Anomalous single top production via photon-proton interactions at the LHC

J. de Favereau, UCLouvain

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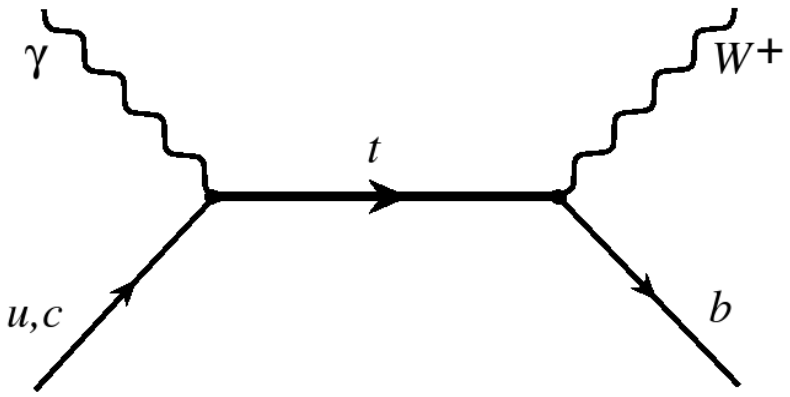
Signal at LHC



Final state (most promising) :

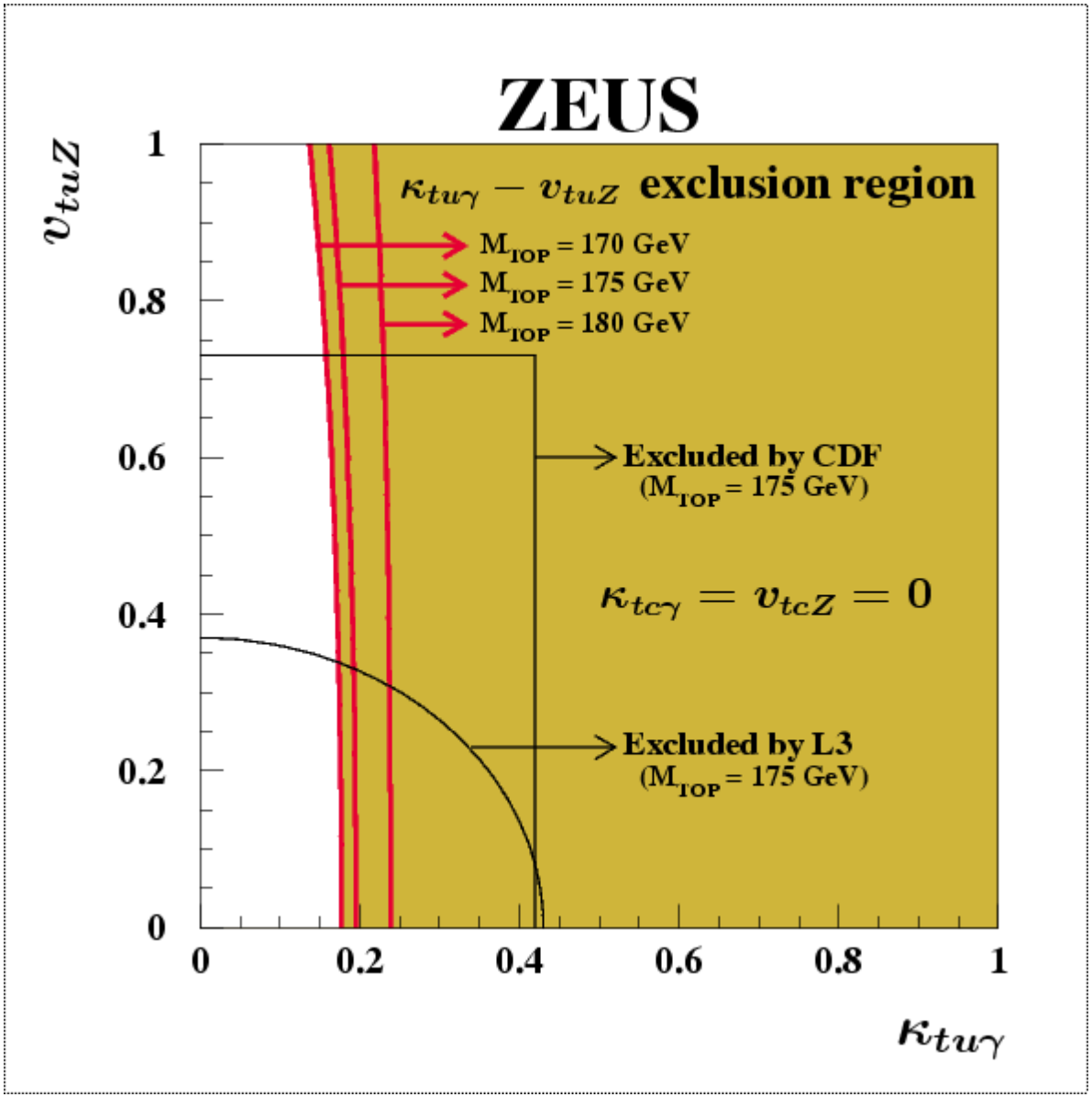
- b-jet
- hard lepton
- missing Et
- forward proton

