1 Further comparisons to NLO calculations, addendum

As a result of the HERA-LHC workshop, a new next-to-leading order (NLO) QCD fit has been performed [1] using recently published inclusive diffractive measurements from the ZEUS experiment, determined using the M_X method [2]. This new fit by Groys-Levy-Proskuryakov (GLP) is based on a similar approach to that used for the ZEUS-LPS fit, except that the latter uses recently published results from ZEUS measured using the Leading Proton Spectrometer (LPS) [3] and earlier ZEUS results on the charm contribution to $F_2^{D(3)}$ [4]. The charm data are particularly important for constraining the diffractive gluon density. All of these fits are able, within the systematic uncertainties, to give a reasonable description of inclusive diffractive DIS measurements.

Figures 1 and 2 show the comparison of the three sets of predictions calculated using the DISENT program [5], adapted to use diffractive PDFs (dPDFs), including the results of the GLP fits. The 20-30% scale uncertainty given previously has been omitted. It is clear that the normalisation of the predictions from the GLP fit is substantially lower than those from the other two sets of dPDFs. Figure 3 shows a comparison of the diffractive quark and gluon densities from the three different fits. It can be seen that the different normalisations observed in figs. 1 and 2 arise from the substantial differences in the diffractive gluon densities. It should be noted that it is not only the normalisation which is different, but also the shapes of the distributions.

A more detailed comparison of the data and the three sets of NLO predictions can be seen in figs. 4, 5 and 6 in which the ratios of data to the ZEUS-LPS NLO predictions are shown. The plots also show the ratios of the cross sections obtained using the H1 2002 fit (prel.) and GLP parametrisations to the ZEUS-LPS fit, respectively. The differences in shape observed in the dPDFs (fig. 3) are clearly reflected in the different predictions, with the new GLP predictions providing a slightly better description of the shapes of the W and β distributions, but a noticeably worse description of the $z_{\mathbb{P}}^{\rm obs}$ distribution.

There are a number of possible explanations for the differences observed between the three sets of predictions, including differing approaches to the fitting procedure and the different constraints imposed on the dPDFs according to which datasets are used in the fits. Whatever the explanation, the differences observed between the three sets of predictions may be interpreted as an estimate of the uncertainty associated with the dPDFs. A better understanding of the dPDFs and their uncertainties is required before a firm statement about the validity of QCD factorisation can be made. It is also clear that these data should be included in future fits, in order to better constrain the diffractive gluon density.

References

[1] M. Groys, A. Levy and A. Proskuryakov, *to be published in the Proc. of the HERA-LHC Workshop*, DESY/CERN (2005).

[2] ZEUS Coll., S. Chekanov et al., accepted by Nucl. Phys. **B**, DESY 05-011 (2005).

[3] ZEUS Coll., S. Chekanov et al., Eur. Phys. J. **C 38**, 43 (2004).

[4] ZEUS Coll., S. Chekanov et al., Nucl. Phys. **B 672**, 3 (2003).

[5] S. Catani and M.H. Seymour, Nucl. Phys. **B 485**, 291 (1997);
Erratum-ibid. **B 510** 503 (1997).

