W helicity measurement in L+jet channel with correction function method (2btag, 1fb-1)

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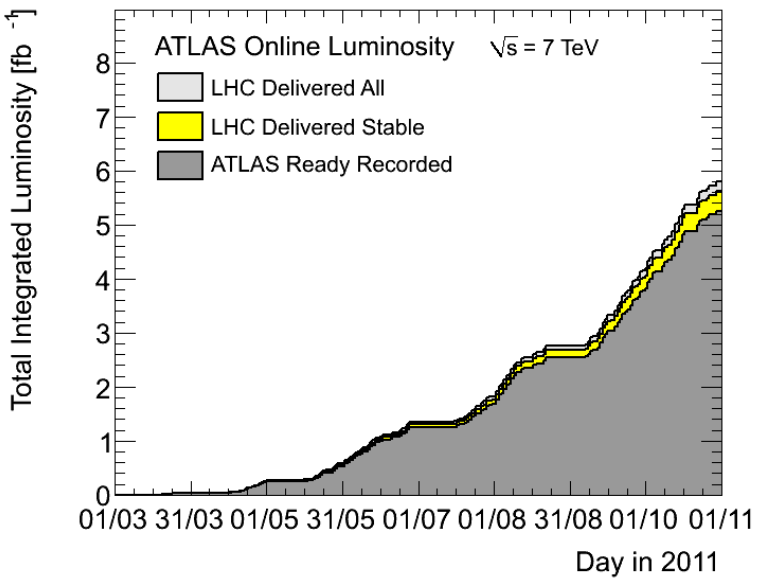
Outline

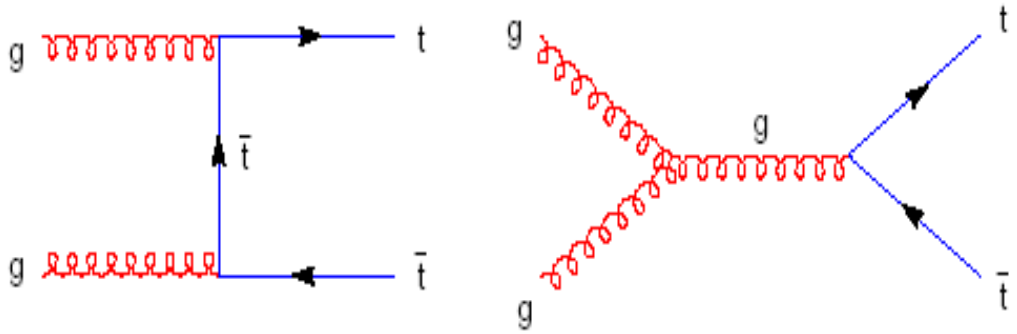
- Introduction
- Common Object selection
- Event selection and reconstruction
- Comparison between data and MC
- Result
- conclusion

Introduction



The whole years(2011) data (5fb-1) :
Periods: B, D -- M
Run number: 177986 -- 191933

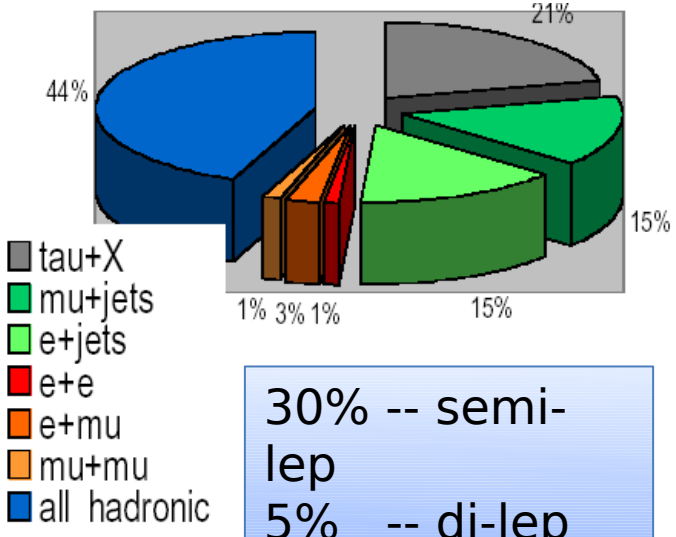
Data of analysis:
Periods: B, D, E, F, G, H (1fb-1)
Run number: 177986 -- 184169



