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Search for Events with Isolated Tau-Leptons and Missing Transverse Momentum at HERA

H1 Collaboration

Abstract

A search for the production of tau leptons in ep collisions with the H1 detector at HERA is presented. A total integrated luminosity of 287 pb^{-1} taken in the years 1994-2005 is analysed, which includes recent data collected in the period 2003-2005 (HERA-II), where 51 pb^{-1} of $e^{+}p$ data and 111 $e^{-}p$ data were taken. Tau leptons are identified by using an identification algorithm based on the search for isolated charged tracks associated to narrow hadronic jets detected in the calorimeters, a typical signature of the one-prong hadronic tau decay. In the region where the hadronic system (X) has a transverse momentum $P_T^X >$ 25 GeV 3 events are observed in the data where the Standard Model (SM) expectation is 0.74$\pm$0.13 events.

1 Introduction

The preliminary results presented here are an update of the recently published search for events with tau leptons and missing transverse momentum (P_T^{miss}) in HERA-I data included in the paper on tau lepton production in ep collisions [1]. The selection is shown in table 1. This search complements the observation of isolated electrons and muons in events with missing transverse momentum [2], [3].

References

[1] H1 Collaboration; *Tau Lepton Production in ep Collisions at HERA*, DESY-06-029, Apr 2006., Submitted to Eur.Phys.J.C, hep-ex/0604022

[2] H1 Collaboration; *Search for Events with Isolated Leptons and Missing Transverse Momentum at HERA*, contributed paper to *The International Europhysics Conference on High Energy Physics, EPS05*, Lisbon 2005, **Abstract 637**.

[3] V. Andreev *et al.* [H1 collaboration], Phys. Lett. B **561** (2003) 241 [hep-ex/0301030].

Selection of $\tau + P_T^{\mathrm{miss}}$ Events		
P_T^{miss} + Isolated Jet Preselection	P_T^{calo}	> 12 GeV
	P_T^{miss}	> 12 GeV
	$E - P_z$	< 50 GeV
	V_{ap}/V_p	< 0.5 (< 0.15 for $P_T^{\mathrm{calo}} < 25$ GeV)
	N_{jets}	> 1
	P_T^{jet}	> 7 GeV
	20°	$< \theta_{jet} < 120^\circ$
	D_{track}	> 1.0
	D_{jet}	> 1.0
Final $\tau + P_T^{\mathrm{miss}}$ Selection	N_{tracks}^{jet}	$= 1$
	P_T^{track}	> 5 GeV
	R_{jet}	< 0.12
	$\Delta\phi$	$< 170^\circ$

Table 1: Selection criteria for events containing an isolated τ lepton and large P_T^{miss}.

H1 Preliminary $\tau + P_T^{\rm miss}$		H1 Data	SM Expectation	SM Signal	Other SM Processes
1994-2004 e^+p	Total	8	$10.6\ ^{+2.2}_{-3.5}$	$1.1\ ^{+0.19}_{-0.27}$	$9.5\ ^{+2.2}_{-3.5}$
153 pb^{-1}	$P_T^X > 25$ GeV	0	$0.40\ ^{+0.10}_{-0.10}$	$0.24\ ^{+0.04}_{-0.06}$	$0.15\ ^{+0.09}_{-0.08}$
1998-2005 e^-p	Total	17	$13.5\ ^{+2.4}_{-2.8}$	$0.9\ ^{+0.15}_{-0.15}$	$12.6\ ^{+2.4}_{-2.8}$
125 pb^{-1}	$P_T^X > 25$ GeV	3	$0.35\ ^{+0.10}_{-0.08}$	$0.19\ ^{+0.03}_{-0.03}$	$0.16\ ^{+0.10}_{-0.07}$
1994-2005 $e^\pm p$	Total	25	$24.2\ ^{+4.2}_{-5.8}$	$2.0\ ^{+0.33}_{-0.40}$	$22.2\ ^{+4.2}_{-5.8}$
278 pb^{-1}	$P_T^X > 25$ GeV	3	$0.74\ ^{+0.19}_{-0.16}$	$0.44\ ^{+0.07}_{-0.09}$	$0.31\ ^{+0.18}_{-0.13}$

Table 2: Summary of the H1 search for events with tau leptons and missing transverse momentum for the e^+p data ($\mathcal{L}$=153 pb^{-1}), e^-p data ($\mathcal{L}$=125 pb^{-1}) and the full HERA data set ($\mathcal{L}$=278 pb^{-1}). The results are shown for the full selected sample and for the subsample at large $P_T^X > 25$ GeV. The number of observed events is compared to the SM prediction. The signal (W decay into τ) and the background contributions are also shown. The quoted errors contain statistical and systematic uncertainties added in quadrature.

