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A Search for Excited Electrons in *ep* scattering at HERA

H1 Collaboration

Abstract

A direct search for production of excited electrons in the mass range from 10 GeV up to 225 GeV is presented by the H1 experiment at HERA. The data were obtained during 1994 and correspond to an integrated luminosity of $\approx 3\,\mathrm{pb}^{-1}$. The decay channel $e^* \rightarrow e\,\gamma$ was investigated. No evidence was found for the production of new excited electrons. Rejection limits for excited electrons are derived.

1 Introduction

This is a short description of the analysis using 1994 data from the H1 detector [1] on the search for excited electrons. At HERA electrons of 27.6 GeV collide with protons of 820 GeV. Details on data selection cuts and results on the search for new heavy leptons using 1993 data can be found in ref. [2]. The decay channel under study in this analysis is $e^* \to e\,\gamma$. The data sample analyzed corresponds to an integrated luminosity of ≈ 3 pb^{-1}.

2 Results

The whole analysis is based mainly on calorimetric information. The data selection cuts are divided into two parts:

(A) 'Elastic selection': Two isolated electromagnetic (e.m.) clusters with a summed energy greater than 20 GeV are required. Additional energy in the rest of the calorimeters must be less than 5 GeV. These cuts select mainly elastic Wide Angle Bremsstrahlung (WAB) events. This is the natural background for the channel $e^* \to e\,\gamma$.

(B) 'High E_T selection': Two isolated e.m. clusters with transverse energies greater than 20 GeV and 12 GeV are required, respectively. This covers the inelastic part of the WAB process and $e^* \to e\,\gamma$ production.

In the elastic selection (A) 402 events are found and 426 are expected from WAB Monte Carlo [3]. Fig. 1 shows the distribution of invariant masses for selected electron-photon-pairs. The highest invariant mass is at 98 GeV. Above masses of 60 GeV 4 events are found in data and 3.4 events are expected from WAB process. A Kolmogorov-Smirnov test gives a probability of 33%, that both distributions agree. There is no hint for any resonant excess of events in the $e\,\gamma$-final state.

In the high E_T selection (B) 12 events are selected in data whilst 13.2 events are expected from WAB process. There is good agreement between data and Monte Carlo expectation.

No signal for excited electron production has been observed. Therefore rejection limits are derived, using a specific model [4]. Fig. 2 shows exclusion limits for excited electrons on $c_{\gamma e^* e}/\Lambda \cdot \sqrt{BR^*}$ at 95% confidence level (CL). Here $c_{\gamma e^* e}$ denote the coupling constant at the production vertex, Λ the scale parameter, and BR^* the branching ratio of e^*. Also shown in Fig. 2 are recently published limits from H1 1993 data, including decay channels $e^* \to e\,Z$ and $e^* \to \nu\,W$ [2].

The limits can be given in a more general way. Fig. 3 shows rejection limits on $\sigma \cdot BR^*$ at 95% CL, where σ is the production cross section of excited electrons. The figure contains also 1993 H1 results including decay channels to $e\,Z$ and $\nu\,W$ final states. In calculating these limits the model [4] is used to estimate total detection efficiencies. The limits on $\sigma \cdot BR^*$ for $e^* \to e\,\gamma$ improve by roughly a factor of 7 compared to the 1993 analysis [2].