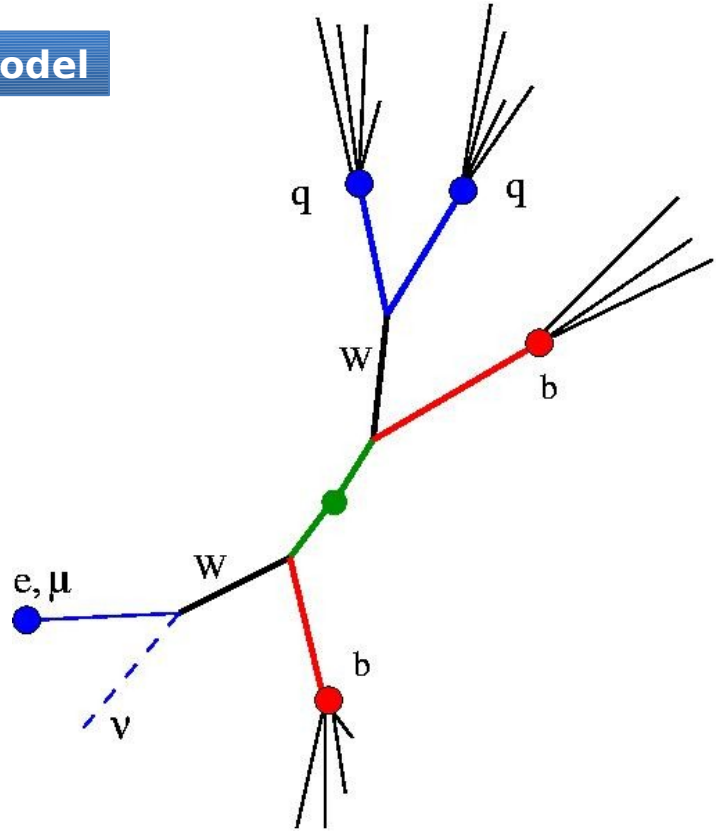
Dominant at LHC

Introduction

Decay model



30% -- semi-lep
5% -- di-lep



Large mt ⇒ probes physics at much higher energies than other fermions.

mt>mW, the W polarization in top decays is very different from that of other weak decays.

W helicity measurement is a test of the SM and an opportunity to look for

Introduction

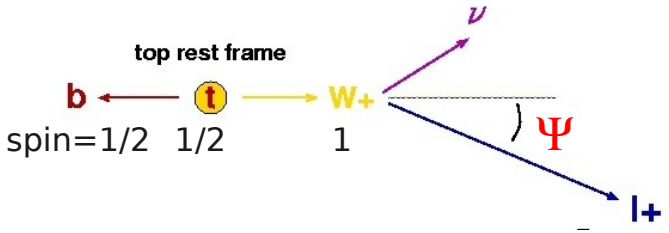
W polarization is measured through angular distribution of charged lepton.

$$\frac{1}{N}\frac{dN}{d\cos\Psi} = \frac{3}{2}\left[F_0\left(\frac{\sin\Psi}{\sqrt{2}}\right)^2 + F_L\left(\frac{1-\cos\Psi}{2}\right)^2 + F_R\left(\frac{1+\cos\Psi}{2}\right)^2\right]$$

