Submitted to
XVIII International Workshop on Deep-Inelastic Scattering, DIS2010, April 19-23, 2010, Florence
Parallel Session **Electroweak and Searches in DIS and Hadron Colliders**
Electronic Access:https://www-h1.desy.de/publications/H1preliminary.short_list.html

Search for Lepton Flavour Violation at HERA

H1 Collaboration

Abstract

A search for the lepton flavour violating processes $ep \to \mu X$ and $ep \to \tau X$ is performed with the H1 experiment at HERA. Final states with a muon or tau lepton and a hadronic jet are searched for in an H1 $e^{\pm}p$ data sample corresponding to an integrated luminosity of 410 pb^{-1}. No evidence for lepton flavour violation is found. Limits are derived on the mass and the couplings of leptoquarks inducing lepton flavour violation in an extension of the Buchmüller–Rückl–Wyler effective model, assuming $\lambda_{eq} = \lambda_{\mu q}$ and $\lambda_{eq} = \lambda_{\tau q}$ for the second and third generations respectively. For the third generation limits, muonic and 1–prong hadronic tau decays are considered. Leptoquarks produced in $e^{\pm}p$ collisions with a coupling strength of $\lambda = 0.3$ and decaying with the same coupling strength to a muon–quark pair or a tau–quark pair are excluded at 95% confidence level up to masses of 530 GeV and 440 GeV, respectively.

$F=2$	Prod./Decay	β_ℓ	$F=0$	Prod./Decay	β_ℓ
Scalar Leptoquarks					
$S_{0,L}$	$e_L^- u_L \to \ell^- u$	$1/2$	$S_{1/2,L}$	$e_R^+ u_R \to \ell^+ u$	1
	$\to \nu_\ell\, d$	$1/2$			
$S_{0,R}$	$e_R^- u_R \to \ell^- u$	1	$S_{1/2,R}$	$e_L^+ u_L \to \ell^+ u$	1
$\tilde{S}_{0,R}$	$e_R^- d_R \to \ell^- d$	1		$e_L^+ d_L \to \ell^+ d$	1
$S_{1,L}$	$e_L^- d_L \to \ell^- d$	1	$\tilde{S}_{1/2,L}$	$e_R^+ d_R \to \ell^+ d$	1
	$e_L^- u_L \to \ell^- u$	$1/2$			
	$\to \nu_\ell\, d$	$1/2$			
Vector Leptoquarks					
$V_{1/2,R}$	$e_R^- d_L \to \ell^- d$	1	$V_{0,R}$	$e_L^+ d_R \to \ell^+ d$	1
	$e_R^- u_L \to \ell^- u$	1	$V_{0,L}$	$e_R^+ d_L \to \ell^+ d$	$1/2$
				$\to \overline{\nu_\ell}\, u$	$1/2$
$V_{1/2,L}$	$e_L^- d_R \to \ell^- d$	1	$\tilde{V}_{0,R}$	$e_L^+ u_R \to \ell^+ u$	1
$\tilde{V}_{1/2,L}$	$e_L^- u_R \to \ell^- u$	1	$V_{1,L}$	$e_R^+ u_L \to \ell^+ u$	1
				$e_R^+ d_L \to \ell^+ d$	$1/2$
				$\to \overline{\nu_\ell}\, u$	$1/2$

Table 1: Leptoquark isospin families in the Buchmüller-Rückl-Wyler model. For each leptoquark, the subscript denotes its weak isospin and the chirality of the incoming lepton, which could mediate their production in $e^\pm p$ collisions. Leptoquarks that couple to a left–handed lepton doublet and can decay into a neutrino-quark pair, have a charged lepton decay branching ratio of $\beta_\ell = \Gamma_{\ell q}/(\Gamma_{\ell q} + \Gamma_{\nu_\ell q}) = 1/2$

