Top Dilepton Tau Analysis based on 100-300 pb^{-1} of ATLAS data.

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PHYSICS MOTIVATION

- To study the feasibility of observing the process:

$$p\bar{p} \rightarrow t\bar{t} + X \rightarrow e,\mu + \nu_{e,\mu} + \tau_{had} + \nu_{\tau} + b\bar{b} + X$$

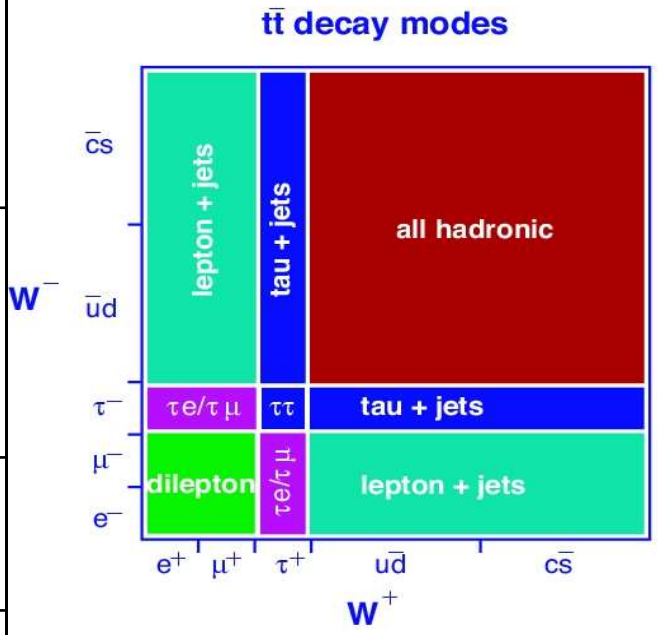
  in the early ATLAS data sample (100-300 pb^{-1})
- To complete the scan of the ttbar channels for cross section measurements.
- To search for beyond the Standard Model effects in the top quark decay:

$$R = \frac{t \rightarrow \tau \nu_{\tau} b}{t \rightarrow \lambda \nu_{\lambda} b} (\lambda = e, \mu) \qquad R > 1 \Rightarrow t \rightarrow bH^{\pm}$$

- Asuming a Standard Model top pair production cross section, to use top pair events for the calibration and tuning of Tau lepton identification algorithms (Tau working group, Sarah Demers SLAC)

Checking BR´s

Category	Decay Mode	Branching ratio	
Dilepton	tt-bar →evb evb	1/81	4/81 (5%)
	tt-bar →μvb μvb	1/81	
	tt-bar →evb μvb	2/81	
	tt-bar →evb τvb	2/81	
	tt-bar →μvb τvb	2/81	
	tt-bar →τvb τvb	1/81	
Lepton+jets	tt-bar →evb qqb	12/81	24/81 (30%)
	tt-bar →μvb qqb	12/81	
	tt-bar →τvb qqb	12/81	
All-hadronic	tt-bar →qqb qqb	36/81	36/81(44%)



The current tools

•Sample: 100K events from files:
trig1_misal1_mc12.005200.T1_McAtNlo_Jimmy.recon.AOD.v12000601_tid005997

•Two alternative ntuples in order to find potential bugs:

1) TopView:
user.top.TopView1211_MuidTau1p3p.005200.T1_McAtNLO_Jimmyv12000601.001.AANTO
Starting point: checking the branching ratios in order to compute detector acceptance to the ttbar tau dilepton signal.
(TopView TruthAnaTree:
for ttbar final state: LepW_N, El_N, Mu_N, Tau_N..
for hadronic tau decay: Tau_Vhad_matched, nSableCharged..etc)

2) "Alternative ntuples":
12.0.6.TopQuarkAODtoROOTuple
(5200 re-ntupled:
to include the TauJet(1p3p) AOD information
to include all the MC truth particle AOD container information in "event" block)

