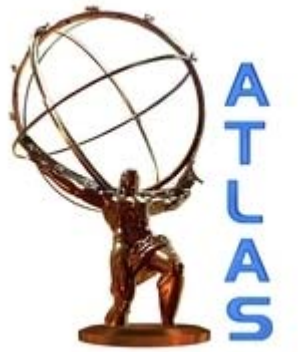
Single top trigger studies at ATLAS

Clemens Lange

Humboldt-Universität zu Berlin



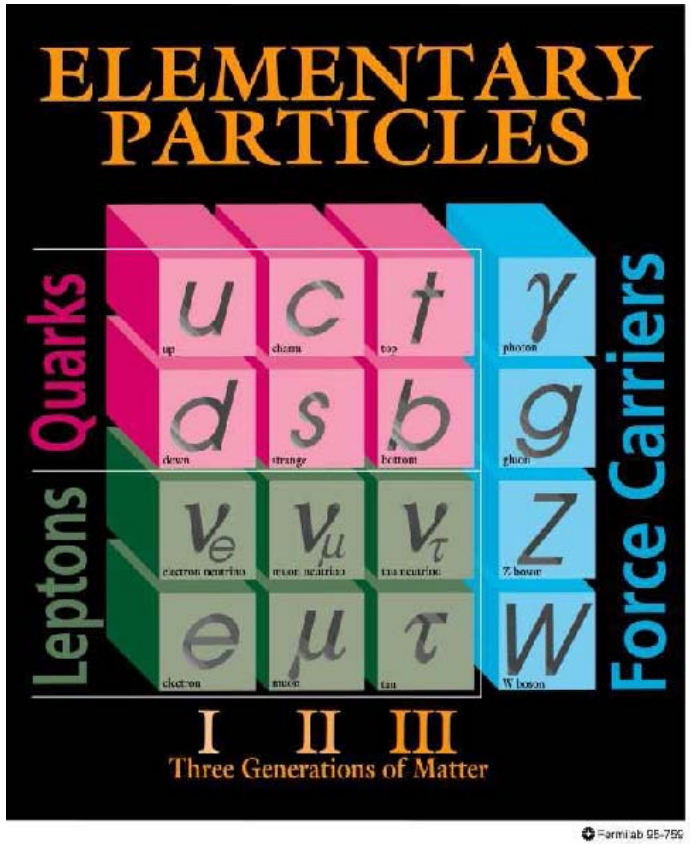
outline

1. standard model & top quark
2. production and decay chain at LHC
3. trigger cuts & turn-on curves
4. mass reconstruction
5. outlook

top quark within standard model

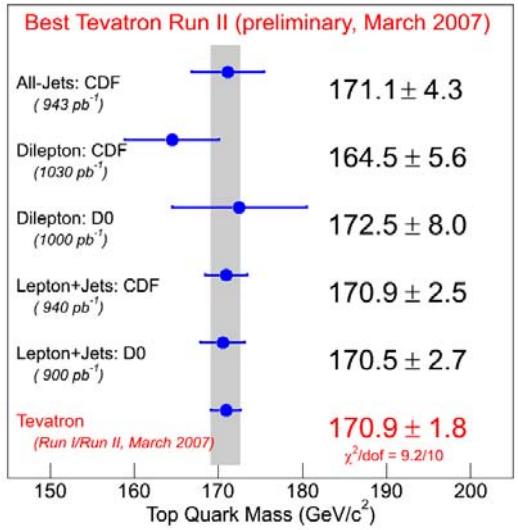
- SM very successful
- top quark discovered at Fermilab in 1995
- completed three-generation structure of SM
- heaviest of all quarks
- origin of mass not understood

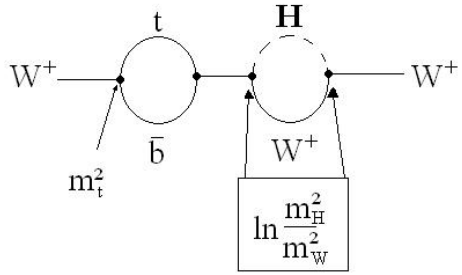
  → Higgs boson?

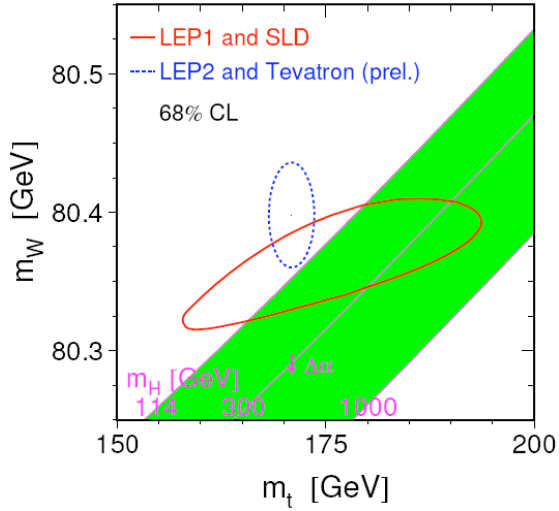


impacts of top quark on physics

- mass: 170.9 ± 1.8 GeV/c², precision ~1%
- constraint on Higgs mass via loop corrections of W±
- confirm unitarity of CKM-matrix (V_{tb}) or give indirect evidence for fourth (quark) generation