SM value

$FL = 0.304$

$FR = 0.001$



angle between lepton in W rest frame and W direction in top rest frame

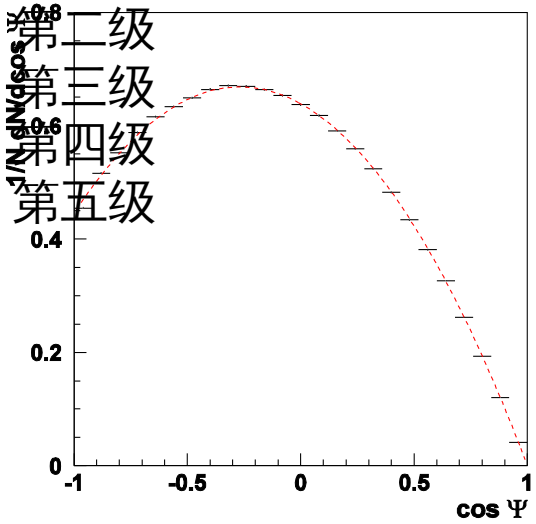
单击此处编辑母版文本样式

第二级

第三级

第四级

第五级



Common Object selection, electron

- Trigger
  - Single high Pt electron, 20 GeV threshold (EF_e20_medium)

- Official offline selection
  - tight, standard or softe algorithm (author ==1 or 3)
  - transverse energy > 25GeV
  - 0<|eta(cluster)|<2.47 excluding (1.37, 1.52)
  - Isolation: pt-corrected etcone20 energy < 3.5 GeV
  - el_OQ flag to avoid dead OTX(LAr Front-End-Board opto-transmitter plug-ins)
  - Remove LAr Hole (after period E)

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TopCommonObjects#Electrons

Common Object selection, muon

- Trigger
  - Single muon trigger, 18 GeV threshold (EF_mu18)
- Official offline selection
  - Combined muon (author ==12)
  - MCP recommendations on the track quality
  - PT > 20 GeV and |eta| < 2.5
  - $\Delta R(\mu, jet) > 0.4$, Etcone30<4GeV, ptcone30<4GeV
- Efficiency scale factor
  - Measured by full EF_mu18 chain.
  - 2011 data(B2—F3), Z→mumu+Njet of mc10b(r2300_p572)

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TopCommonObjects#Muons

Common Object selection, jet

- Official offline selection
  - AntiKt 0.4 TopoCluster jets with EM+JES calibration
  - Pt>25GeV and |EM-scale eta after corrected| < 2.5
  - Remove el-jet overlap (dR<0.2)
  - Remove mu-jet overlap (jet Pt > 20GeV)
  - Remove bad jet (event level)

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TopCommonObjects#Jets

- >=2 b-tag
  - **jetFitterCOMBNN > 0.35** (JetFitter combined, Neural Network based)
  - Efficiency is 0.702

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/BTaggingBenchmarks#JetFitterCOMBNN_AN1

Event selection and reconstruction

Cut 0: require triggered
Cut 1: Non-collision background rejection

Cut 2: At least 1 lepton
Cut 3: Exactly 1 lepton

Energy Scale, smear and scale factors are included

Cut 4: Exactly 0 muons PT>20 GeV (e+jets) or exactly 0 electrons ET>25 GeV (mu+jets)
Cut 5: the lepton matches the trigger

Cut 6: remove events tagged as e-mu overlap
Cut 7: Jet Cleaning (for data ONLY): no bad jets with Pt > 20 GeV

