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Search for Anomalous Single Top Quark Production at HERA Update of the Hadronic Channel

H1 Collaboration

Abstract

A search for anomalous top quark production mediated by a flavour changing neutral current via a gamma-u-t coupling is performed in $e^{\pm}p$ collisions at HERA. The search exploits data collected from 1994 to 2000 and is motivated by the previous observation of outstanding events with isolated leptons, missing transverse momentum and a jet with large transverse momentum. Following a corresponding analysis in the leptonic channel we here present the search for top decays into a b-jet and a W-boson, which decays hadronically. The data is compared to the Standard Model expectation and to an anomalous top production model. No excess is found in the data. Leptonic and hadronic decay modes are combined and an upper limit on the anomalous gamma-u-t coupling is established in a region of parameter space not excluded by other experiments at LEP and TEVATRON.

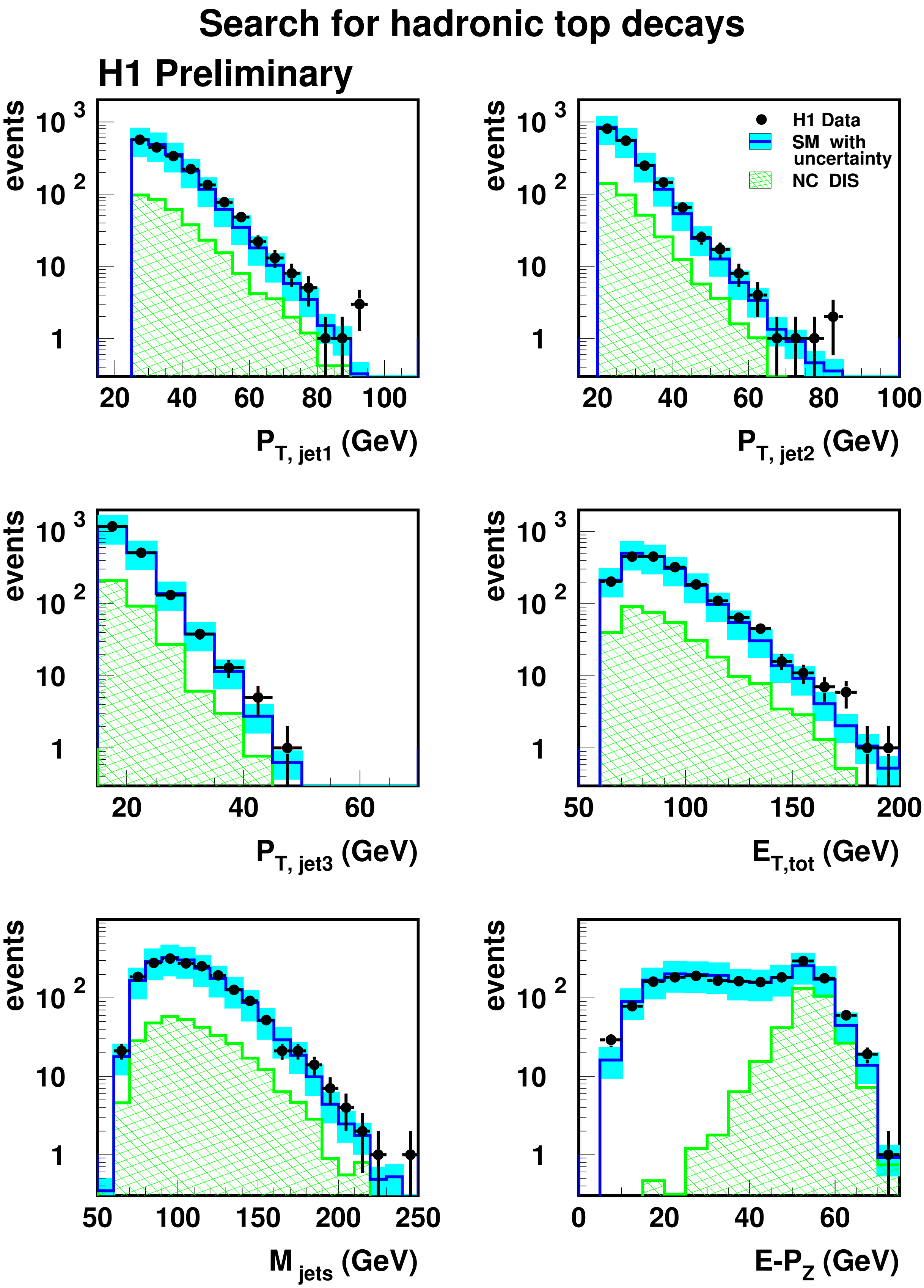

Figure 1: Control plots for the 3-jet sample ($P_T^{jet} > 25, 20, 15$ GeV) in 1994-2000 data.