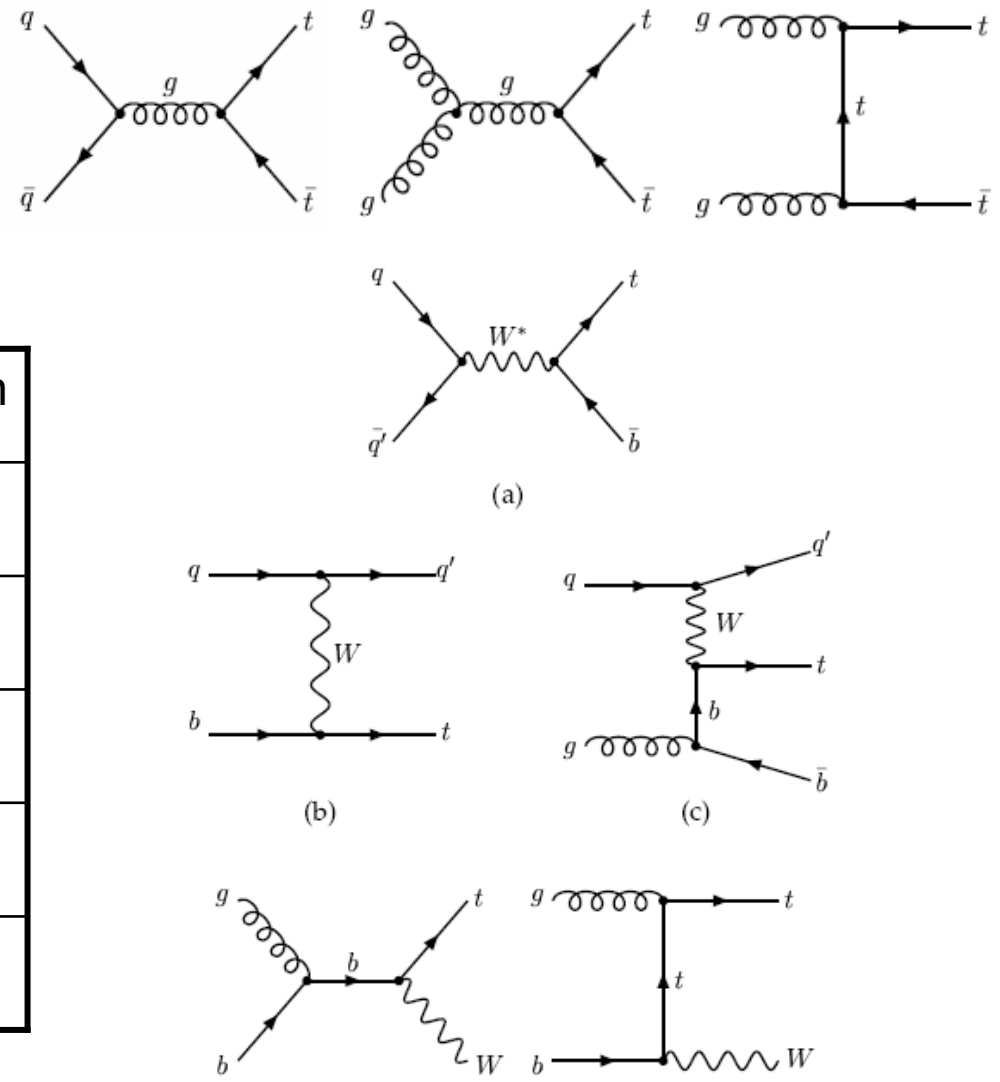




top production at LHC

- production of ttbar pairs and single top

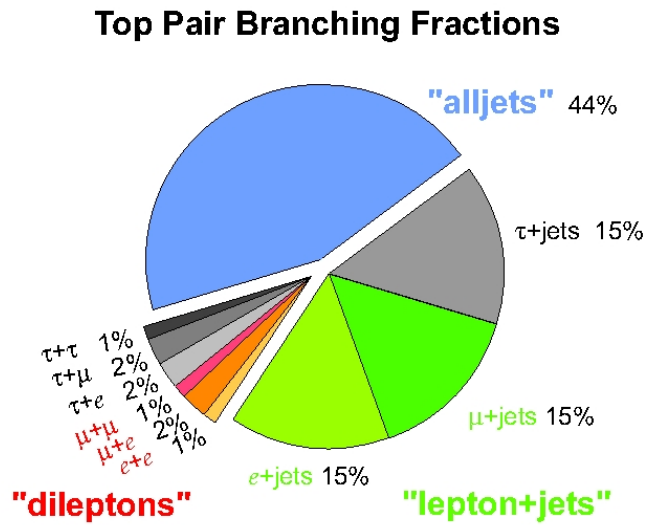
process	cross-section
ttbar	833 pb
s-channel (a)	10 pb
t-channel (b,c)	239 pb
associated W	64 pb
total single top	313 pb

