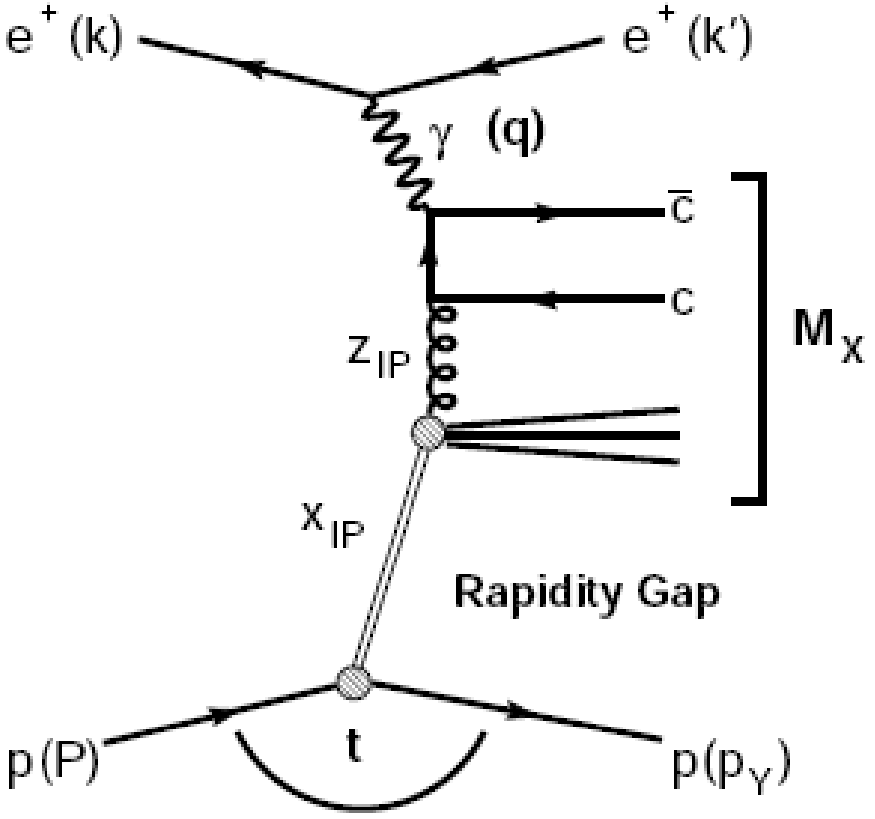
D* Production in Diffractive DIS

- status report -

Karel Černý

H1 Collaboration metting 11th September 2013, Liverpool

Motivation



the goal is:

- measure σ of D*
- measured in golden channel
- where signal is observed in

$\Delta m = \Delta m(K\pi\pi_s) - \Delta m(K\pi)$

$$D^{*+} \to D^0 \pi^+_{slow} \to (K^-\pi^+)\pi^+_{slow} \ \ (+\mathrm{C.C.})$$

- HERA II data, L ~ 300 pb^{-1}
- prev. analysis L ~ 47 pb^{-1}
- comparison with NLO QCD predicitions

Last presented status

to end 2012

- trigger efficiencies evaluated
- event selection settled
- procedure of normalization of MC contributions defined
- control plots well described
- signal extraction based on Δm fits not really working
- theory prediction in NLO QCD by HVQDIS available

Data and MC

- subtrigger S61

  (SPCLe_IET>2) || SPCLe_IET_Cen_3

  &&

  FTT_mul_Td>0

- data periods:

  2005e-

  2006e-,

  2006e+/2007e+ (E_p=920GeV)