$\sigma_{pp} \sim 2.5$ pb ($k_{\gamma ut} = 0.1$)

Note: SM cross-section negligible

At HERA only u-quarks relevant, at LHC also c-quarks contribute

Actual limits from ZEUS



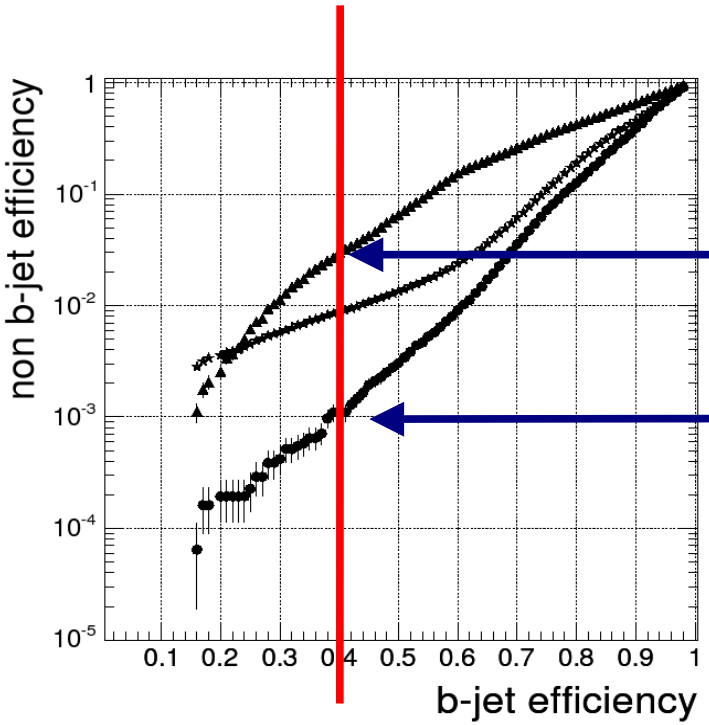
Main backgrounds

- $\gamma\, p \rightarrow W + jet + X$
- $\gamma\, p \rightarrow W + c\text{-}jet + X$
- $p\, p \rightarrow W + jet + X$
- $p\, p \rightarrow W + c\text{-}jet + X$

- pp processes contribute via accidental single diffractive protons in forward detectors.