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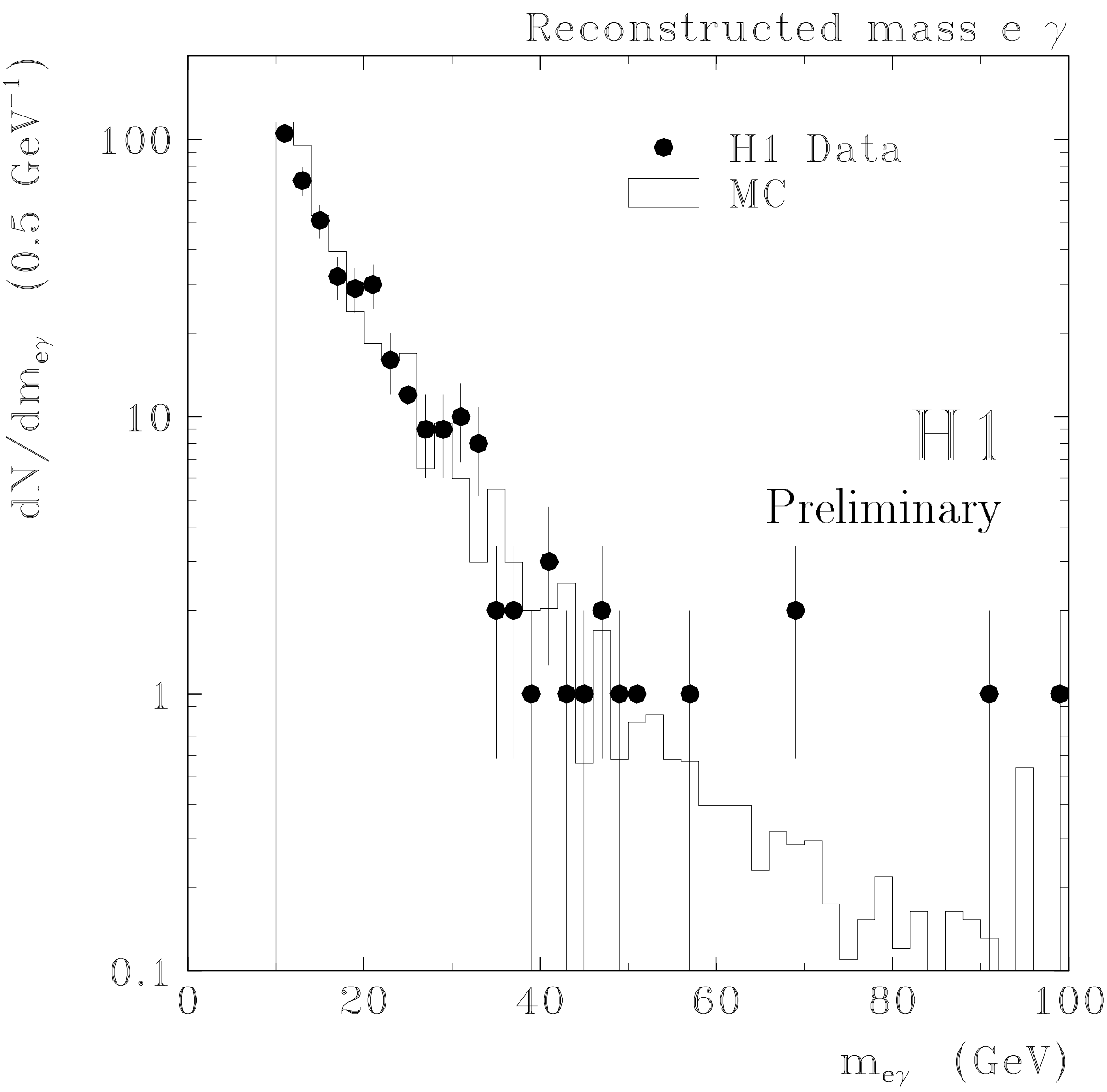

Figure 1: Distribution of invariant masses for electron-photon-pairs from elastic selection (A) compared with Monte Carlo expectation from WAB process.