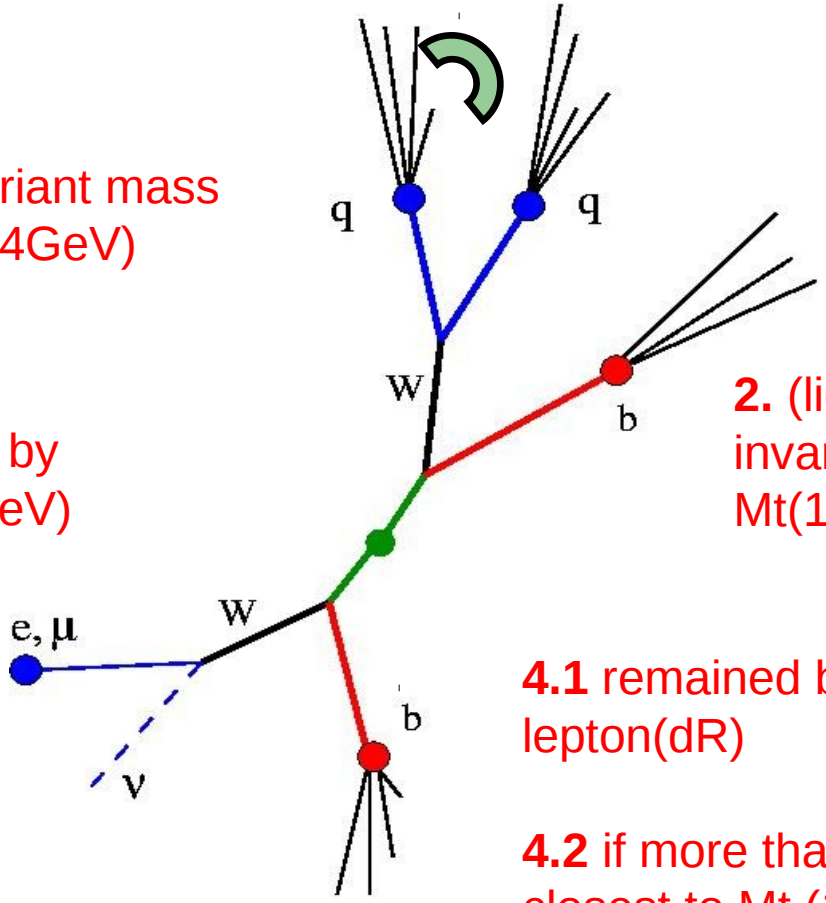
Cut 8: e+jets: MET>35 GeV, mu+jets: MET>20GeV
Cut 9: e+jets: MTW>25 GeV, mu+jets: MET+MTW> 60 GeV

Cut 10: At least 4 jets with Pt > 25 GeV, |eta| < 2.5
Cut 11: >=2 good jet (25 GeV and |eta|<2.5) with jetFitterCOMBNN weight > 0.35
Cut 12: LAr error flag cut: larError != 0

https://espace.cern.ch/topxsec/Lists/Updated%20Ljets%20AtlasPhysics166551/AllItems.aspx

Event selection and reconstruction

1. Two light jets' invariant mass closest to Mw (80.4GeV)



2. (light jet pair+ bjet) invariant mass closest to Mt(172.5GeV)

3. Nue Pz is solved by fixing Mw(80.4GeV)

4.1 remained bjets closest to the lepton(dR)

4.2 if more than one solutions, Mblv closest to Mt (172.5GeV) is reserved

Comparison between data and MC: event yield

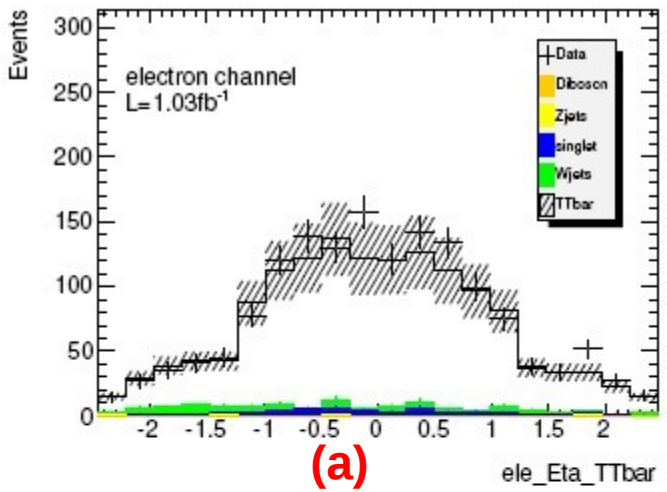
	pre-b-tagging	Standard selection 1 b-tagged	Standard selection 2 b-tagged	+ reconstruction 2 b-tagged
$t\bar{t}$ signal	4857.4 ± 1106.8	4277.6 ± 901.2	2183.4 ± 520.9	1301.7 ± 294.7
W + jests	5446.8 ± 393.4	847.5 ± 137.9	99.3 ± 26.8	62.3 ± 17.3
Z + jets	663.2 ± 46.5	84.3 ± 14.1	3.3 ± 1.3	3.0 ± 1.2
Z + jets	693.6 ± 48.7	87.3 ± 14.6	3.4 ± 1.3	3.1 ± 1.2
di boson	81.1 ± 6.0	13.8 ± 2.2	1.7 ± 0.3	1.2 ± 0.2
single t	323.0 ± 63.5	257.3 ± 45.7	90.0 ± 22.3	51.7 ± 12.5
QCD	932 ± 1189	269 ± 269	150 ± 150	68 ±68
Total expected	12333.9 ± 1673.3	5752.5± 951.76	2527.8 ± 543.1	1488.0 ± 303.20
Collision data	12111.0	5838.0	2545.0	1527.0