- c-jets have been separated from others because the b mistag rate is higher (see plot)

b-tagging and mistag

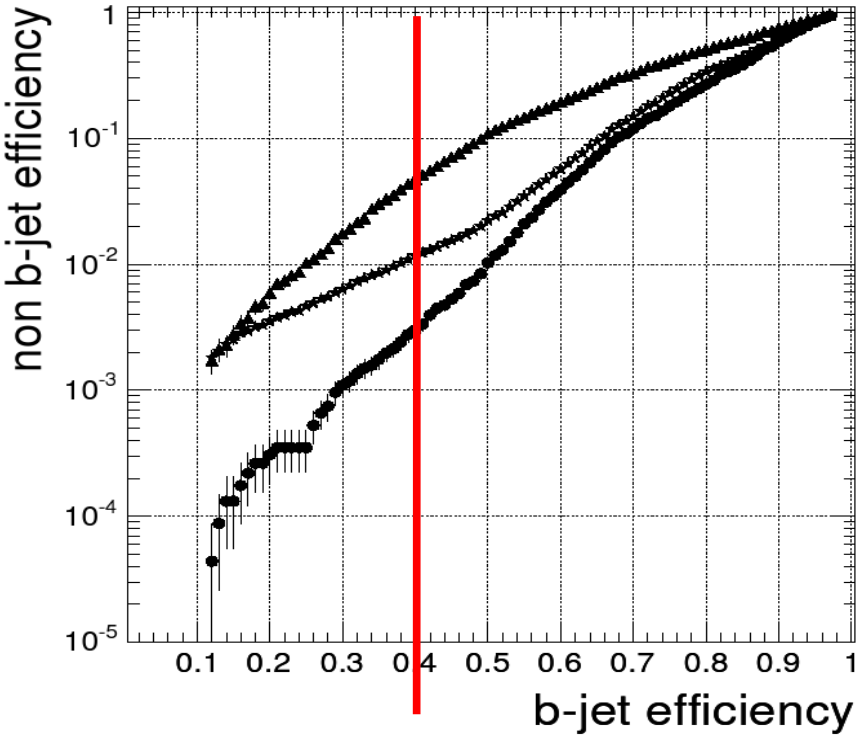


c-jets tagged as b-jets

uds-jets tagged as b-jets

$\eta < 1.4$

$1.4 < \eta < 2.5$



Simulation

- Processes have been simulated using MADGRAPH
- Hadronisation done by PYTHIA
- Detector simulation using LHC olympics's PGS
- Forward detector acceptances using Hector fast simulation

Low and very low luminosity

Very low lumi scenario (1 fb^{-1}) :

- pileup is negligible : no pp backgrounds
- Selection : veto energy in forward calorimeters

Low lumi scenario (30 fb^{-1}) :