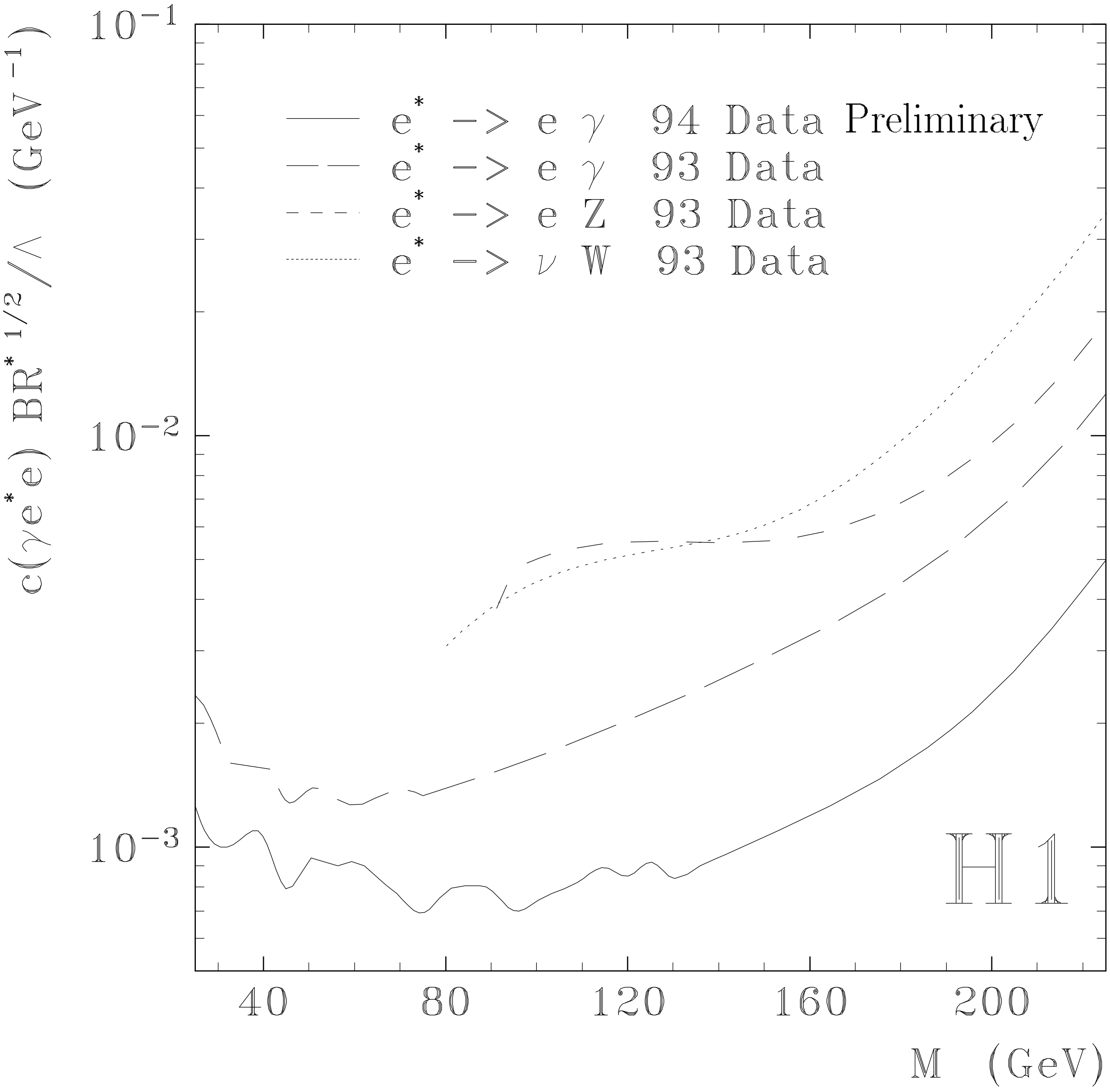

Figure 2: Exclusion limits on $c_{\gamma e^* e}/\Lambda \cdot \sqrt{BR^*}$ for excited electrons (95% CL). Different decay channels of W and Z are combined. Regions above the curves are excluded.

