

ZEUS Status Report

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On behalf of the ZEUS collaboration

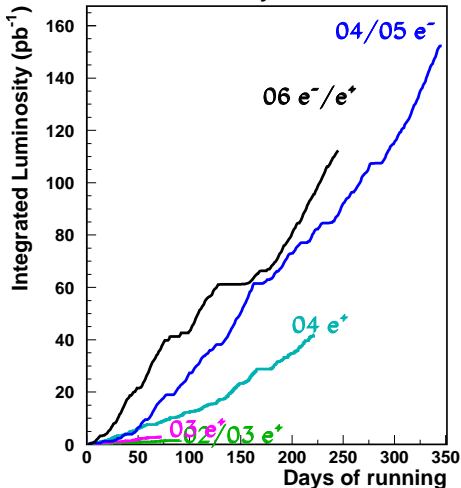
62nd Physics Research Committee Meeting
October 23rd, 2006



- 1 Data Taking and Running
- 2 Physics Highlights
- 3 Low Energy Running Preparation
- 4 Summary



ZEUS Luminosity 2002 - 2006



- ZEUS gated luminosity as a function of days of running.
- Thank you for the excellent performance of HERA in 2006



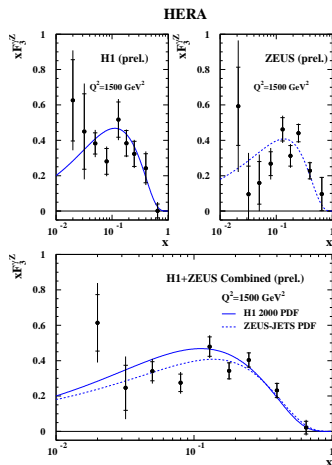
- Completing HERA I measurements
 - New results in diffraction
- Measurements making strong use of new HERA II detectors:
 - D^+ lifetime
- Searches and measurements using data samples benefitting from large HERA II luminosity
 - D^* cross sections
 - J/ψ helicity
 - CC DIS inclusive Jets
 - Isolated Leptons
 - Contact Interactions
 - Multilepton events
- Combined ZEUS + H1 work



- NC DIS results have been combined with those of H1.
- Enables investigation of the interference of weak and electromagnetic interactions at high Q^2

$$\tilde{\sigma}^- - \tilde{\sigma}^+ = 2 \frac{Y_-}{Y_+} (-a_e \cdot k x F_3^{\gamma Z} + 2v_e a_e \cdot k^2 x F_3^Z)$$

- We now have accurate combined measurements of the interference structure function $x F_3^{\gamma Z} \Rightarrow$



HERA Combined NC Measurements

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Diffraction
Heavy Flavour
QCD
Exotics

In HERA II we now have access to
Polarisation asymmetries:

$$A^\pm = \frac{2}{\mathcal{P}_R - \mathcal{P}_L} \cdot \frac{\sigma^\pm(\mathcal{P}_R) - \sigma^\pm(\mathcal{P}_L)}{\sigma^\pm(\mathcal{P}_R) + \sigma^\pm(\mathcal{P}_L)}$$

to a good approximation:

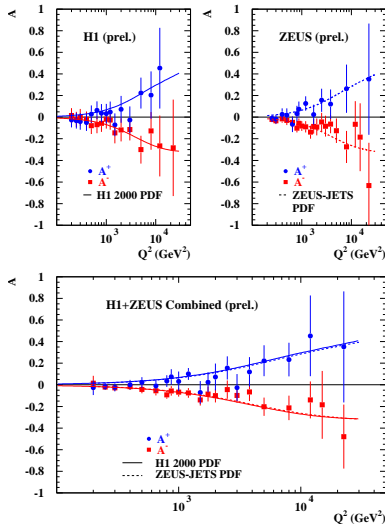
$$A^\pm \simeq \mp k a_e \frac{F_2^{\gamma Z}}{F_2}$$