e+jet event yield (stat. +syst.)

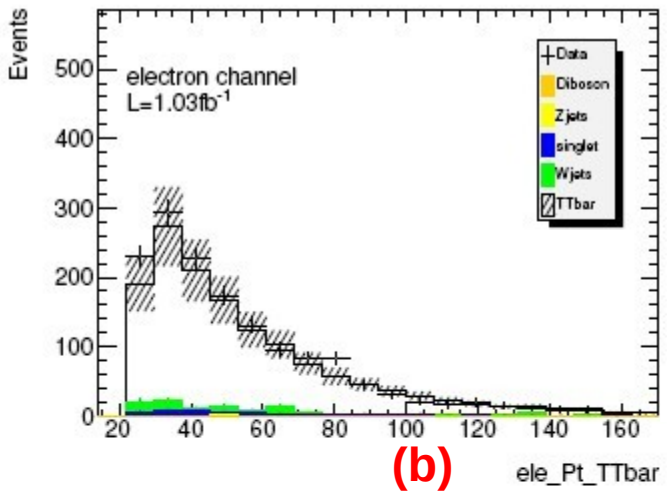
	pre-b-tagging	Standard selection 1 b-tagged	Standard selection 2 b-tagged	+ reconstruction 2 b-tagged
$t\bar{t}$ signal	7088.6 ± 1636.7	6262.9 ± 1339.1	3223.0 ± 778.9	2057.7 ± 471.4
W + jests	8384.3 ± 584.6	1322.1 ± 224.1	158.4 ± 45.4	99.7 ± 26.6
Z + jets	892.8 ± 57.4	112.1 ± 18.6	8.2 ± 2.5	6.2 ± 1.9
di boson	127.7 ± 8.6	21.7 ± 3.8	2.9 ± 0.7	2.3 ± 0.6
single t	442.1 ± 87.8	351.5 ± 62.5	127.7 ± 30.6	85.0 ± 19.2
Multi-jets	1450± 1450	509± 509	249± 249	113± 113
Total expected	18385.5 ± 2265.8	8579.3 ± 1451.4	3769.2 ± 819.57	2363.90 ±485.87
Collision data	19300.0	8975.0	3856.0	2514.0

mu+jet event yield (stat. +syst.)

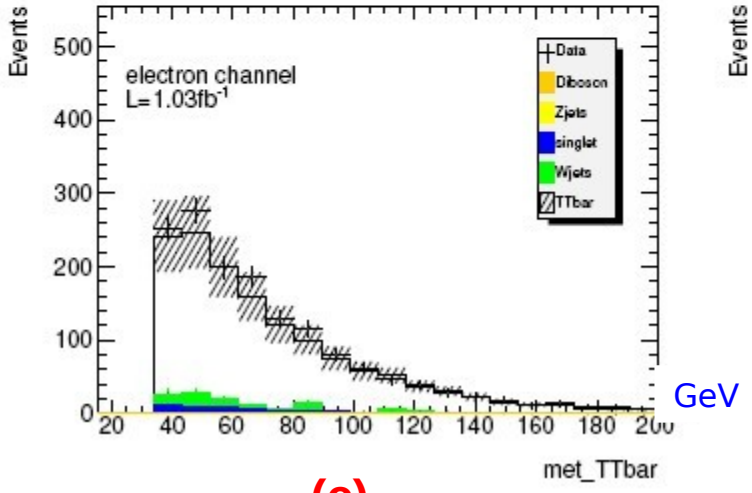
Comparison between data and MC: e channel



