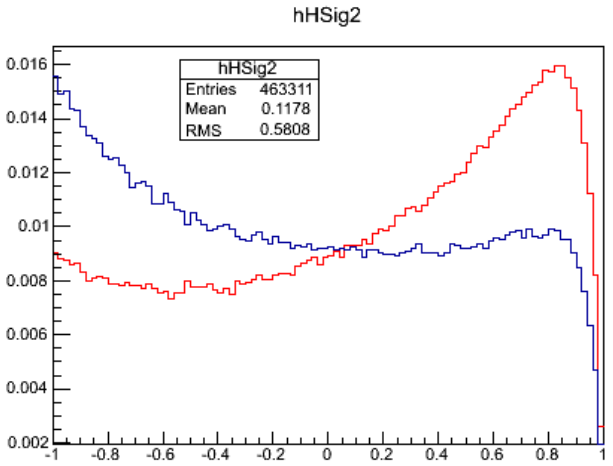
Blu: leptone da top adronico

Backup

Segnale: leptone da top adronico

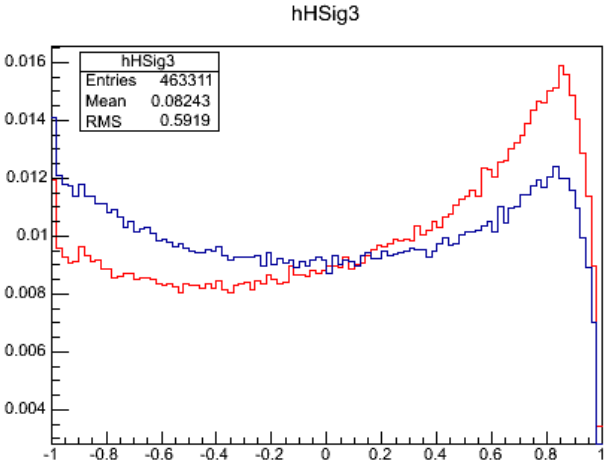
Angolo Ltop-Lb

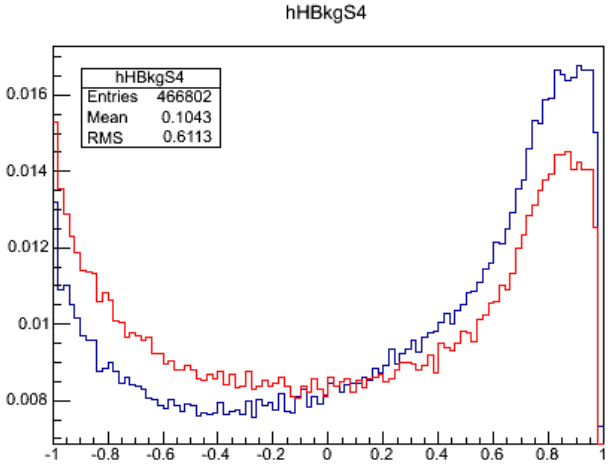




Angolo Jantibtag-Lb

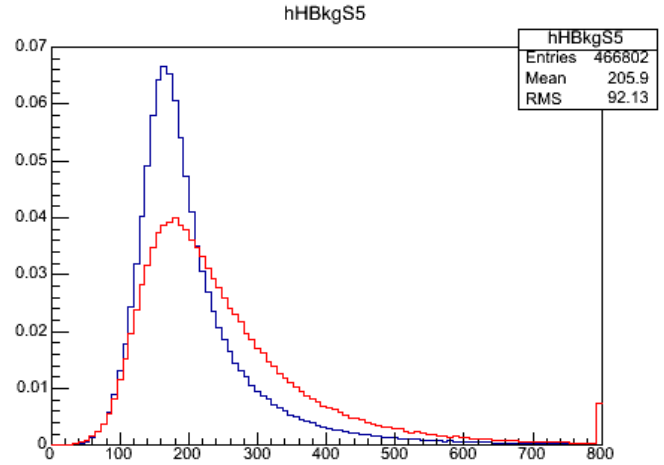
Angolo Ltop-Jetbtag no L

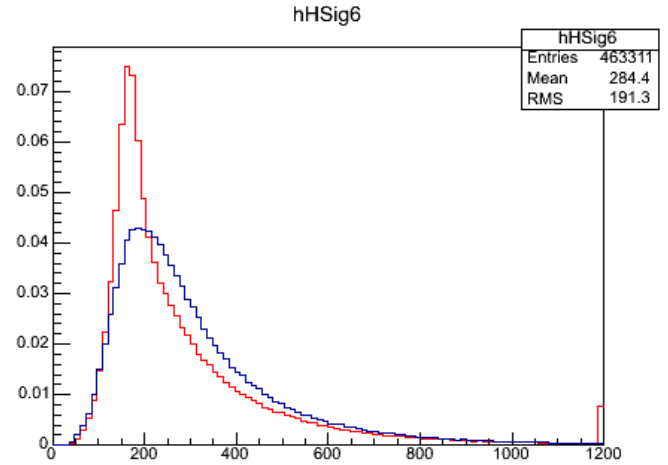




Angolo Jantibtag-Jetbtag no L

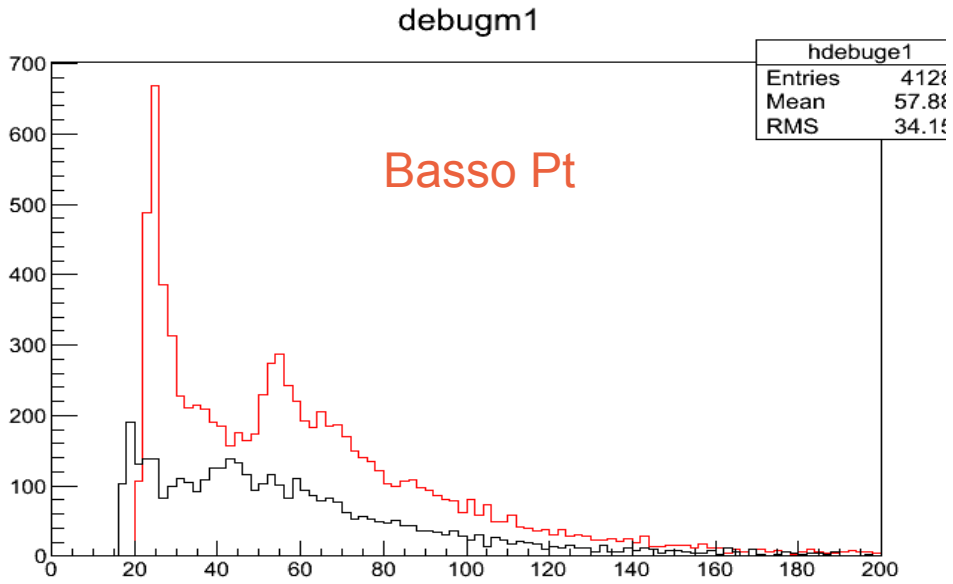
Massa Top semi leptonico cn Jet leptone

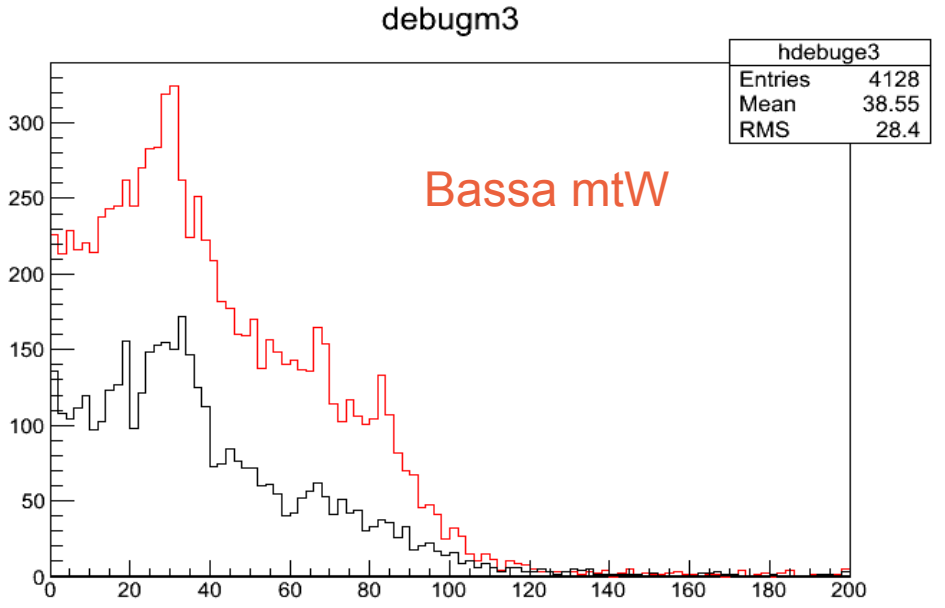


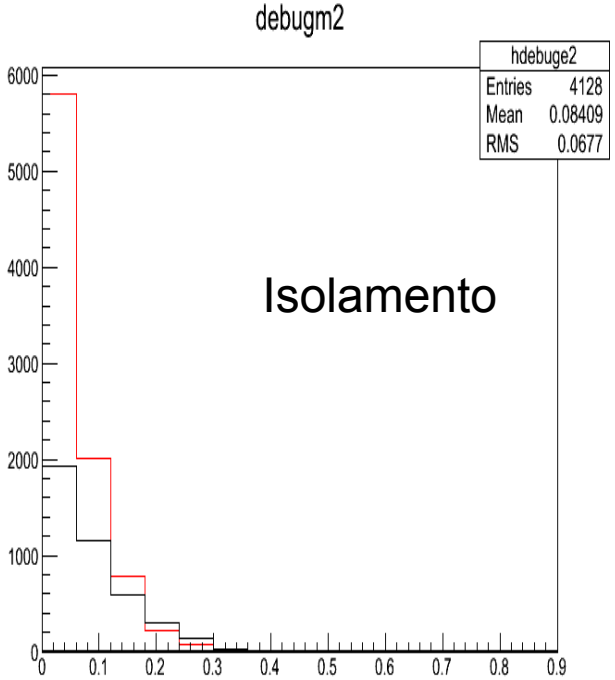


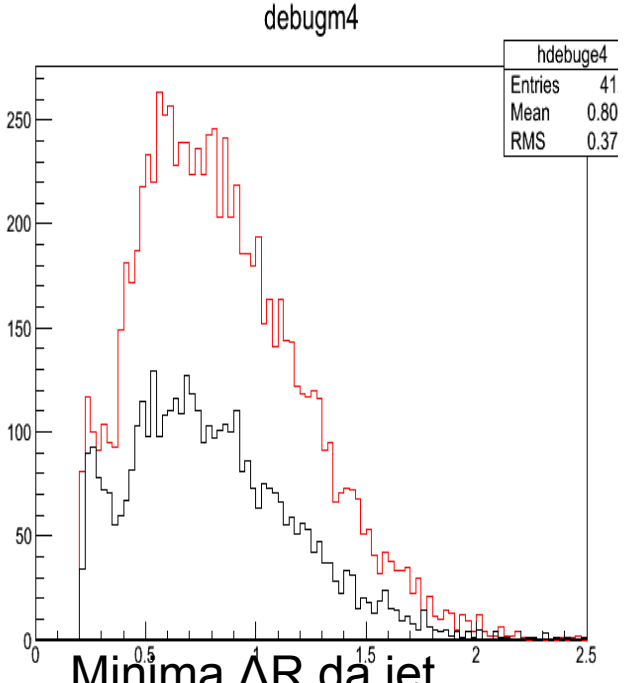
Massa Top adronico con Jet leptone

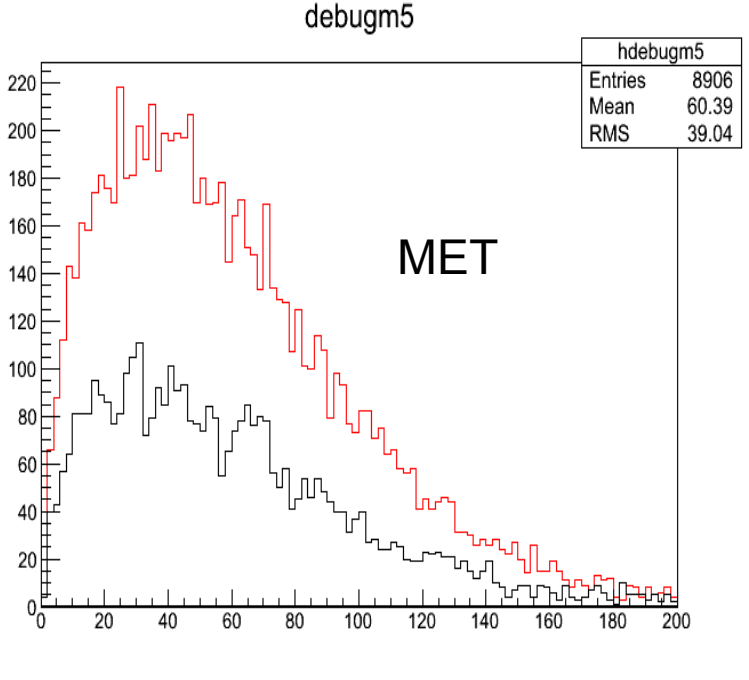
Picco Likelihood: Separazione elettroni/muoni