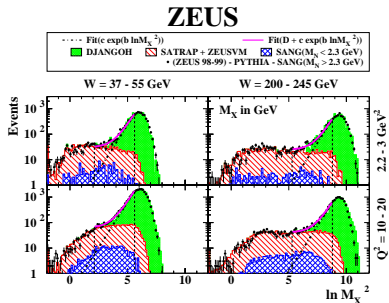
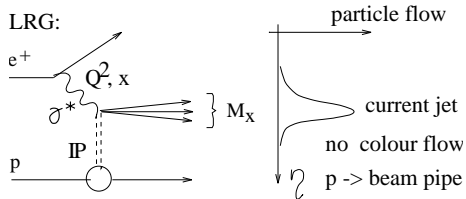
at large Bjorken- x

$$A^\pm \simeq \mp -k \frac{1+d_v/u_v}{4+d_v/u_v}$$

At $Q^2 \approx 5000 \text{ GeV}^2$ δA has a
probability of 3.1×10^{-3} of being
zero.

HERA





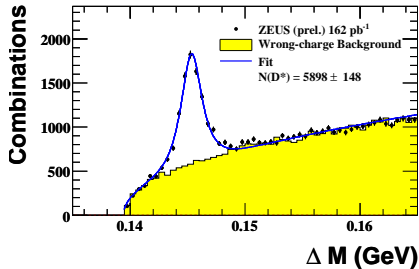
- 3 different methods used to tag diffraction: LRG, LPS, M_X
- Different methods measure slightly different processes



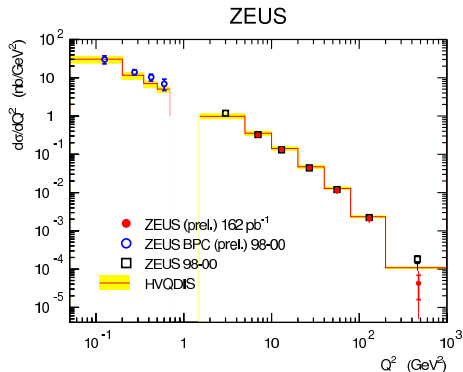
DIS Charm at HERA II

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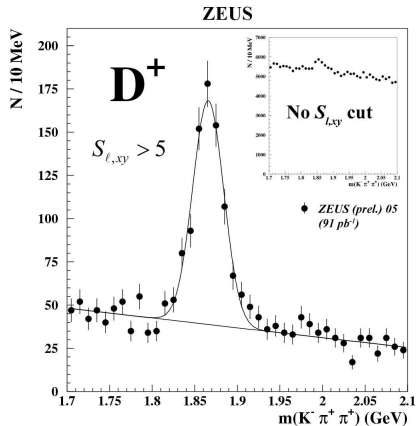
- Our first charm cross sections for HERA II, from D^* mesons
- HERA II and HERA I cross sections consistent with each other and NLO



D^+ lifetime with MVD

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Our first charm measurement based on MVD data.

- Measurement made possible by alignment work shown last PRC
- D^+ signal significantly enhanced with significance cuts
- Production analysed in ct bins:

$$ct = \frac{m}{p_T} l_{xy}$$

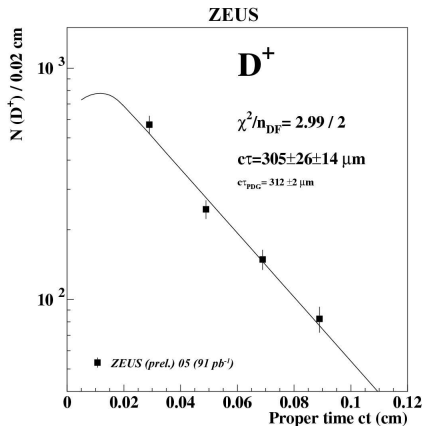


D^+ lifetime with MVD

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$$\frac{dN}{d(ct)} \propto \int d(ct)_{true} \exp\left(-\frac{(ct)_{true}}{c\tau}\right) \int d\left(\frac{pT}{m}\right) g\left(\frac{pT}{m}\right) h\left(\frac{pT}{m} (ct - (ct)_{true})\right)$$



