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Search for Leptoquarks in ep collisions at HERA

H1 Collaboration

Abstract

A search for scalar and vector leptoquarks coupling to first generation fermions is performed in the H1 experiment at the ep collider HERA. No significant evidence for the direct production of such particles is found in $\sim$ 37 pb $^{-1}$ of e^+p integrated luminosity collected at $\sqrt{s} = 300$ GeV from 1994 to 1997, although a slight excess over the Deep Inelastic Scattering Standard Model expectation is observed in the mass spectrum for masses $M \simeq 200$ GeV. No significant evidence for leptoquark production is found in ~ 14.4 pb $^{-1}$ of e^-p data collected at $\sqrt{s} = 320$ GeV from 1998 to 1999. Mass dependent constraints on the Yukawa coupling of leptoquarks are derived. The constraints on leptoquarks with fermionic number $F = 0$ ($F = 2$) make use of the e^+p (e^-p) data sample. For leptoquarks masses far above the centre-of-mass energy constraints are also derived from indirect searches performed in a contact interaction approach. A preliminary analysis of ~ 47.6 pb $^{-1}$ of new e^+p data collected in 1999 to 2000 reveals no evidence for direct leptoquark production.

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A search for leptoquarks in $e^+p \to e + X$ and $e^+p \to \nu + X$ processes using 1994 to 1997 data collected at $\sqrt{s} = 300$ GeV by H1 has been presented in ref. [1]. Since no significant