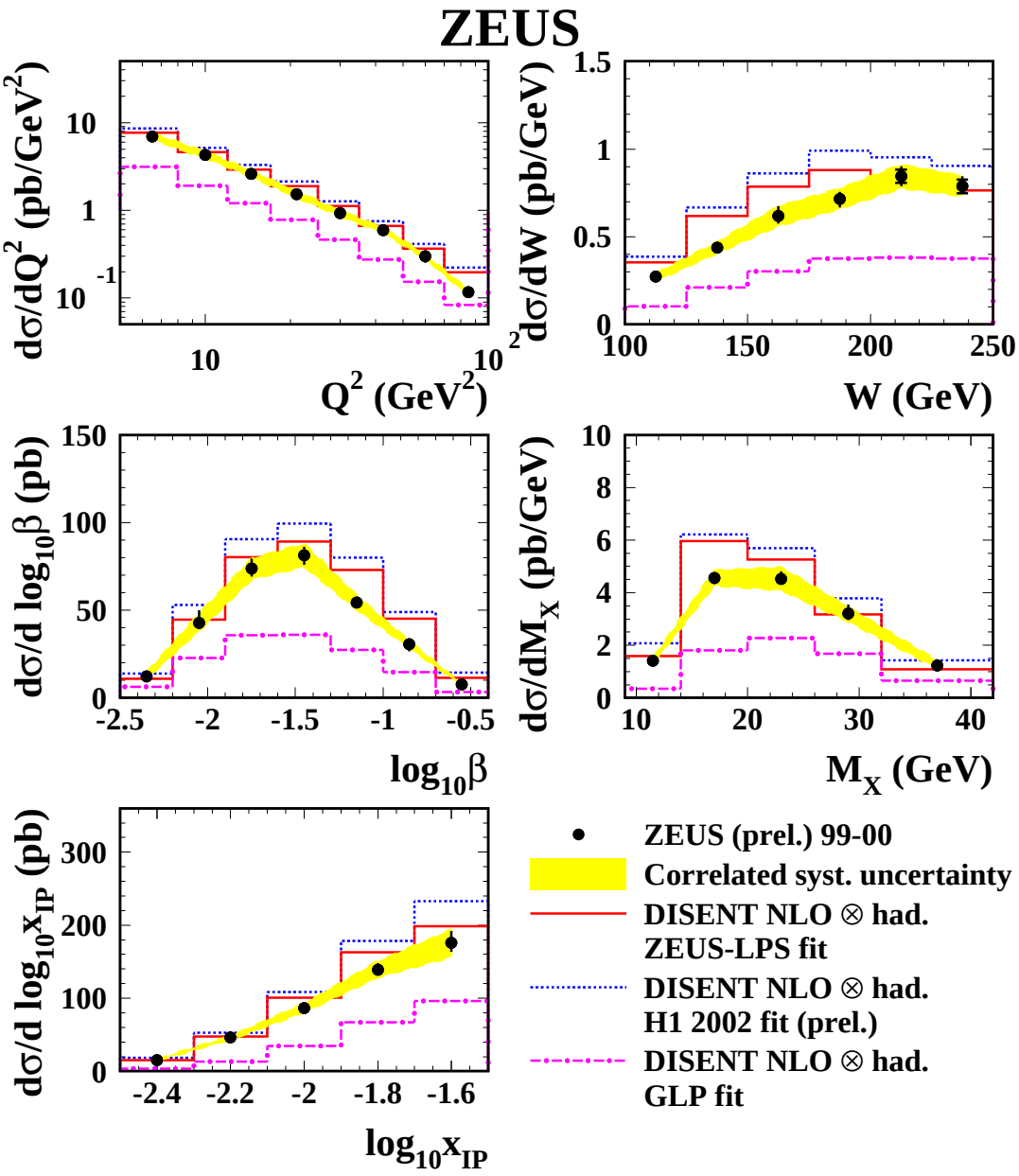

Figure 1: *The single differential cross sections in Q^2, W, $log_{10}\beta$, M_X and $\log x_{\mathbb{P}}^{\rm obs}$ compared to the three NLO QCD predictions. The diffractive PDFs from the ZEUS-LPS fit, H1 2002 fit (prel.) and the GLP fit are used for the NLO predictions. The data are shown as dots; the inner error bars represent the statistical uncertainty while the outer error bars represent the statistical and systematic uncertainties added in quadrature. The shaded band represents the correlated error, as described in the text. The solid lines represent the NLO cross sections from the ZEUS-LPS fit, while the NLO predictions from the H1 2002 fit (prel.) are drawn with a dotted line. The new predictions based on the GLP fit are shown as a dash-dotted line.*