- tagging with forward detectors necessary
- pp backgrounds taken into account

Signal selection

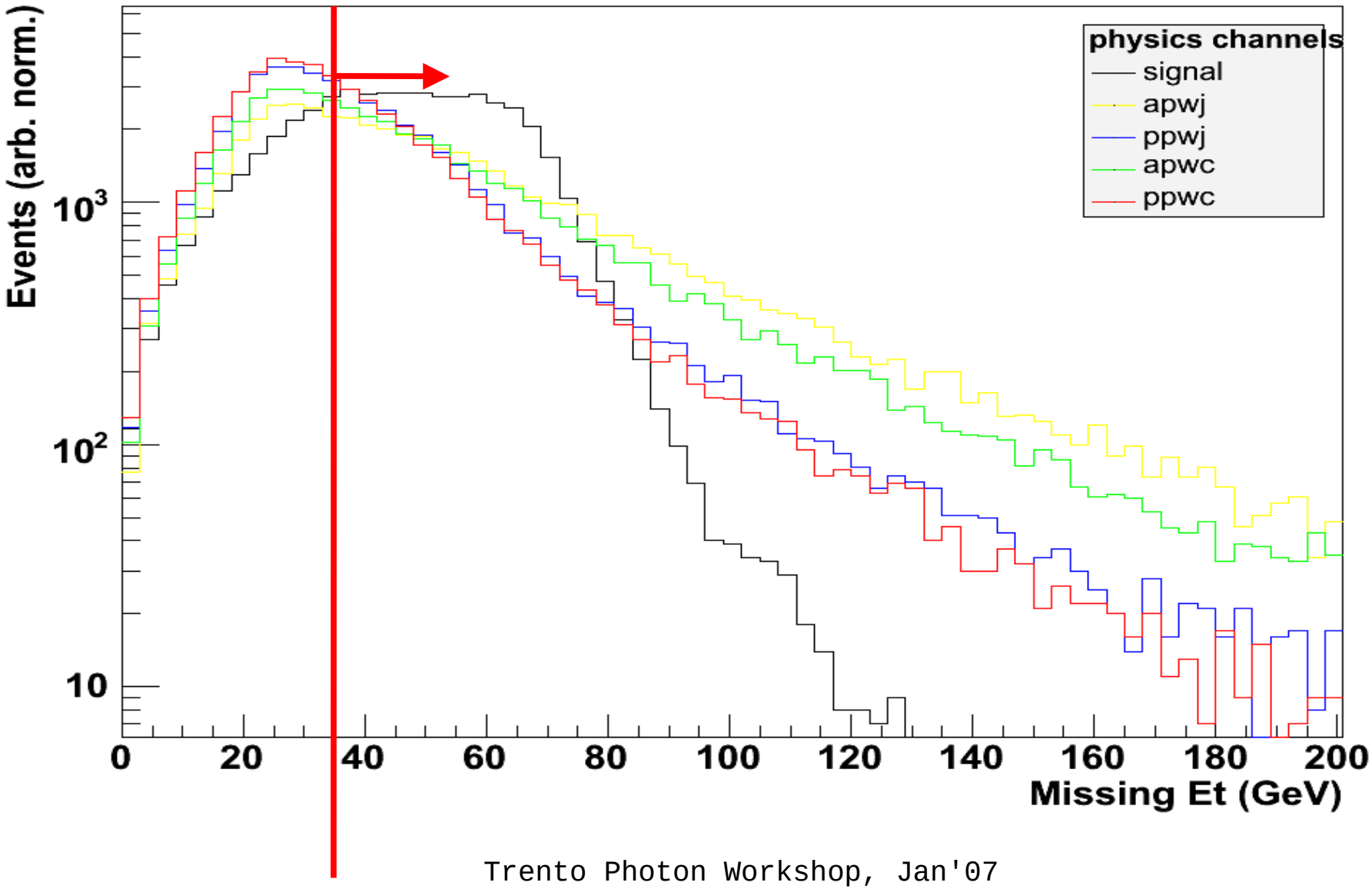
Very low luminosity :

- Energy in forward $(3<|\eta|<5)$ calorimeters < 50 GeV
- Only one jet, b-tagged
- Muon or Electron (P_T > 25 GeV)
- Missing E_T > 35 GeV
- 90 < Reconstructed top mass < 190 GeV
- $\cos \theta_b > 0.8$ ($tg(\theta_b) = P_T / P_{cms}$)