Resolution function h assumed to be a Gaussian with resolution of $160 \mu\text{m}$ + beam spot spread

	$\tau(D^+)$ (fs)
ZEUS (prel.) 05	$1017 \pm 86 \pm 47$
World average	1040 ± 7

Similar accuracy to CERN SPS experiments

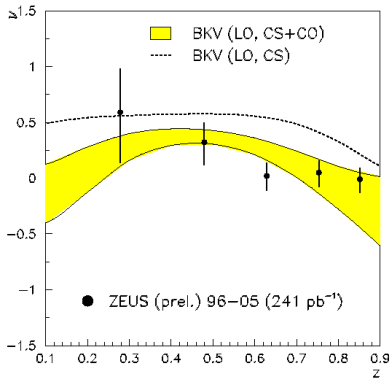
Demonstrates our understanding of the MVD resolution



$$\frac{1}{\sigma} \frac{d^2\sigma}{d\Omega dz} = 1 + \lambda(z) \cos^2 \theta^* + \mu(z) \sin 2\theta^* \cos \phi^* + \frac{\nu(z)}{2} \sin^2 \theta^* \cos 2\phi^*$$

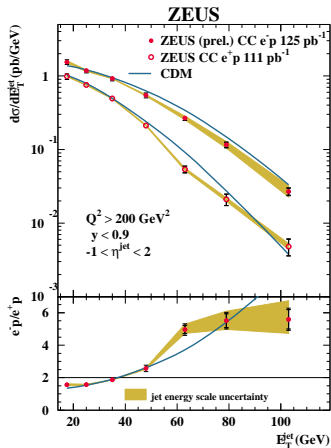
- Measurement of ν may allow distinction between colour-singlet and colour-octet models for J/ψ production
- Analysis of ν as a function of z shows that ZEUS data seems to disfavour CS only picture

$$z = \frac{P \cdot p_{J/\psi}}{p \cdot q}$$



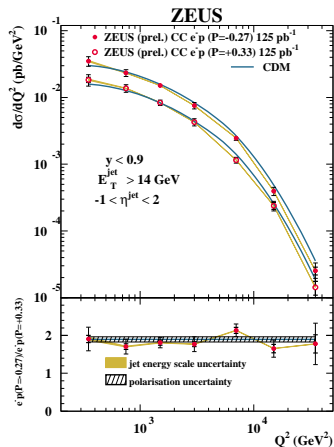
Our first HERA II Jet measurements:

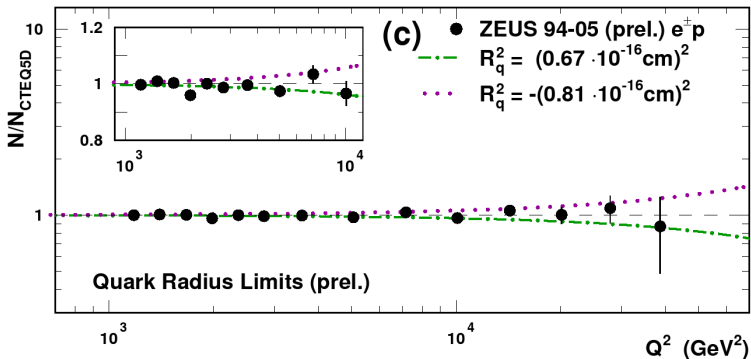
- Test of SM
- Factor $\times 7$ more e^-p lumi than in HERA I
- Measurements were compared to e^+p data
- Cross section in good agreement with SM expectations



Our first HERA II Jet measurements:

