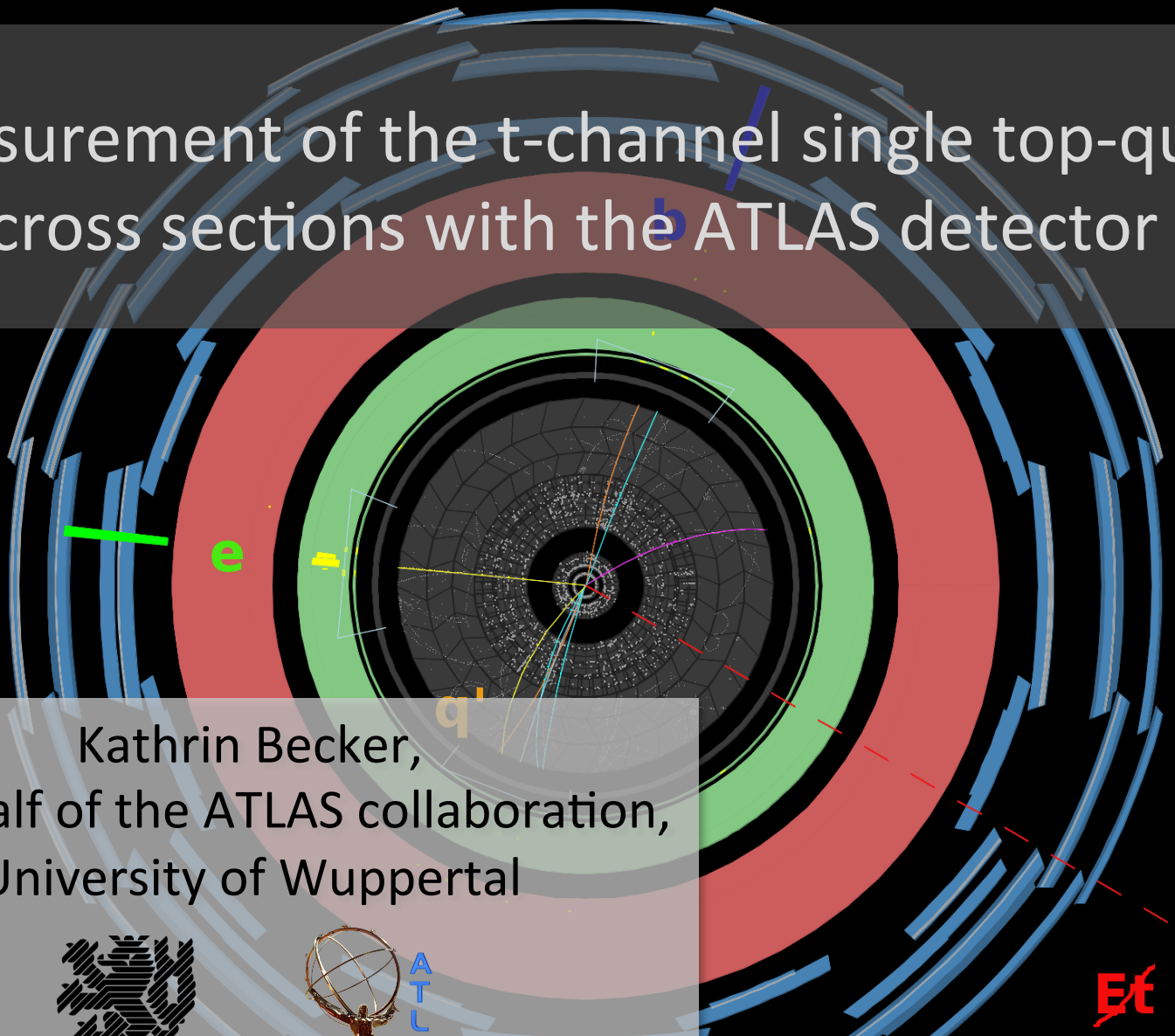
Measurement of the t-channel single top-quark cross sections with the ATLAS detector