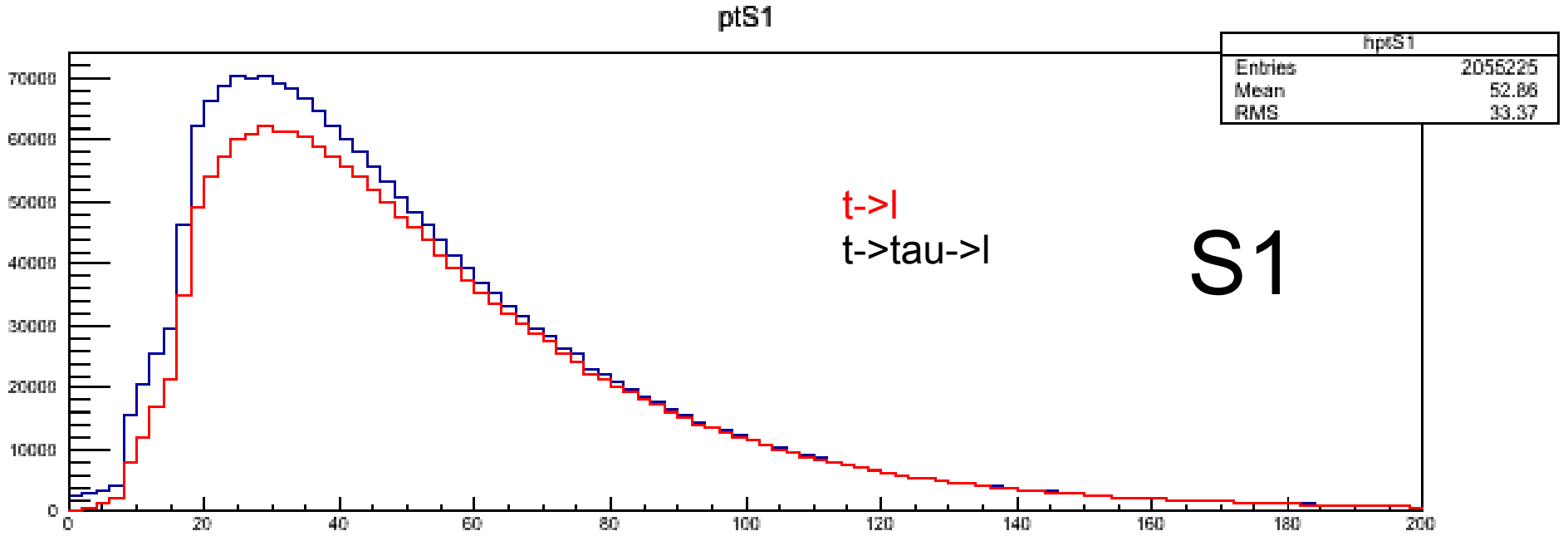


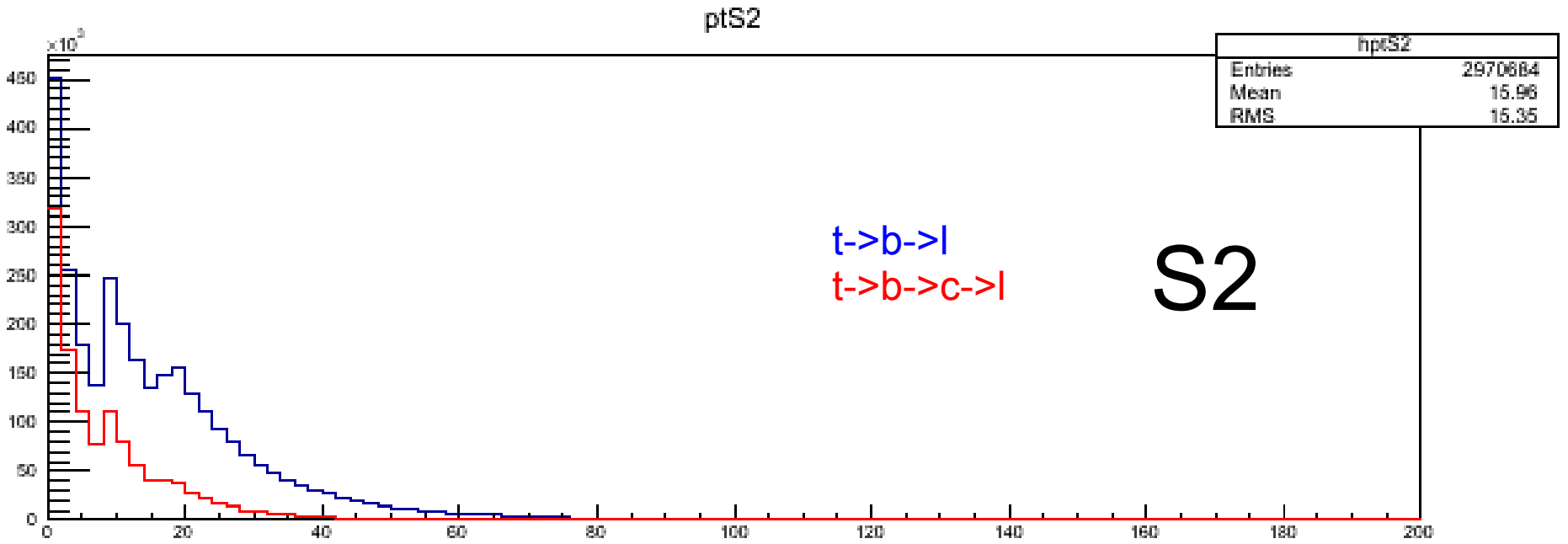


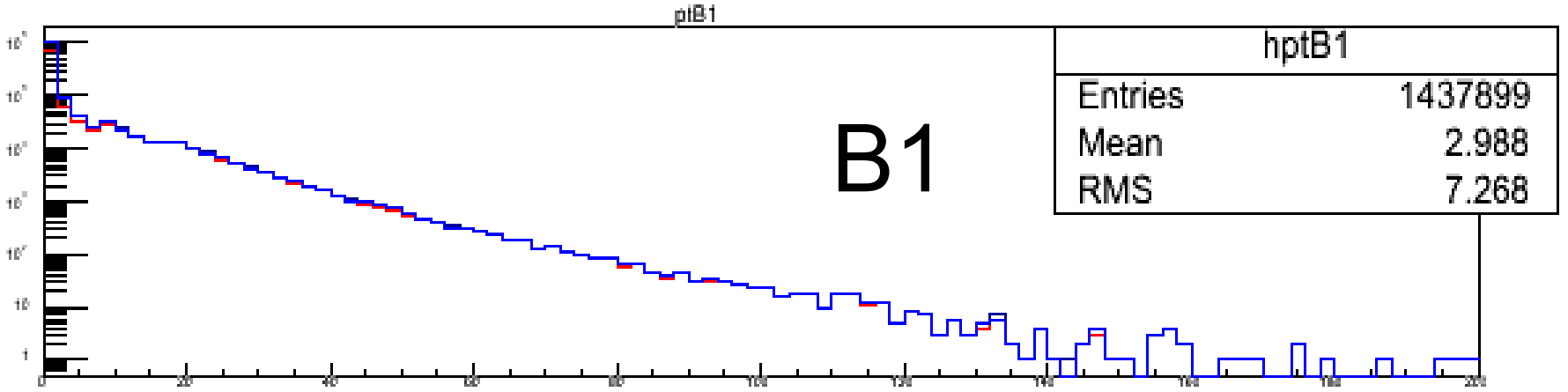


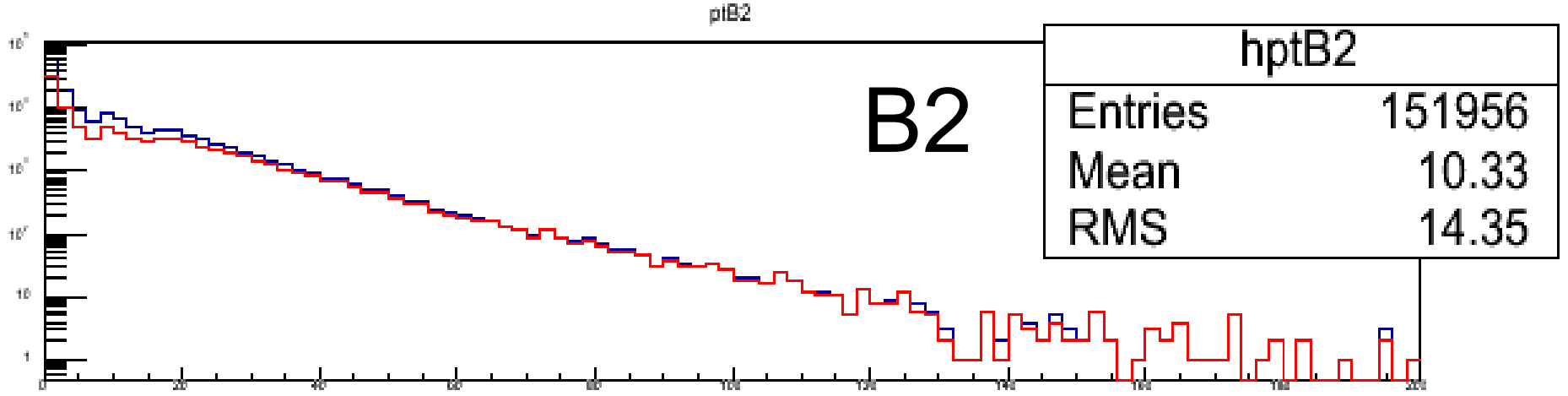


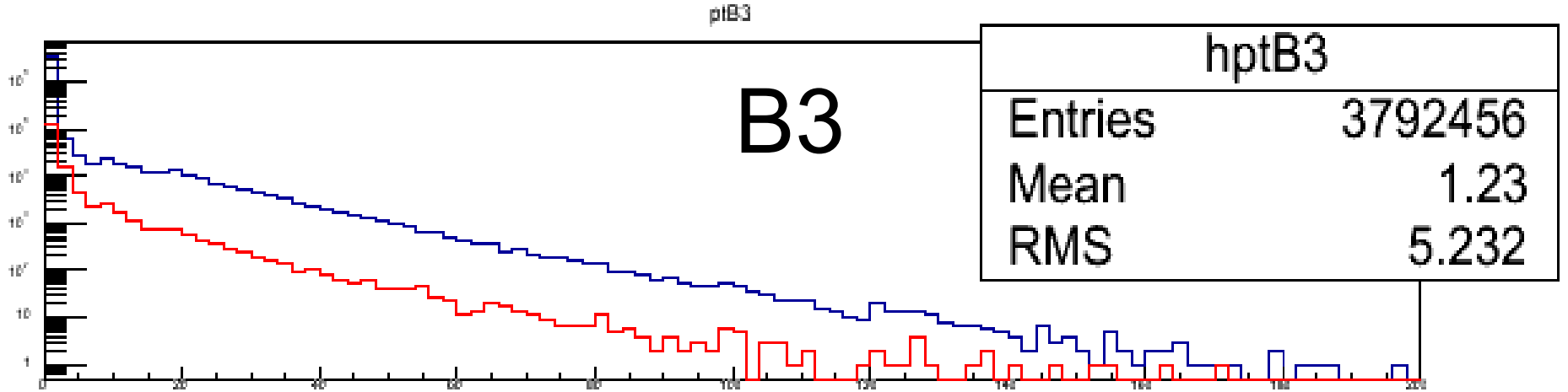
Pt generato varie classi elettroni e muoni assieme