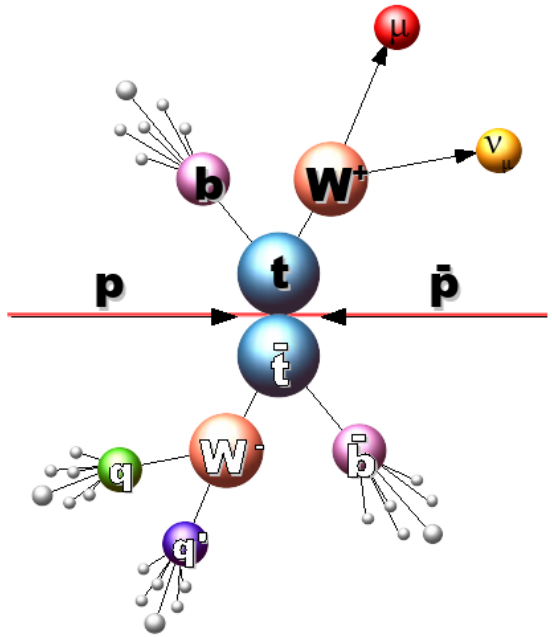


top decay

- top lifetime of 4×10^{-25} s shorter than characteristic QCD hadronisation time of 28×10^{-25} s

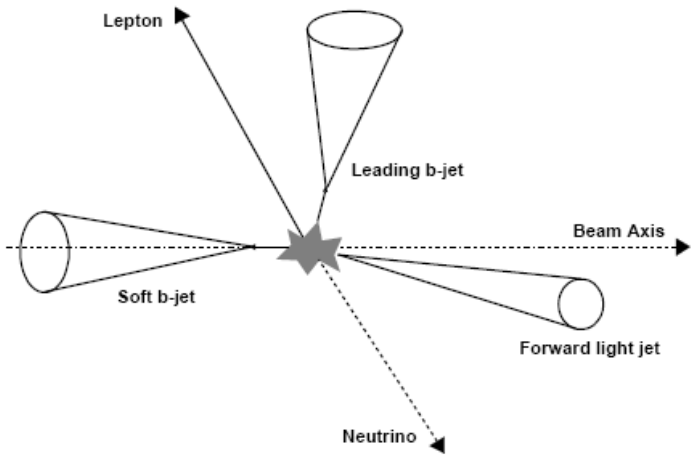
  → no toponium resonances





cuts for single top

- ttbar is background to single top
- only looked at t-channel with leptonic W-decay
- selection cuts:
  - exactly two jets with p_T>30 GeV
  - one of the jets with |η|>2.5
  - other jet b-tagged and p_T>50 GeV
  - H_T>200 GeV and total m_{inv}>300 GeV (not implemented so far)
  - reconstructed mass between 150 and 200 GeV (not implemented)



efficiencies

LVL1 Trigger
- PassedL1: 0.373786
- PassedL1_2J45: 0.808838
- PassedL1_2J45_XE20: 0.695834
- PassedL1_2J45_lept: 0.432221
- PassedL1_XE20: 0.853303
- PassedL1_lept: 0.507503
- PassedL1_lept_XE20: 0.435213

LVL2 Trigger
- PassedL2: 0.377537
- PassedL2_2j20: 0.880967
- PassedL2_lept: 0.418412

Event Filter
- PassedEF: 0.326674
- PassedEF_jet20bEtEF_jet20bEt: 0.837722
- PassedEF_lept: 0.376571

Complete trigger chain

LVL2 Trigger
- PassedL2Combi: 0.287204
- PassedL2_2j20Combi: 0.373786
- PassedL2_leptCombi: 0.287204

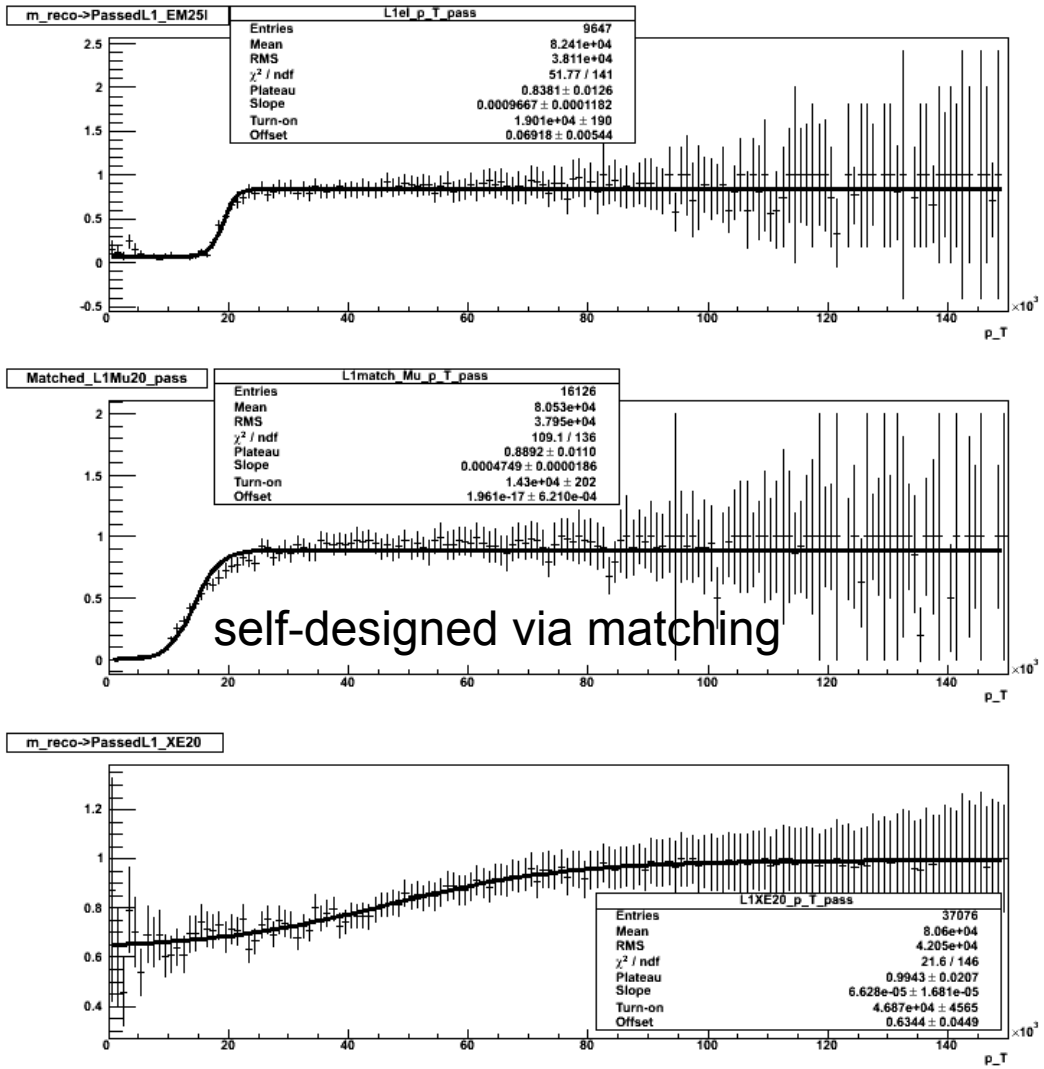
Event Filter
- PassedEFCombi: 0.24985
- PassedEF_jet20bEtEF_jet20bEtCombi : 0.280046
- PassedEF_leptCombi: 0.256272