- Monte Carlo

  QED rad. Rapgap

  IPRO = 1400 … $\gamma g \rightarrow c\,\bar{c}$

  all D^0 decays

  H1 2006 Fit B DPDF or CTEQ66

  samples

  elastic IP, IR

  p-diss IP, IR

  non-diff

Event Selection

electron

$0.02 < y < 0.65$

$5 < Q^2 < 100\ GeV^2$

$E_{e'} > 11GeV$

$13 < r_{clus} < 74\ cm$

$ECRA < 4\ cm$

$40 < E\text{-}p_z < 70\ GeV$

diffractive

$\eta_{max} < 3.2$

FMD cut

FTS cut

$x_{IP} < 0.03$

$M_Y < 1.6\ GeV$

$|t| < 1\ GeV^2$

D* selection

$p_T(K) > 0.3\ GeV$

$p_T(\pi) > 0.3\ GeV$

$p_T(\pi_{slow}) > 0.12\ GeV$

$p_T(K) + p_T(\pi) > 2\ GeV$

$\mathbf{D^0_{cand} = K\,\pi'\ \ldots\ D^*_{cand} = K\pi\pi_{slow}}$

$|m_{PDG}(D^0) - m(D^0_{cand})| < 0.08\ GeV$

$|m(D^*_{cand}) - m(D^0_{cand})| < 0.17\ GeV$

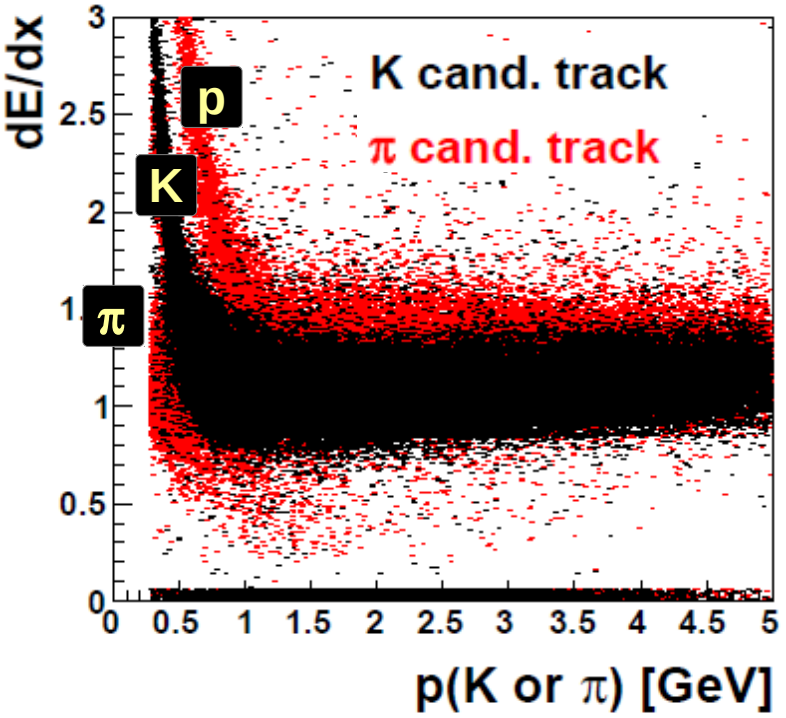
$p_T(D^*_{cand}) > 1.5\ GeV$

$|\eta(D^*_{cand})| < 1.5$

dE/dx

(Dstar → GetKaon() → GetDedx**Likelihood**(H1Dedx::kKaon) > **0.01**
&& Dstar → GetKaon() → Get**Nhit**Dedx() >= **10**
&& Dstar → GetKaon() → Get**Dedx**() > **0.1**
) || (TRUE if GetNhitDedx or GetDedx(s) fails to pass for Kaon)

i.e (Kaon is like Kaon)