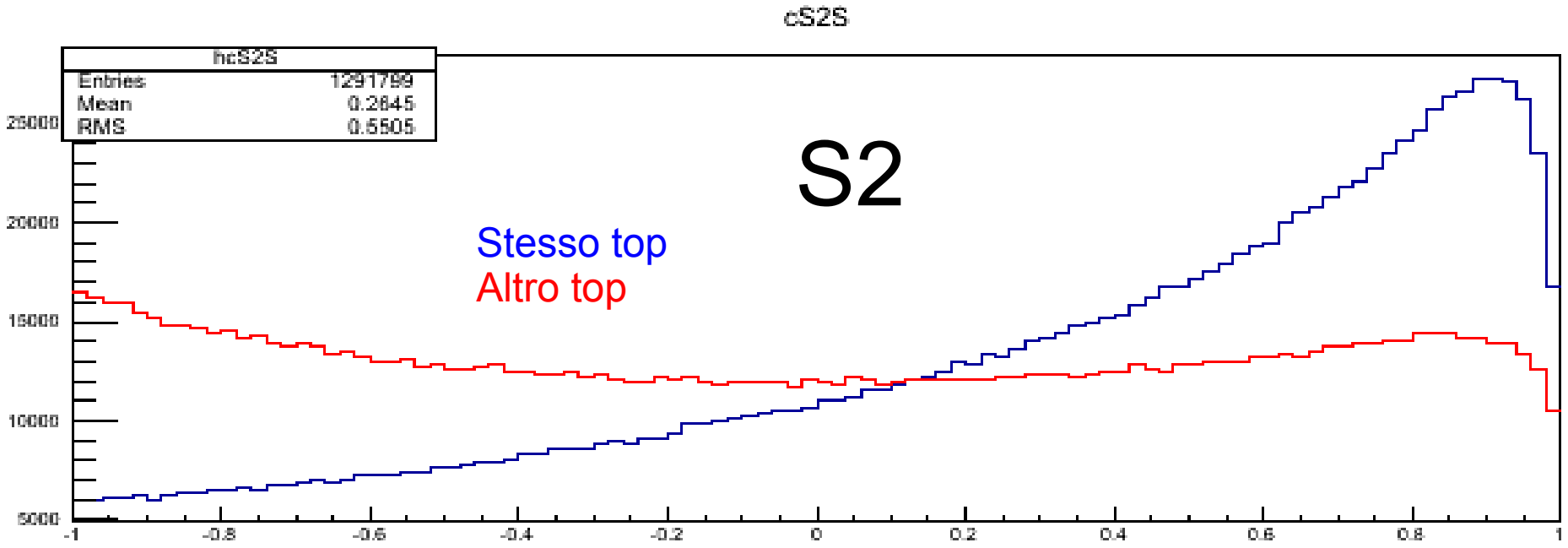


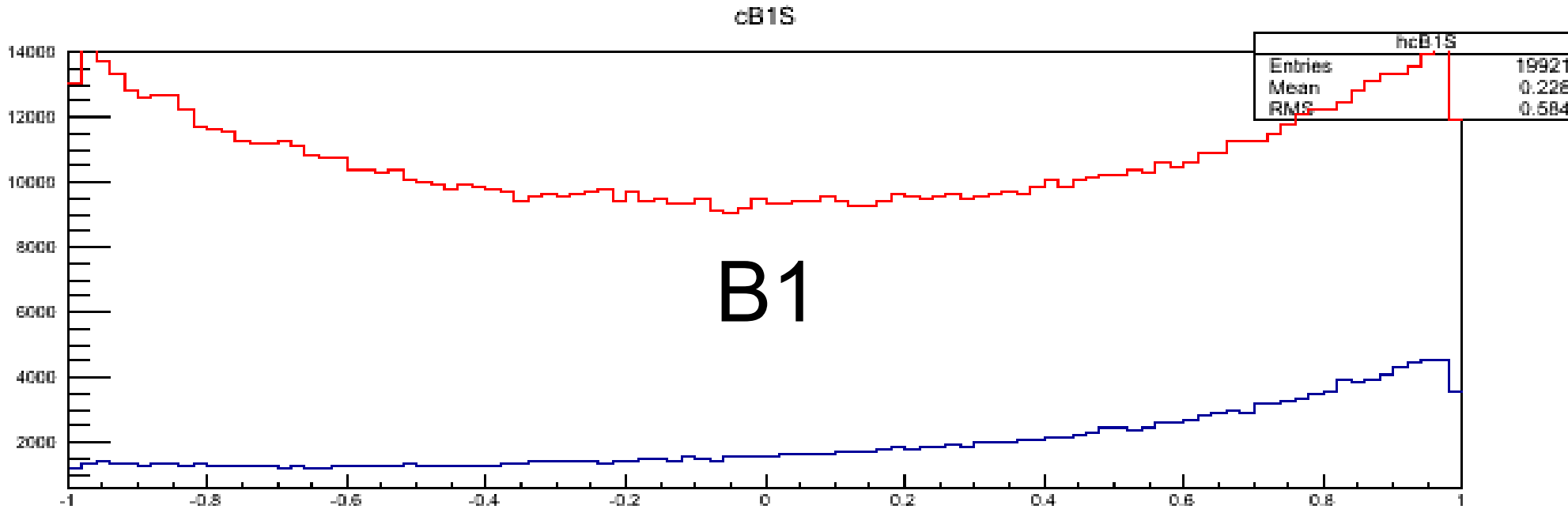

ptB1
B1
hptB1
Entries 1437899
Mean 2.988
RMS 7.268

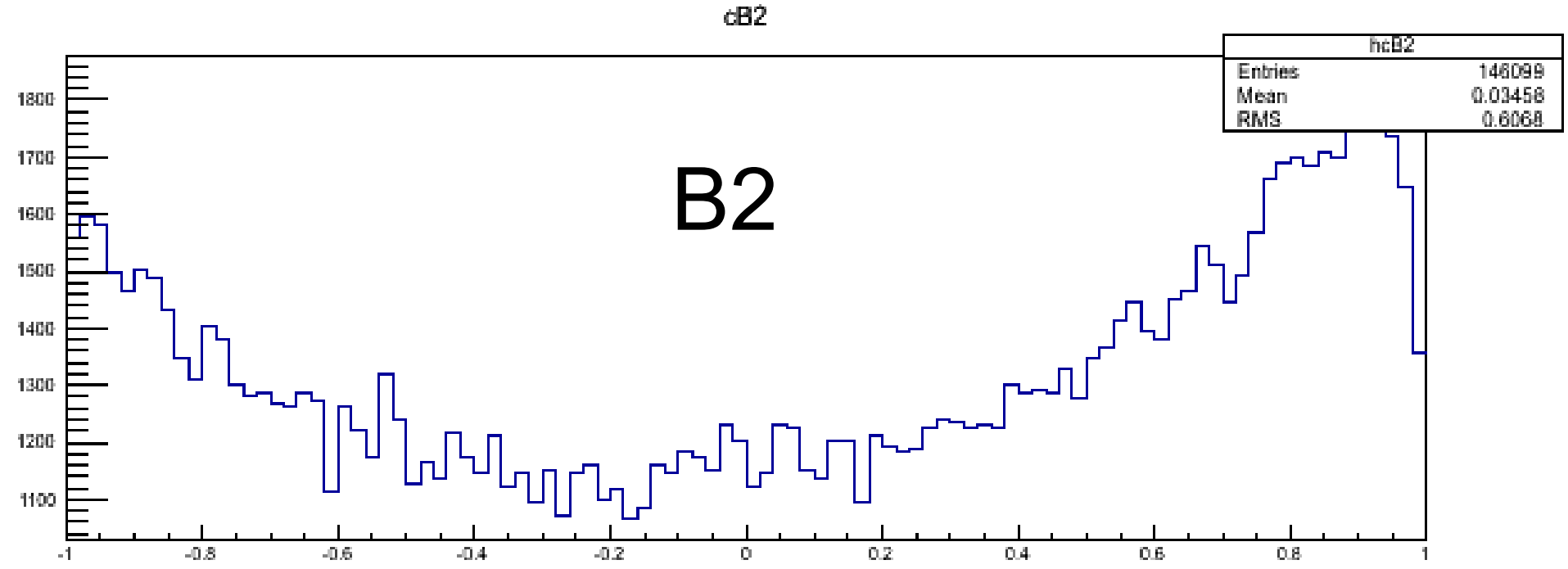

ptB2
B2
hptB2
Entries 151956
Mean 10.33
RMS 14.35

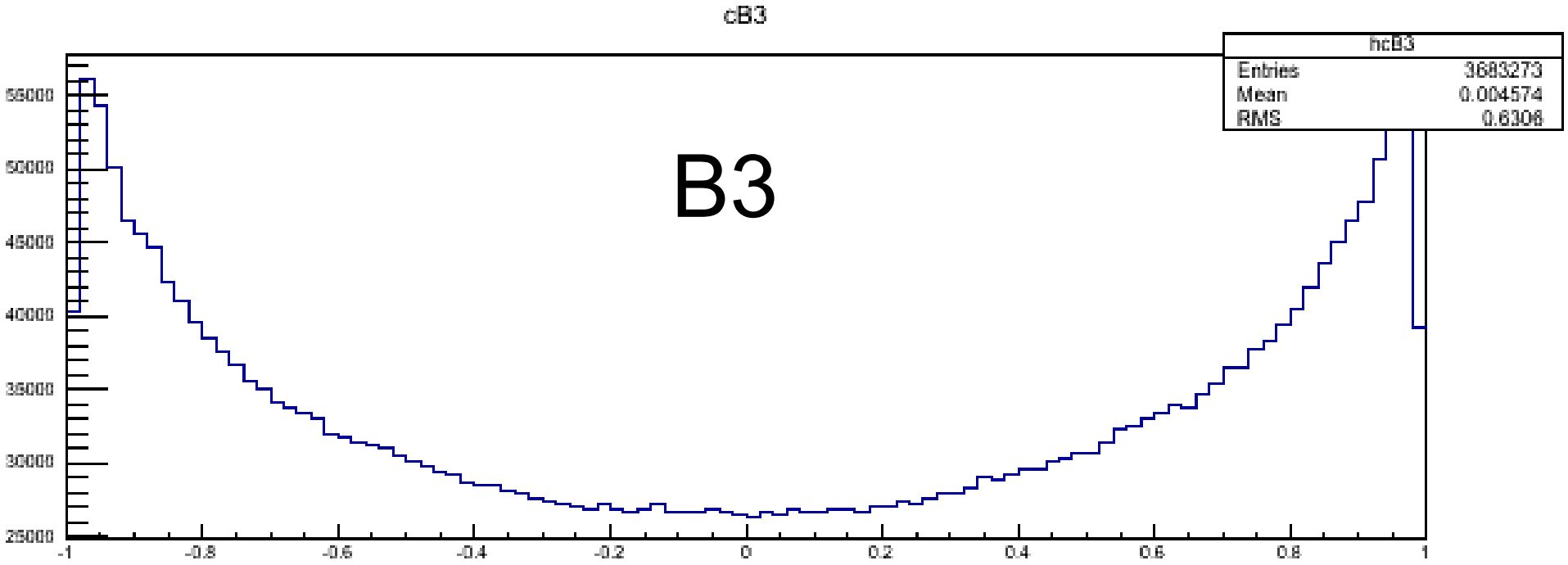

ptB3
B3
hptB3
Entries 3792456
Mean 1.23
RMS 5.232

Angolo leptone da top-altro leptone generato varie classi

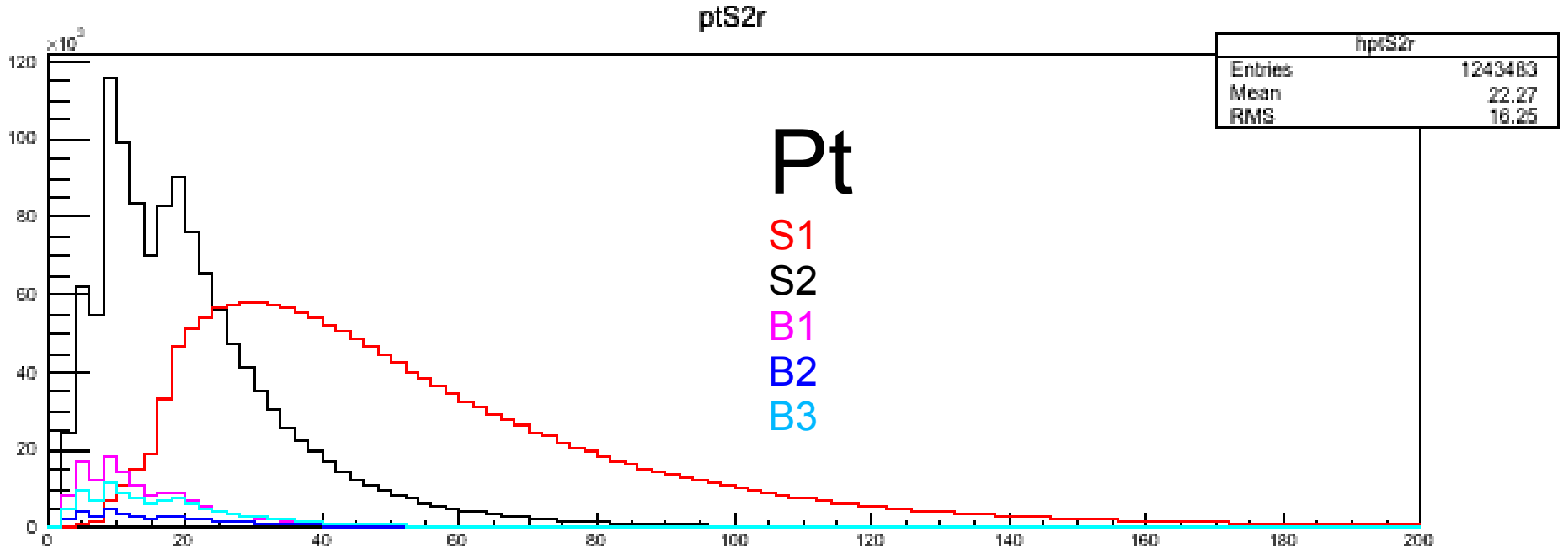


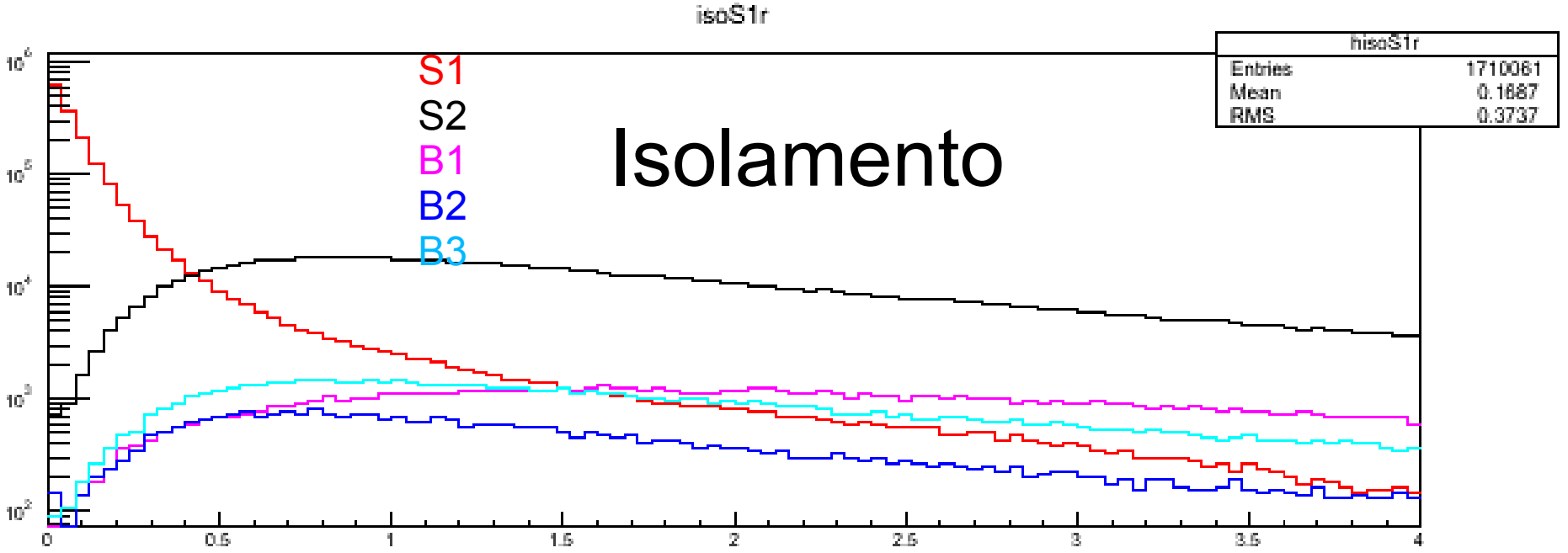


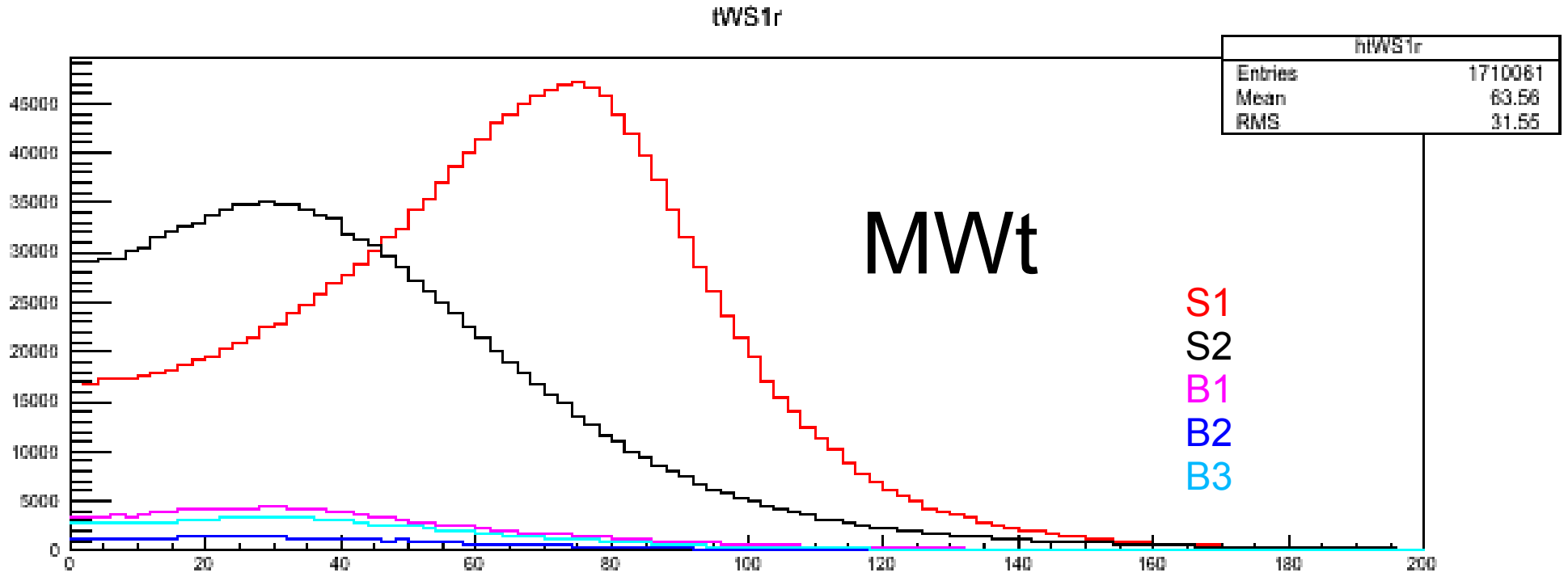

cB2
hcB2
Entries 146099
Mean 0.03458
RMS 0.6068
B2
1800
1700
1600
1500
1400
1300
1200
1100
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