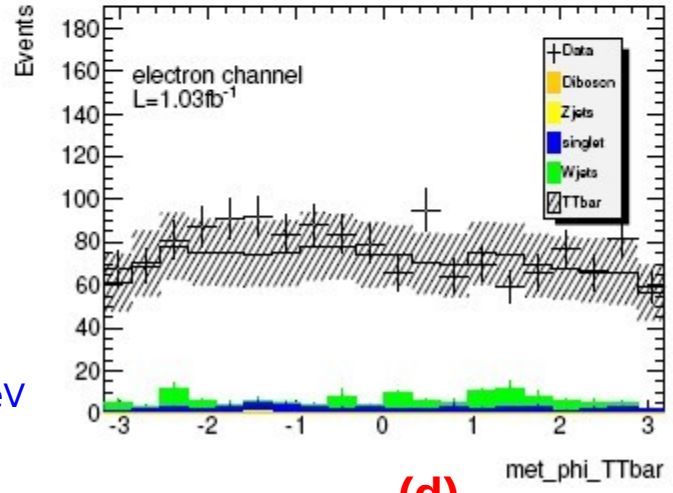
(a)



(b)



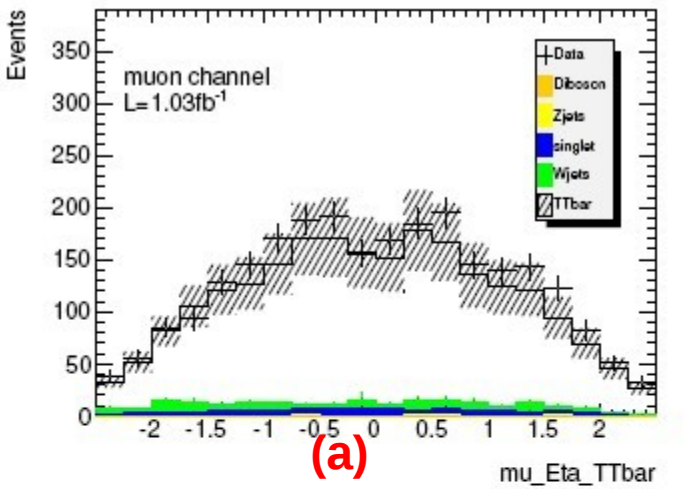
(c)



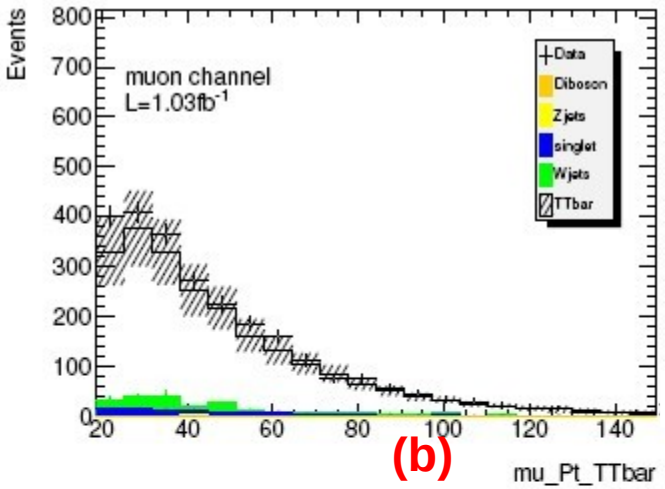
(d)