- Samples with different polarisation were compared
 - Good agreement with expectations
- Inclusive jet sample is under control
 - Now we can look at multijets and jet substructure in CC e^-p data





$$\frac{d\sigma}{dQ^2} = \frac{d\sigma^{\text{SM}}}{dQ^2} \left(1 - \frac{R_e^2}{6}\right)^2 \left(1 - \frac{R_q^2}{6}\right)^2$$

$$R_q < 0.67 \times 10^{-3} \text{ fm}$$

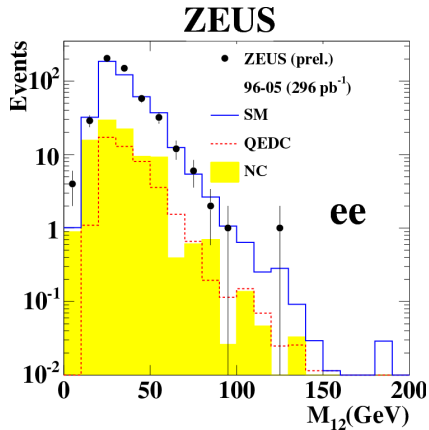


Multi-Lepton Events

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- Production of di-lepton and 3-lepton events is sensitive to new physics, especially at high masses
- H1 have observed an excess at high invariant masses ($3/0.44 \pm 0.1 > 100\text{GeV}$ in ee channel)
- No excess observed in ee or eee channel by ZEUS

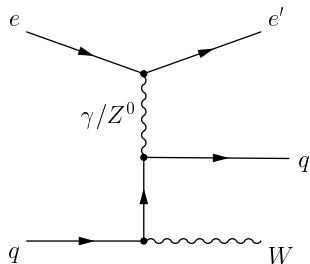


Reminder

- At the last PRC ZEUS presented first isolated muon results for a W production optimised search (similar to H1 search)
- Search on 1998-2005 data (249 pb^{-1} , $143 \text{ pb}^{-1} e^-p$, $106 \text{ pb}^{-1} e^+p$) made preliminary for ICHEP06

- **New for this PRC:** Analysis has been extended to cover full HERA data taking period up to October 2006:

- $175 \text{ pb}^{-1} e^+p$
- $204 \text{ pb}^{-1} e^-p$



Isolated e	$12 < p_T^X < 25 \text{ GeV}$	$p_T^X > 25 \text{ GeV}$
ZEUS (prel.) 96-97 e^+p (39 pb^{-1})	2 / 0.3 ± 0.2 (85%)	0 / 0.5 ± 0.2 (62%)
ZEUS (prel.) 05-06 e^-p (61 pb^{-1})	2 / 0.9 ± 0.3 (52%)	2 / 0.9 ± 0.3 (62%)
ZEUS (prel.) 03-06 e^+p (70 pb^{-1})	1 / 0.8 ± 0.2 (64%)	0 / 1.0 ± 0.2 (76%)

Isolated μ	$12 < p_T^X < 25 \text{ GeV}$	$p_T^X > 25 \text{ GeV}$
ZEUS (prel.) 96-97 e^+p (39 pb^{-1})	1 / 0.3 ± 0.2 (84%)	0 / 0.4 ± 0.2 (68%)
ZEUS (prel.) 04-06 e^-p (187 pb^{-1})	2 / 2.0 ± 0.3 (68%)	2 / 2.0 ± 0.3 (86%)
ZEUS (prel.) 03-06 e^+p (70 pb^{-1})	2 / 0.9 ± 0.2 (64%)	0 / 1.0 ± 0.2 (82%)

In 30 pb^{-1} 2006 e^+p data: 1 new e^- event and 1 new μ event, both with $12 < P_T^X < 25 \text{ GeV}$.