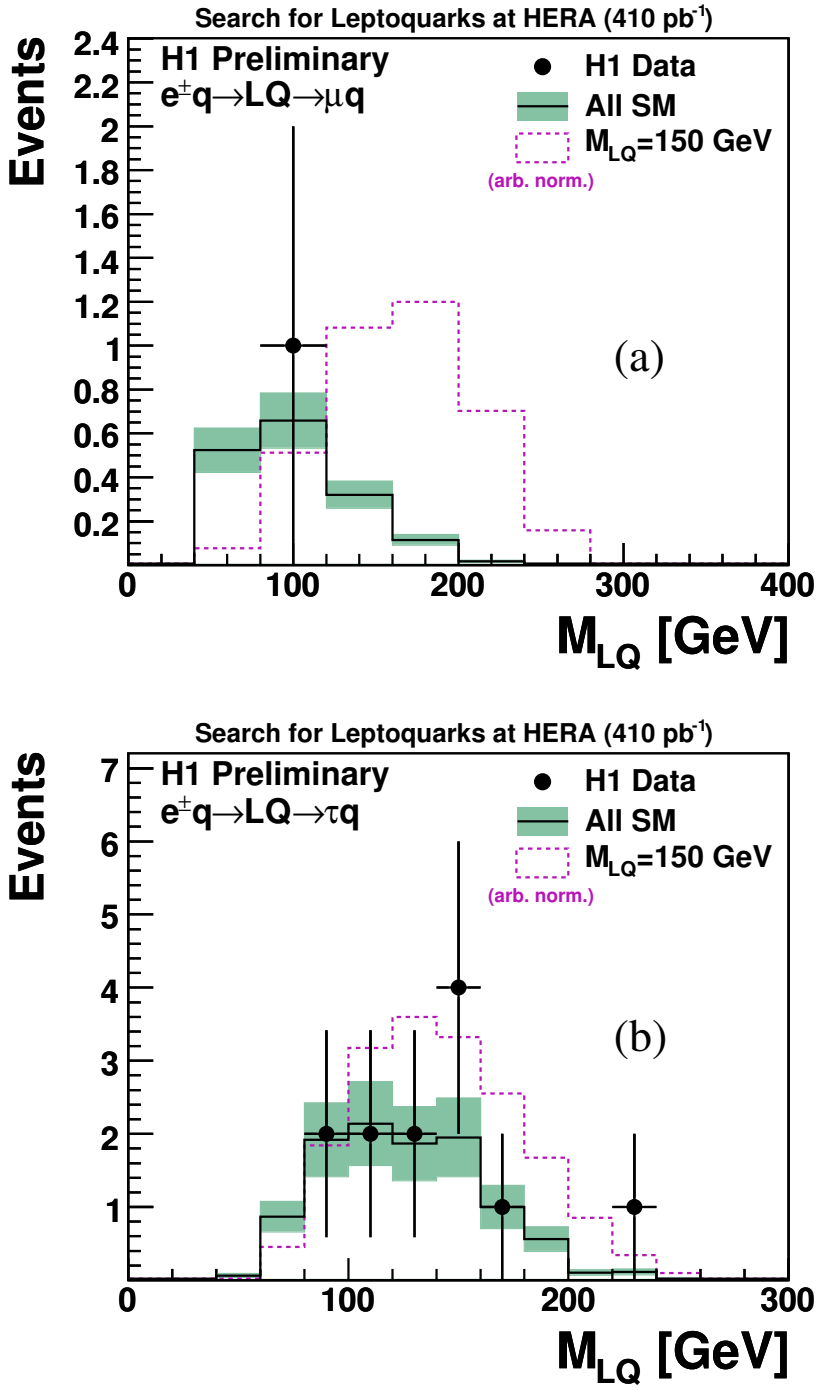

Figure 1: The reconstructed leptoquark mass in the search for (a) $ep \to \mu X$ and (b) $ep \to \tau X$ events. The data are the points and the total uncertainty on the SM expectation (open histogram) is given by the shaded band. The dashed histogram indicates the LQ signal with arbitrary normalisation for a leptoquark mass of 150 GeV.