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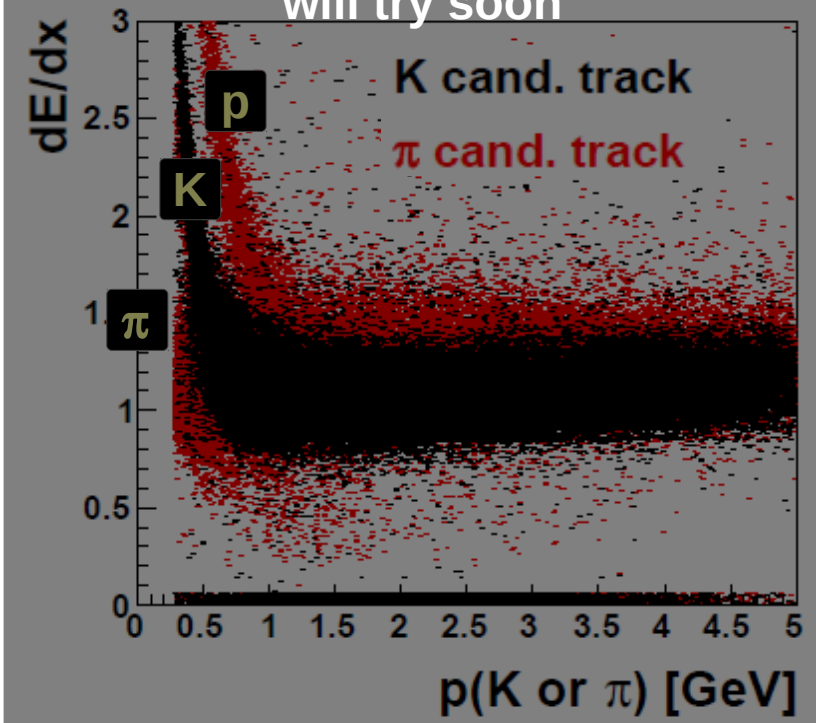
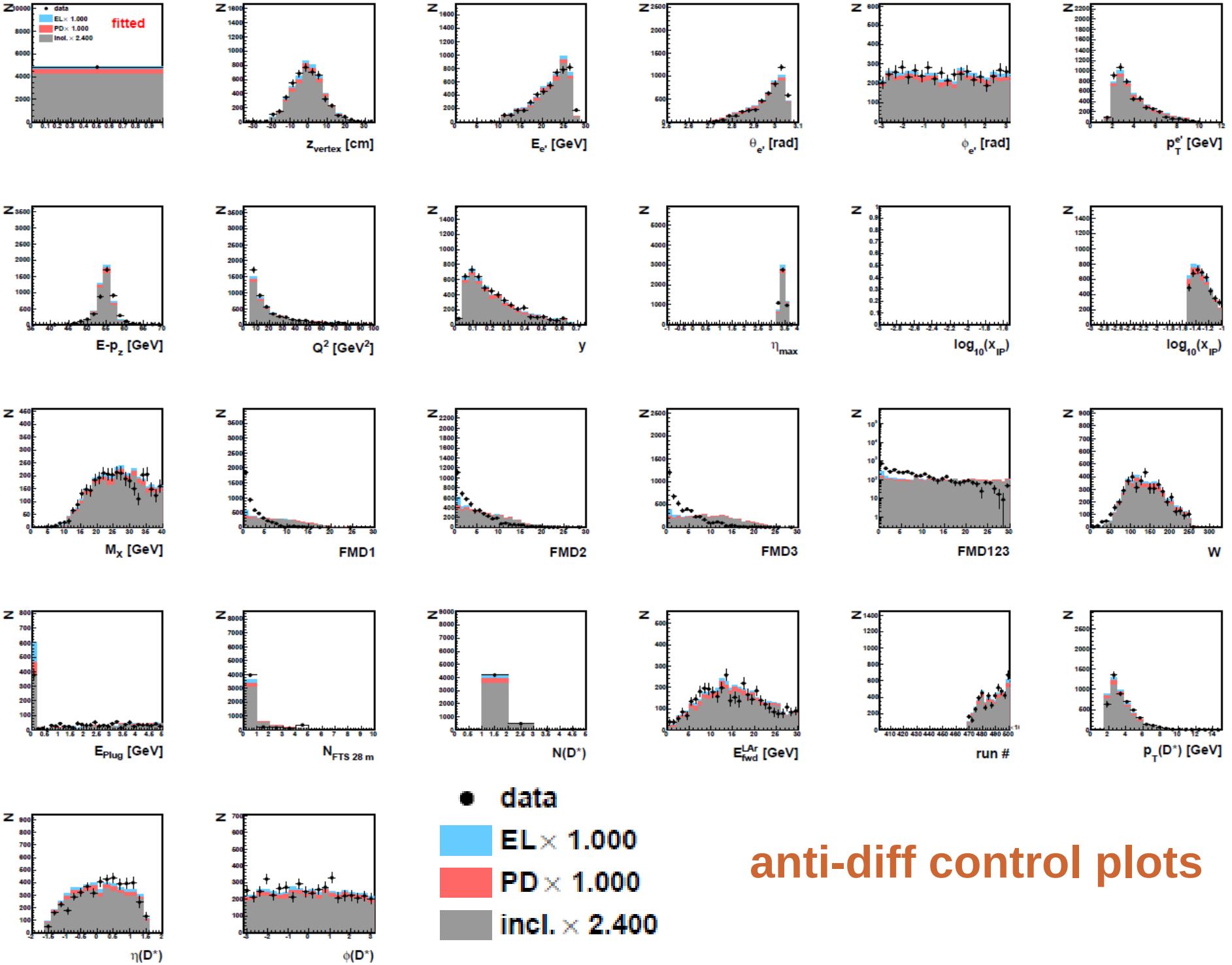
suggested to remove this will try soon

