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Probing Strangeness via Charm Production in Charged Current DIS at HERA

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Abstract

A high-$Q^2(> 200\,\mathrm{GeV}^2)$ measurement of charm production in charged current deep inelastic scattering has been performed in $e^{\pm}p$ collisions recorded at HERA with the ZEUS detector in 2003–2007 with an integrated luminosity of $358\,\mathrm{pb}^{-1}$. The measurement has been performed separately for positively and negatively charged events at a center-of-mass energy $\sqrt{s} = 318\,\mathrm{GeV}$ within a kinematic phase region $Q^2 > 200\,\mathrm{GeV}^2, y < 0.9, E_T^{jet} > 5\,\mathrm{GeV}$ and $-2.5 < \eta^{jet} < 2.5$. The total cross sections have been extrapolated from the visible cross sections for the full kinematic phase region. In addition, single-differential cross sections $d\sigma/dQ^2$ are presented as a function of Q^2.

Q^2 range (GeV^2)	$\frac{d\sigma}{dQ^2}(10^{-3}\,\mathrm{pb\,GeV}^{-2})$				
e^+p					
200–1554.9	8.3	± 3.5	(stat.)	$^{+0.17}_{-0.31}$	(sys.)
1554.9–100000	-0.013	± 0.050	(stat.)	$^{+0.00054}_{-0.00018}$	(sys.)
e^-p					
200–1554.9	-0.71	± 3.7	(stat.)	$^{+0.28}_{-0.28}$	(sys.)
1554.9–100000	-0.016	± 0.066	(stat.)	$^{+0.0025}_{-0.0030}$	(sys.)

Table 1: *Single-differential cross section $d\sigma/dQ^2$ measurements obtained in each bin with corresponding bin width. The listed systematic uncertainty does not include the uncertainty in ZEUS luminosity measurement.*

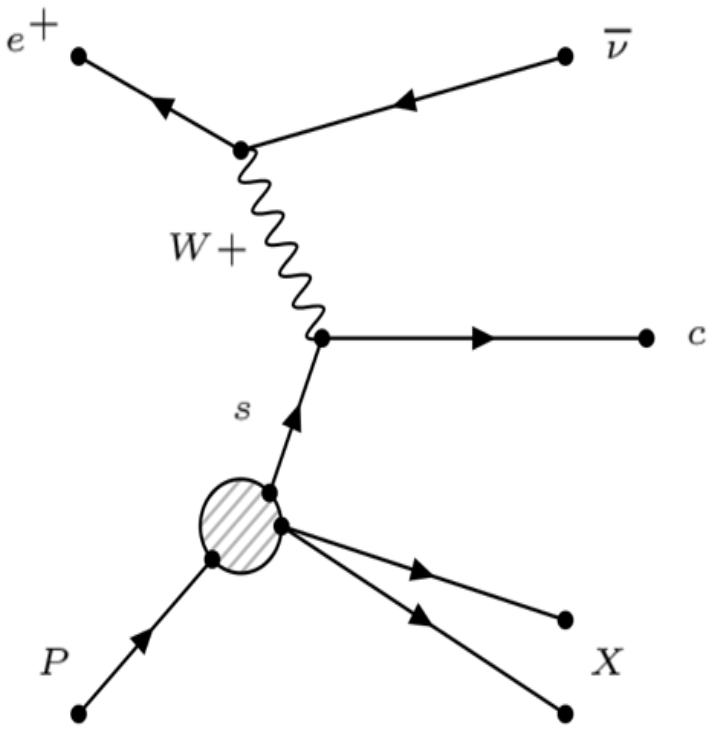

Figure 1: *LO Feynman diagram of charm production in CC DIS in e^+p collisions. In e^-p collisions, a $\bar{c}$ quark is produced from $W^-\bar{s}$ coupling. The same process is available via $d(\bar{d})$ replacing $s(\bar{s})$. However, this process is Cabbibo-suppressed.*