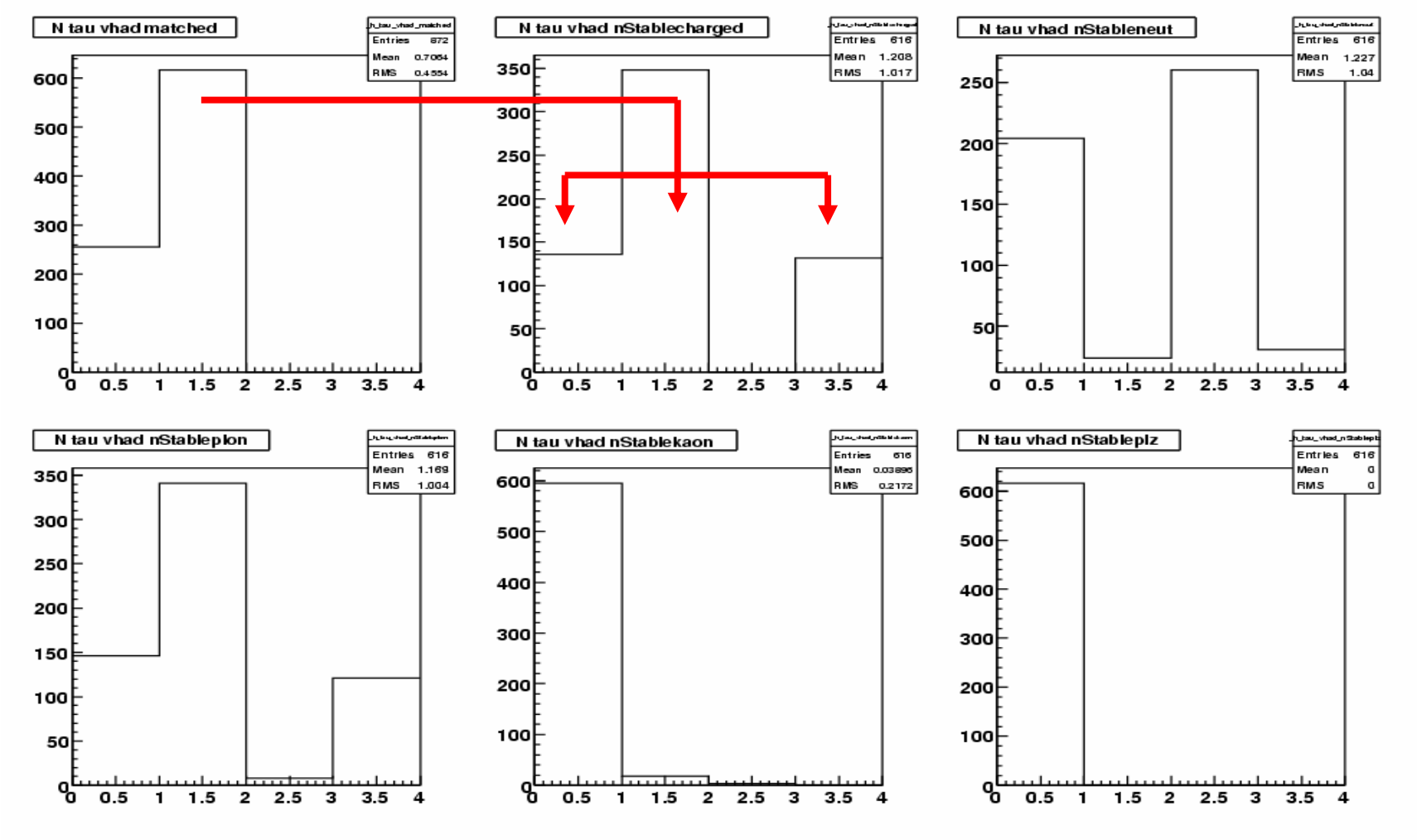
ttbar BR´s in 5200

Category	Decay Mode	Branching ratio		TopView (100K)	"Alternative ntuples"(100K)
Dilepton	tt-bar →evb evb	1/81	4/81 (5%)	2178	2208
	tt-bar →μνb μνb	1/81		2266	2238
	tt-bar →evb μνb	2/81		4364	4432
	tt-bar →evb τνb	2/81		4342	4324
	tt-bar →μνb τνb	2/81		4543	4450
	tt-bar →τνb τνb	1/81		2261	2203
Lepton+jets	tt-bar →evb qqb	12/81	24/81 (30%)	26567	28792
	tt-bar →μνb qqb	12/81		26699	28885
	tt-bar →τνb qqb	12/81		26787	28865
All-hadronic	tt-bar →qqb qqb	36/81	36/81(44%)	0	0