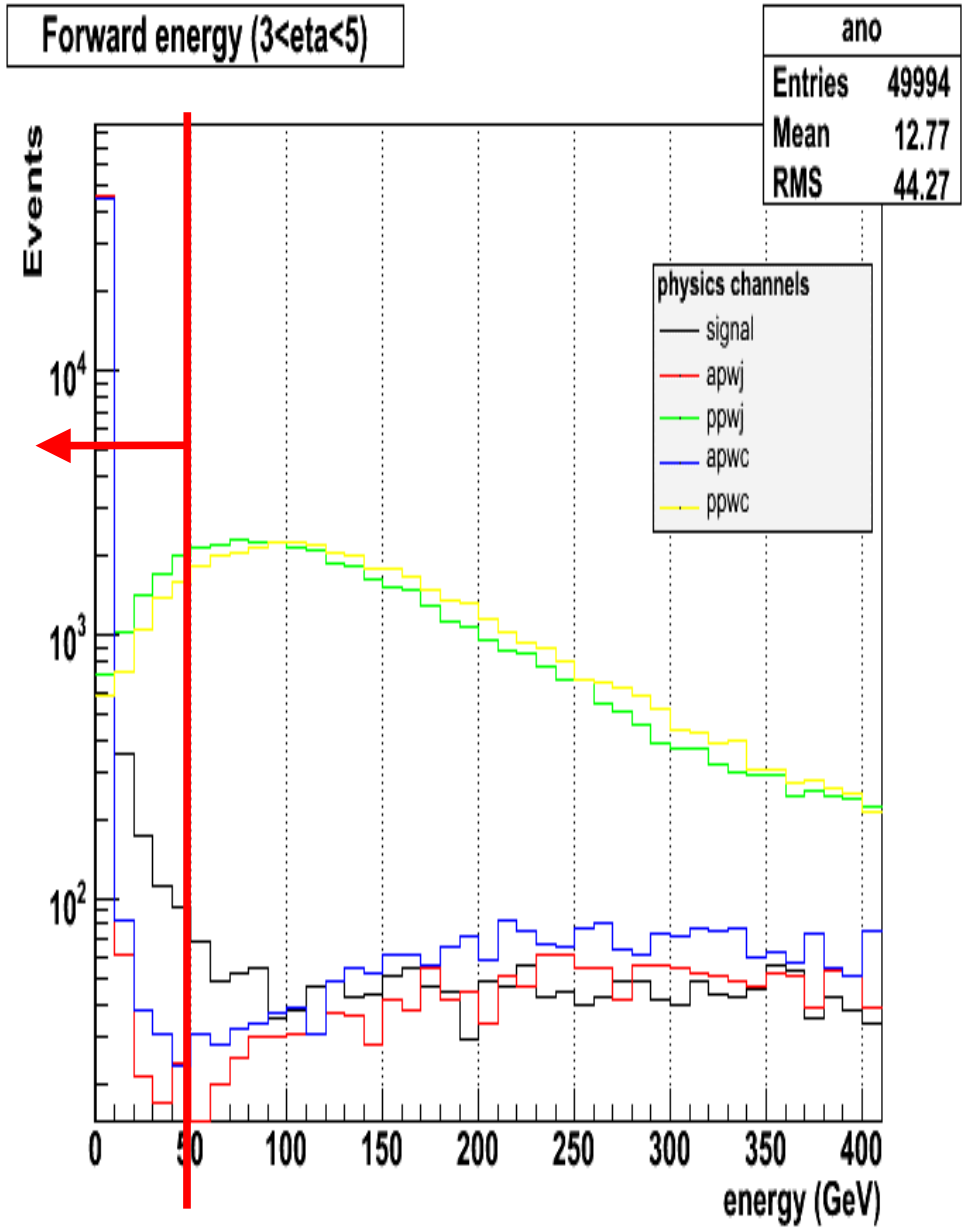
Low luminosity :