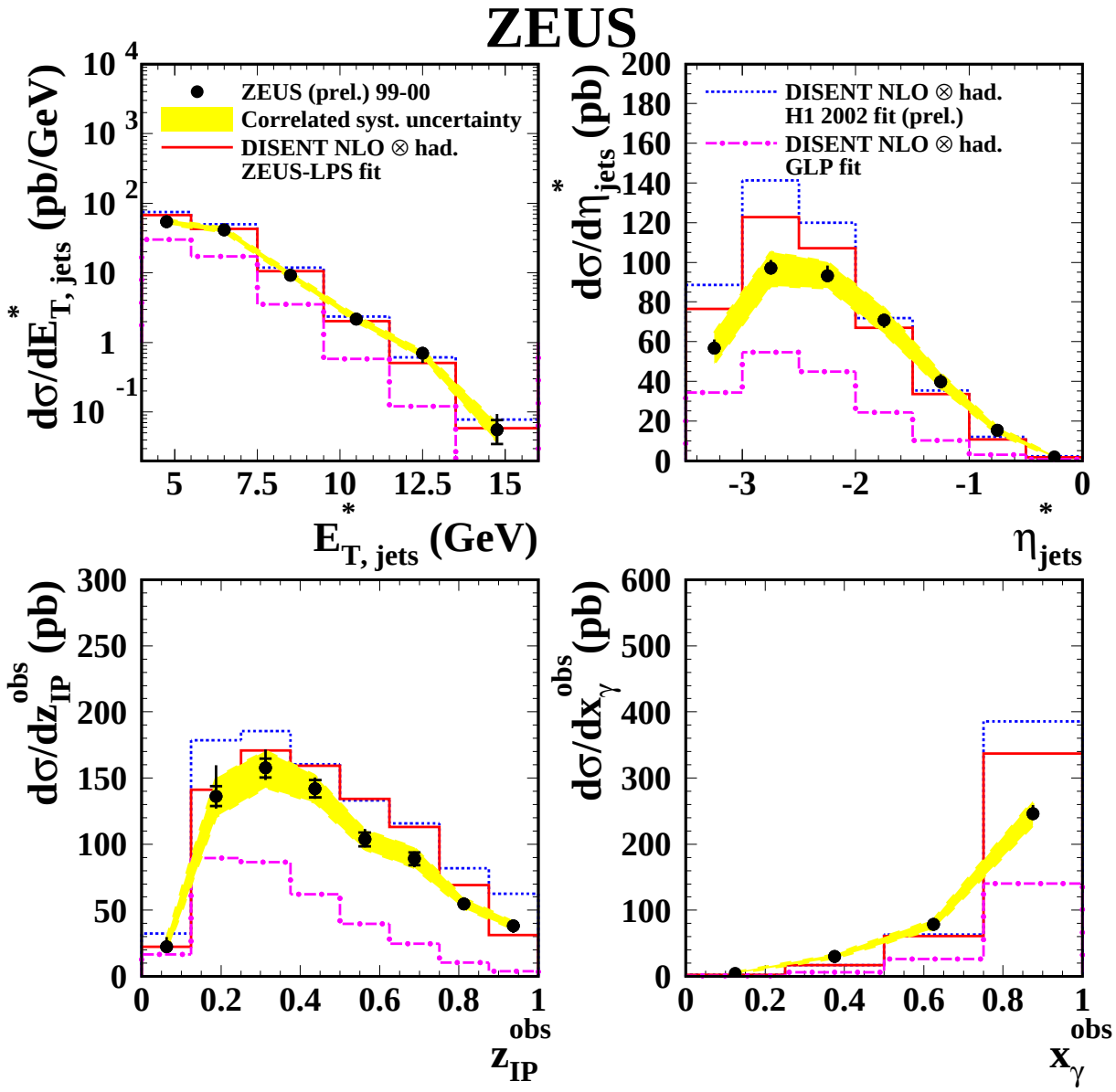

Figure 2: *The single differential cross sections in $E^*_{T,\mathrm{jet}}$, η^*_{jet}, $z^{\mathrm{obs}}_{\mathbb{P}}$ and $x^{\mathrm{obs}}_{\gamma}$ compared to the three sets of NLO QCD predictions. The data are shown as dots; inner error bars represent the statistical uncertainty while the outer error bars represent the statistical and systematic uncertainties added in quadrature. The shaded band represents the correlated error, as described in the text. The solid lines represent the NLO cross sections from the ZEUS-LPS fit, while the NLO predictions from the H1 2002 fit (prel.) are drawn with a dotted line. The new predictions based on the GLP fit are shown as a dash-dotted line.*