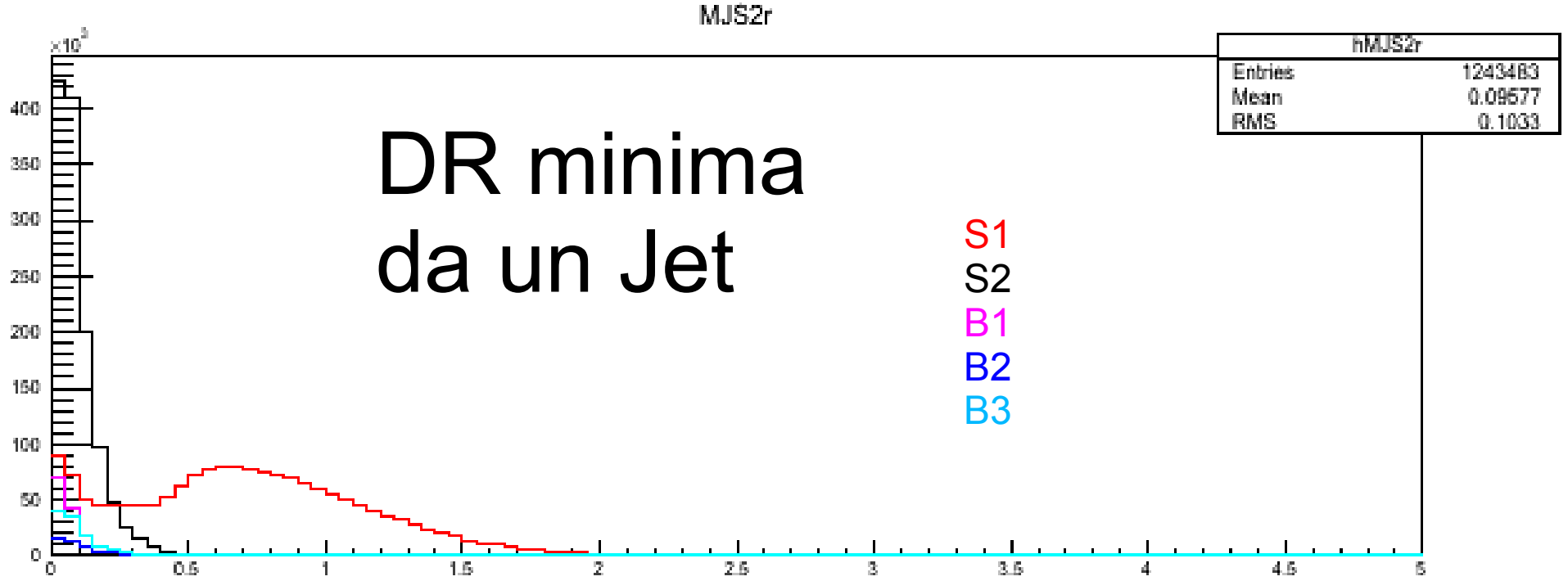

cB3
hcB3
Entries 3683273
Mean 0.004574
RMS 0.6306
B3
55000
50000
45000
40000
35000
30000
25000
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

Grandezze ricostruite varie classi

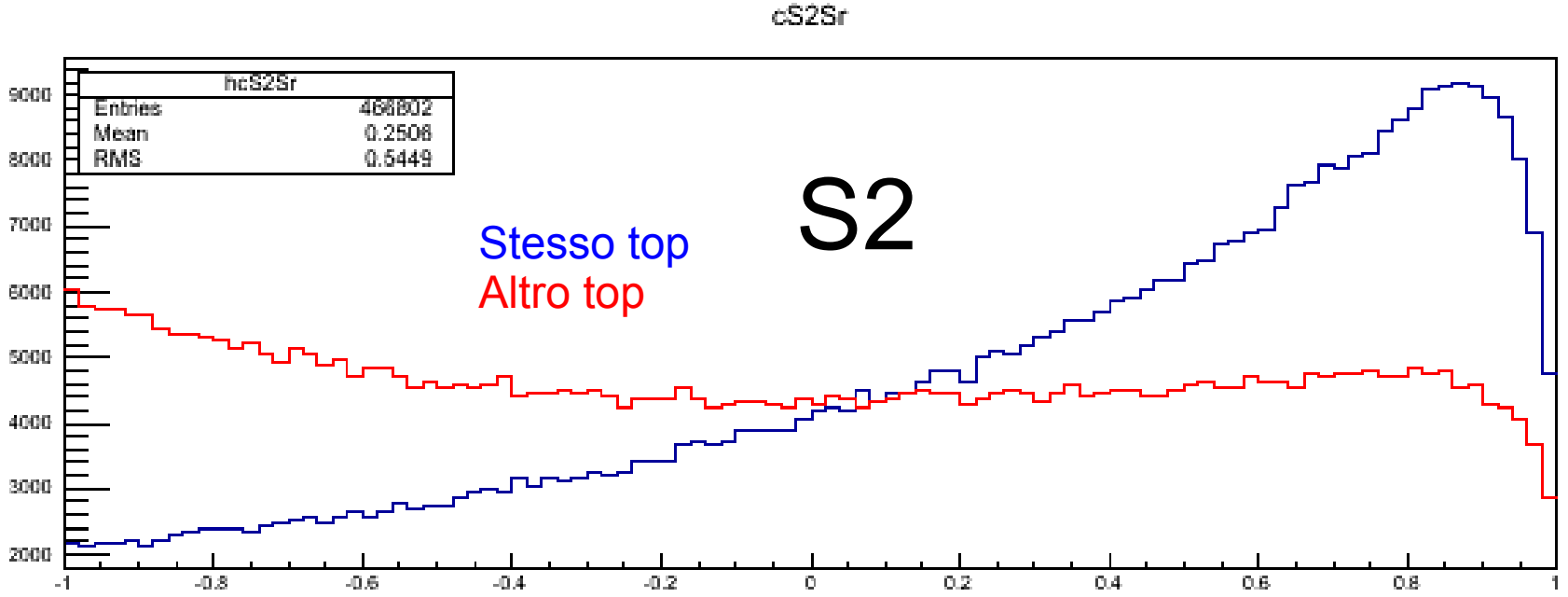


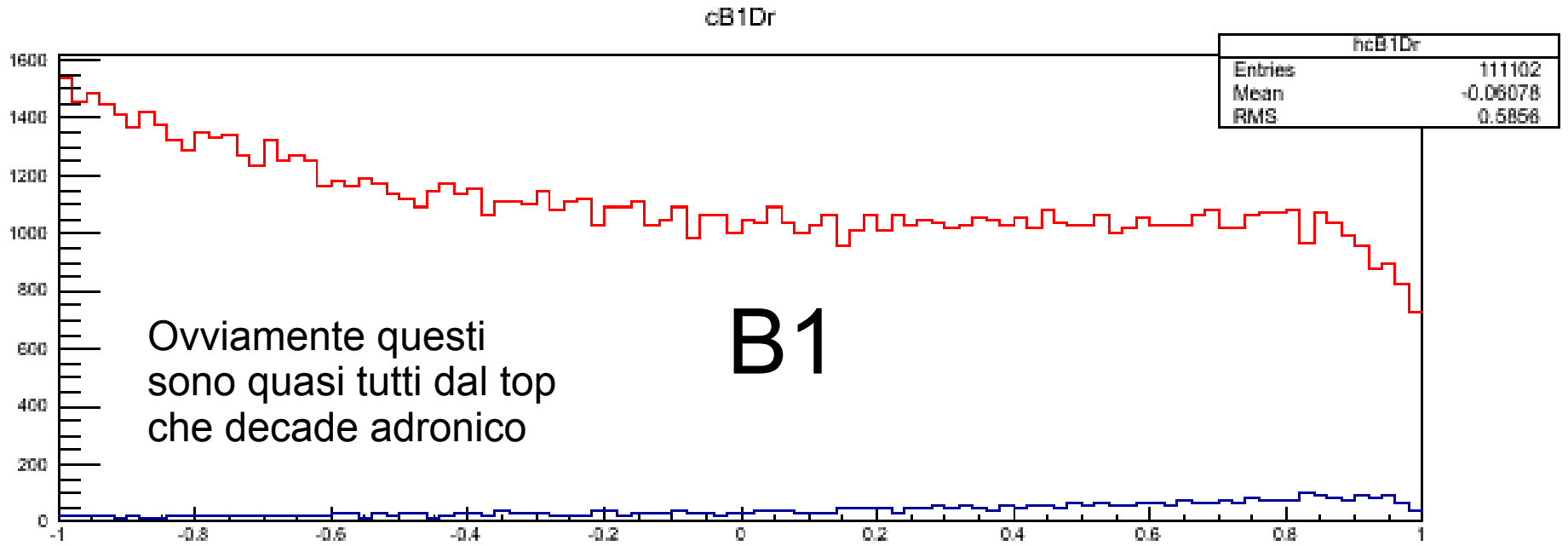


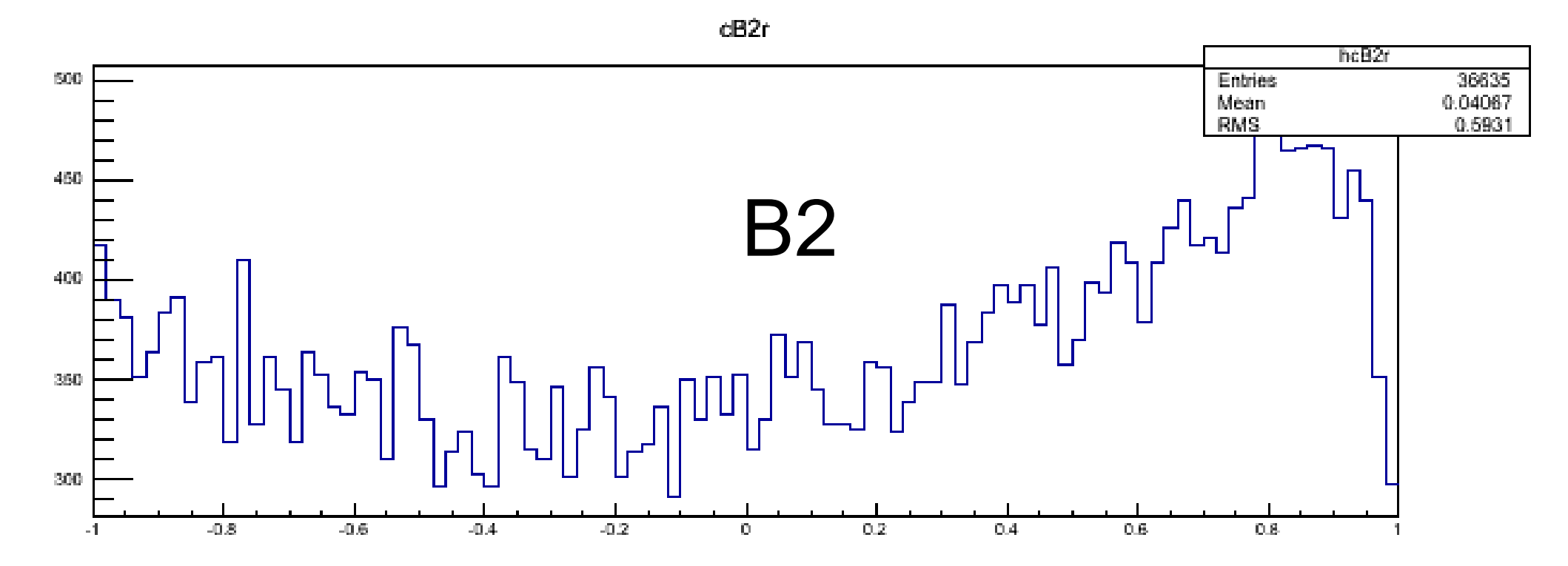

tWS1r
hWS1r
Entries 1710061
Mean 63.56
RMS 31.55
MWt
S1
S2
B1
B2
B3

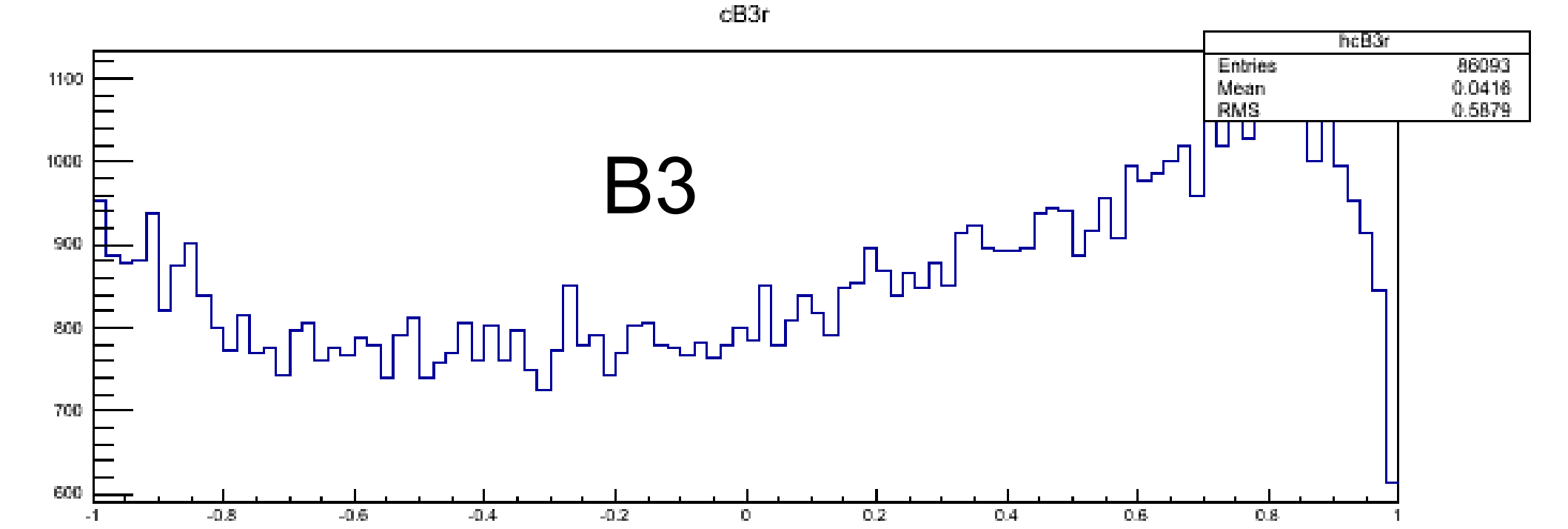

MJS2r
hMJS2r
Entries 1243483
Mean 0.09577
RMS 0.1033
DR minima
da un Jet
S1
S2
B1
B2
B3