Isolated e	$12 < p_T^X < 25 \text{ GeV}$	$p_T^X > 25 \text{ GeV}$
ZEUS (prel.) 96-06 $e^+ p$ (175 pb $^{-1}$)	4 /2.1 \pm 0.3 (63%)	1 /2.2 \pm 0.3 (75%)
ZEUS (prel.) 98-06 $e^- p$ (204 pb $^{-1}$)	6 /2.9 \pm 0.5 (56%)	5 /3.8 \pm 0.6 (55%)
ZEUS (prel.) 96-06 $e^\pm p$ (379 pb $^{-1}$)	10 /5.0 \pm 0.6 (59%)	6 /6.0 \pm 0.7 (63%)

Isolated μ	$12 < p_T^X < 25 \text{ GeV}$	$p_T^X > 25 \text{ GeV}$
ZEUS (prel.) 96-06 $e^+ p$ (175 pb $^{-1}$)	3 /1.9 \pm 0.4 (71%)	1 /2.3 \pm 0.4 (78%)
ZEUS (prel.) 98-06 $e^- p$ (204 pb $^{-1}$)	2 /2.2 \pm 0.3 (68%)	2 /2.2 \pm 0.3 (86%)
ZEUS (prel.) 96-06 $e^\pm p$ (379 pb $^{-1}$)	5 /4.1 \pm 0.5 (75%)	3 /4.5 \pm 0.5 (82%)

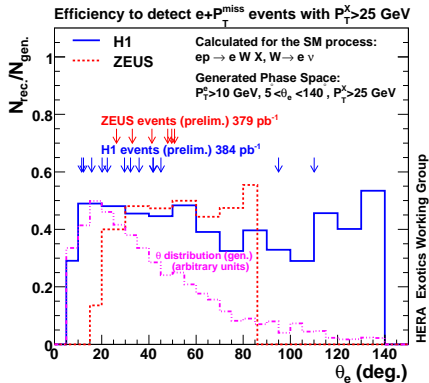
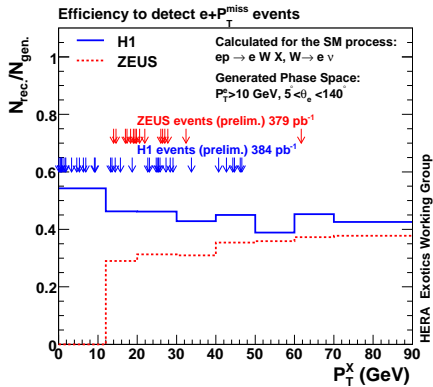


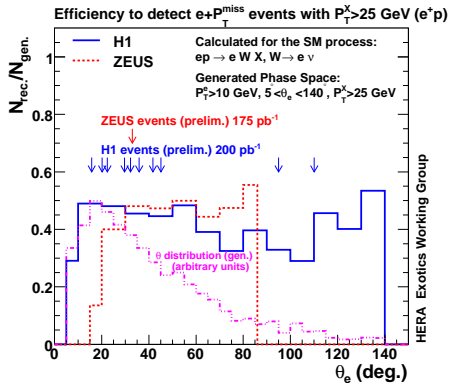
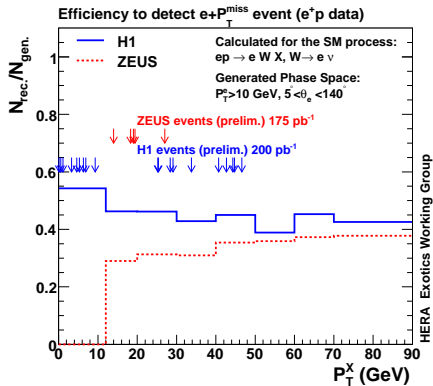
HERA Exotics Working Group

Members of the Working group focused on isolated leptons:

- H1: G. Brandt, C. Diaconu, D. South
 - ZEUS: J. Ferrando, K. Korcsak-Gorzo
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- Work has focused on trying to understand possible differences between H1 and ZEUS searches
 - Common analysis region for future comparison has been agreed
 - Managed to send first results (efficiency comparisons of existing searches) to ICHEP06