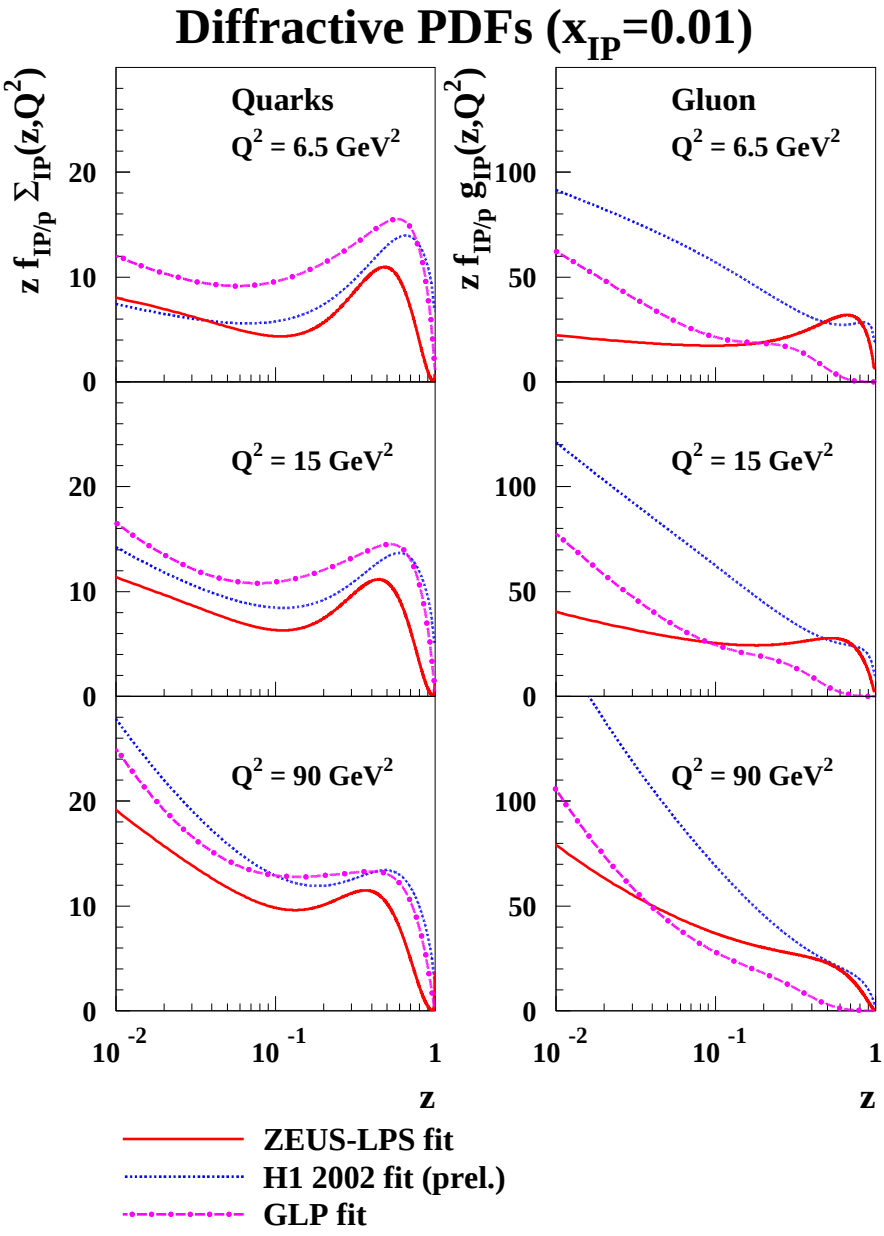

Figure 3: *The predicted dPDFS from the different NLO QCD fits. Both the quark and gluon distributions are shown for* $x_{\mathbb{P}}^{\rm obs} < 0.01$ *and for different values of* Q^2*. The gluon density is clearly dominant in the diffractive exchange and it is in these distributions that the most significant differences between the different fits lie. The solid lines represent the predictions from the ZEUS-LPS fit, while the dotted lines represent the H1 2002 fit (prel.). The GLP fit is shown as the dash-dotted lines.*