Comparison between MC and data

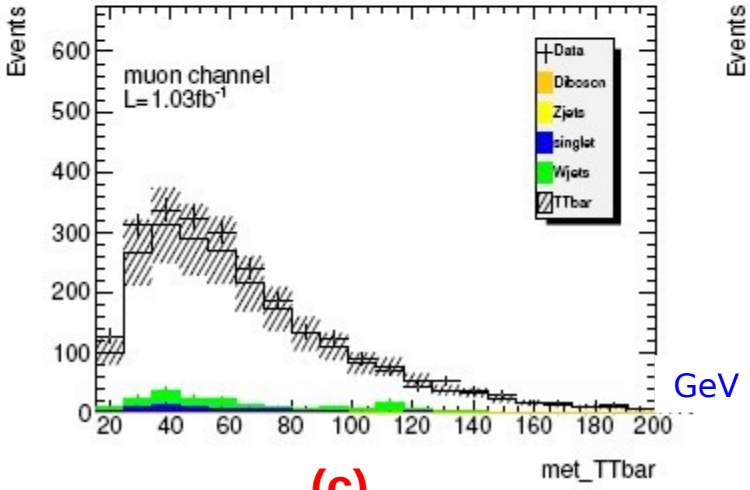
Comparison between data and MC: mu channel



(a)



(b)



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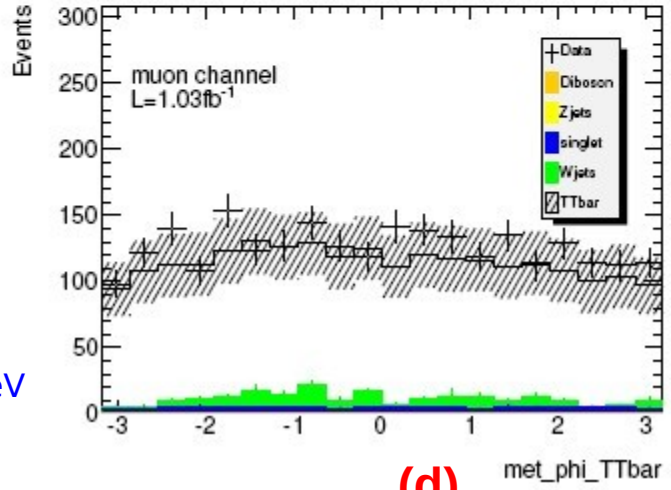
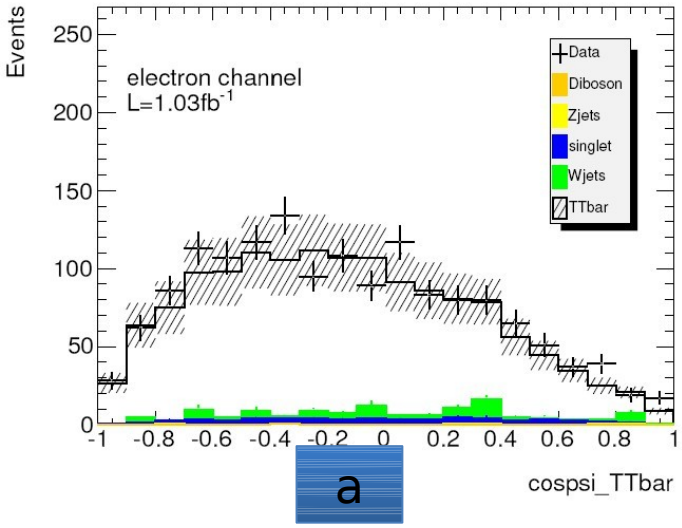


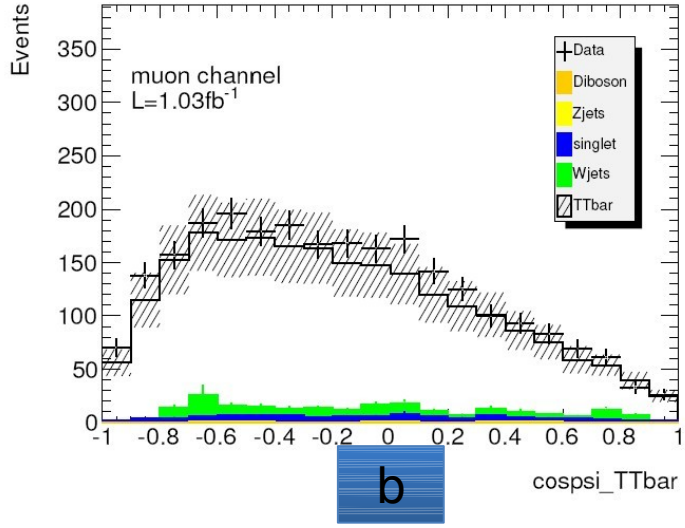
(d)