Analysis cuts
- PassedAna: 0.102854
- PassedAnaL1: 0.0523962
- PassedAnaL2: 0.0489125
- PassedAnaEF: 0.0449816
- Passedfwjet: 0.462738
- Passedbjet50: 0.261542
- Passedlept20: 0.102854

→ agree with TDR studies

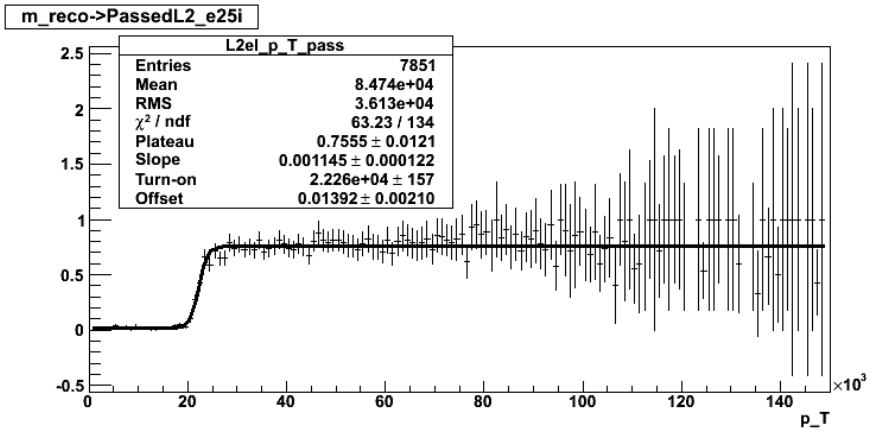
trigger turn-on curves

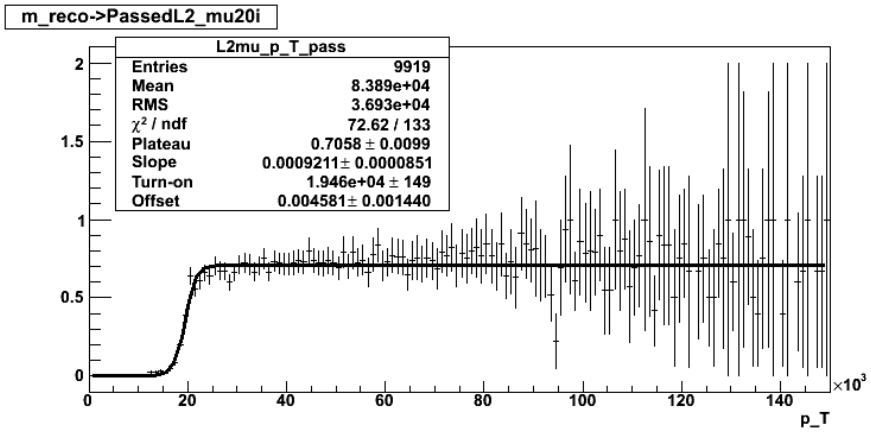
- relative to Truth values using Passed*_p_T variables from FullReco
- fit with Fermi-Dirac function
- OK for leptons, bad for E_T miss