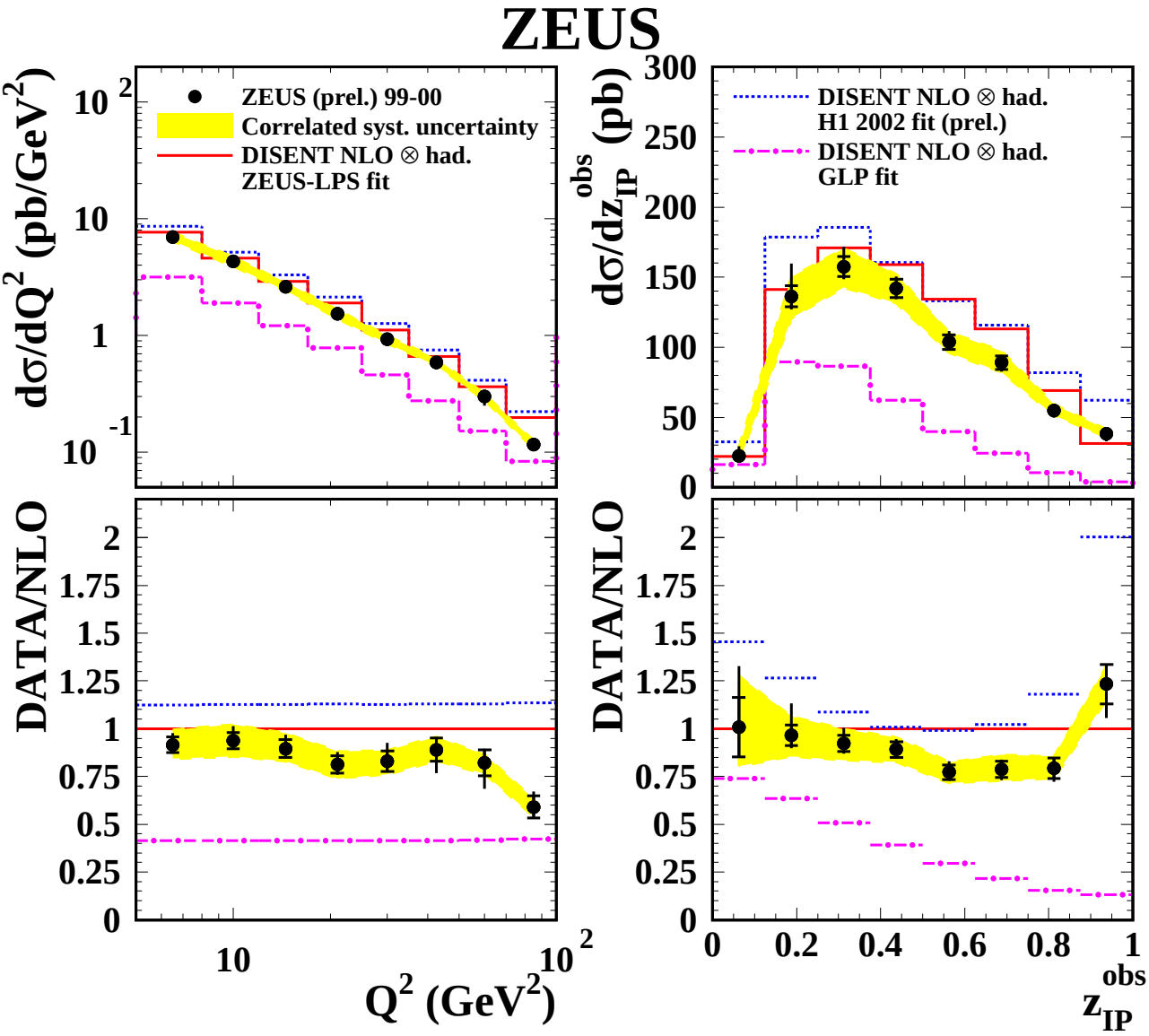

Figure 4: *Comparisons between data and NLO QCD predictions in Q^2 and $z_{\mathbb{P}}^{\rm obs}$. The upper plots show the single differential cross sections compared to the NLO QCD predictions while the lower plots show the ratio of data cross sections over NLO predictions from the ZEUS-LPS fit. The shaded band represents the correlated error, as described in the text. The solid lines represent the predictions based on the ZEUS-LPS fit, while the dotted lines show the ratio of the NLO predictions from H1 2002 fit (prel.) to those from the ZEUS-LPS fit. The ratio of the predictions from the GLP fit to those from the ZEUS-LPS fit are shown as dash-dotted lines.*