Angolo leptone da top-altro leptone ricostruito varie classi

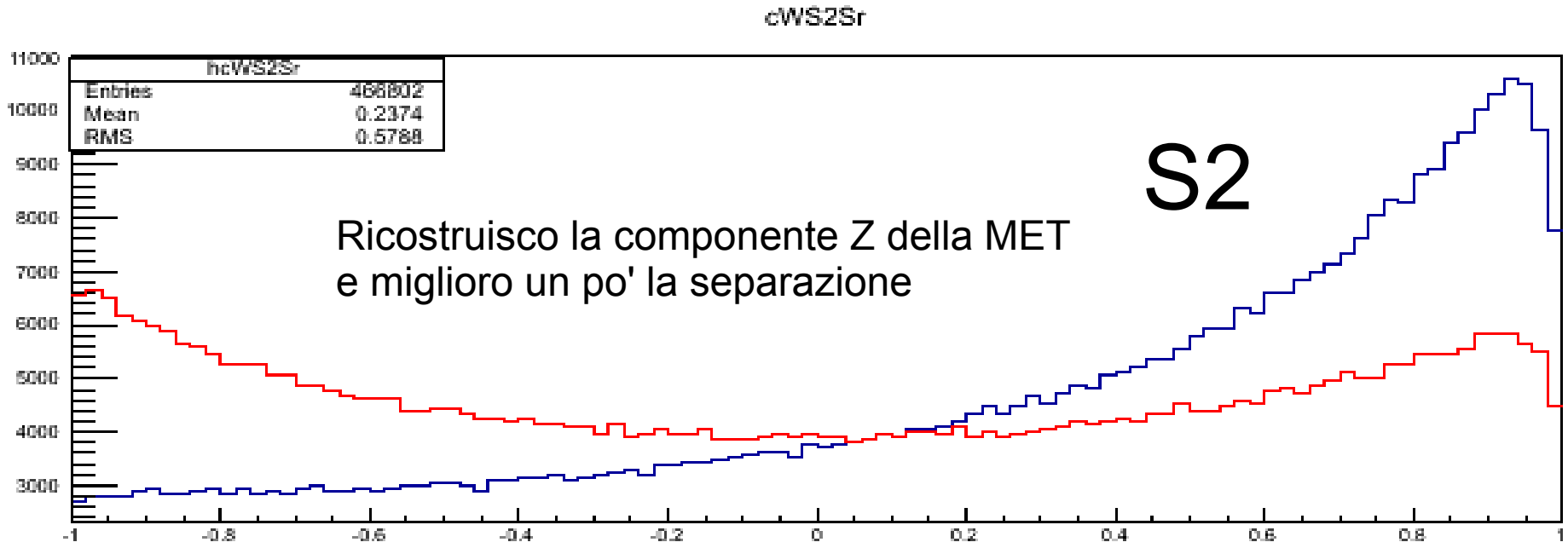


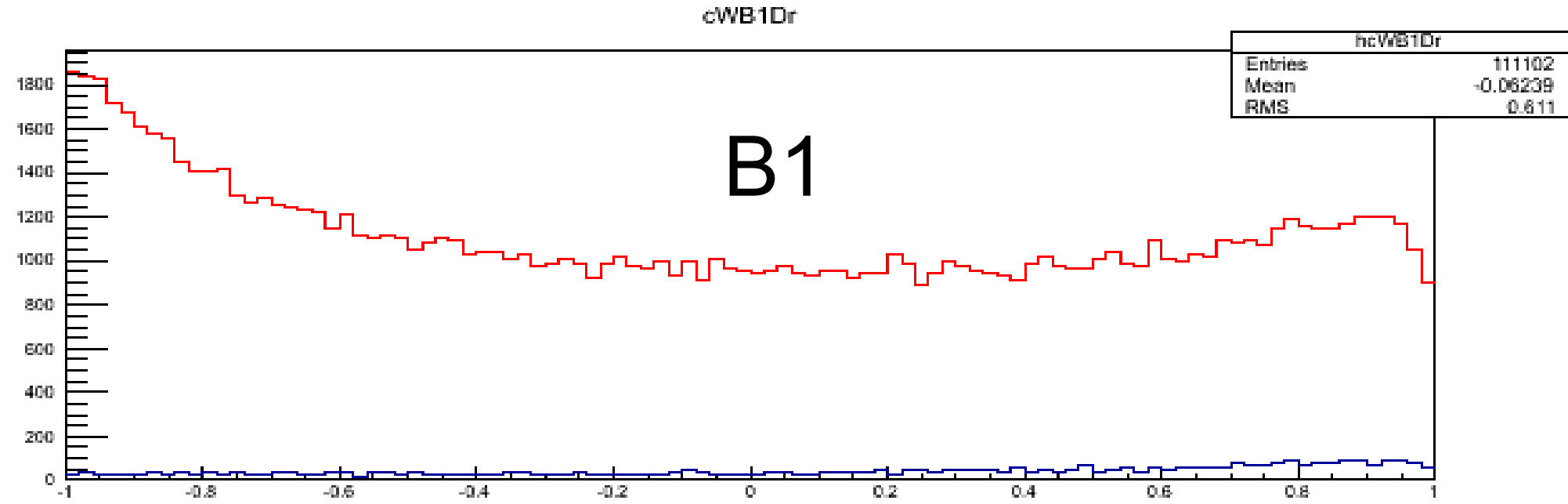


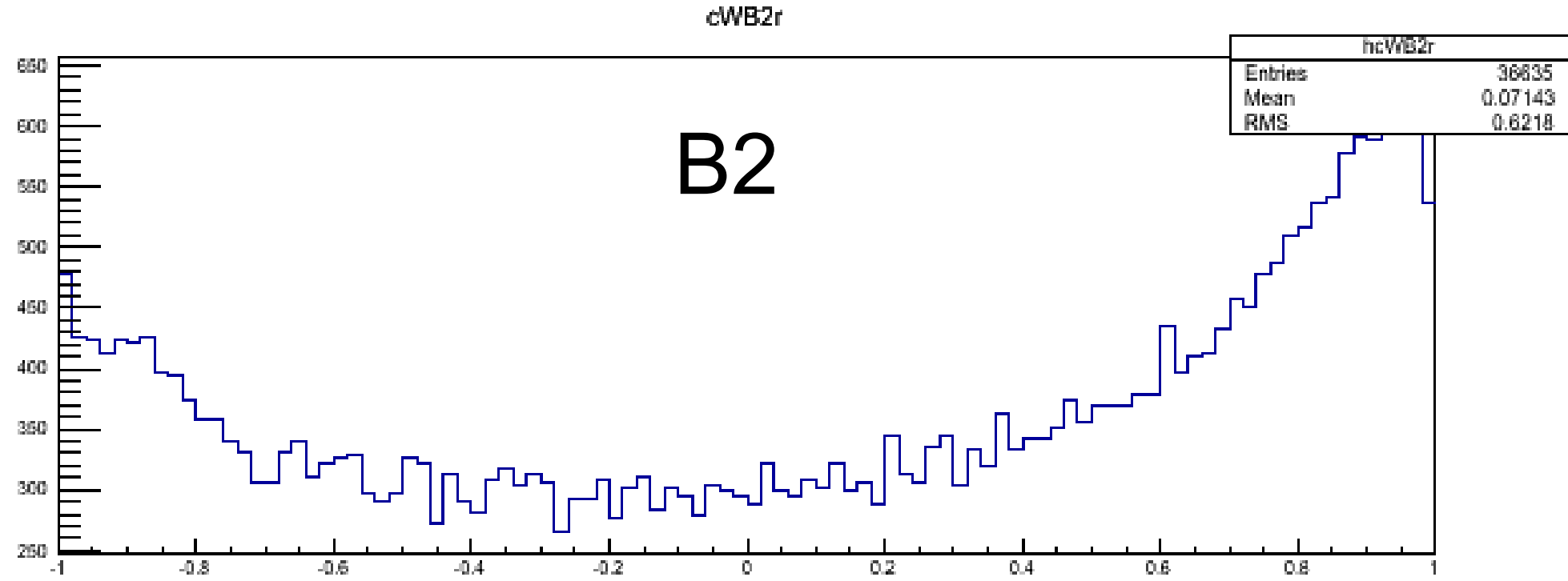

cB2r
hcB2r
Entries 36835
Mean 0.04087
RMS 0.5931
B2
500
450
400
350
300
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

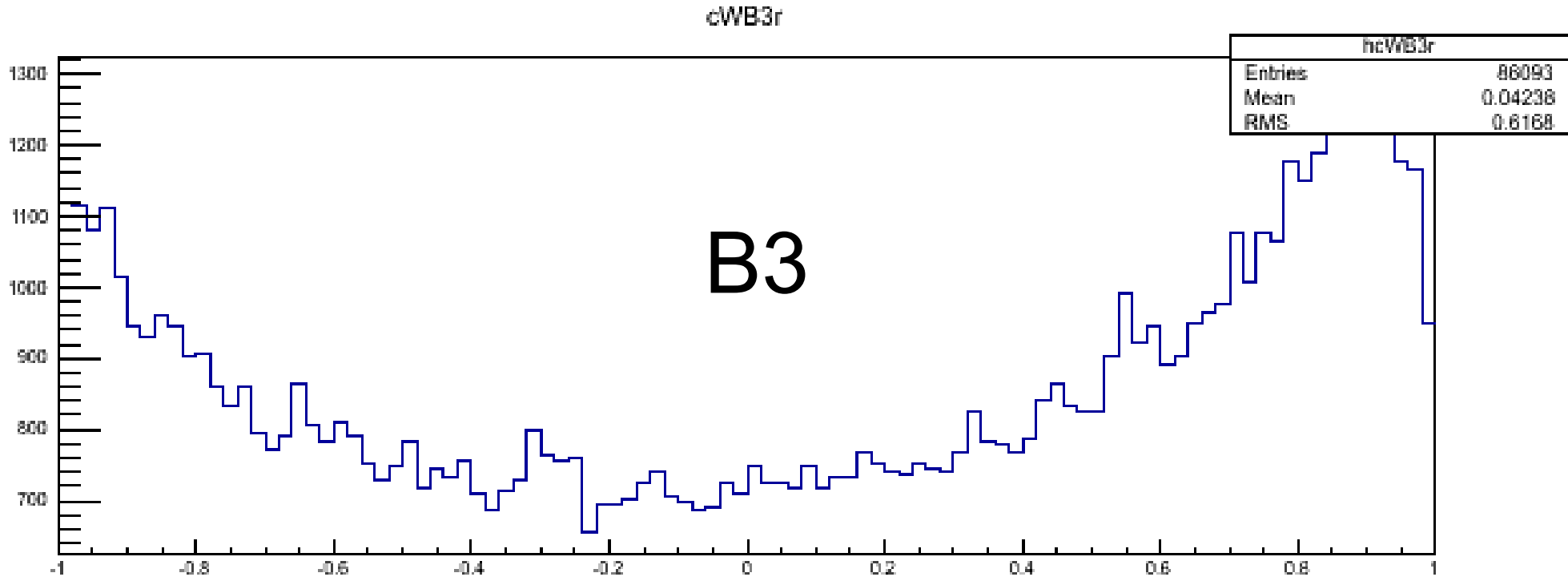

cB3r
hcB3r
Entries 86093
Mean 0.0416
RMS 0.5879
B3
1100
1000
900
800
700
600
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

Angolo W(l+nu) da top-altro leptone (Pi(nu) ricostruito)






cWB2r
hcWB2r
Entries 36835
Mean 0.07143
RMS 0.6218
B2
680
600
560
500
460
400
360
300
260
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

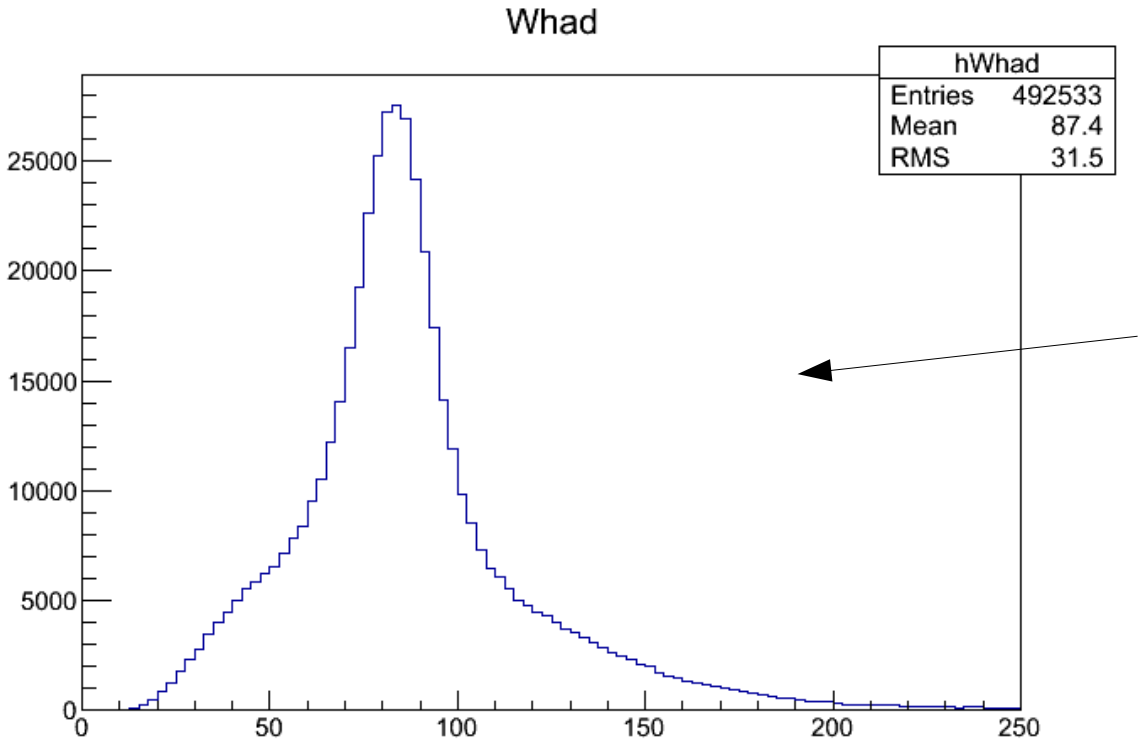

cWB3r
hcWB3r
Entries 86093
Mean 0.04238
RMS 0.6168
B3
1300
1200
1100
1000
900
800
700
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

B2 sono un potenziale problema? (3.5% degli S2). Vengono da b anche loro come il segnale S2, ma sono senza correlazione al top (gluon splitting) : mi aspetto un angolo piatto con entrambi i W (leptonico e adronico).

Possibilita` 1: cercare di separare i B2 dagli S2 vicini all'altro top.

Possibile taglio di eventi con 3 jet-btaggati da studiare

Possibilita` 2: correggere il risultato del mixing (sono pochi)