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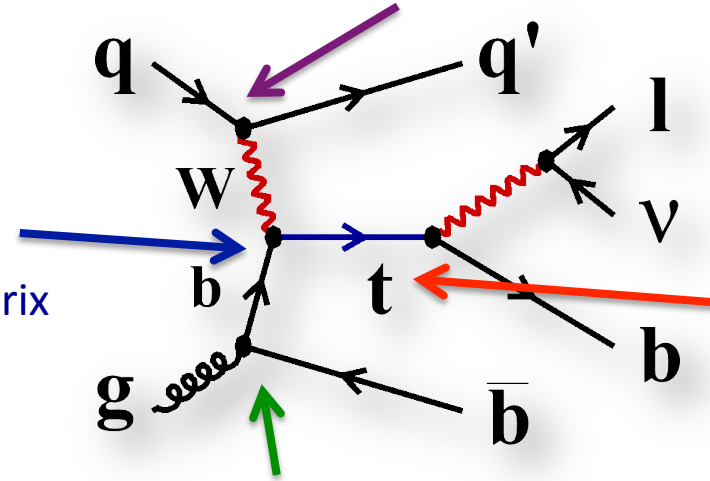
on behalf of the ATLAS collaboration,
University of Wuppertal

Moriond EW session, La Thuile, 04.03.2013

Introduction to t-channel single top-quark physics

- Single top quark production via t-channel: highest cross section @LHC
- Checks of the Standard Model:

Sensitive to ratio of u- and d-quark PDF



Measurement of $R_t = \sigma_t(t)/\sigma_t(\bar{t})$ in 7 TeV (**ATLAS-CONF-2012-056**)

Direct measurement of $|V_{tb}|^2$ (α cross section)
Unitarity test of CKM matrix

Polarized top quark due to V-A structure of Wtb vertex

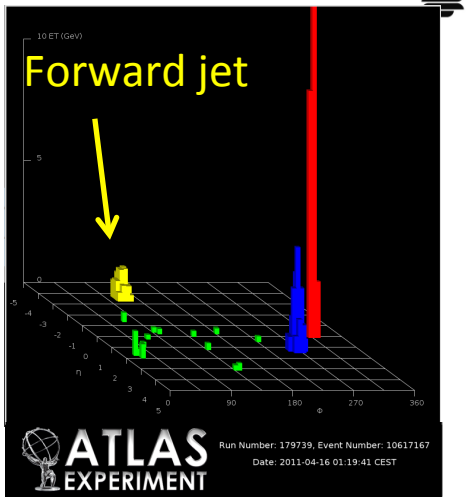
Test of the b-quark PDF

Measurement of $\sigma_t(t+\bar{t})$ in 7 TeV and 8 TeV, determined $|V_{tb}|$ (**Phys. Lett. B 717 (2012) 330-350, ATLAS-CONF-2012-132**)

t-channel events in LHC run 1:
7 TeV: ~5500 events (4.7 fb^{-1})
8 TeV: ~7200 events (5.8 fb^{-1})
→ ~25000 events (20 fb^{-1})

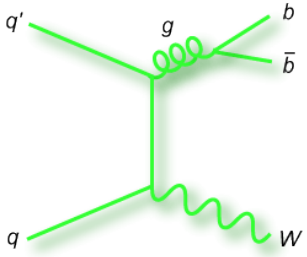
Signal and Backgrounds

- Signal:
  - One lepton with large transverse momentum
  - At least 2 jets, one of them b-tagged, one forward
  - Missing transverse energy
  - Theory cross sections:
    65.9 pb (7 TeV), 87.2 pb (8 TeV)*

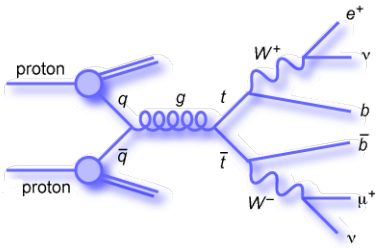


- Backgrounds:

* N.Kidonakis: [arXiv:1212.2844 [hep-ph]]



W+jets
- Acceptance and kinematics from MC
- Normalization and heavy flavor from data