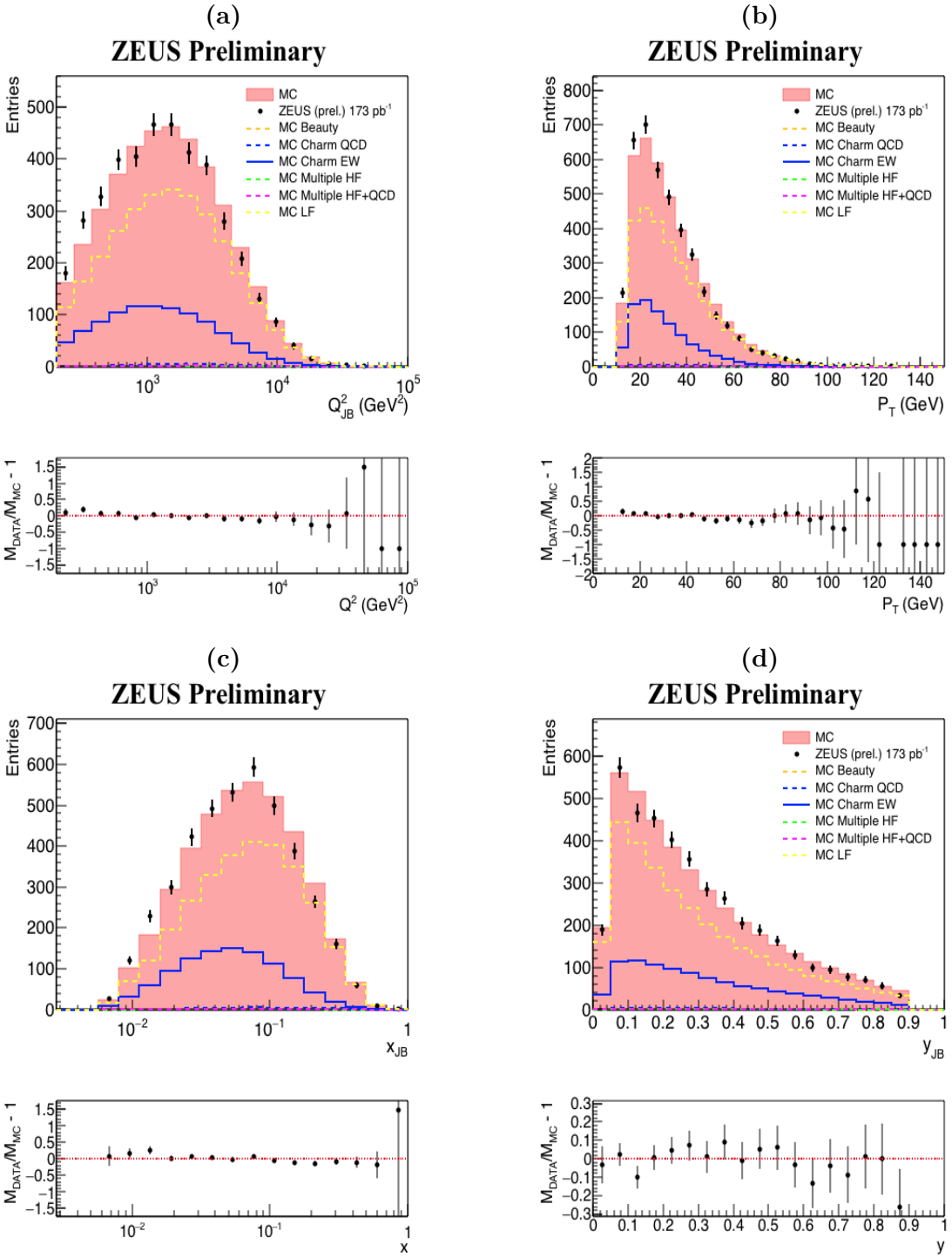

Figure 2: *Comparison between data and MC in kinematic variables (a) Q^2_{JB}, (b) $P_{T,miss}$, (c) x_{JB} and (d) y_{JB} in e^+p collisions. The error bars represent the statistical uncertainty in data. A good agreement between data and inclusive CC DIS MC (filled in red) is observed. Charm EW represents charm quarks from W^+s/d coupling. Charm QCD represents gluon-splitting events $g \to c\bar{c}$. MC LF represents the contribution from light-flavored particles, which is the dominant source of background. MC Beauty represents events containing b quarks. Multiple HF and Multiple HF + QCD represent events with $c + b$ and $c + b + \bar{c}$ quarks in the final state, respectively.*