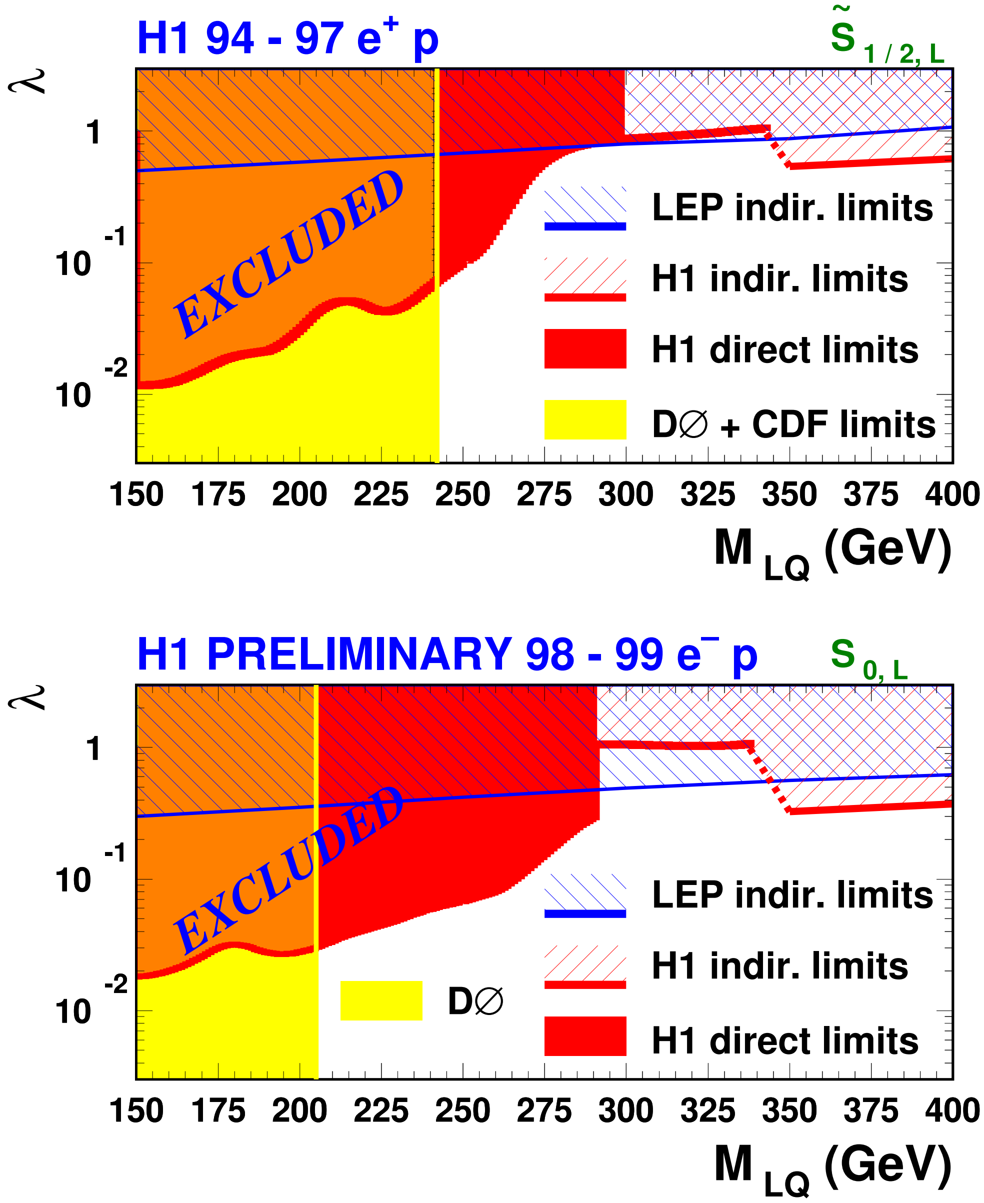

Figure 1: Exclusion limits at 95% CL on the Yukawa coupling λ as a function of the LQ mass for (top) a scalar LQ with $F = 0$ and (bottom) a scalar LQ with $F = 2$ described by the BRW model. Greyed and hatched domains are excluded.

evidence for a LQ signal has been observed, constraints on the Yukawa coupling of leptoquarks were derived, which represent the best constraints available from H1 for direct searches for leptoquarks carrying fermionic number $F = 0$. The figure 1 (top) shows for example a summary of the H1 constraints on the $\tilde{S}_{1/2,L}$ leptoquark described in the Buchmüller-Rückl-Wyler model [4] and a comparison to constraints set at LEP [5] and Tevatron [6]. Also plotted is the corresponding bound derived by H1 via a contact interaction (CI) analysis using all the available data [1] accumulated by H1 between 1994 and 2000 [7]. Also discussed in ref. [1] were constraints set in "generic" models where an arbitrary branching ratio β_e for the LQ to decay into $e + X$ is assumed, as well as direct and indirect constraints on LQ induced lepton flavour violating processes.

A search for leptoquarks in $e^- p \to e + X$ processes has been performed using ~ 14.4 pb $^{-1}$ of $e^- p$ data collected at $\sqrt{s} = 320$ GeV from 1998 to 1999. No evidence for leptoquark production was found and constraints were derived [9, 10]. The figure 1 (bottom) shows for example a summary of the H1 constraints on the $S_{0,L}$ leptoquark described in the Buchmüller-Rückl-Wyler model and a comparison to constraints set at LEP [5] and Tevatron [6]. Also plotted is the corresponding constraint derived by H1 via a CI analysis using all available data accumulated by H1 between 1994 and 2000 [7].