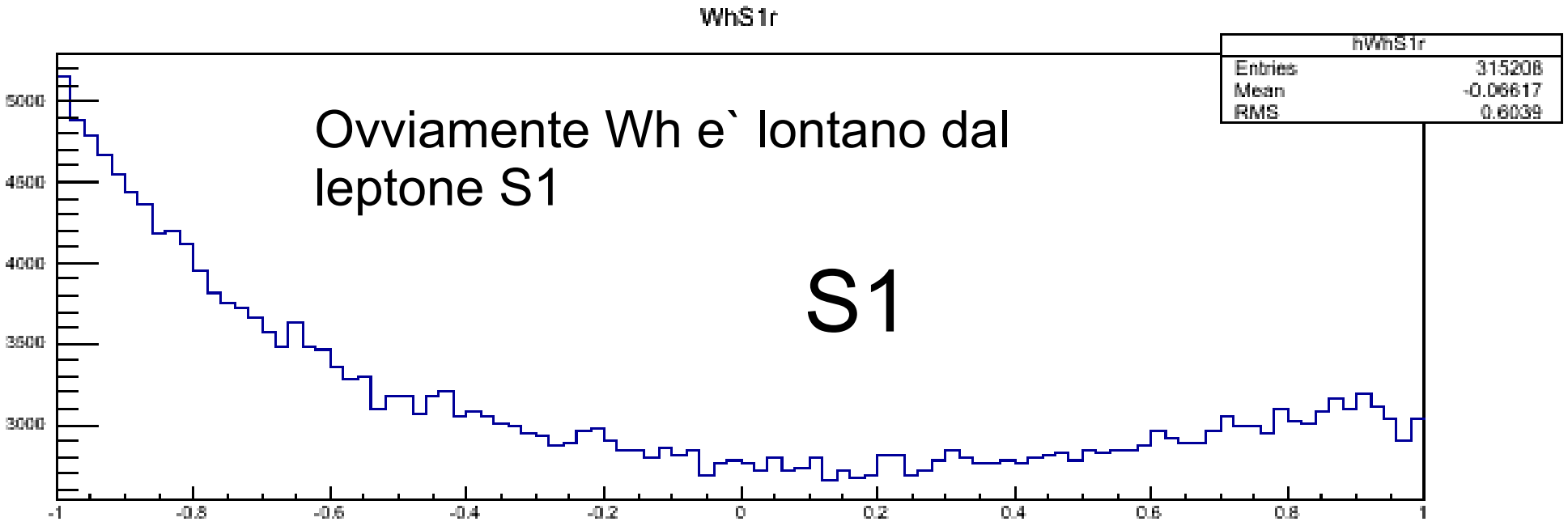


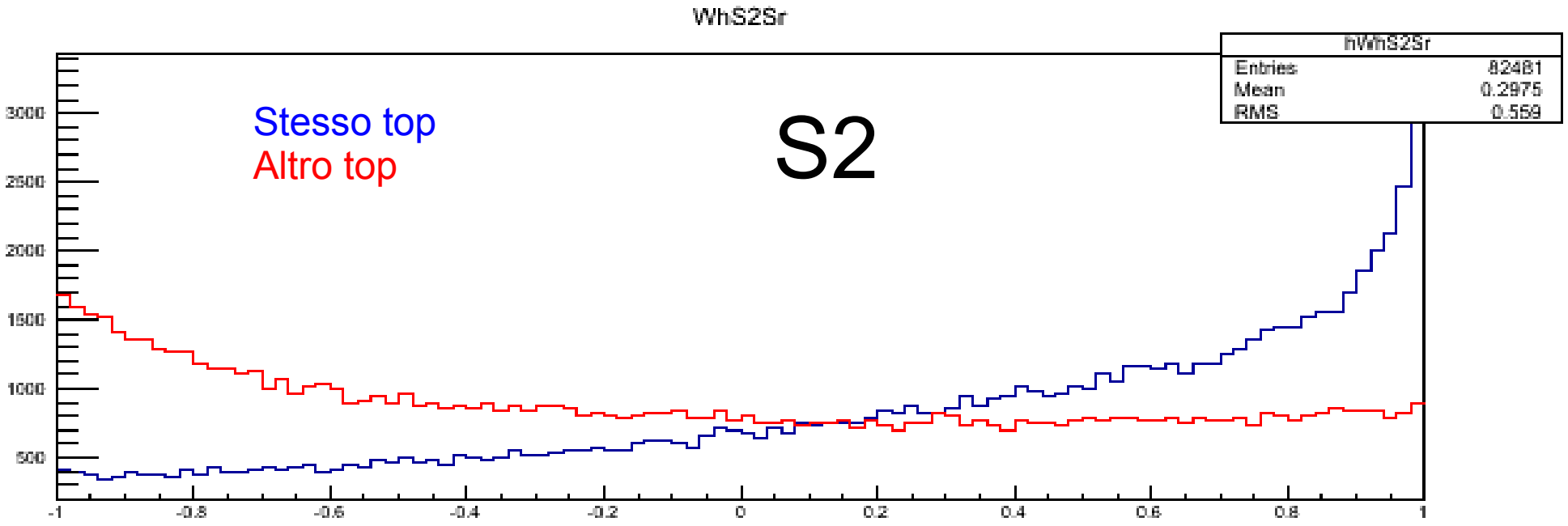
Cerco di calcolare la loro direzione rispetto al W adronico

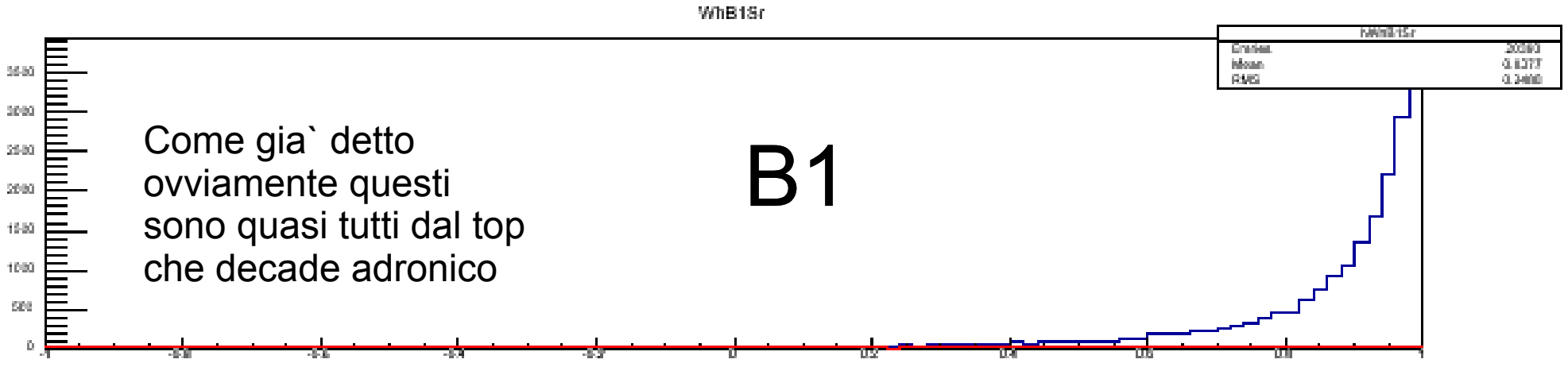
W adronico ricostruito con i due jets antibitaggati a maggiore Pt

Efficienza non brillantissima...

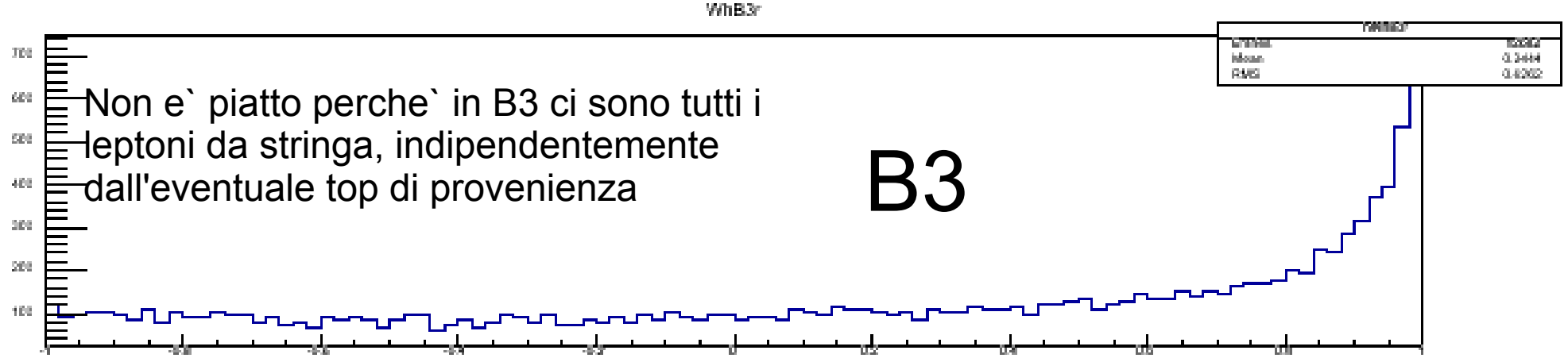
Angolo W adronico - leptone



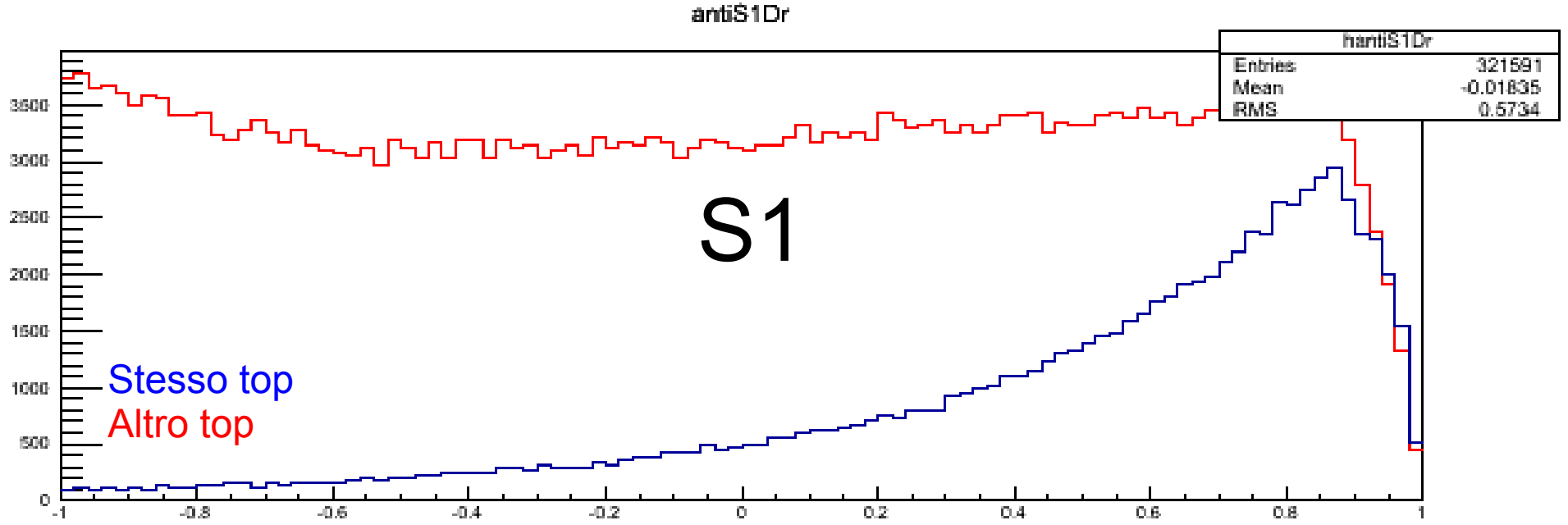


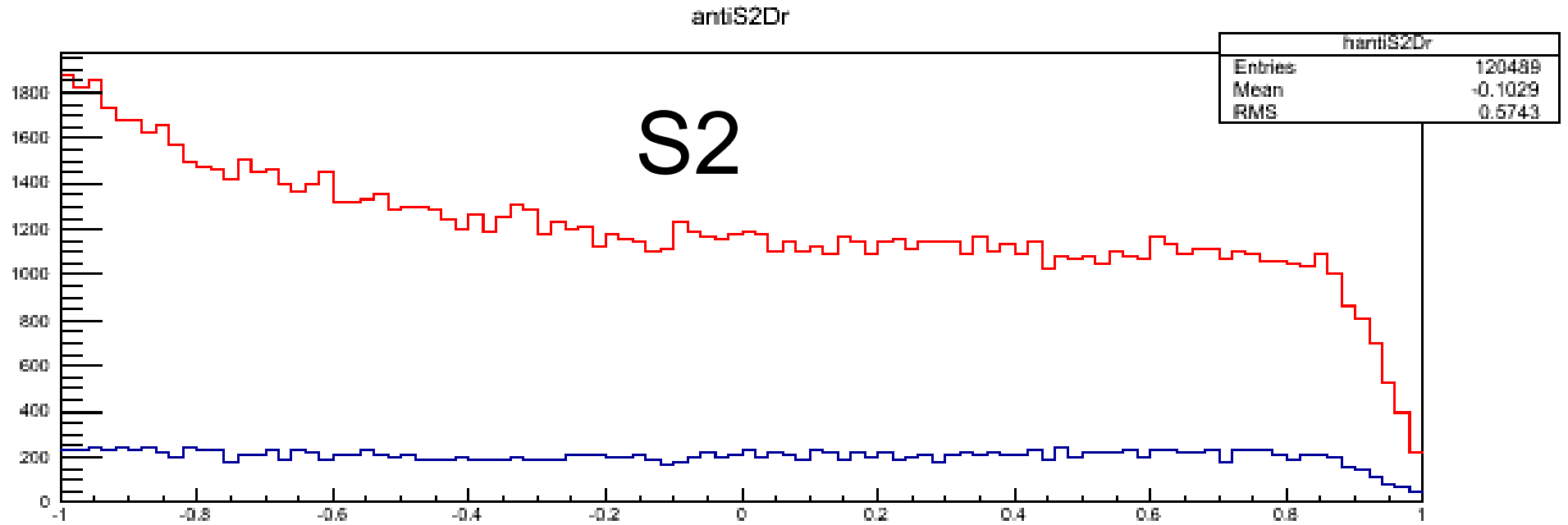

WhB1Sr
Come gia` detto
ovviamente questi
sono quasi tutti dal top
che decade adronico
B1

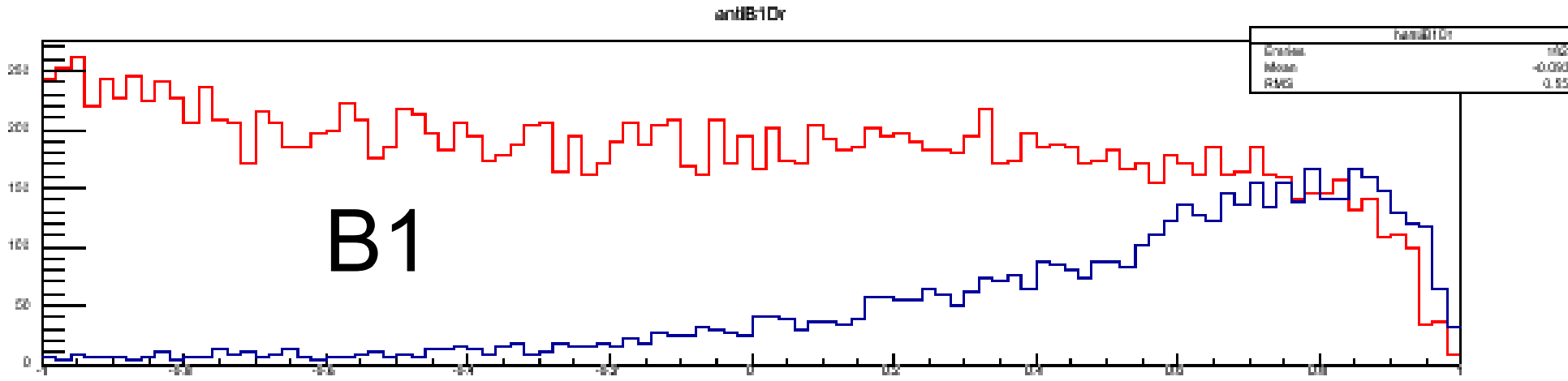

Piatto come si sperava ma pochi eventi
B2

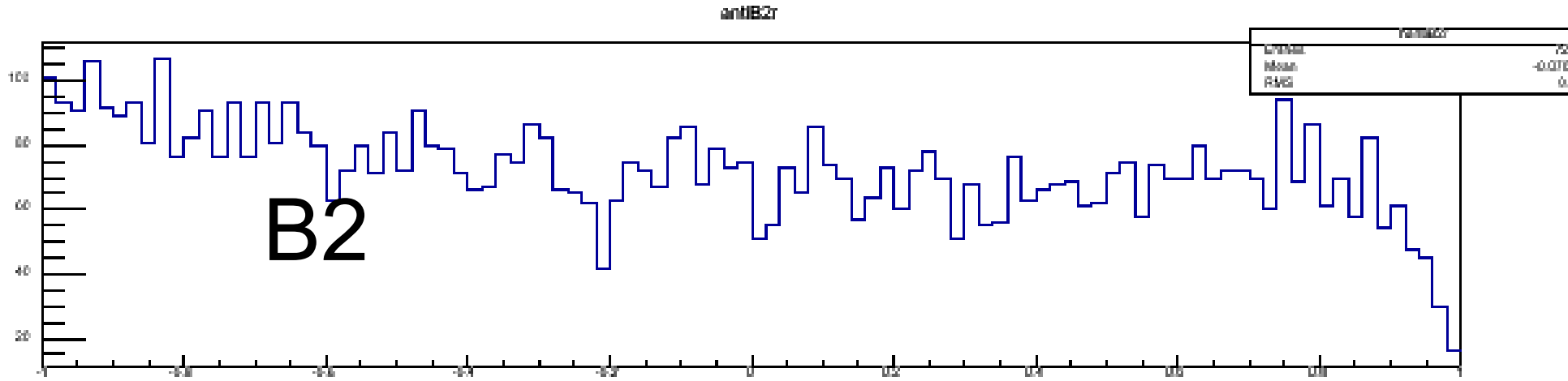

WhB3r
Non e` piatto perche` in B3 ci sono tutti i
leptoni da stringa, indipendentemente
dall'eventuale top di provenienza
B3