Tau lepton decay BR´s in 5200

Category	τ Decay Mode	Theo.	TopView (100K)	"Alternative ntuples"(100K)
tt-bar →evb τvb	τ →all		4342	4324
	τ →had	~65%	2985	2847
	τ →had (1p)	~50%	1706(~40%)	2604
	τ →had(3p)	~15%	608	243(~6%)
tt-bar →μvb τvb	τ →all		4532	4450
	τ →had	~65%	3073	2847
	τ →had (1p)	~50%	1742(~40%)	2589
	τ →had(3p)	~15%	629	260(~6%)

Tau lepton decay BR´s in 5200



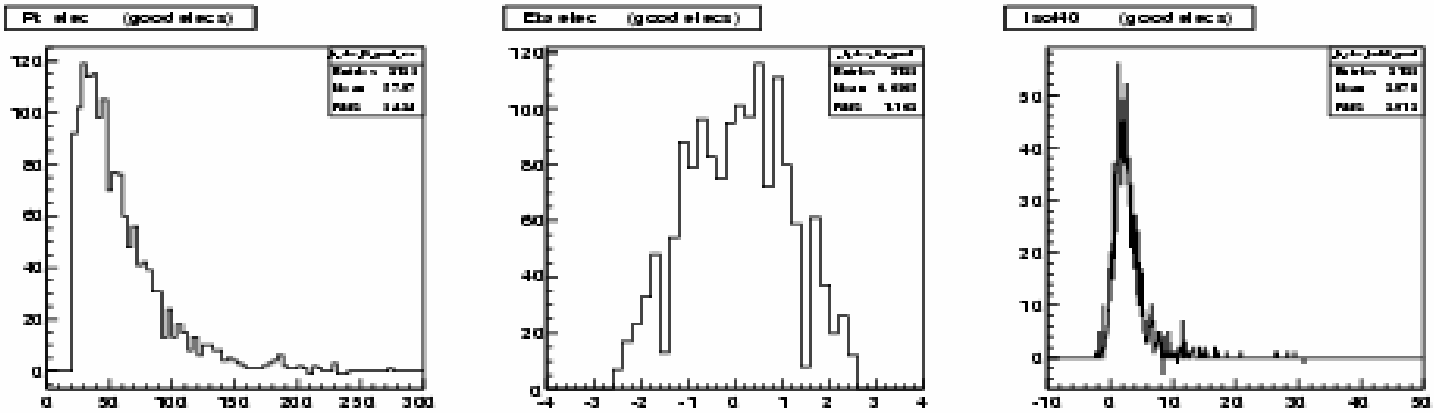
Electron and muon Selection.

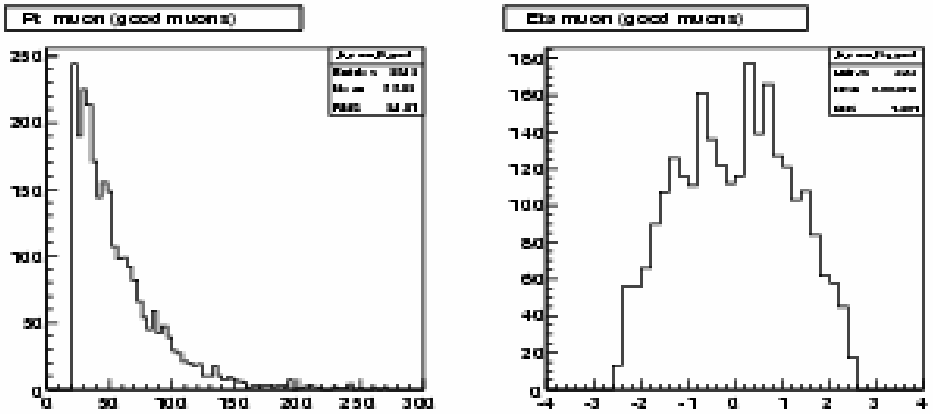
Electron objects from AOD: IsEM=0

From ATL-COM-PHYS-2007-023

E_T in a cone R=0.4 < 20% P_T

$|\eta|$ <2.5 and 1.35 < $|\eta|$ <2.5 excluded.