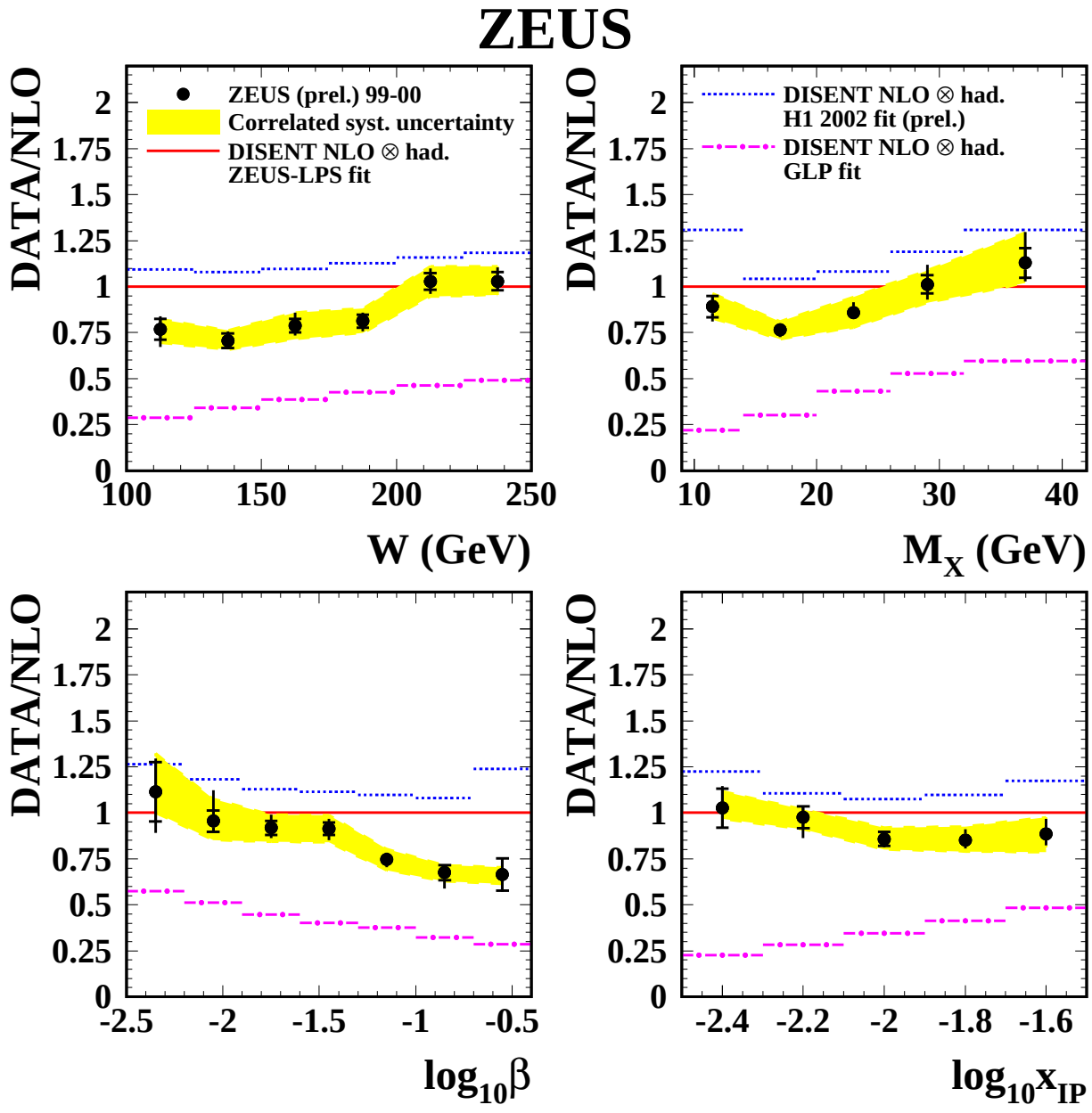

Figure 5: *Comparisons between data and NLO QCD predictions in W, M_X, $log_{10}\beta$ and $x_{\mathbb{P}}^{\rm obs}$. The plots show the ratio of data cross sections over NLO predictions. The data are shown as dots; the inner error bars represent the statistical uncertainty while the outer error bars represent the statistical and systematic uncertainties added in quadrature. The shaded band represents the correlated error, as described in the text. The solid lines represent the predictions based on the ZEUS-LPS fit, while the dotted lines show the ratio of the NLO predictions from H1 2002 fit (prel.) to those from ZEUS-LPS fit. The ratio of the predictions from the GLP fit to those from the ZEUS-LPS fit are shown as dash-dotted lines.*