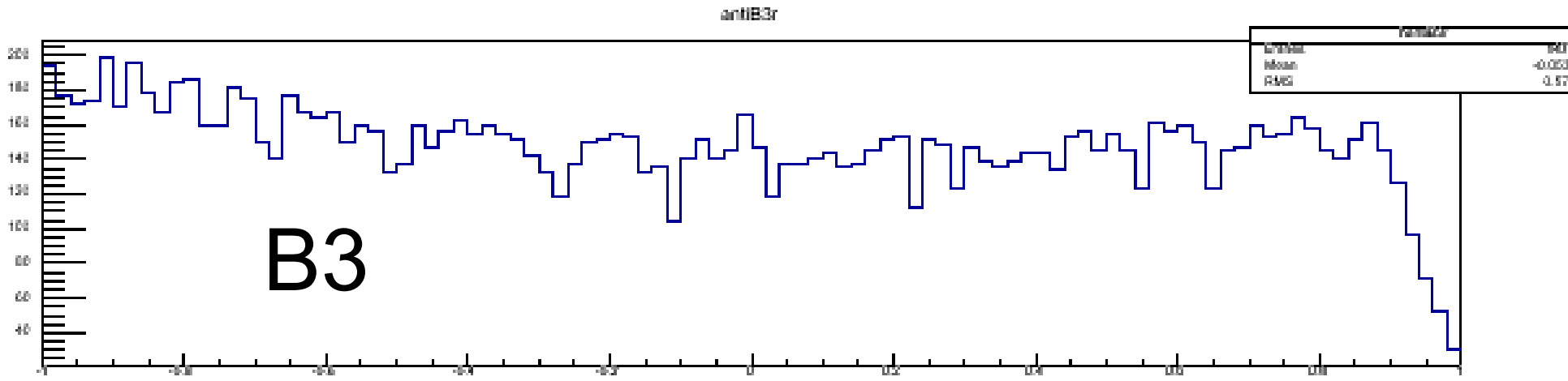
Angolo leptone-Jet (piu`) btaggato senza leptone



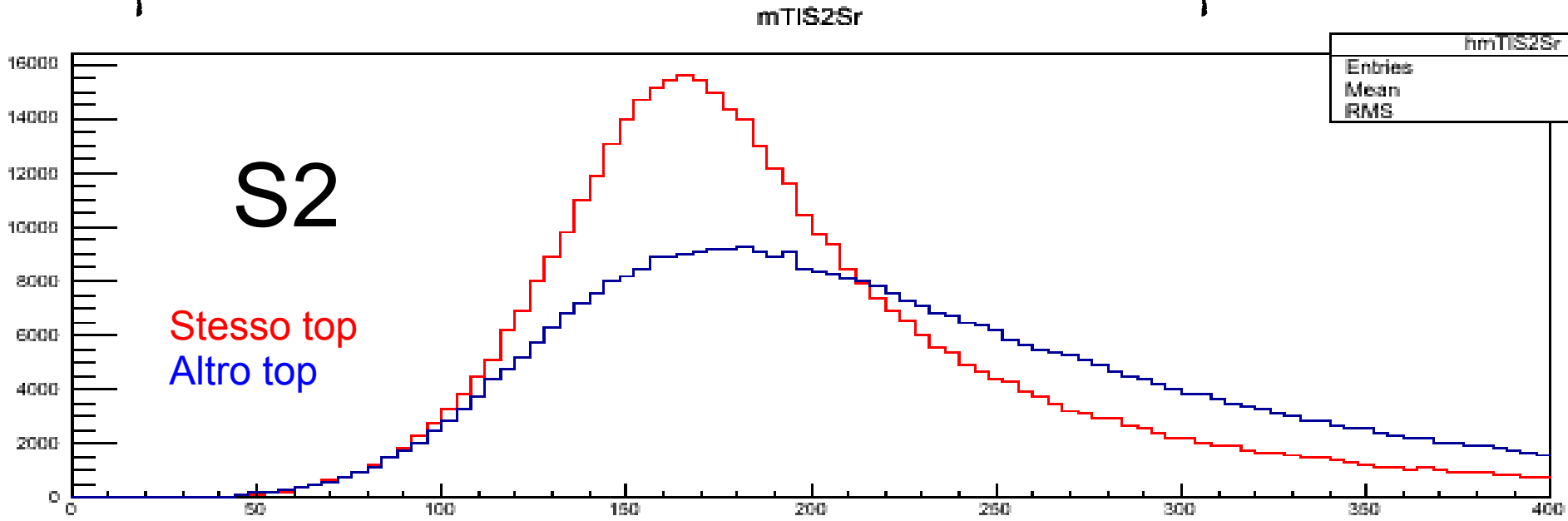


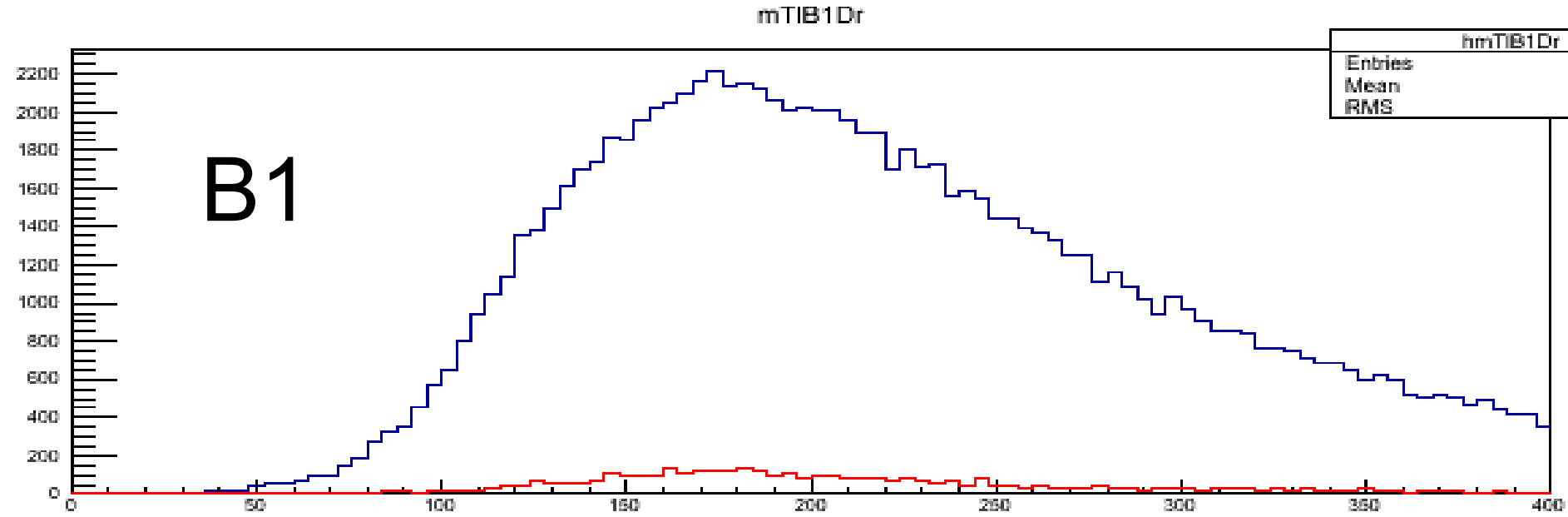

antiB1Dr
B1

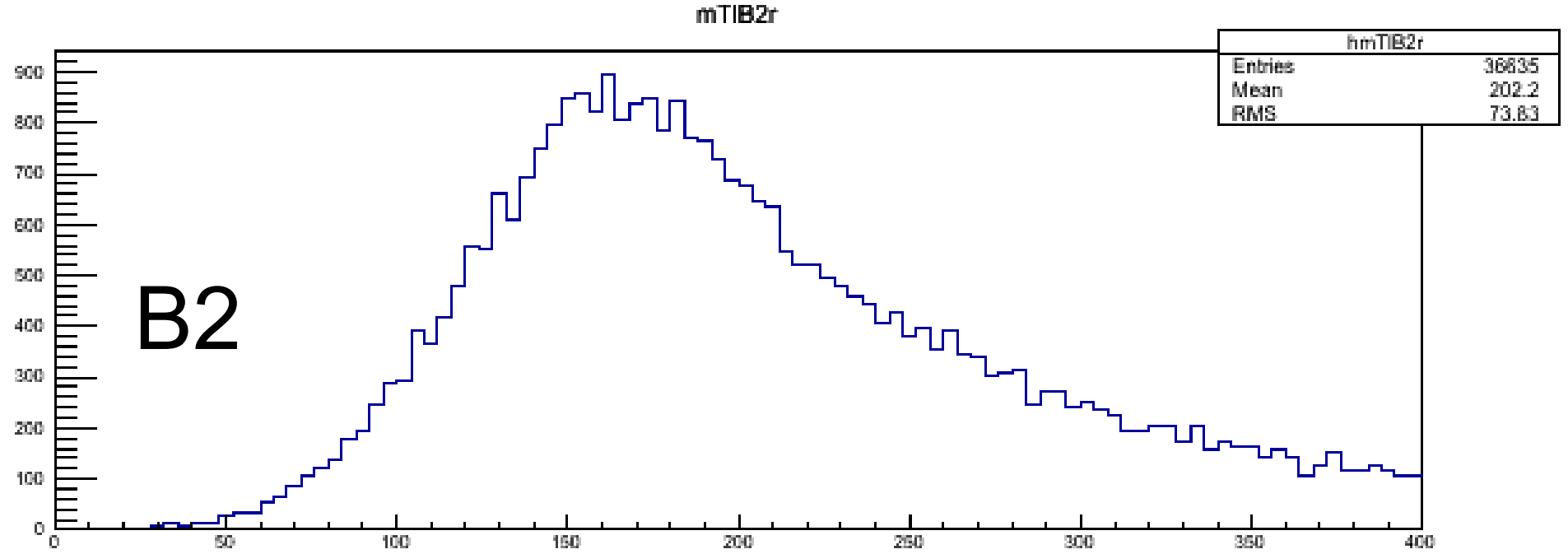

antiB2r
B2

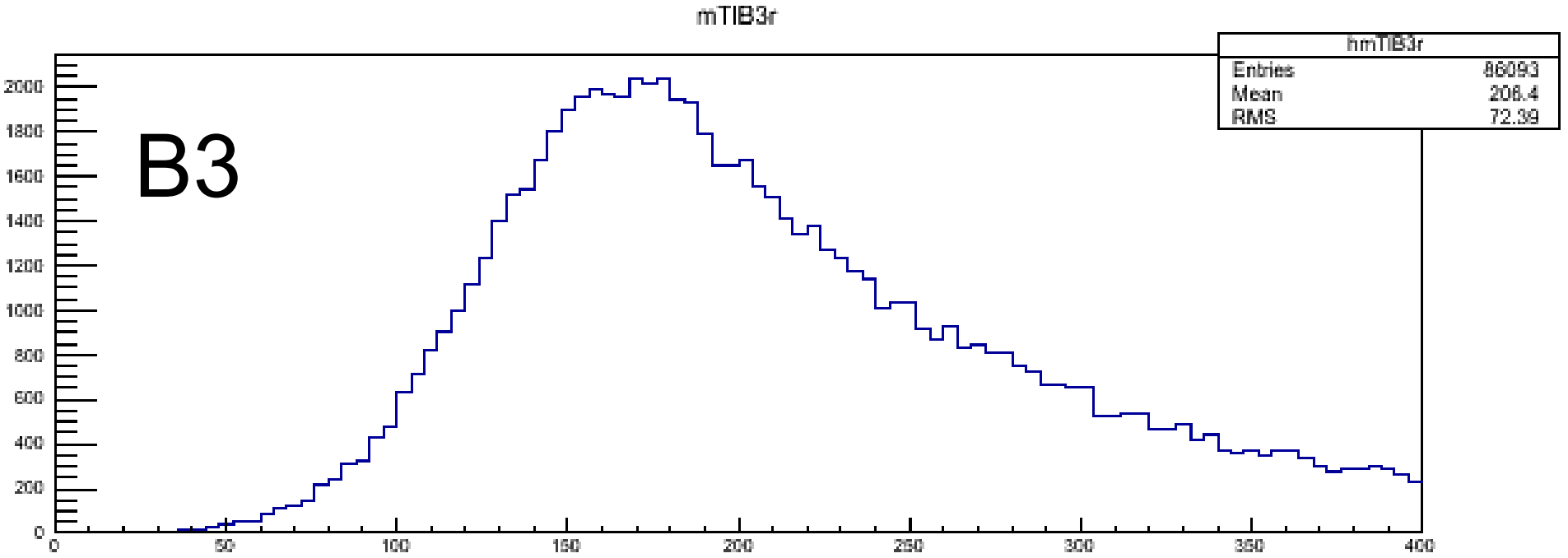

antiB3r
B3

Massa del top semileptonico fatta con: l da top, neutrino e jet del leptone che si considera (dallo stesso top di l-nu o no)