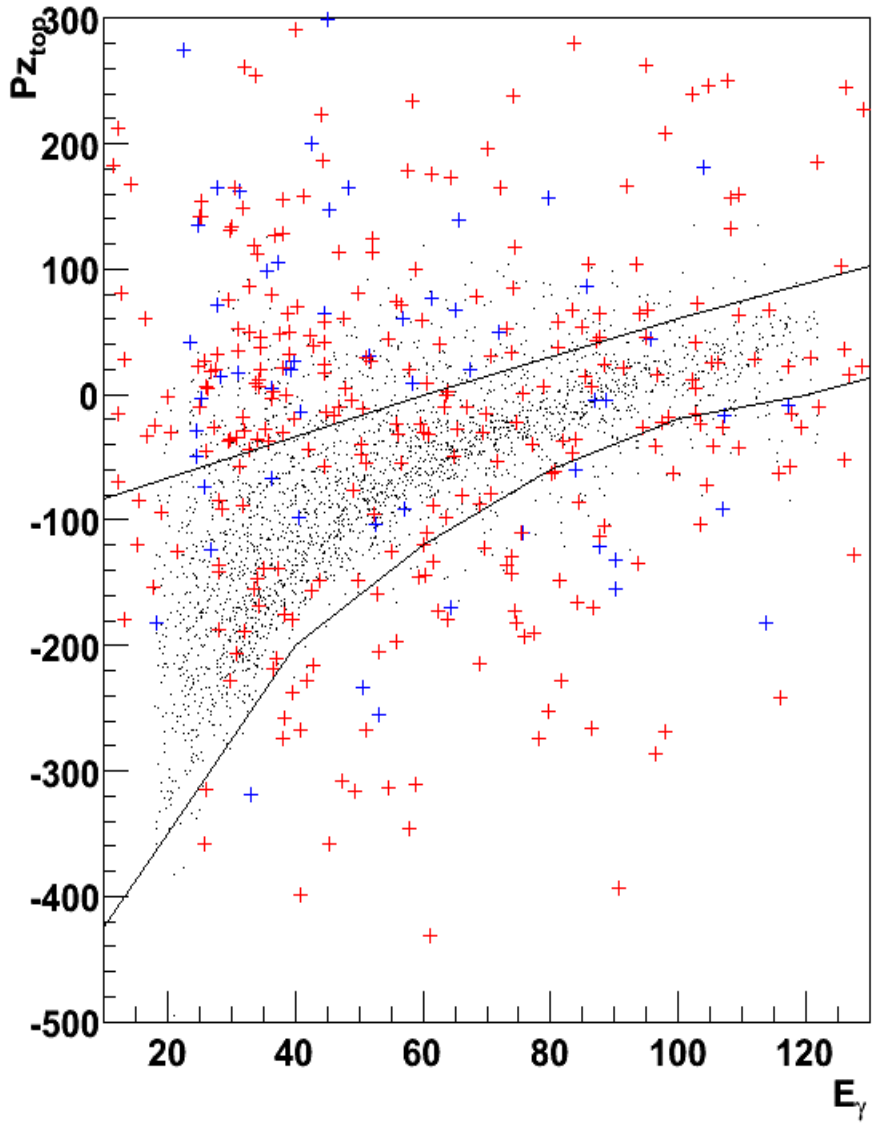
- Same cuts, but requiring hit in the forward detectors instead of veto in forward calorimeters
- Plus photon-energy vs top P_z correlation cut

Control plots (I)