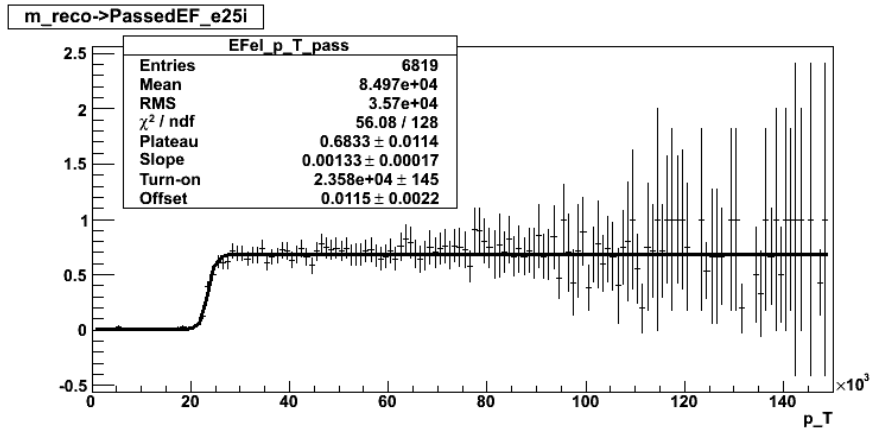
LVL2 & EF turn-on curves

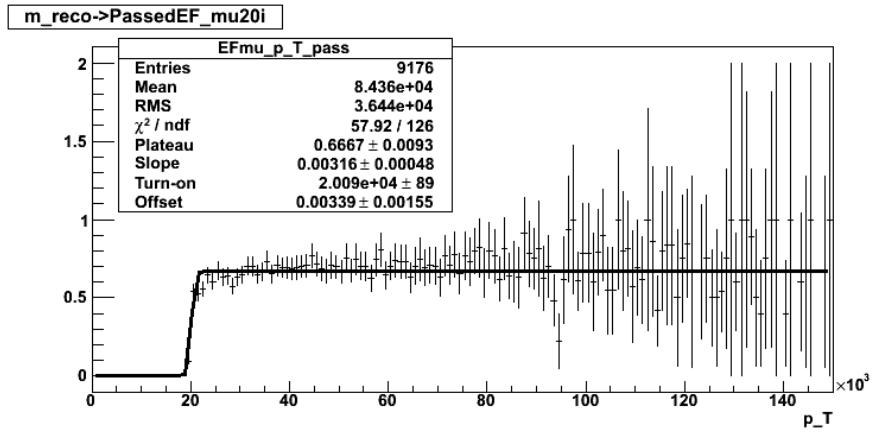
LVL2





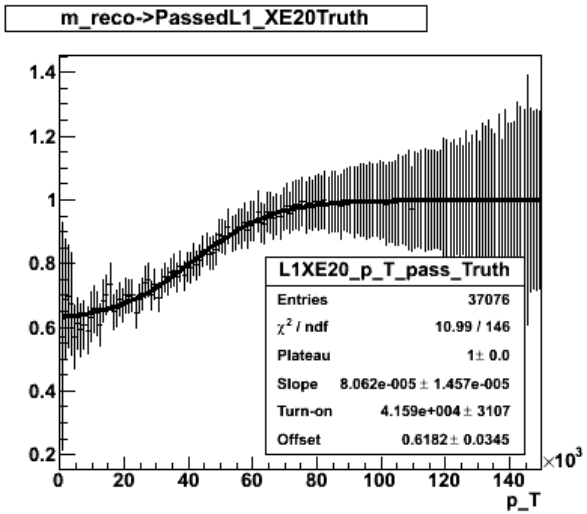
EF

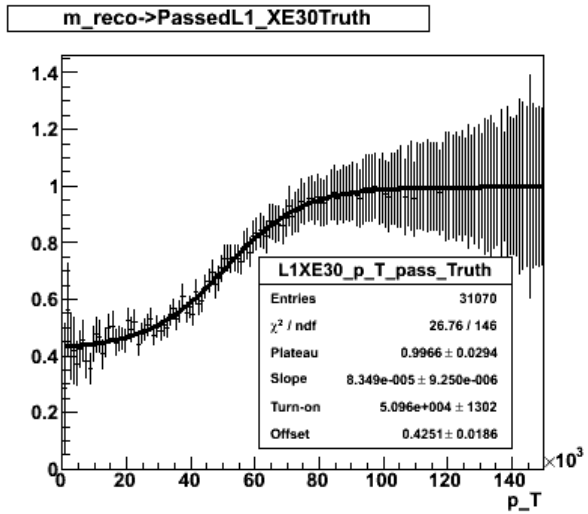


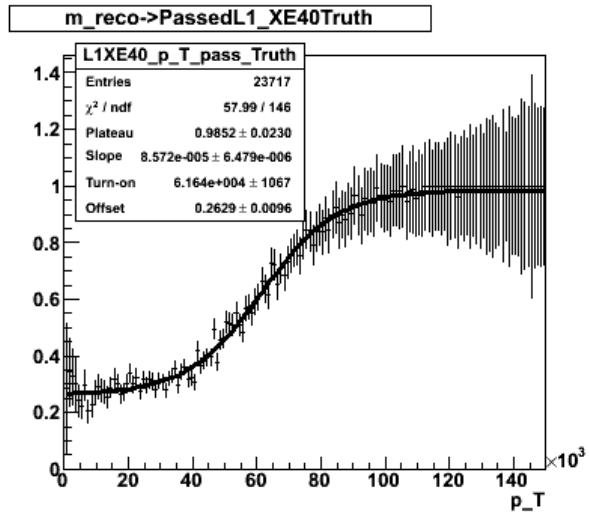


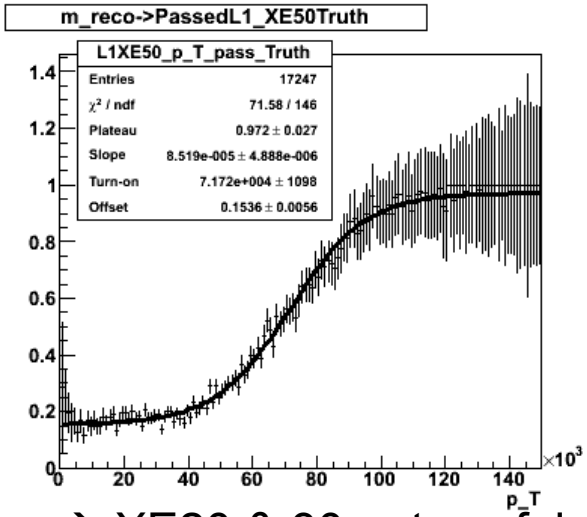
further improvement of turn-on behaviour