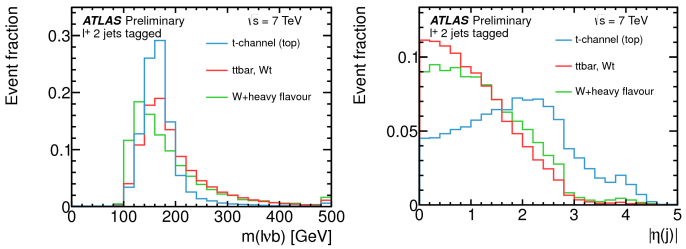


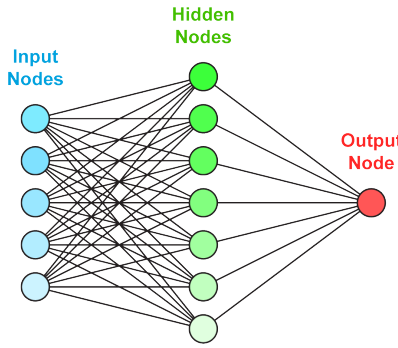
$t\bar{t}$ production
- Acceptance and kinematics from MC
- Normalization from data

  - Small contributions from Diboson, Z+jets,other single top processes (from Monte Carlo) and QCD multijets (from data-driven models)

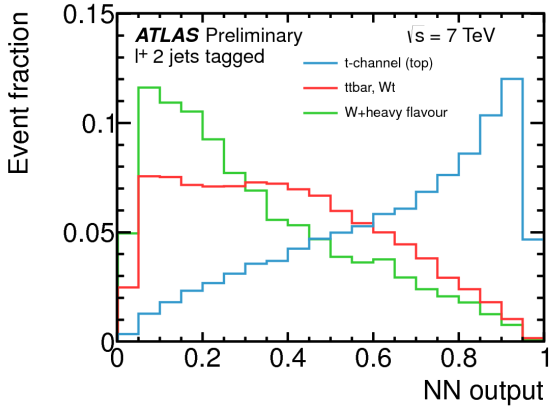
Extracting the signal with neural networks