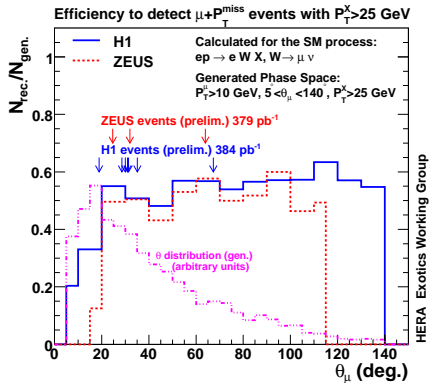
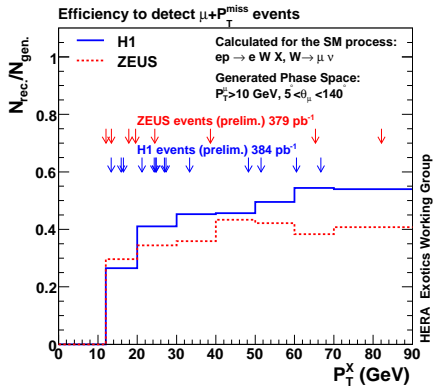


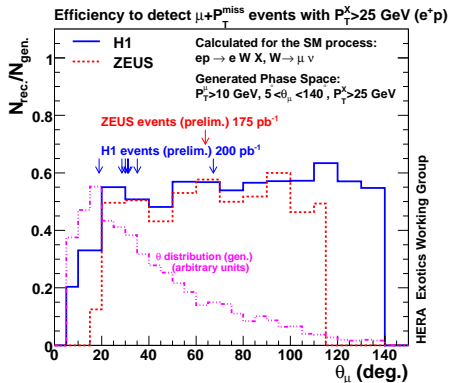
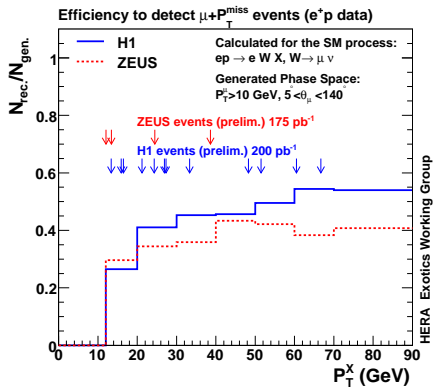


Combination Work

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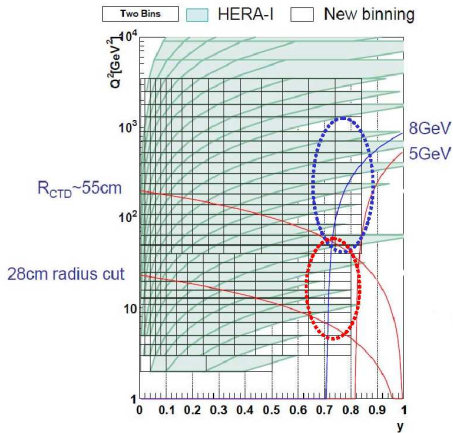




$e^{\pm}p$ Data Preliminary $P_T^X > 25 \text{ GeV}$		Electron obs./exp.	Muon obs./exp.	Combined obs./exp.	
e^+p	H1	200 pb $^{-1}$	10 / 3.1 ± 0.6	7 / 2.9 ± 0.5	17 / 6.0 ± 1.0
	ZEUS	175 pb $^{-1}$	1 / 2.2 ± 0.3	1 / 2.3 ± 0.4	2 / 4.5 ± 0.7
	H1+ZEUS	375 pb $^{-1}$	11 / 5.3 ± 0.9	8 / 5.2 ± 0.9	19 / 10.5 ± 1.7
e^-p	H1	184 pb $^{-1}$	3 / 3.8 ± 0.6	0 / 3.1 ± 0.5	3 / 6.9 ± 1.1
	ZEUS	204 pb $^{-1}$	5 / 3.8 ± 0.6	2 / 2.2 ± 0.3	7 / 6.0 ± 0.9
	H1+ZEUS	388 pb $^{-1}$	8 / 7.6 ± 1.2	2 / 5.3 ± 0.8	10 / 12.9 ± 2.0



Preparing for F_L by measuring F_2 at high y :



- Low x region: measurement can be performed only at HERA
- important for extracting the gluon density
- F_L contribution may be observed