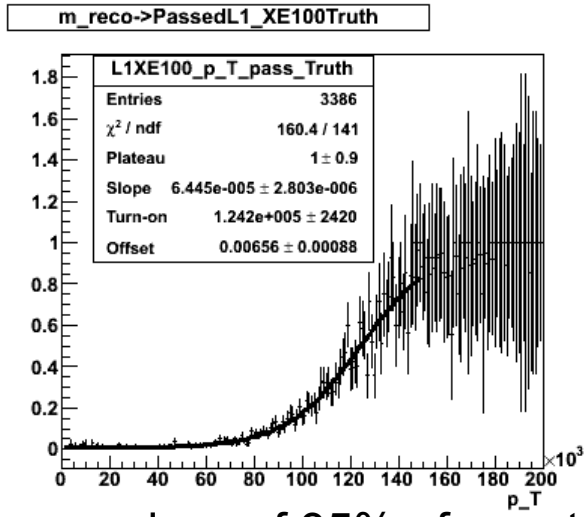
missing E_T turn-on curves

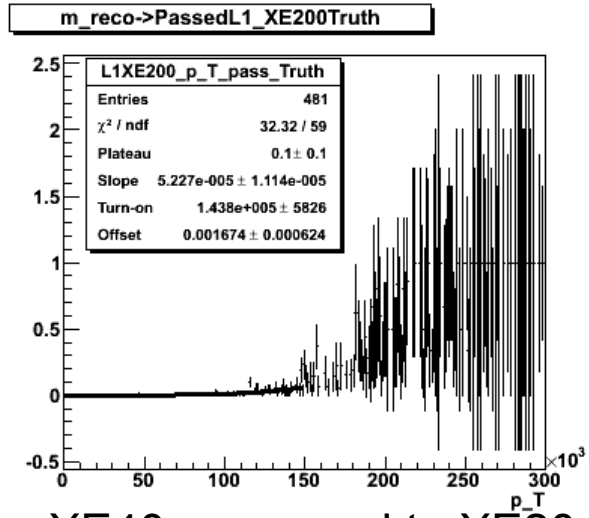






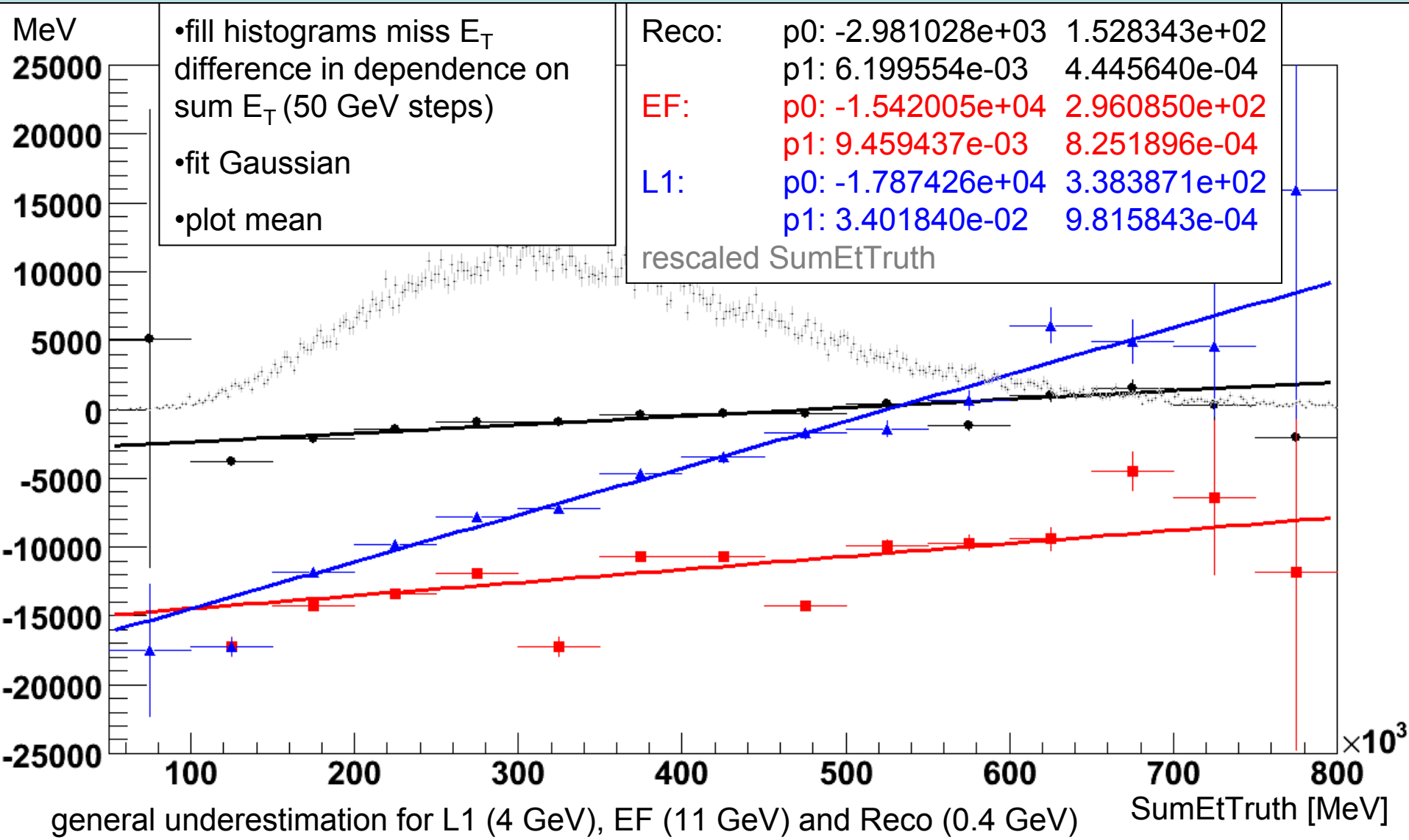






→ XE20 & 30 not useful, however loss of 35% of events for XE40 compared to XE20

E_T shift & E_T sum dependence

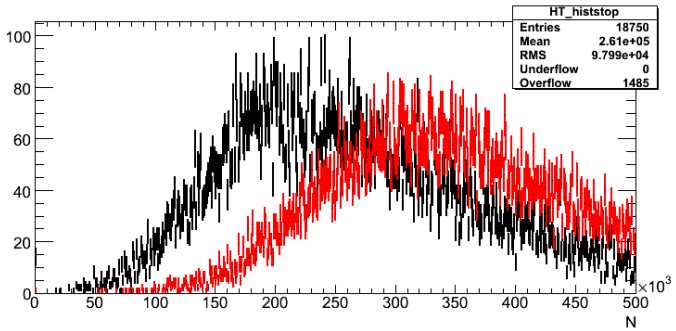


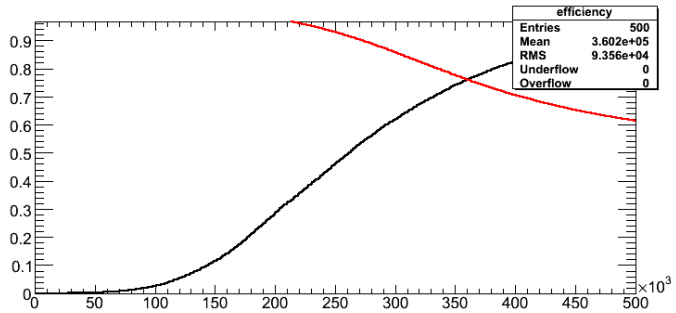
general underestimation for L1 (4 GeV), EF (11 GeV) and Reco (0.4 GeV)