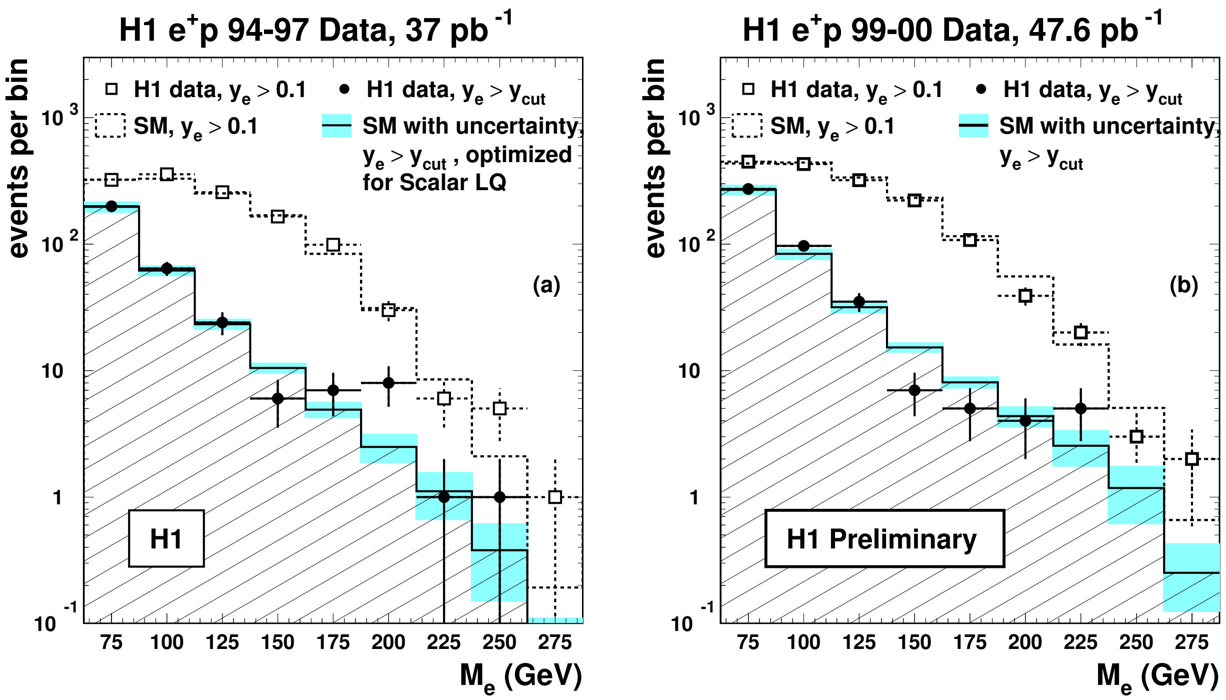

Figure 2: Mass spectra for NC DIS-like final states for data (symbols) and DIS expectation (histograms). The NC DIS-like comparison is shown before (open squares, white histogram) and after (closed dots, hatched histogram) a y cut designed to maximize the significance of an eventual scalar. The spectra are shown for (a) 1994 to 1997 data and (b) 1999 to 2000 $e + p$ data. The greyed boxes indicate the $\pm 1\sigma$ error band combining the statistical and systematic errors of the NC DIS expectation.

Although no significant deviation from the Standard Model expectation was found in the

[1]New CI constraints combining the information from all available $e^+ p$ and $e^- p$ data are presented for the first time at this ICHEP2000 conference [7].

94-97 e^+p data an excess of events was observed for masses around 200 GeV as can be seen in Fig. 2a, where the mass distribution of the observed high Q^2 DIS candidates is compared to the SM expectation. A search for leptoquarks in $e^+p \to e + X$ processes using ~ 47.6 pb $^{-1}$ of new data collected in 1999 to 2000 reveals no evidence for direct leptoquark production as can be seen in Fig. 2b. The excess seen in the mass spectrum from the previous analysis [1] based on 1994 to 1997 data (Fig. 2a) is not confirmed by the new data (Fig. 2b).

Acknowledgements

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References

[1] H1 Collaboration, C. Adloff et al., *Eur. Phys. J.* **C 11** (1999) 447; *Erratum published online (April 2000)*

[2] H1 Collaboration, C. Adloff et al., *Z. Phys.* **C 74** (1997) 191; ZEUS Collaboration, J. Breitweg et al., *Z. Phys.* **C 74** (1997) 207.

[3] H1 Collaboration, C. Adloff et al., *Eur. Phys. J.* **C 13** (2000) 609.

[4] W. Buchmüller, R Rückl and D Wyler, *Phys. Lett.* **B 191** (1997) 442; *Erratum Phys. Lett.* **B 1999** (320) .

[5] OPAL Collaboration, K. Ackerstaff et al., *Eur. Phys. J.* **C 6** (1999) 1.

[6] CDF and $D\emptyset$ Collaborations, "Combined Limits on First Generation Leptoquarks from the CDF and $D\emptyset$ Experiments", hep-ex/9810015, Oct. 1998, 9pp.

[7] H1 Collaboration, "Search for Compositeness, Leptoquarks and Large Extra Dimensions in eq Contact Interactions at HERA, Contributed paper #951, 30th International Conference on High Energy Physics, ICHEP2000, Osaka, Japan (July 2000) 11pp.

[8] H1 Collaboration, C. Adloff et al., *Phys. Lett.* **B 479** (2000) 358.

[9] G. Rädel , "Search for New Phenomena at HERA", Proceedings of the XXXVth Rencontres de Moriond on Electroweak Interactions and Unified Theories (March 2000) 8pp.

[10] H1 Collaboration, "A Search for Leptoquark Bosons in e^-p Collisions at HERA", Contributed paper #954, 30th International Conference on High Energy Physics, ICHEP2000, Osaka, Japan (July 2000) 10pp.