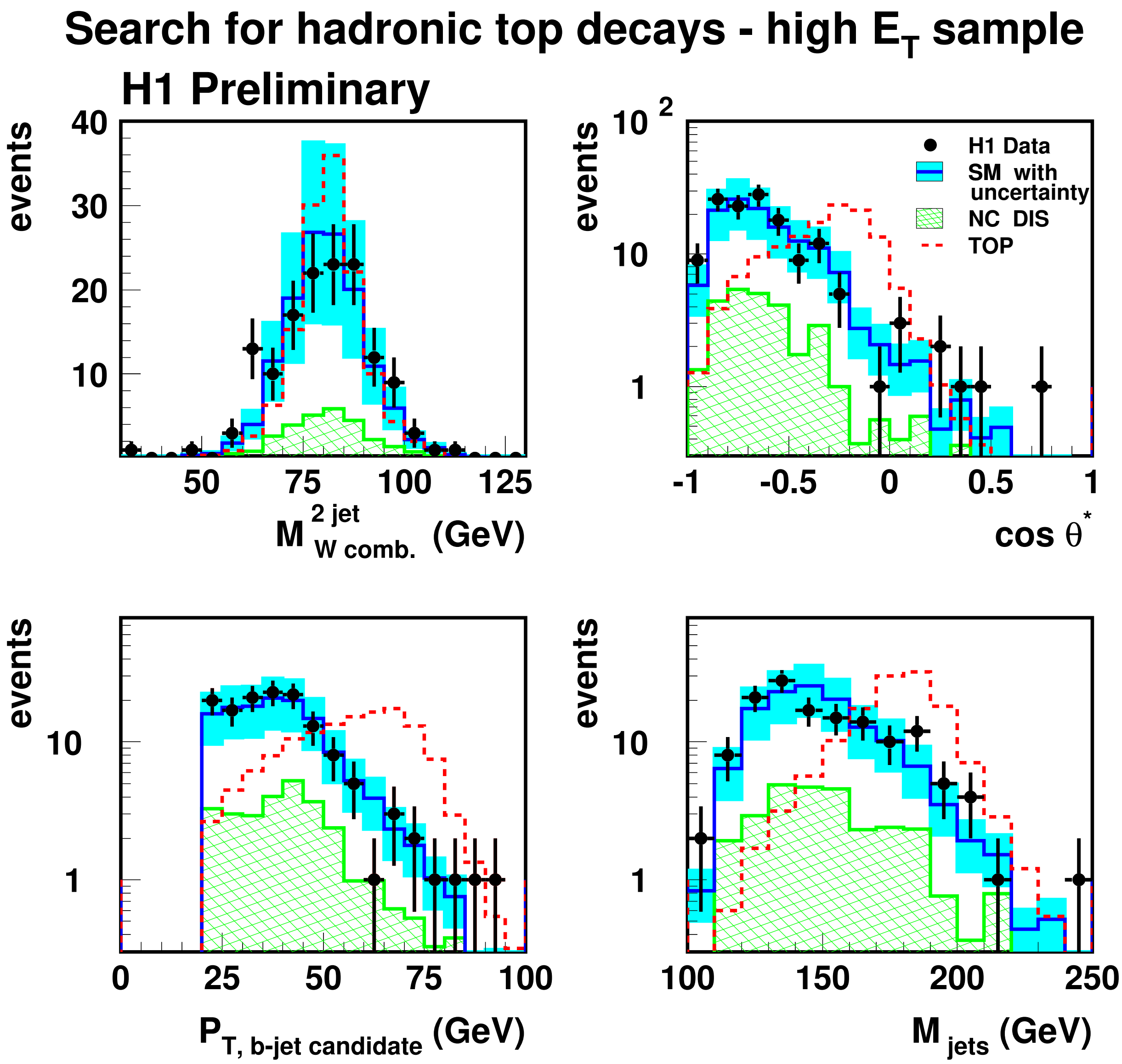

Figure 2: Observables used for top / SM discrimination in the high E_T sample ($E_{T,tot} > 110$ GeV, $P_T^{jet} > 40, 25, 20$ GeV). A top ansatz is used assigning the two jets with an invariant mass closest to 80 GeV to the W (W combination) and the remaining high-P_T jet to the b-quark (b-jet candidate) from the top decay. The angle $\theta^\star$ denotes the angle in the top system between the two jets forming the W combination. The top Monte Carlo is displayed in arbitrary normalization.

Top Cuts:

- W mass window: $70\ \text{GeV} < M^{2jet}_{W comb.} < 90\ \text{GeV}$
- Top mass window: $150\ \text{GeV} < M_{jets} < 210\ \text{GeV}$
- Angular cut: $\cos\Theta^{*} > -0.5$