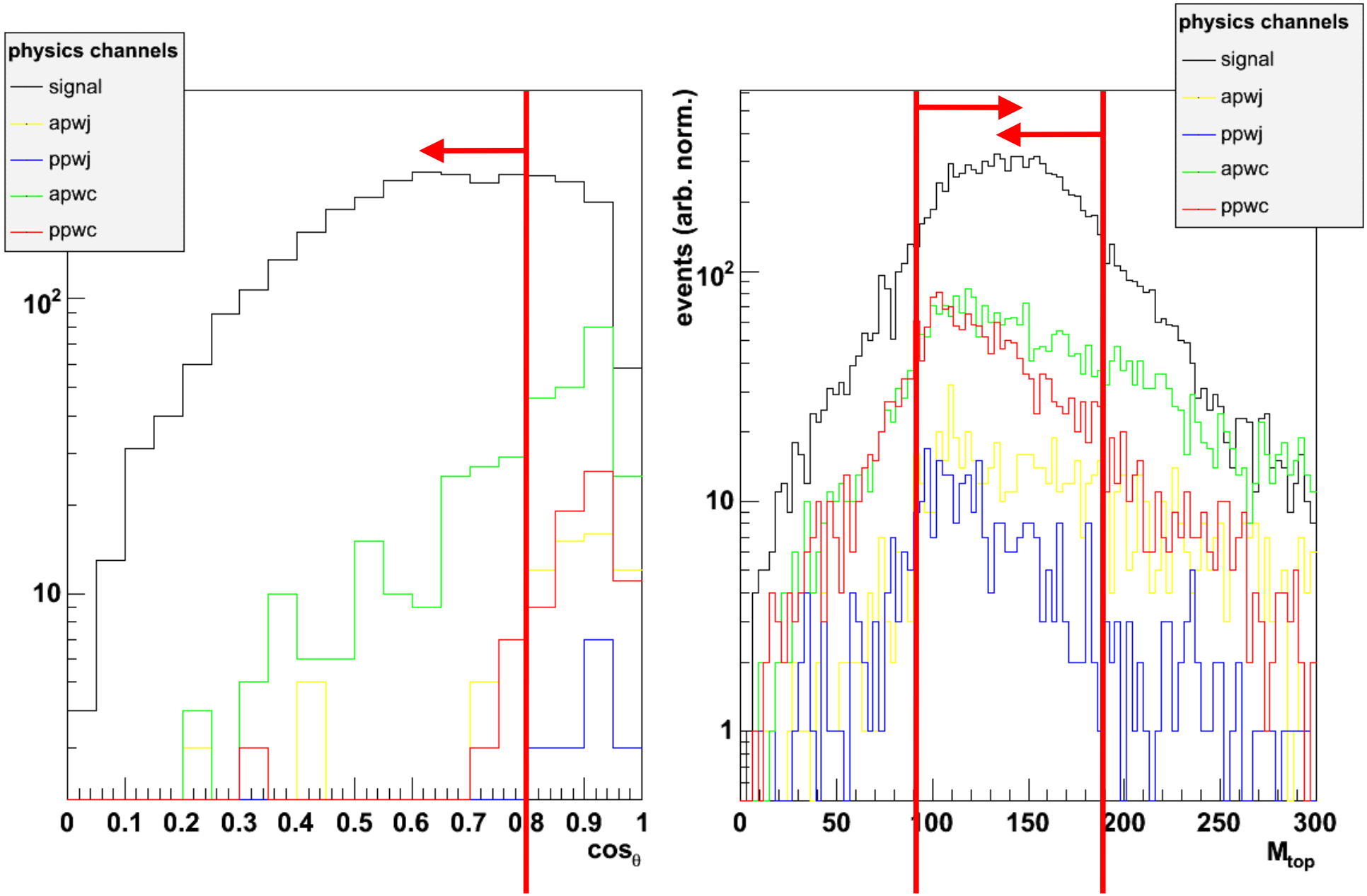


Control plots (II)