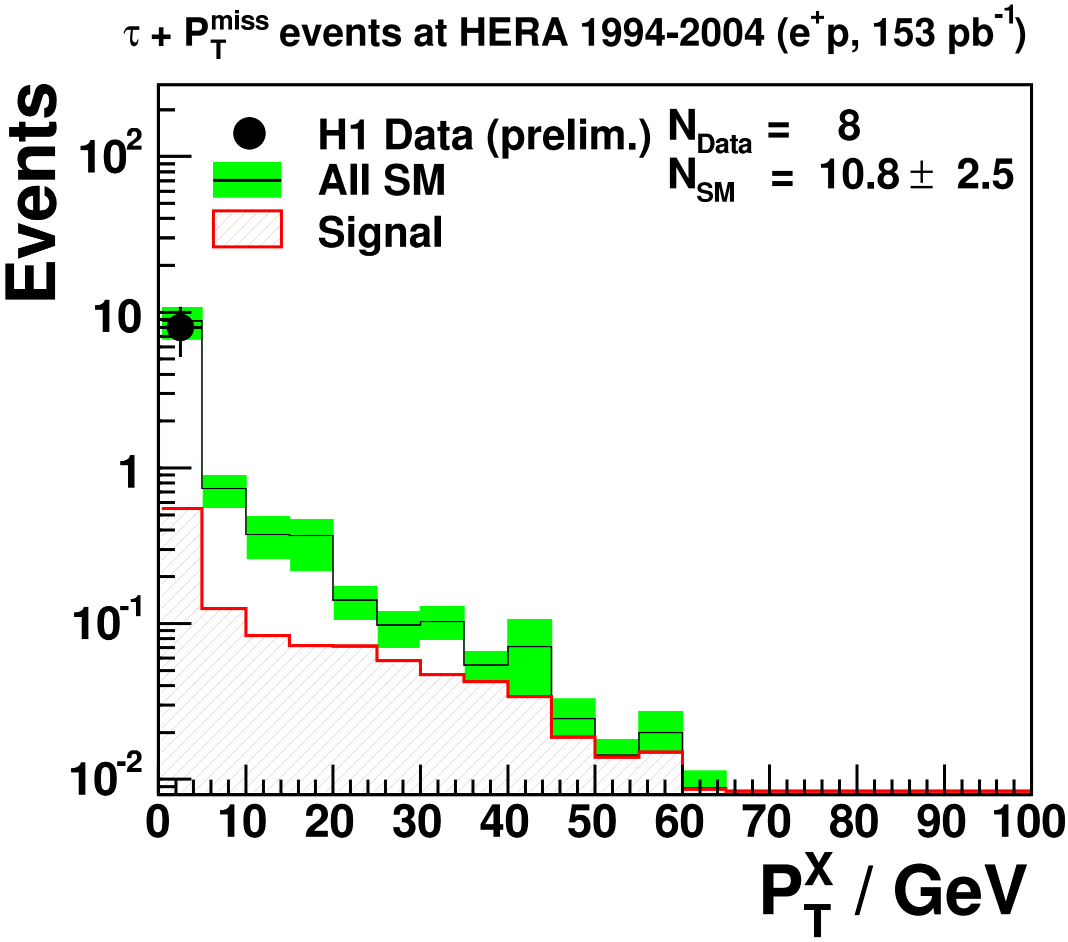

Figure 1: The hadronic transverse momentum distribution of $\tau + P_T^{\rm miss}$ events in HERA e^+p data ($\mathcal{L} = 153$ pb^{-1}) is compared to the SM expectation (open histogram). The signal component of the SM expectation, dominated by real W production, is given by the hatched histogram. $\rm N_{Data}$ is the total number of data events observed, $\rm N_{SM}$ is the total SM expectation. The total error on the SM expectation is given by the shaded band.