Comparison between MC and data

Result: 1035pb-1



a



b

Comparison of data and MC on cospsi distribution: (a) e+jet, (b) μ+jet

	e+jets	μ+jets	combined
F_0	0.53±0.12 ± 0.10	0.79 ±0.06 ± 0.10	0.72 ±0.05 ± 0.09
F_L	0.39±0.06 ± 0.06	0.27± 0.05 ± 0.05	0.31± 0.04 ± 0.06
F_R	0.08±0.06 ± 0.06	-0.06 ± 0.03 ± 0.06	-0.03± 0.04 ± 0.05

In the table stat. + syst. error

$$F0 = 0.695$$
$$FL = 0.304$$
$$FR = 0.001$$

SM value

Result of systematic uncertainty

Following the procedure of top reconstruction and property group recommendation:

Source	e+jets			μ+jets			Combined		
	F_0	F_L	F_R	F_0	F_L	F_R	F_0	F_L	F_R
B-tagging	0.028	0.014	0.003	0.024	0.005	0.011	0.03	0.022	0.011
e/μ Reco effi	0.016	0.007	0.009	0.029	0.006	0.008	0.027	0.028	0.01
e/μ trigger effi	0.013	0.007	0.006	0.048	0.008	0.022	0.041	0.03	0.007
e/μ energy reso	0.014	0.009	0.005	0.012	0.006	0.005	0.004	0.002	0.001
e/μ energy scale	0.014	0.007	0.006	0.011	0.006	0.005	0.002	0.001	0.001
Jet energy reso	0.009	0.006	0.003	0.011	0.008	0.003	0.010	0.006	0.0004
E_T^{miss}	0.0033	0.0013	0.0020	0.0018	0.0004	0.0014	0.0004	0.0006	0.0002
Lar Hole Correction	0.036	0.016	0.011	0.013	0.013	0.005	0.032	0.018	0.012
Jet energy scale	0.022	0.003	0.018	0.019	0.007	0.018	0.017	0.005	0.016
Jet reconstr. eff.	0.005	0.003	0.001	0.011	0.006	0.005	0.004	0.002	0.002
background	0.005	0.005	0.004	0.007	0.003	0.004	0.006	0.003	0.004
Showering/had..	0.012	0.006	0.006	0.009	0.011	0.021	0.0007	0.010	0.010
ISR/FSR	0.054	0.030	0.038	0.033	0.019	0.018	0.040	0.018	0.026
Color reconnection	0.016	0.010	0.018	0.008	0.005	0.008	0.011	0.001	0.012
MC Generators	0.018	0.015	0.003	0.026	0.009	0.017	0.023	0.011	0.012
Top mass	0.007	0.007	0.00007	0.004	0.006	0.001	0.006	0.006	0.0006
Method systematics	0.057	0.033	0.035	0.040	0.028	0.028	0.033	0.016	0.017
Total	0.102	0.056	0.062	0.095	0.044	0.059	0.092	0.058	0.050

https://twiki.cern.ch/twiki/bin/view/AtlasProtected/TopSystematicUncertainties

Conclusion

	e+jets	μ+jets	combined
F_0	0.53±0.12 ± 0.10	0.79 ±0.06 ± 0.10	0.72 ±0.05 ± 0.09
F_L	0.39±0.06 ± 0.06	0.27± 0.05 ± 0.05	0.31± 0.04 ± 0.06
F_R	0.08±0.06 ± 0.06	-0.06 ± 0.03 ± 0.06	-0.03± 0.04 ± 0.05

In the table stat. + syst. error

$F0 = 0.695$

$FL = 0.304$

$FR = 0.001$

SM value

- All the details in ATL-COM-PHYS-2011-1441
  - The paper is under preparation.
- Dilep channel is working on.
  - Two Rec. methods has been studied and verified each other very well.
  - Develop analysis on the full 2011 data.