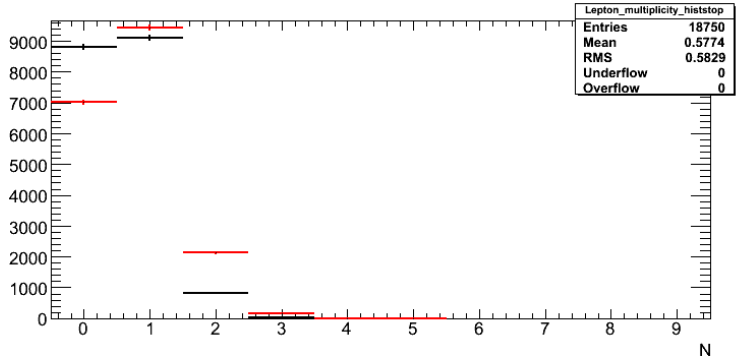
ttbar background analysis cuts

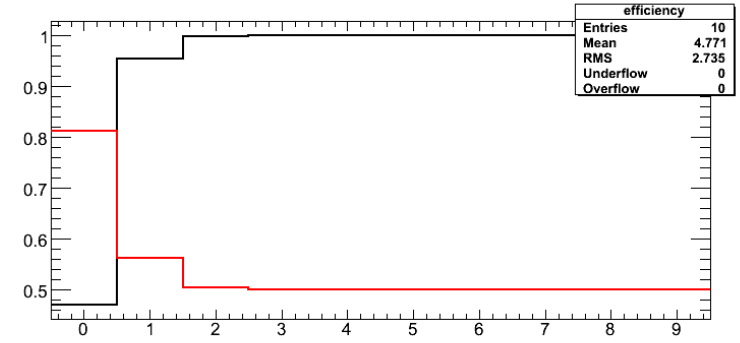
purity & efficiency curves for

- multiplicities & p_T:
  - all jets, b jets
  - forward jets
  - leptons





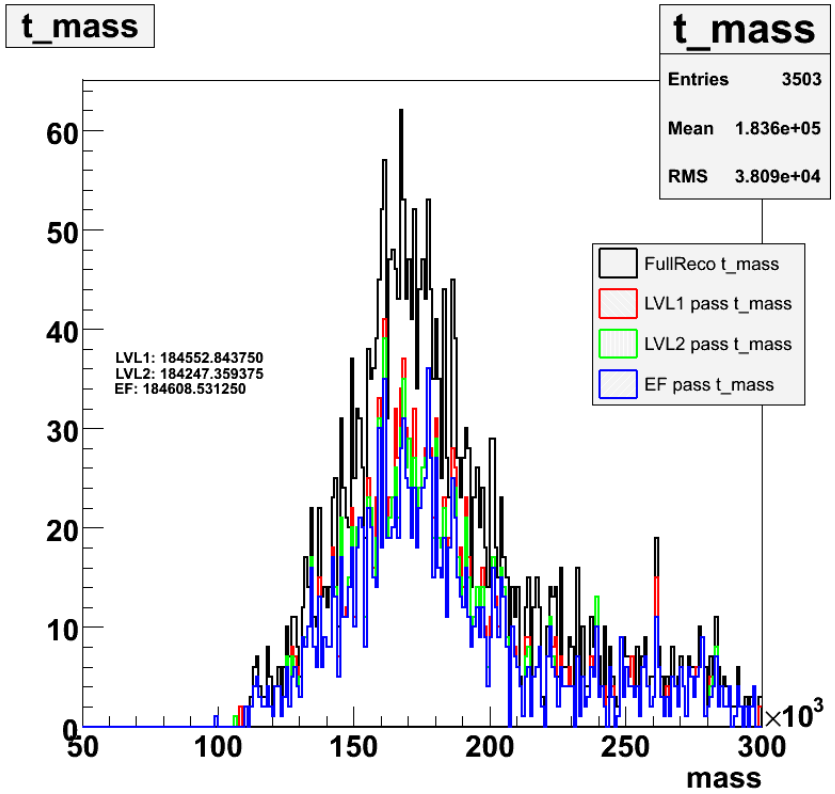


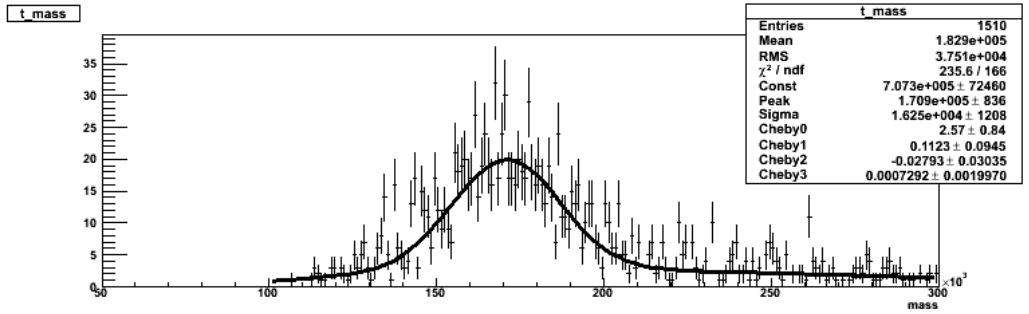


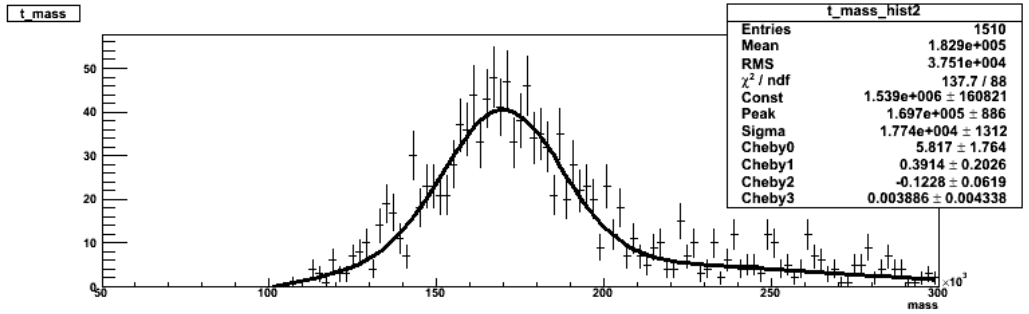
- HT
- missing ET
- „Passed_1J1Jfwd“