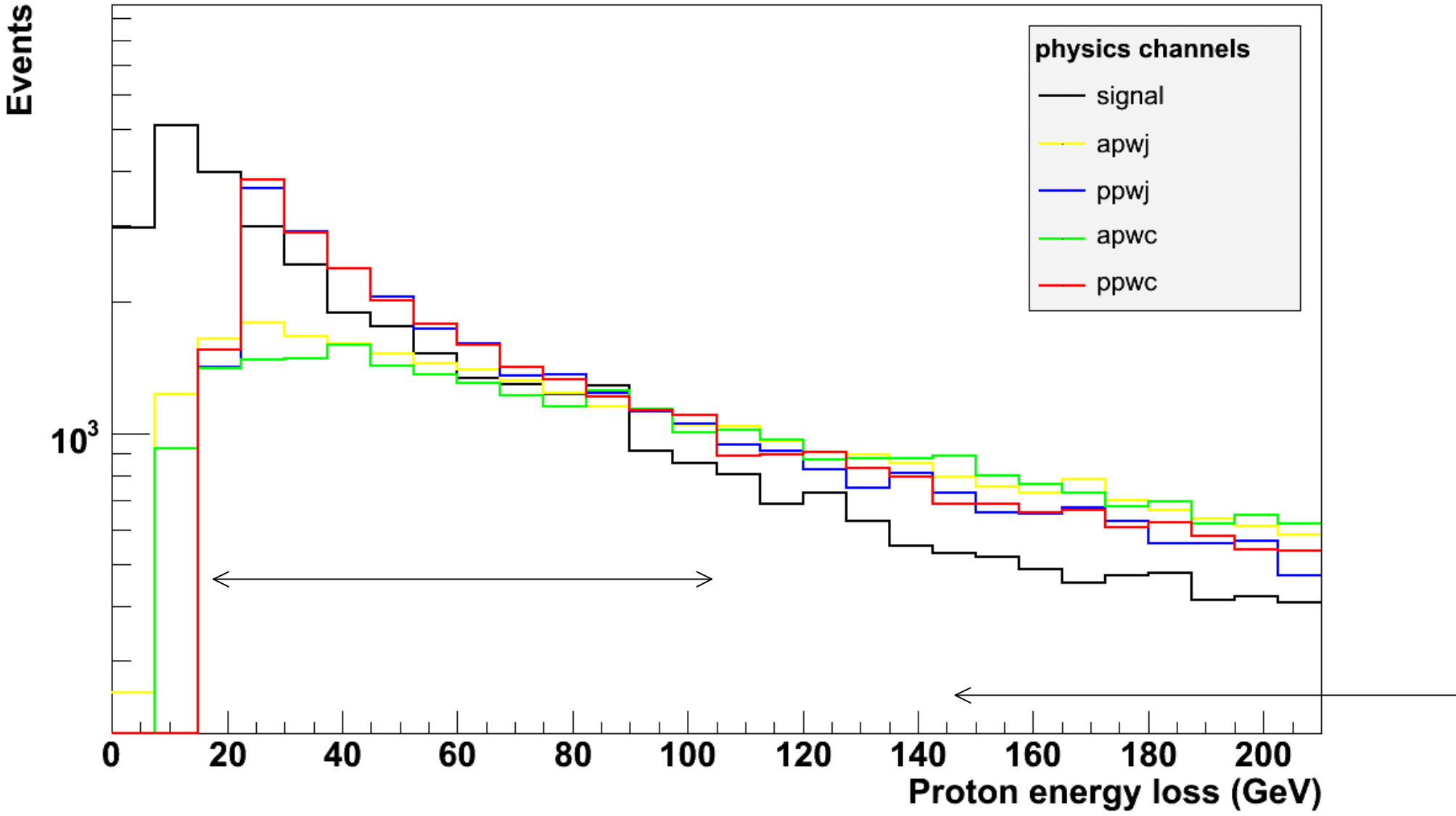




Control plots (III)



Control plots (IV)



Very preliminary event numbers (very low luminosity)

for $k_{\gamma ut} = 0.1$:

- signal : 25.2 ± 0.5 events
- $\gamma p \rightarrow Wj$: 2.5 ± 0.5 events
- $\gamma p \rightarrow Wc$: 3.5 ± 0.3 events

$S / \sqrt{B} = 10$

Very preliminary event numbers (low luminosity)

For $k_{\gamma ut} = 0.1$:

- Signal : 555 ± 13 events
- $\gamma p \rightarrow Wj$: 49 ± 12 events
- $pp \rightarrow Wj$: 814 ± 332 events
- $\gamma p \rightarrow Wc$: 68 ± 7 events
- $pp \rightarrow Wc$: 896 ± 123 events

$S / \sqrt{B} = 13$

Summary and prospects

- First preliminary results are promising : limits might be improved already at very low luminosity

Prospects :

- Full detector simulation in progress
- Using measured photon energy to improve event reconstruction
- More Monte Carlo statistics needed and cut optimization
- Vetoing soft tracks associated with event vertex should reduce pp background at low luminosity