Search for Second Generation Leptoquarks

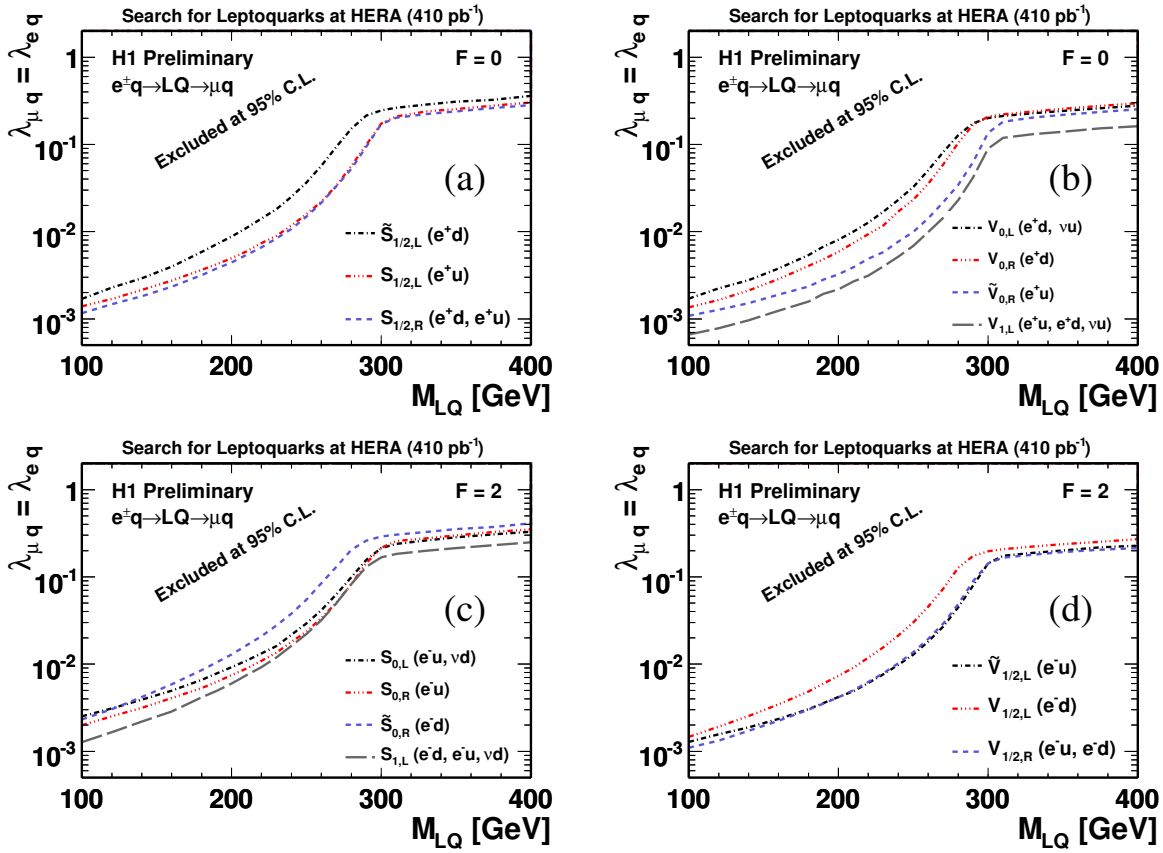

Figure 2: Exclusion limits on the coupling constants $\lambda_{\mu q} = \lambda_{eq}$ as a function of the leptoquark mass $\mathrm{M_{LQ}}$ for (a) scalar LQs with $\mathrm{F} = 0$, (b) vector LQs with $\mathrm{F} = 0$, (c) scalar LQs with $\mathrm{F} = 2$ and (d) vector LQs with $\mathrm{F} = 2$. Regions above the lines are excluded at 95% CL.