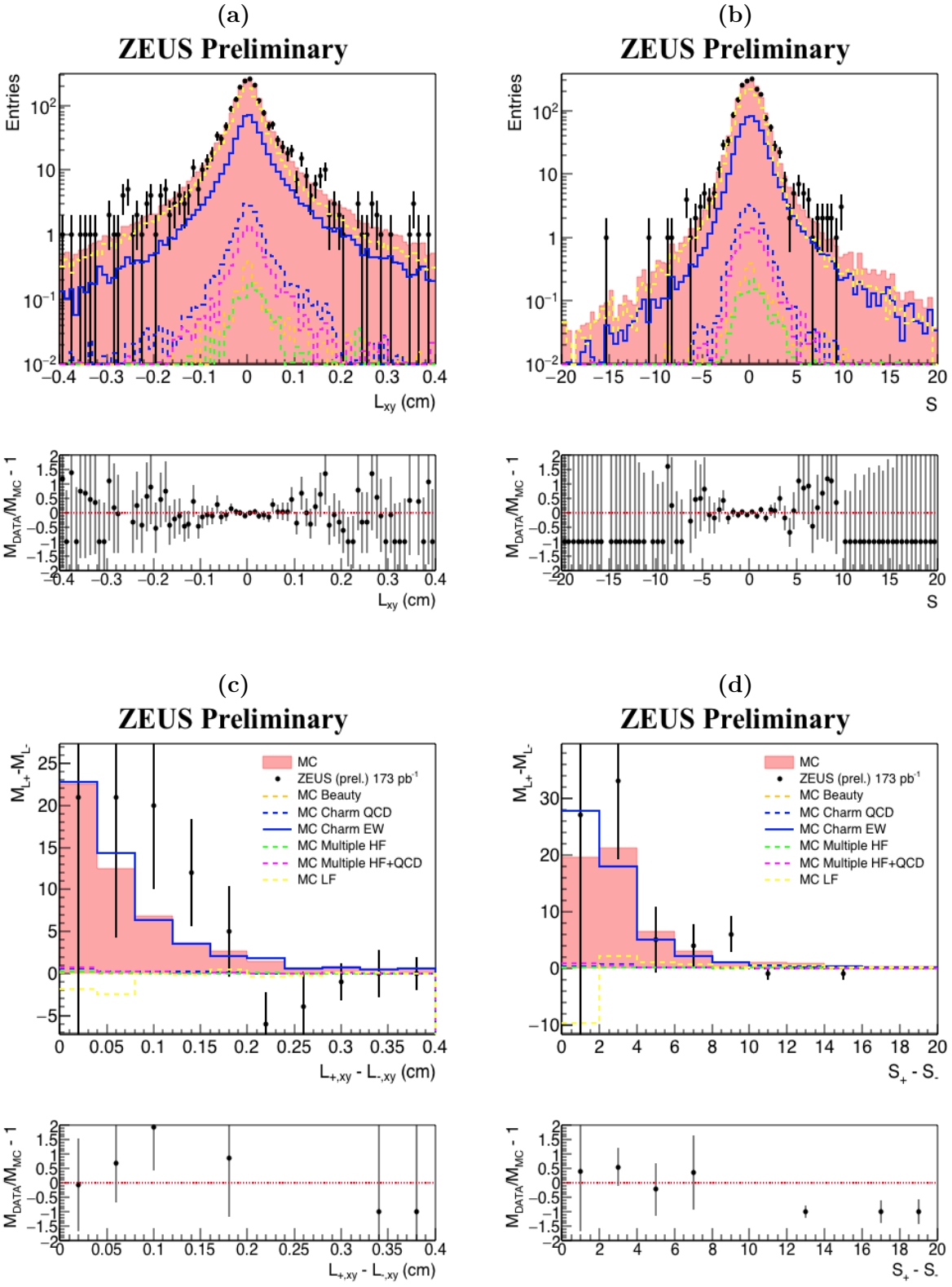

Figure 3: *Charm identification performed by using the lifetime-tagging method. The decay length and significance distributions are illustrated in (a) and (b), respectively. The asymmetry of charmed vertex-distribution is visible in these plots. Upon the mirroring of decay length distribution around $L_{xy} = 0$, the light-flavored contribution is suppressed, leaving behind a charm-dominating signal.