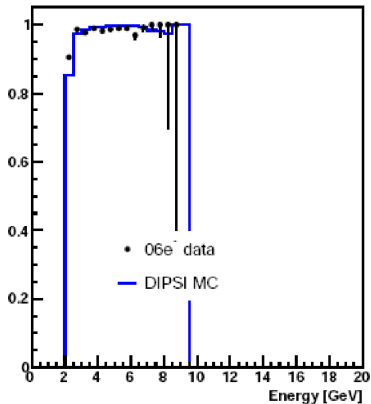
Studies also valuable because they develop technology for measuring F_L :

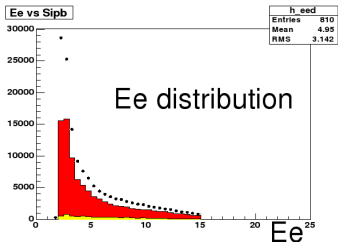
- Studies of expanding measurement to lower E_e
- New Low E_e trigger (running since August 2006)



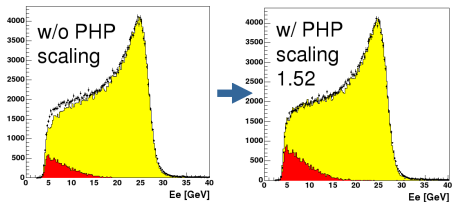
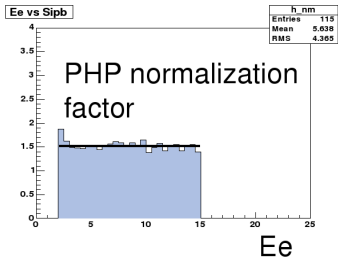
- Electron finding at low energies is crucial for the F_L measurement and F_2 at high y
- ZEUS F_L study \rightarrow large systematic contribution from electron finding efficiency at low energies
- Efficiency of electron finder at low E_e has been evaluated using $J/\psi \rightarrow ee$ events.

Finding efficiency vs. E_{CAL}





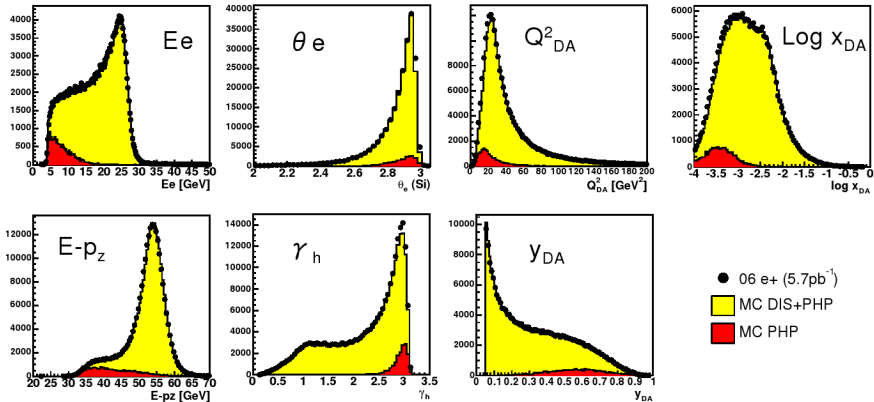
- γp is the main background for F_2 at high y / F_L
- A low $E - p_Z$ trigger was used to select a γp enriched sample



Control Plots

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F_2 at High y
 e Efficiency
Controlling γp background



- In 2006 ZEUS DAQ has been operating well
- In the last few months ZEUS has achieved efficiency consistently $> 80\%$.
- HERA-II detector configuration understanding progressing well, first fully MVD-based results arriving
- HERA-II physics analysis progressing well providing timely results
- Work on combined results progressing well, first results were already sent to ICHEP06 → Thanks to our H1 colleagues for a positive and effective collaborative effort
- ZEUS are addressing the challenges of Low-Energy F_L running with a strong and dedicated team. Benefits of studies also apparent for high-energy running results