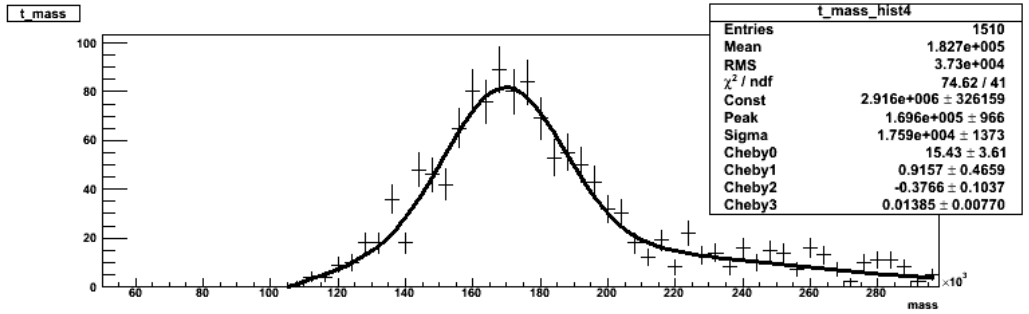
top mass reconstruction

- apply trigger cuts
- solve quadratic equation for p_z of neutrino using missing E_T
- reconstruct top mass by calculating invariant mass









outlook

- investigate further efficiency drops due to single top selection cuts
- investigate further missing E_T turn-on curves
- implement angular correlations (Wjj rejection)
- implement own 1J1Jfwd trigger