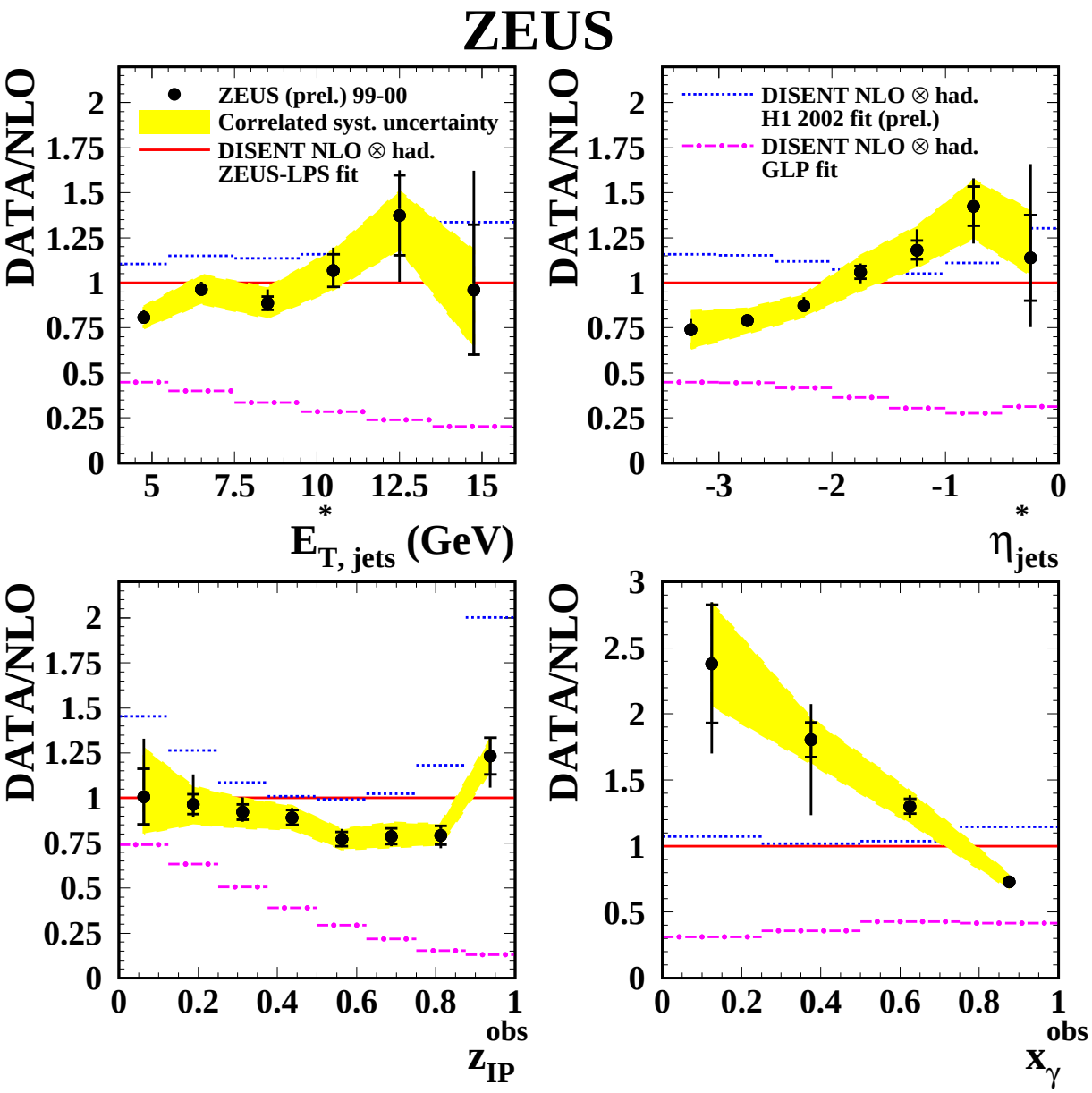

Figure 6: *Comparisons between data and NLO QCD predictions in $E^*_{T,\mathrm{jets}}$,η^*_{jets} and $\log x_\gamma^{\mathrm{obs}}$. Plots show the ratio of data cross sections over NLO predictions. The data are shown as dots; inner error bars represent the statistical uncertainty while the outer error bars represent the statistical and systematic uncertainties added in quadrature. The shaded band represents the correlated error, as described in the text. Solid lines with the hatched area indicate the predictions and their theoretical uncertainties. Dotted lines show the ratio of the NLO predictions from H1 2002 fit (prel.) over those from ZEUS-LPS fit, while dash-dotted lines show the ratio of NLO preoductions from the GLP fit to those from the ZEUS-LPS fit.*