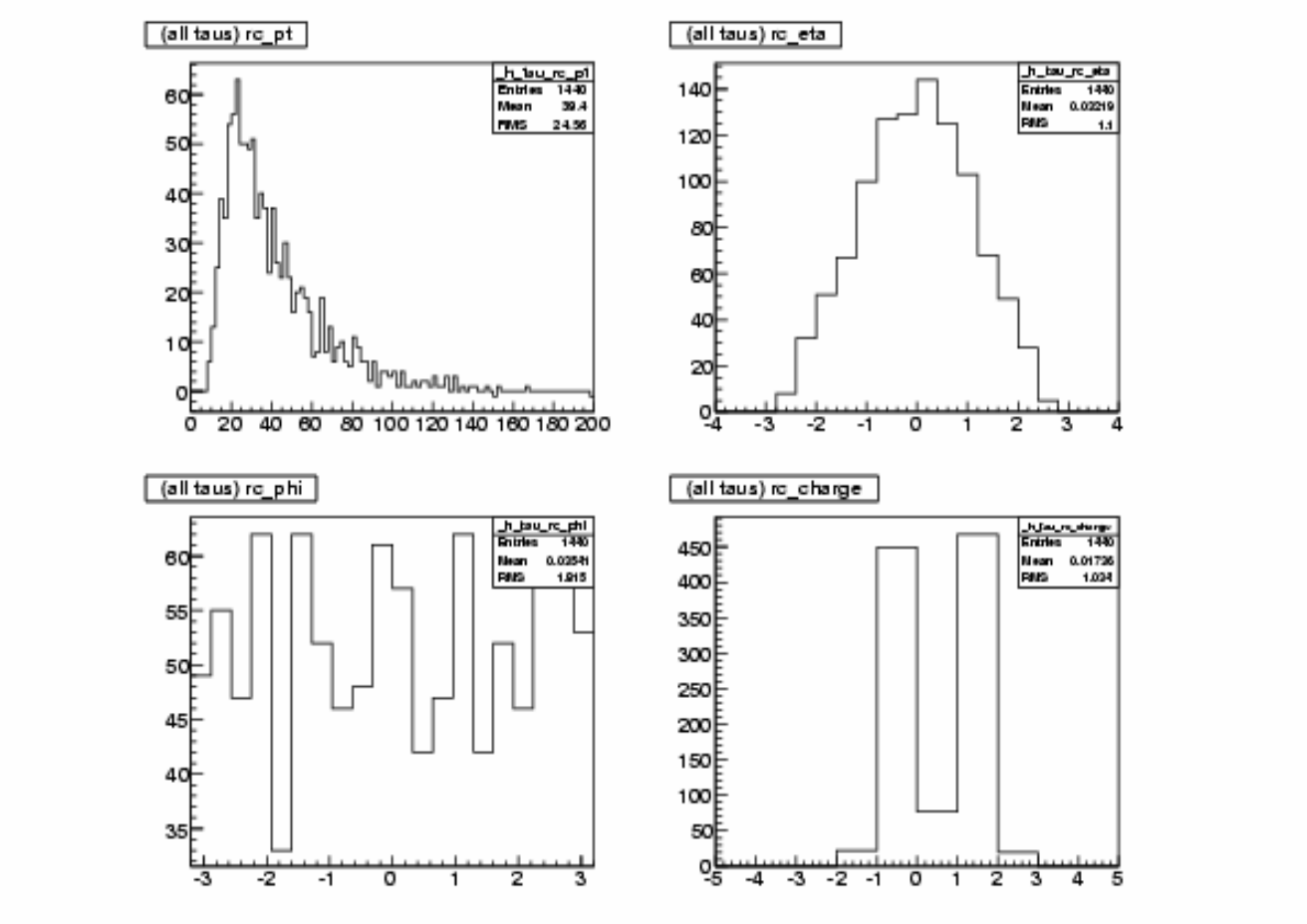


MuID muons from AOD

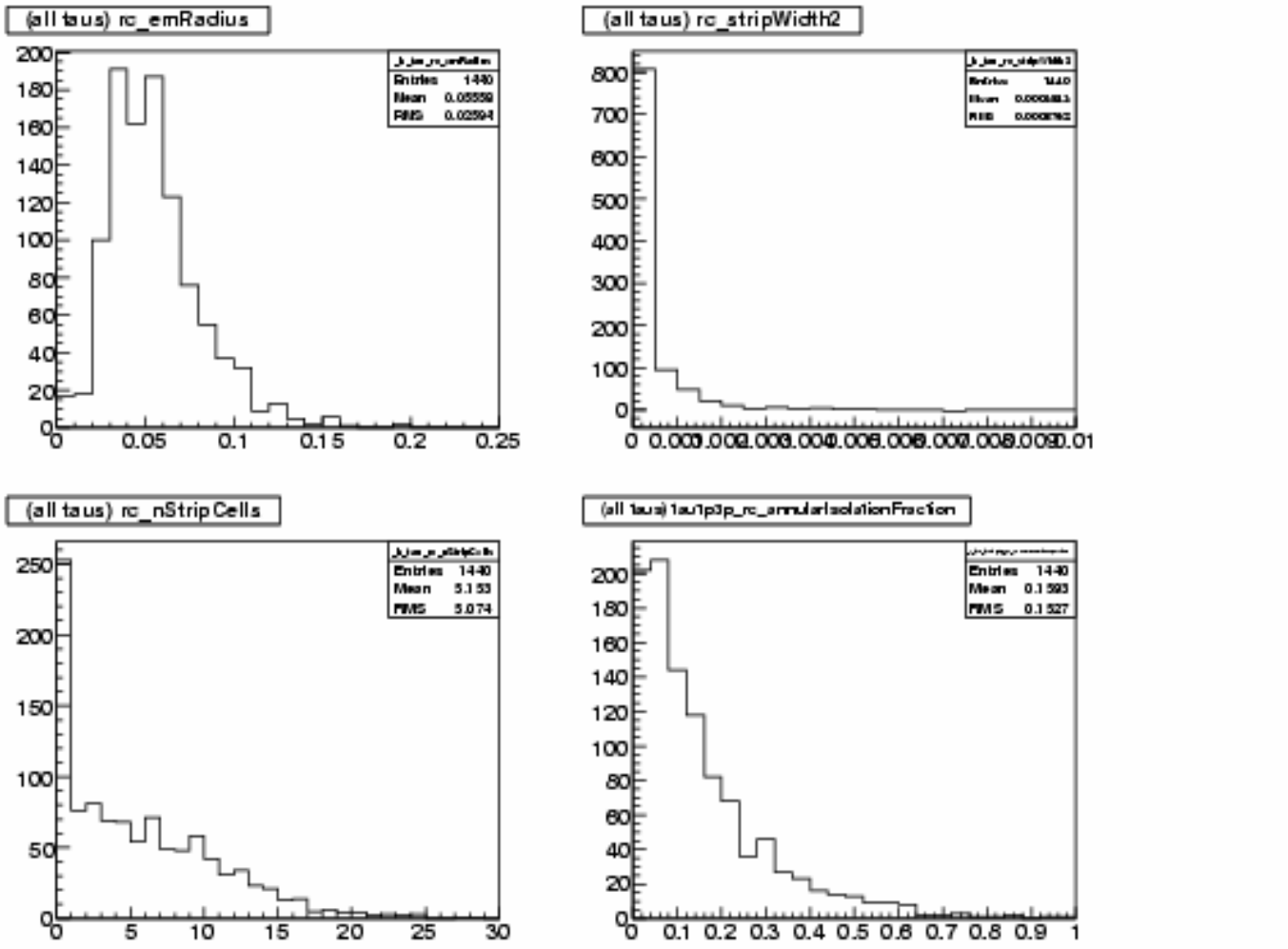
- $|\eta|$ <2.5
- dR(closets ParticleJet(R=0.4) > 0.4

Tau Selection.

- TAU: from AOD TauJet1p3p
  - TauJet1P3P discriminant = 1 (from Elzbieta Richter-Was)



Lepton and Event Selection.



Event Selection.