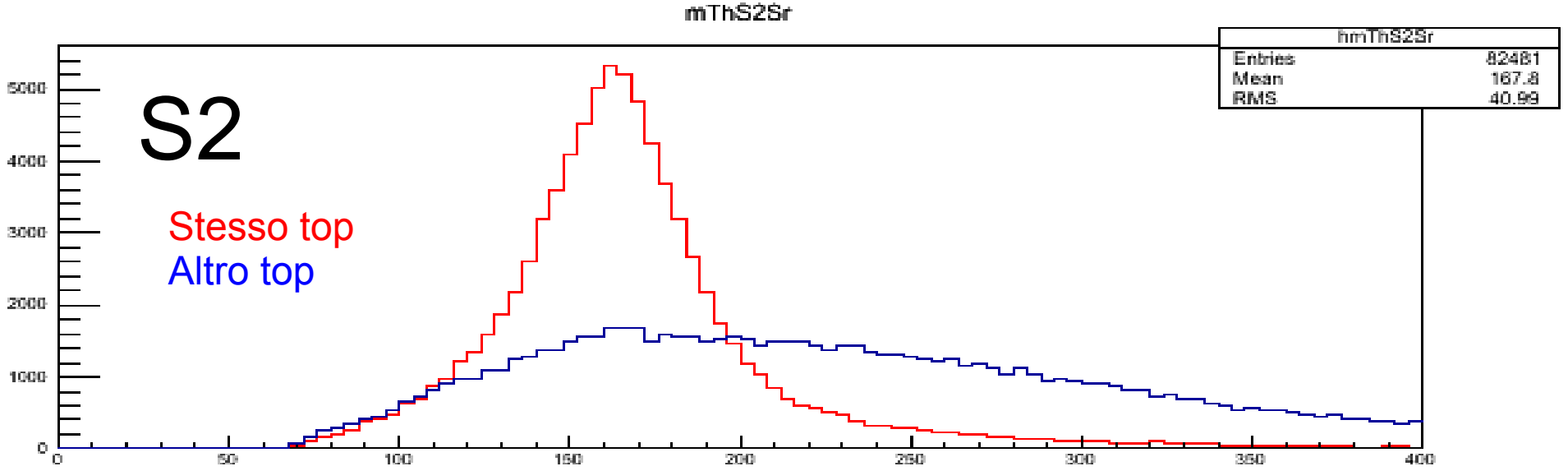


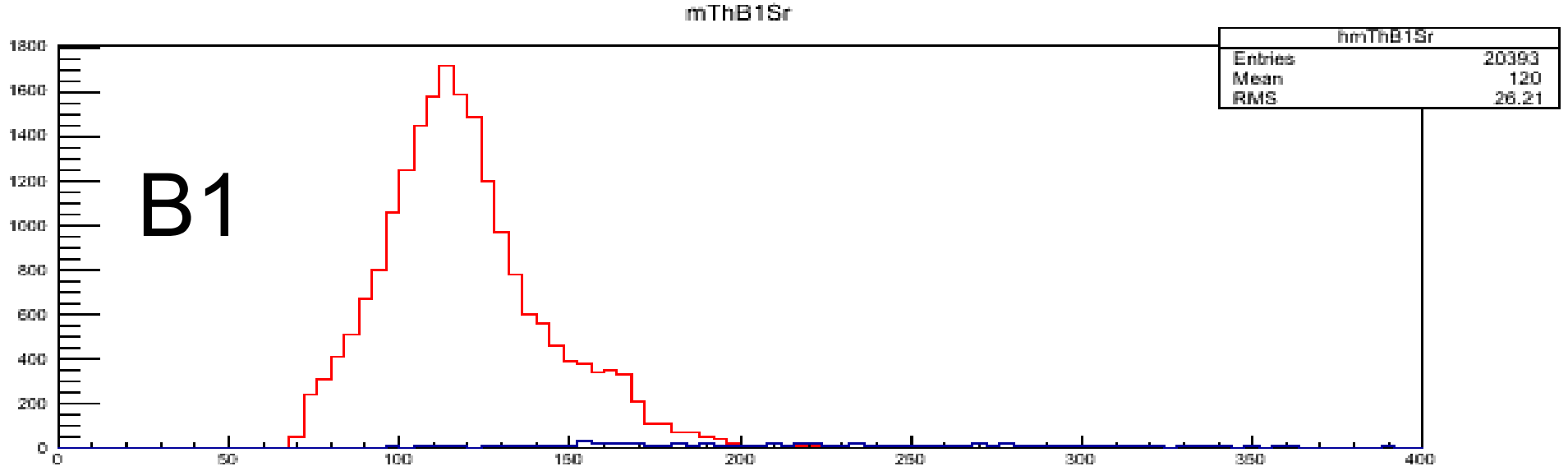


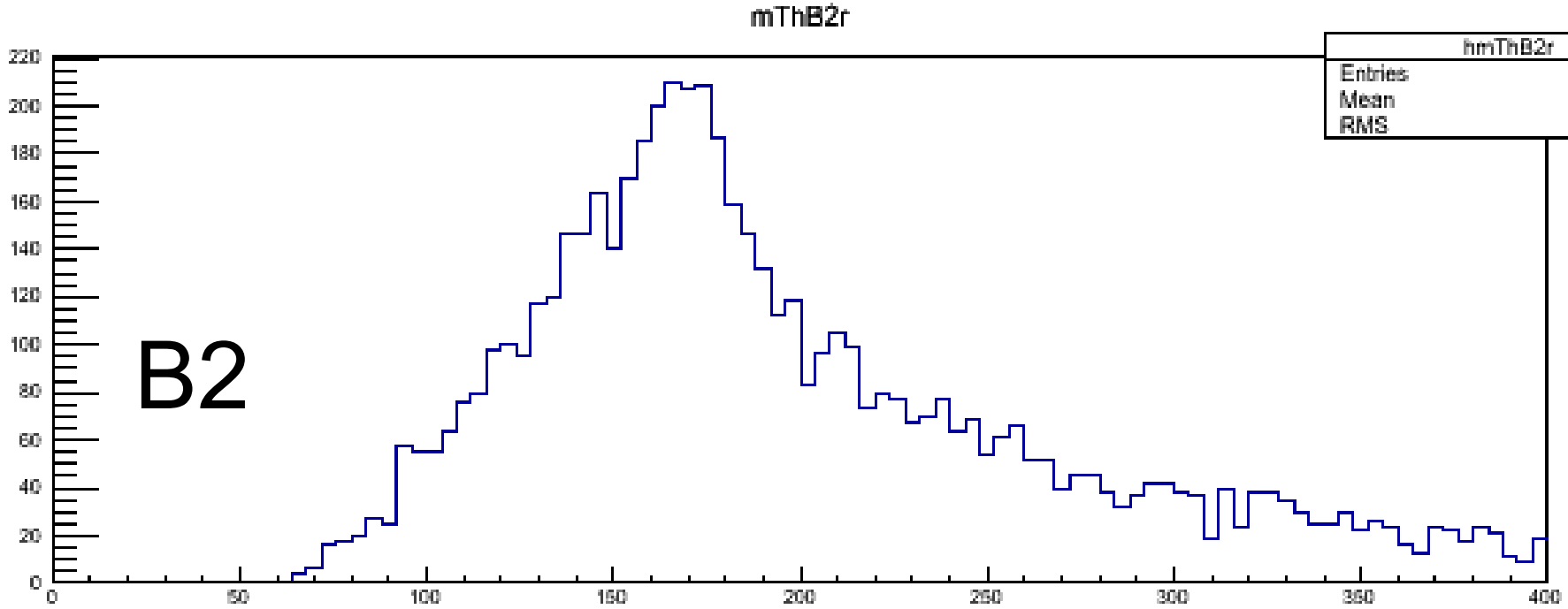

mTIB2r
hmTIB2r
Entries 36835
Mean 202.2
RMS 73.83
B2
0
100
200
300
400
500
600
700
800
900
0
50
100
150
200
250
300
350
400

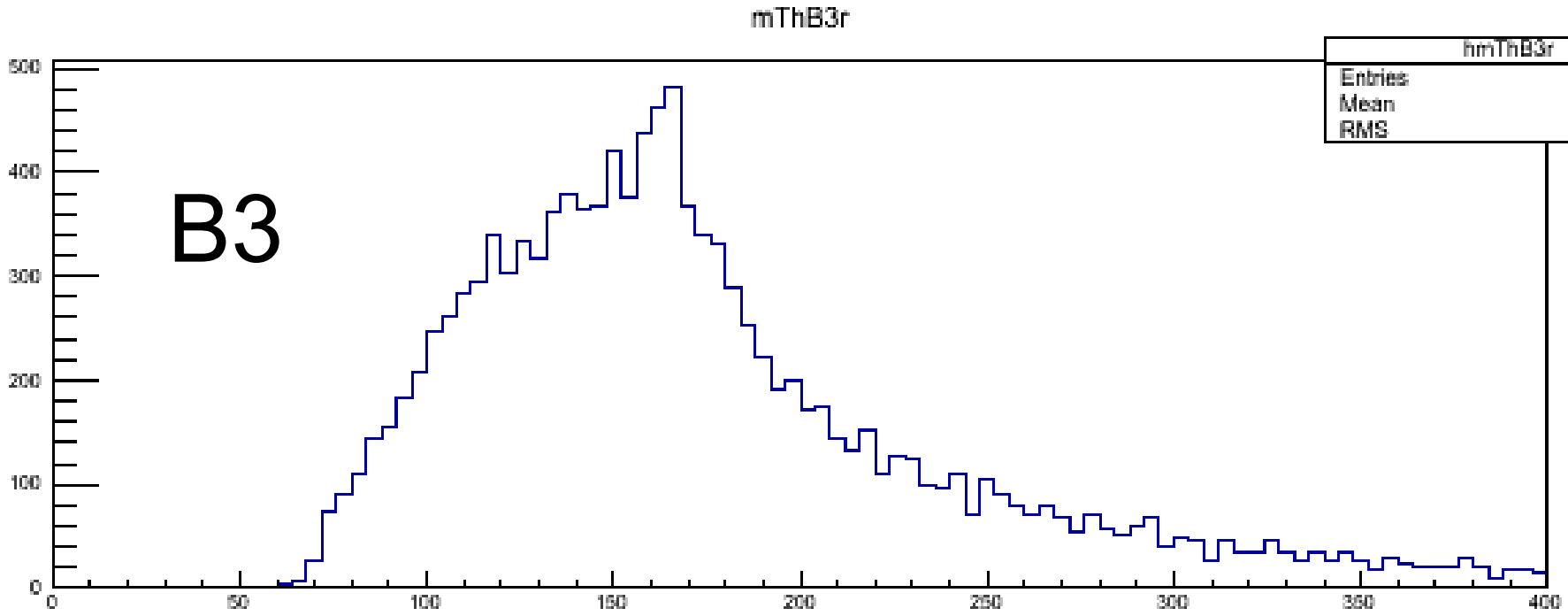

mTIB3r
hmTIB3r
Entries 46093
Mean 206.4
RMS 72.39
B3
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
50
100
150
200
250
300
350
400

Massa del top adronico fatta con i due jet antibtaggati di max Pt e jet del leptone che si considera (dallo stesso top dei jet o no)

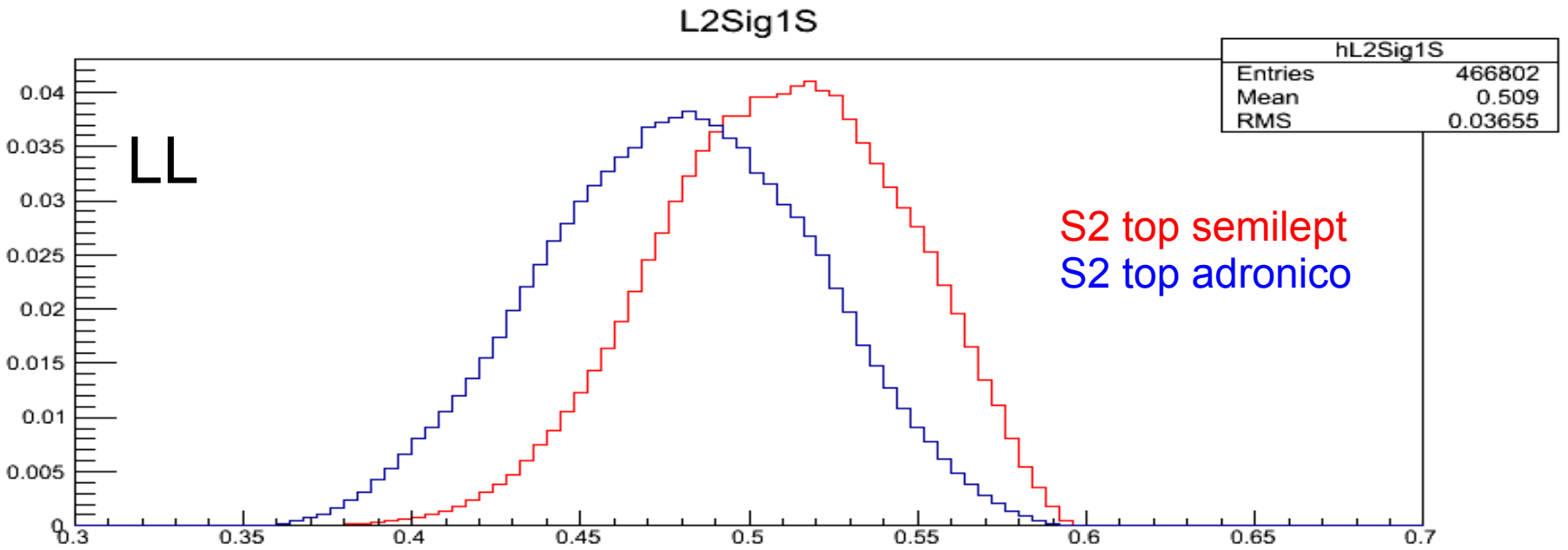


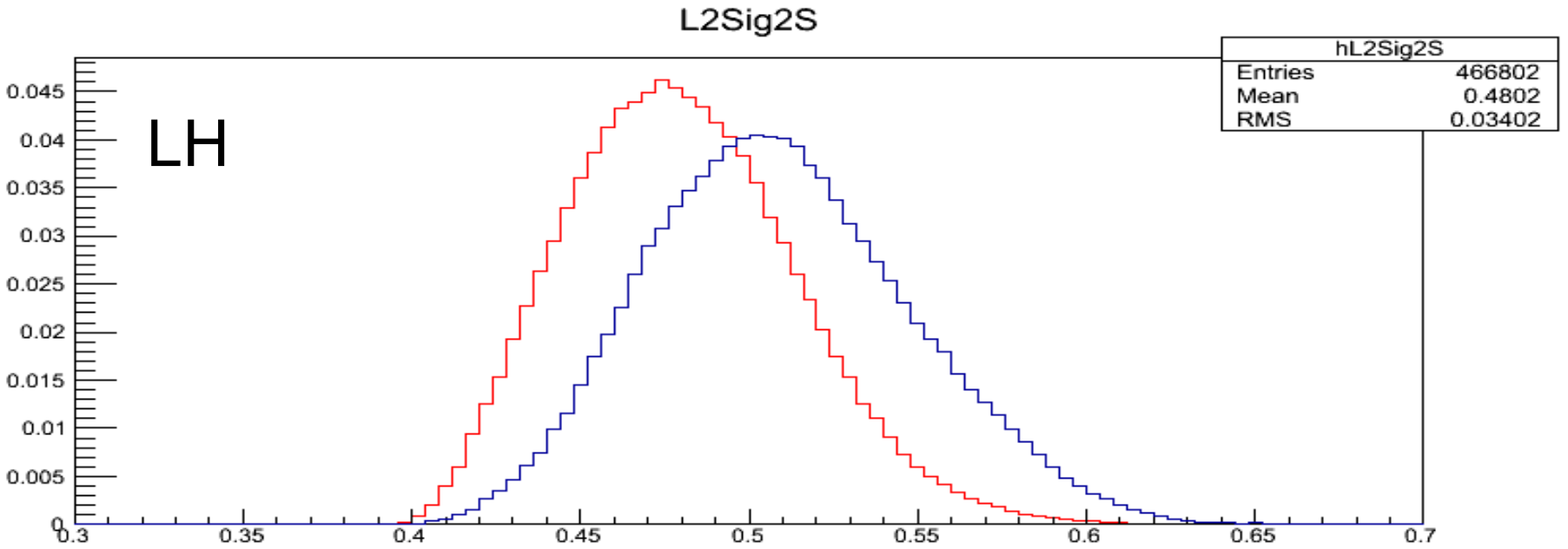



mThB2r
hmThB2r
Entries 6306
Mean 198.2
RMS 69.97
B2
0 20 40 60 80 100 120 140 160 180 200 220
0 50 100 150 200 250 300 350 400


mThB3r
hmThB3r
Entries 12682
Mean 172.8
RMS 64.03
B3
0 100 200 300 400 500
0 50 100 150 200 250 300 350 400

Combinazione LL e LH per S2 da top semileptonico





Combinazione LL e LH per S2 da top adronico