Search for Third Generation Leptoquarks

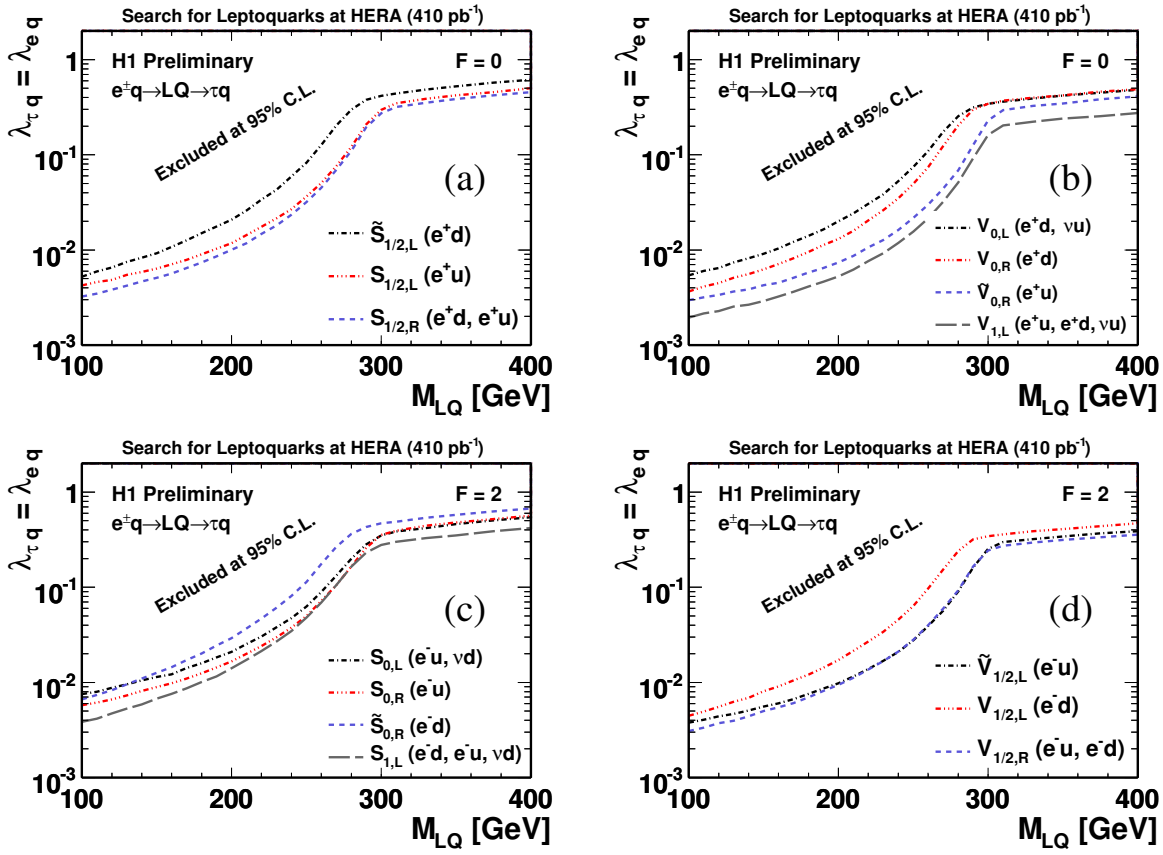

Figure 3: Exclusion limits on the coupling constants $\lambda_{\tau q} = \lambda_{eq}$ as a function of the leptoquark mass $\mathrm{M_{LQ}}$ for (a) scalar LQs with $\mathrm{F} = 0$, (b) vector LQs with $\mathrm{F} = 0$, (c) scalar LQs with $\mathrm{F} = 2$ and (d) vector LQs with $\mathrm{F} = 2$. Regions above the lines are excluded at 95% CL.