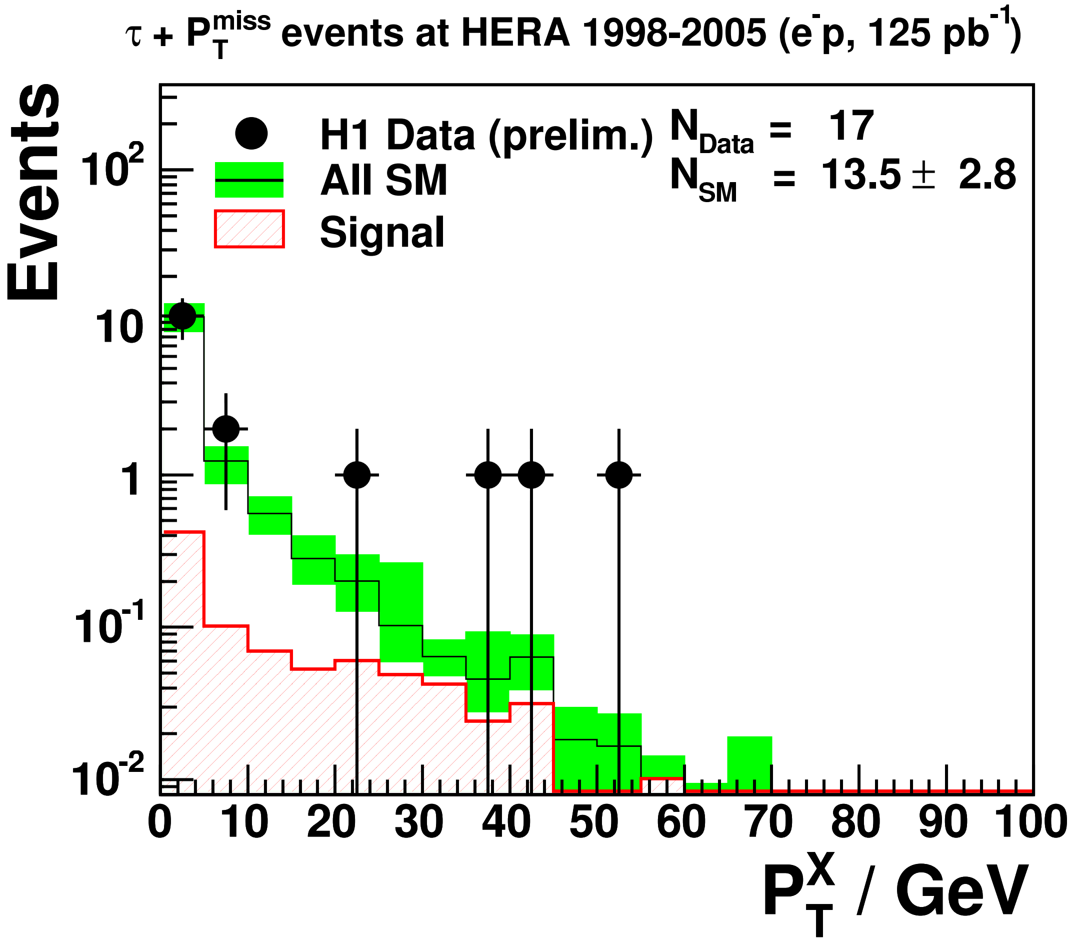

Figure 2: The hadronic transverse momentum distribution of $\tau + P_T^{\rm miss}$ events in HERA e^-p data ($\mathcal{L} = 125$ pb^{-1}) is compared to the SM expectation (open histogram). The signal component of the SM expectation, dominated by real W production, is given by the hatched histogram. $\rm N_{Data}$ is the total number of data events observed, $\rm N_{SM}$ is the total SM expectation. The total error on the SM expectation is given by the shaded band.