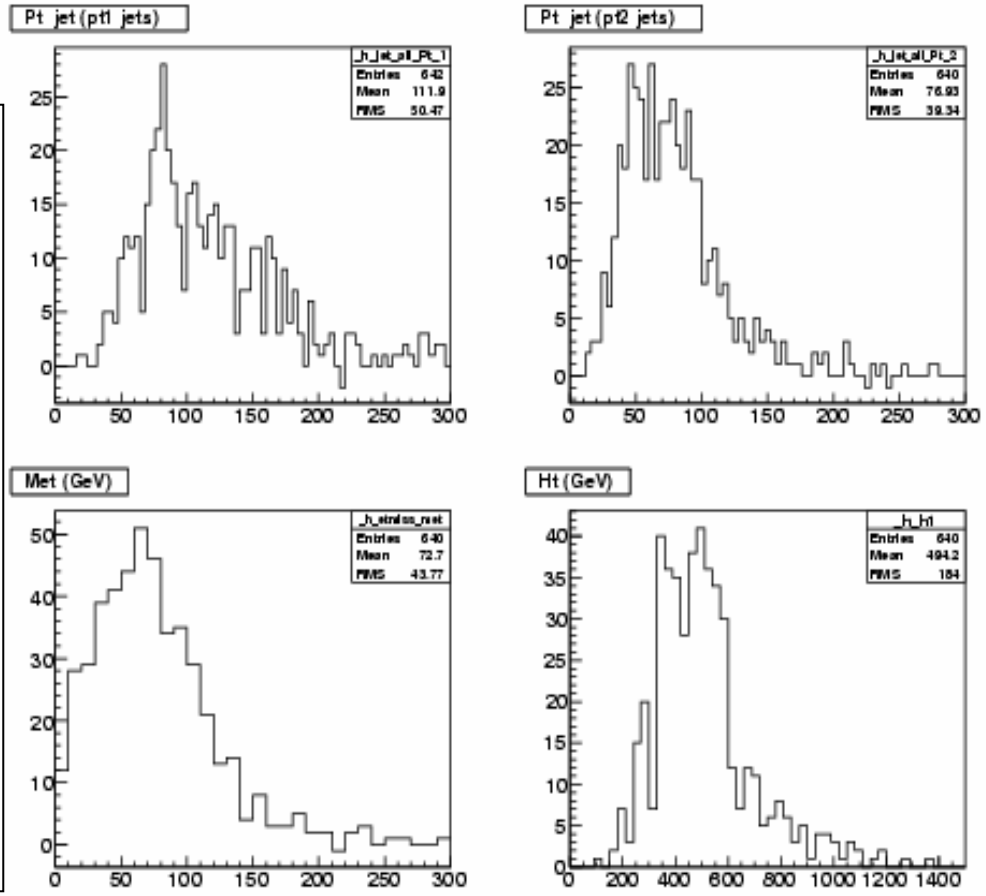
- Starting point:

CDF analysis 350 pb-1
(CDF public note 8376, Aurore Savoy-Navarro and S. Tourneur)

1 ele (or mu) Pt > 20 GeV
(for the trigger)

1 tau →had Et>15 GeV
2 jets:
1st (Et>25 GeV)
2nd (Et> 15 GeV)

Missing transverse energy > 20 GeV
Ht> 205 GeV
Veto Z→ττ+2jets



Expected yield in 100 pb^{-1} (300 pb^{-1})

N_{TOT} = 100K (5200) **XS NNLL: 872.8 (±15) pb [Kidonakis03]**

	e τ(had)	μτ(had)	100 pb-1		300 pb-1	
N_{MC}	2847	2849	1392	1392	4174	4177
1 e,μ,Pt> 20 GeV	1290	1870	631	914	1891	2742
1τ, Et> 15 GeV	419	615	205	301	614	901
Tau1p3p_ discriCut=1	250	379	122	185	366	555
1st jet Et>15 GeV	249	378	122	185	365	554
2nd jet Et> 25 GeV	248	378	121	185	363	554
MET > 20 GeV	232	350	113	171	340	513
Ht> 205 GeV	222	346	109	169	325	507

Conclusions and Plans.

Numbers presented computed using 12.0.6.TopQuarkAODtoROOTuple´s , cross-check with latest TopView ntuples is coming.

Main backgrounds to be included:

W (→μ,e)+ 3 o more jets, with 1 jet faking a tau

6104 W(→enu)+3parton (A) Loose Cut

6110 W(→munu)+3parton (A) Loose Cut

Z→τ(→e,μ)τ(→had)+2jets

trig1_misal_mc12.008156.AlpgenJimmyZtautauNp2LooseCut.recon.AOD.v12000601

Implement Z veto (it should reduce only about 8% of top dilepton tau hadronic signal)

Feasibility studies:

using b-tagging with the first 100-300 pb^{-1} .

relaxing tau ID using cut based Tau1p3p calorimetry and tracking related variables.

Preliminary numbers point out that a top dilepton signal with taus could be extracted in the first ATLAS data.

Backups