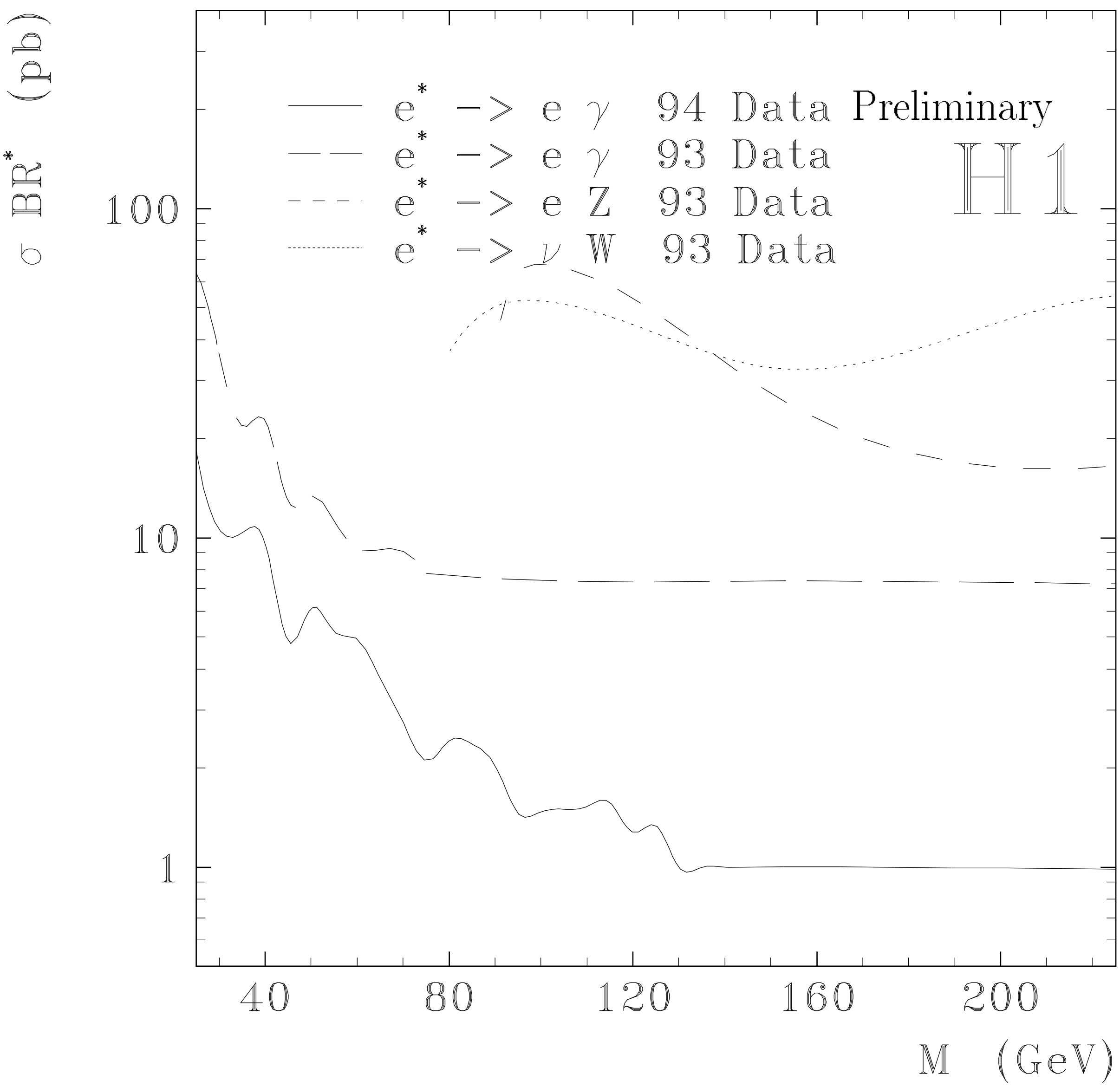

Figure 3: Exclusion limits on $\sigma \cdot BR^*$ for excited electrons (95% CL). Different decay channels of W and Z are combined. Regions above the curves are excluded.