H1 Candidate Event in the Search for Second Generation Leptoquarks

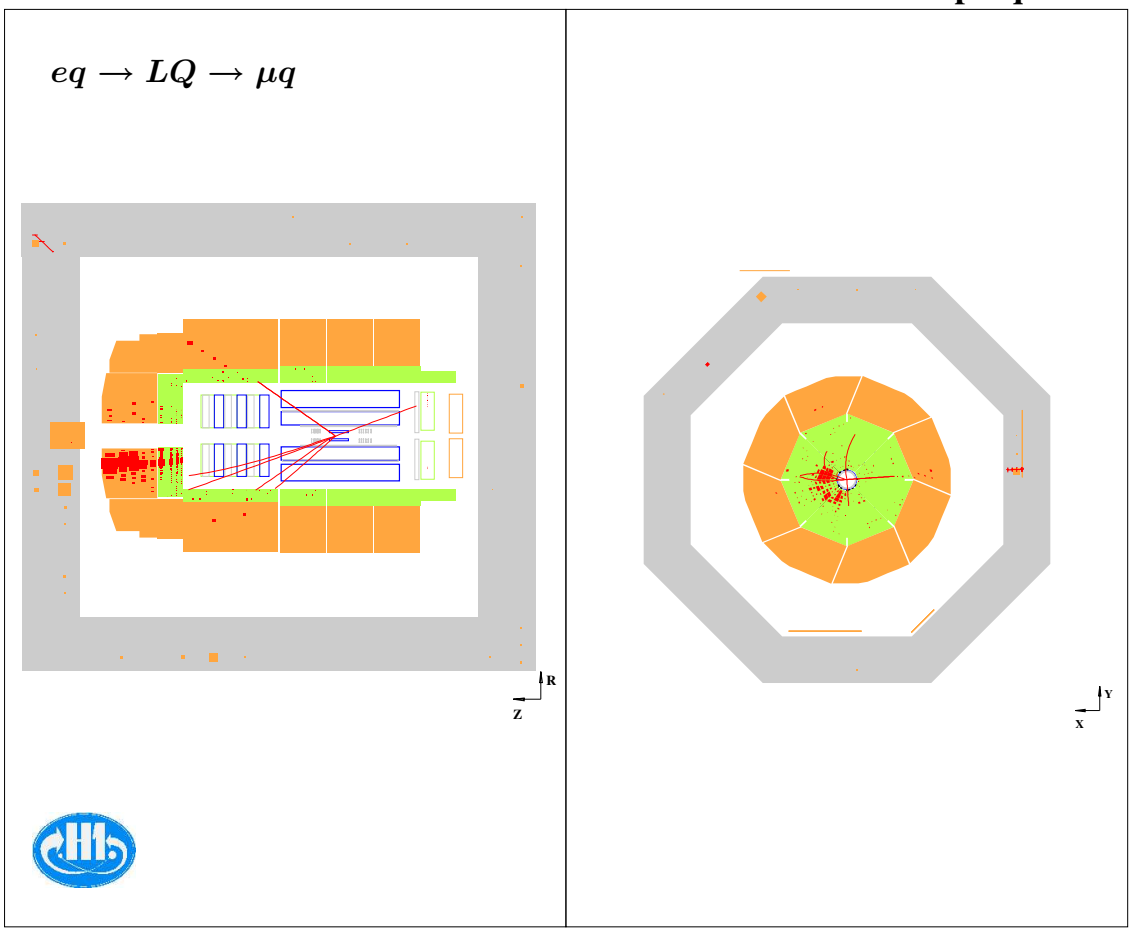

Figure 4: Display of the H1 $ep \rightarrow \mu X$ candidate data event observed in the search for second generation leptoquarks.

H1 Candidate Event in the Search for Third Generation Leptoquarks

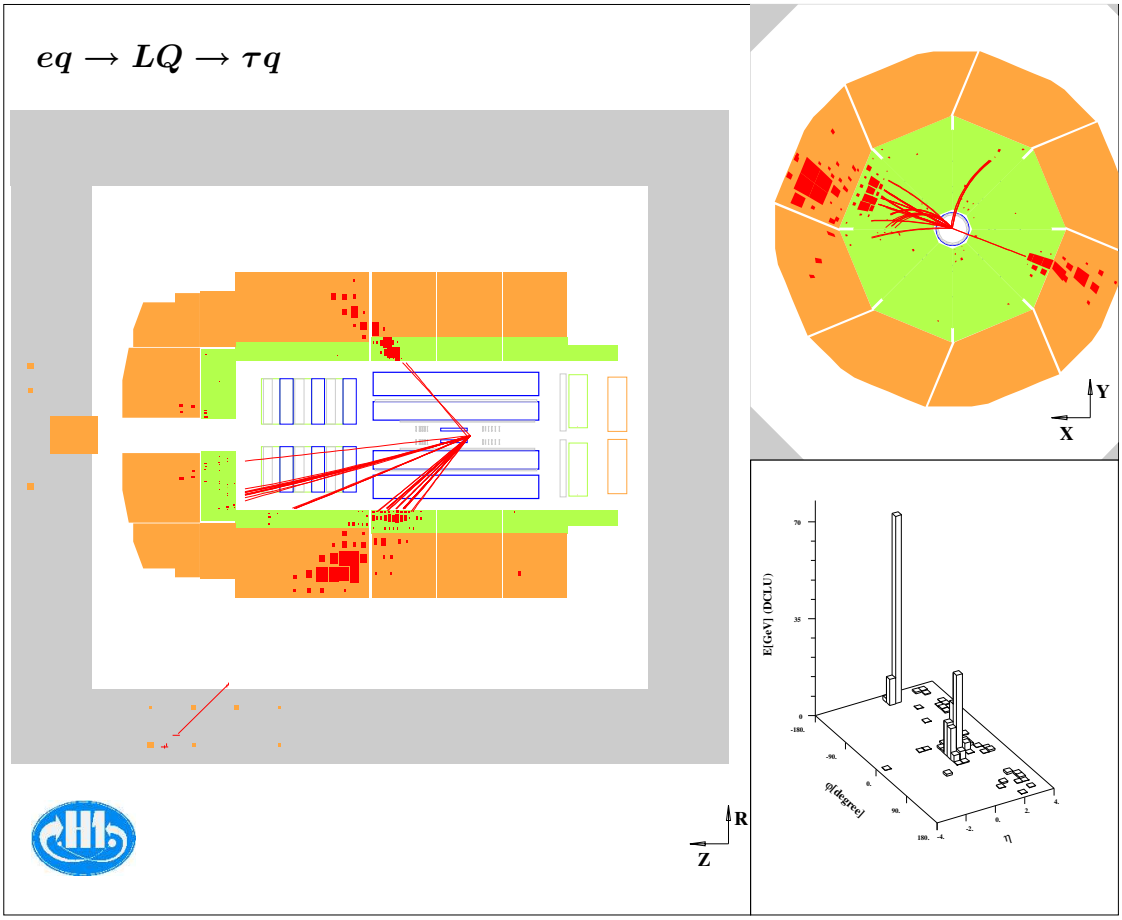

Figure 5: Display of an H1 $ep \rightarrow \tau X$ candidate data event observed in the search for third generation leptoquarks.