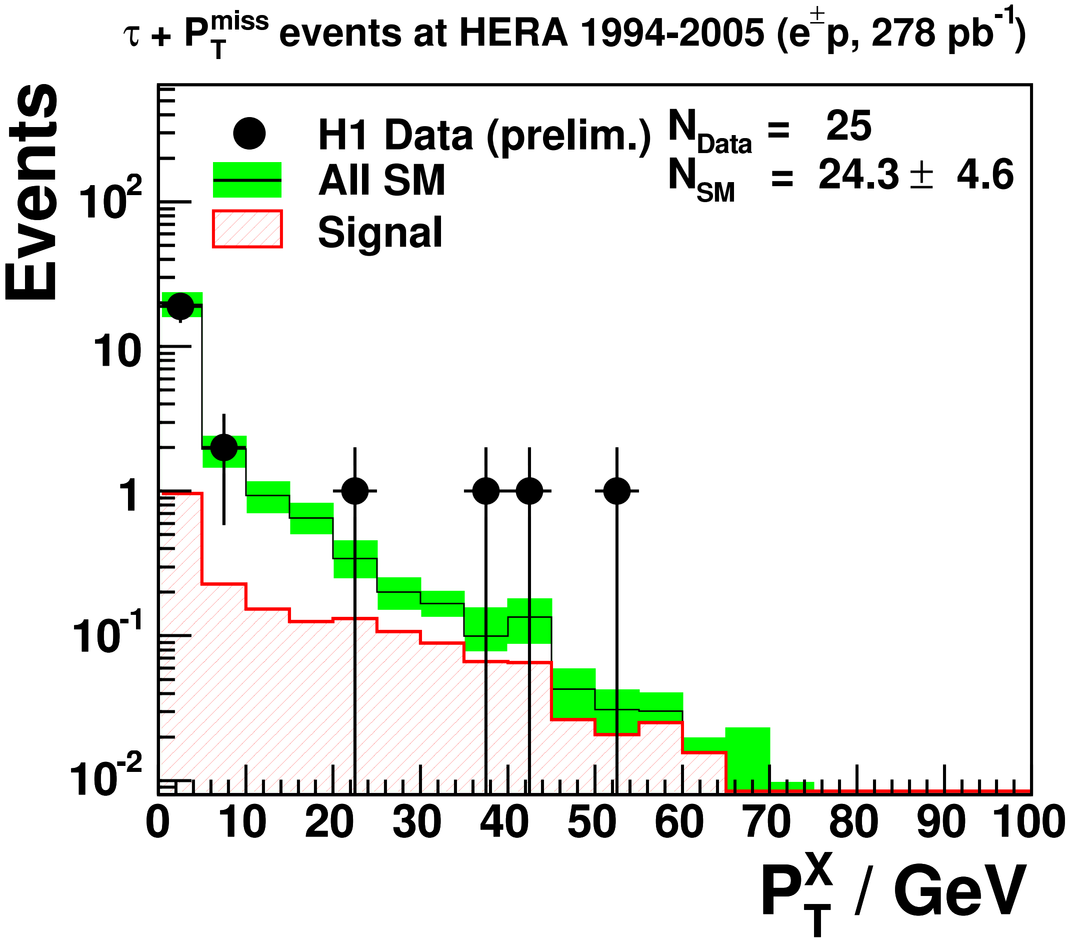

Figure 3: The hadronic transverse momentum distribution of $\tau + P_T^{\rm miss}$ events in HERA $e^{\pm}p$ data ($\mathcal{L} = 278$ pb^{-1}) is compared to the SM expectation (open histogram). The signal component of the SM expectation, dominated by real W production, is given by the hatched histogram. $\rm N_{Data}$ is the total number of data events observed, $\rm N_{SM}$ is the total SM expectation. The total error on the SM expectation is given by the shaded band.