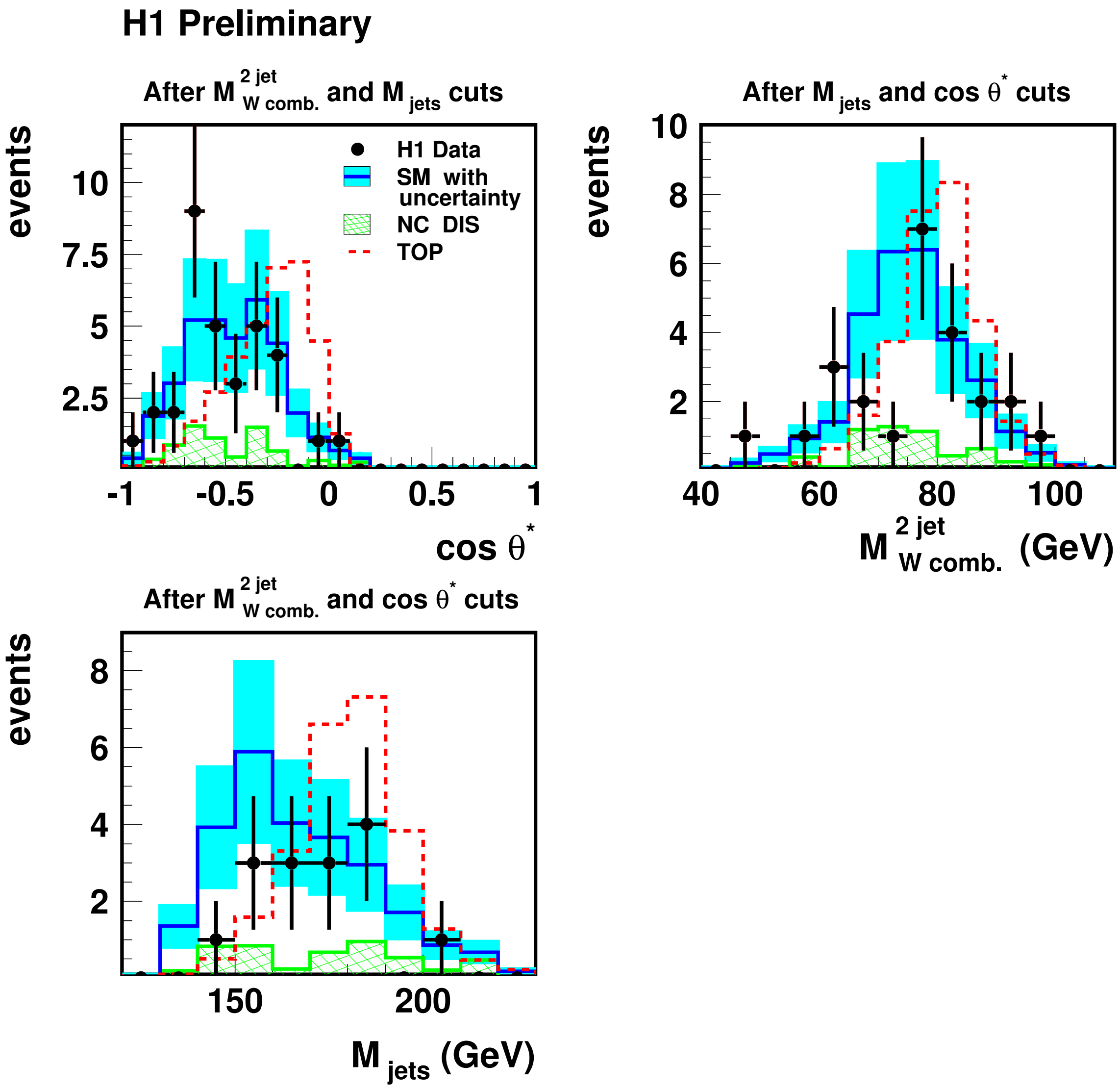

Figure 3: Distributions of the decay angle $\cos\theta^{\star}$, the invariant mass of all jets, and the invariant 2-jet mass of the the W combination in the high E_T sample after cuts on the other variables.

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	After Top Cuts
$Data$	14
SM	$19.6\ \pm 7.8$