*

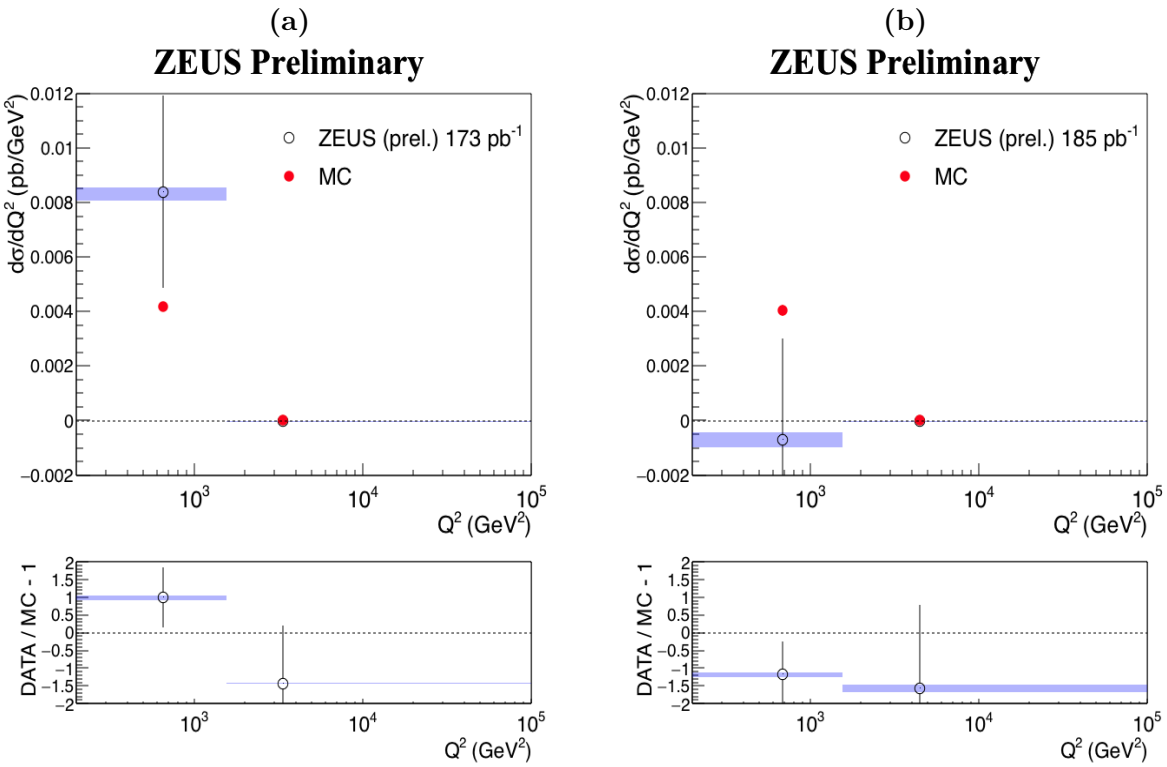

Figure 4: *Electroweak charm differential cross sections in Q^2 in (a) e^+p and (b) e^-p collisions. The error bars represent the statistical uncertainty. The blue boxes represent the systematic uncertainties summed in quadrature, excluding the uncertainty in the luminosity measurement.*