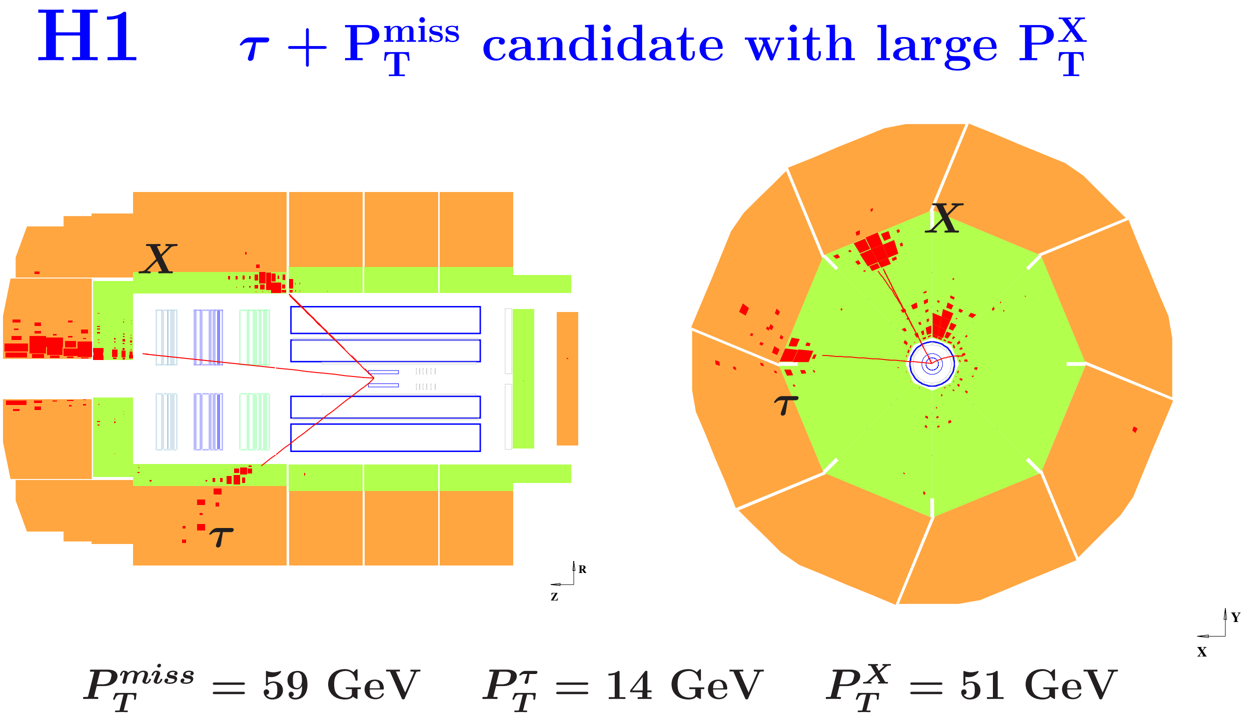

Figure 4: Candidate event with an isolated tau and $P_T^{\rm miss}$ containing a prominent hadronic system X.