Efficiency ($t \rightarrow 3\ jets$)	27%

Table 1: Number of observed and expected events in the hadronic top selection (high E_T sample after all top cuts) of 1994-2000 data.

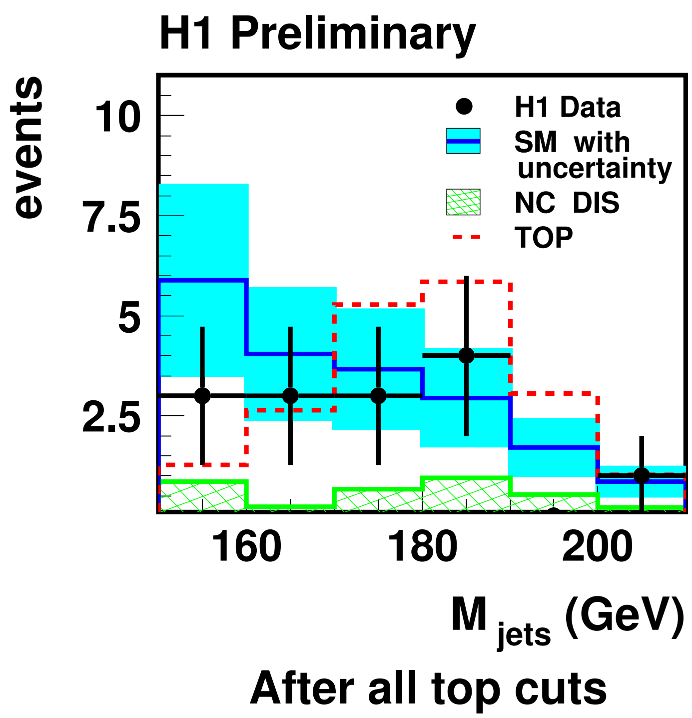

Figure 4: Reconstructed top mass after all top cuts. The top Monte Carlo is displayed in arbitrary normalization.