1. Choose suitable input variables:
e.g. m(top), |η(j)|, m(jb)

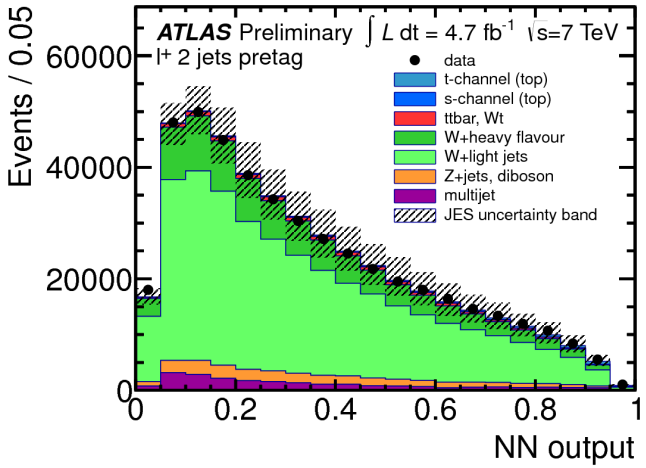




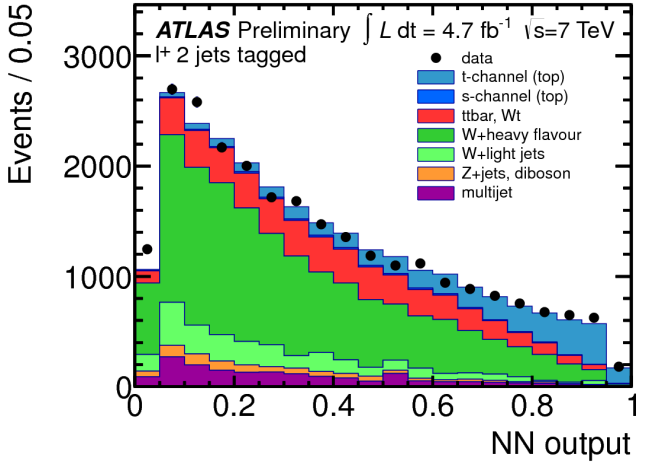
2. Train a neural network



3. Verify neural network output in control region (pretag)



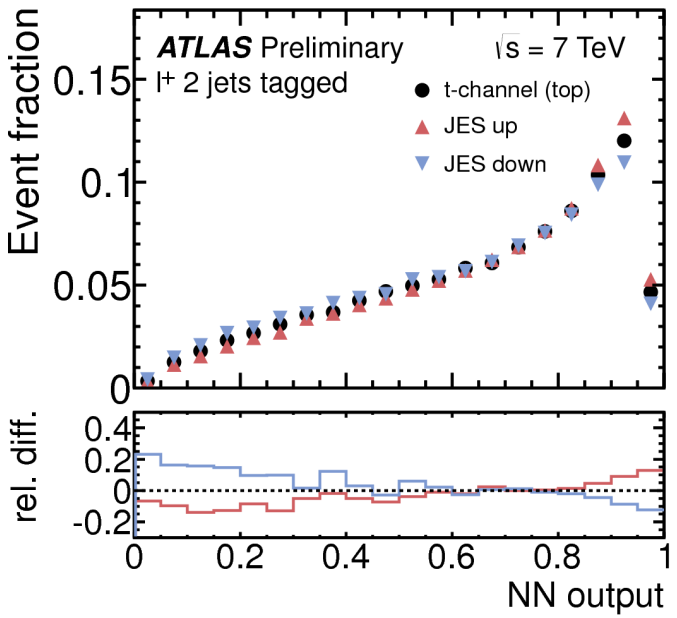
4. Extract signal and backgrounds with a binned maximum-likelihood fit to the NN output



Treatment of systematic uncertainties

- Pseudo experiments used to estimate systematic uncertainties
- Rate and shape uncertainties

- Experimental sources:
  e.g. jet energy scale, luminosity
- Uncertainty on background estimation
- MC modeling, PDF, initial and final state radiation (ISR/FSR)



Cross section measurement:

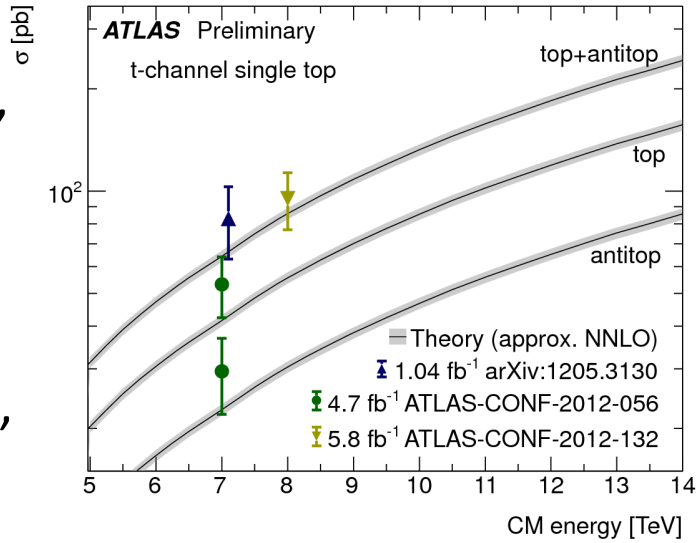
JES	8%
b-tagging efficiency	9%
ISR/FSR	9%

Ratio R_t measurement:

Background normalization	5%
ISR/FSR	4%
JES	4%

Results

- $\sigma_t(t+\bar{t}) = 83 \pm 20$ pb, $|V_{tb}| = 1.13^{+0.14}_{-0.13}$ (7 TeV), **Phys. Lett. B 717 (2012) 330-350**
- $\sigma_t(t) = 53.2 \pm 10.8$ pb, $\sigma_t(\bar{t}) = 29.5^{+7.4}_{-7.5}$ pb, **ATLAS-CONF-2012-056**
- $R_t = 1.81^{+0.23}_{-0.22}$ $(^{+12.8\%}_{-12.4\%})$, **ATLAS-CONF-2012-056**
- $\sigma_t(t+\bar{t}) = 95 \pm 18$ pb, $|V_{tb}| = 1.04^{+0.10}_{-0.11}$ (8 TeV), **ATLAS-CONF-2012-132**



Outlook:

- Lots of candidate events available
- Reduction of systematic uncertainties
- Use t-channel to measure properties of the top quark
- Good basis for new physics searches