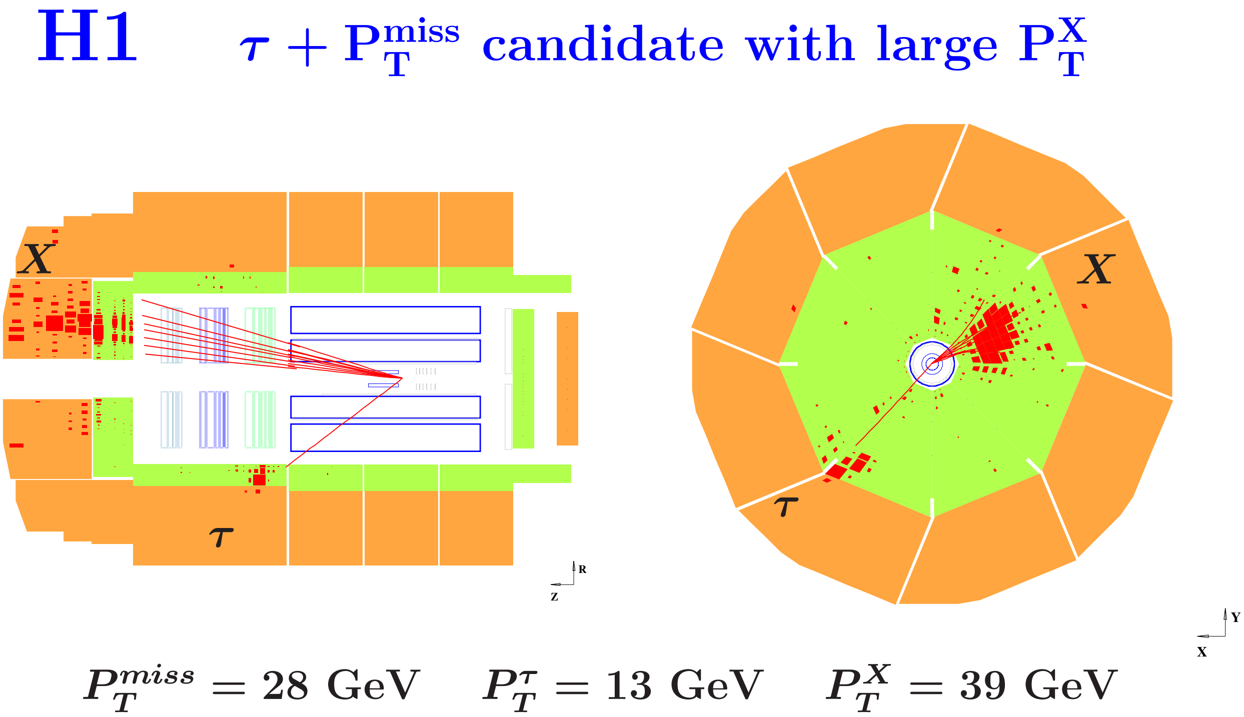

Figure 5: Candidate event with isolated tau and $P_T^{\rm miss}$ containing a prominent hadronic system X.

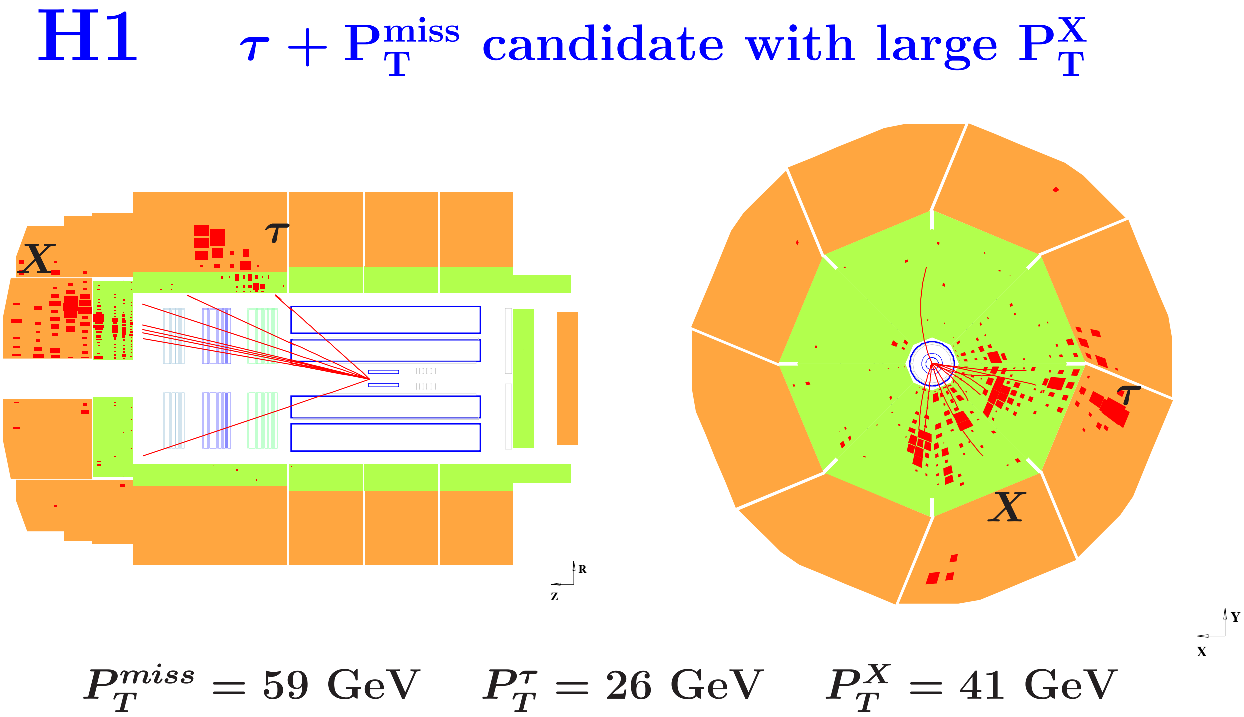

Figure 6: Candidate event with isolated tau and $P_T^{\rm miss}$ containing a prominent hadronic system X.