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	Exclusion Limit at 95% CL
Hadronic Channel	$\sigma_{top}(\sqrt{s} = 320$ GeV)< 0.40 pb
Combined (Hadronic+Leptonic Channel)	$\sigma_{top}(\sqrt{s} = 320$ GeV)< 0.43 pb $\kappa_{\gamma,u} < 0.22$

Table 2: Exclusion limits on the cross section for anomalous top production at HERA and on the $tu\gamma$ coupling $\kappa_{\gamma,u}$.

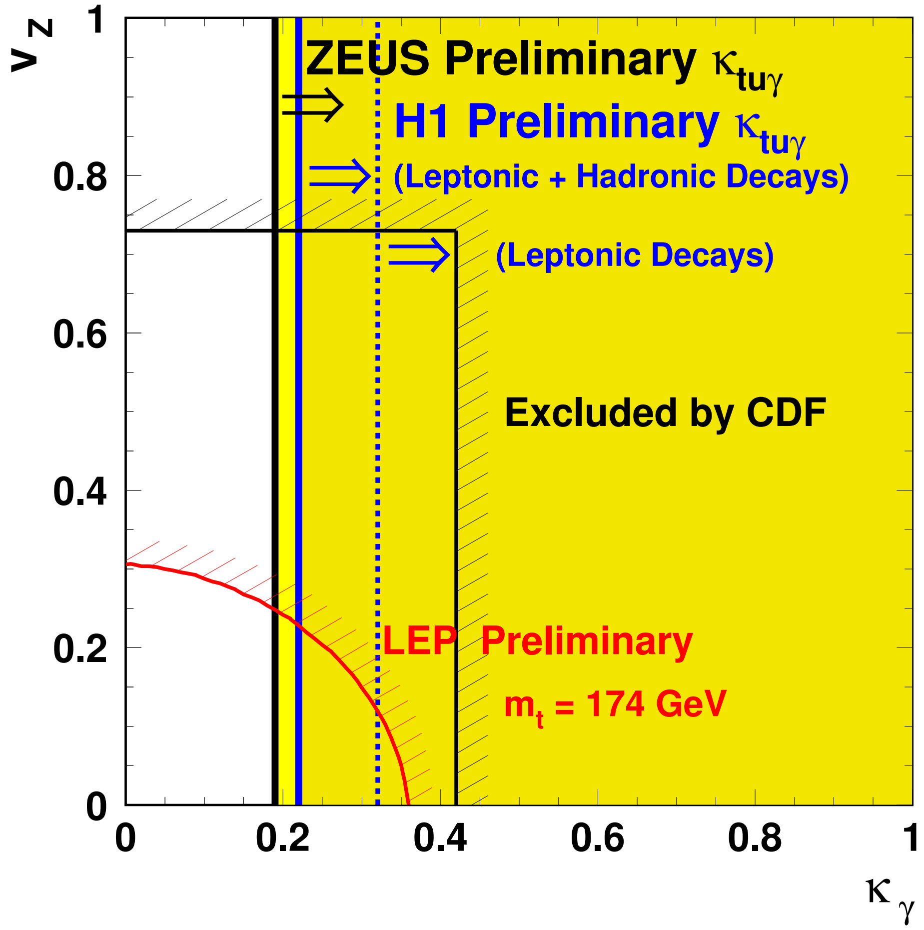

Figure 5: Exclusion limits at 95% CL on the anomalous $tq\gamma$ magnetic coupling κ_γ and the vector coupling v_Z obtained at the TEVATRON, LEP and HERA colliders. The H1 limit applies to the coupling $\kappa_{\gamma,u}$ to the u-quark only. Both the H1 limit for leptonic decays and the H1 combined limit for leptonic and hadronic decays of the top quark are indicated.

References

[1] H1 Collaboration, “Search for Single Top Production in $e^{\pm}p$ collisions at HERA”, contributed paper 824, EPS2001, Budapest