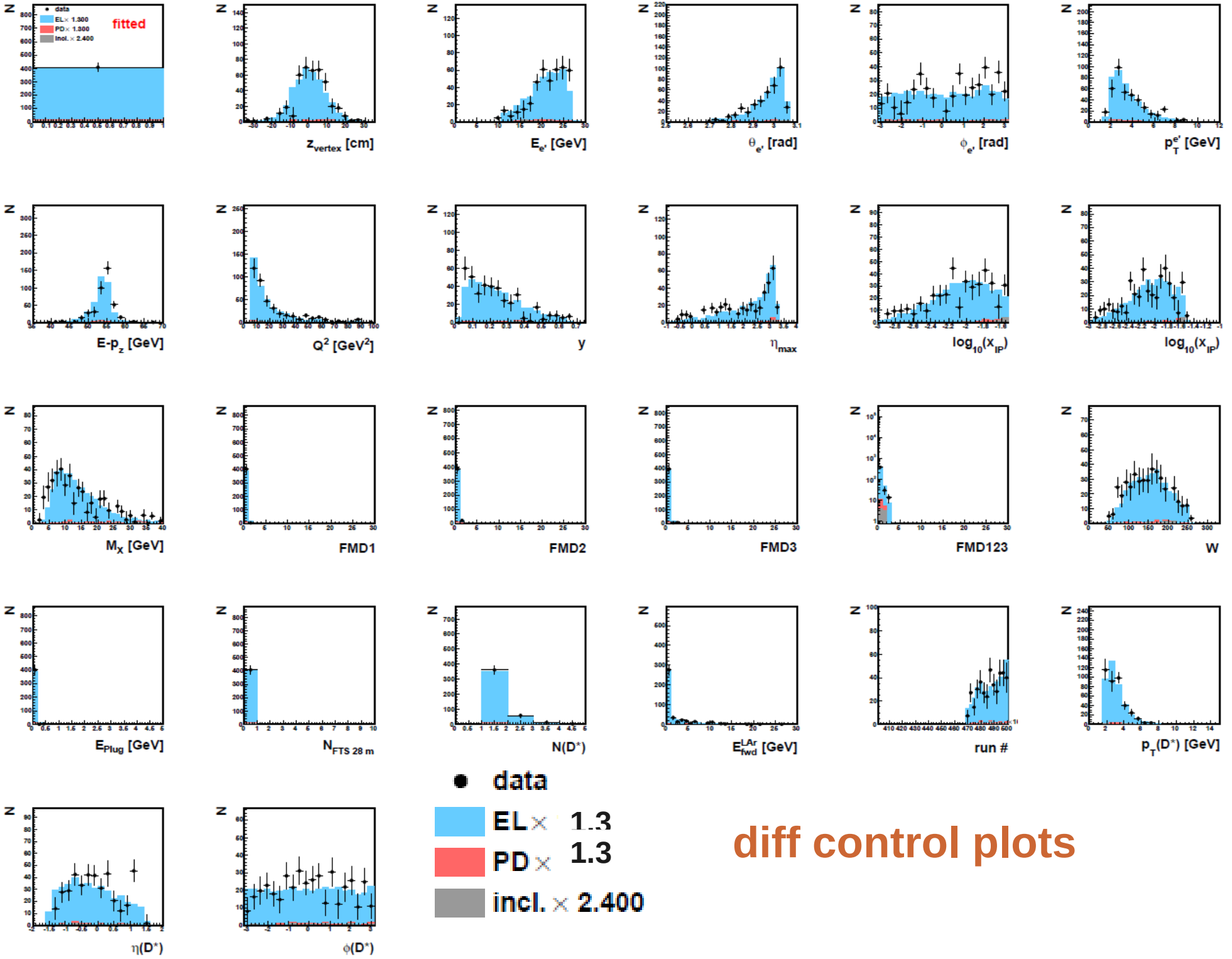


Control Plots

- signal estimated by wrong charge subtraction
- non-diff MC normalized to describe anti-diff control plots
- elastic/pdis ratio set to 1



anti-diff control plots



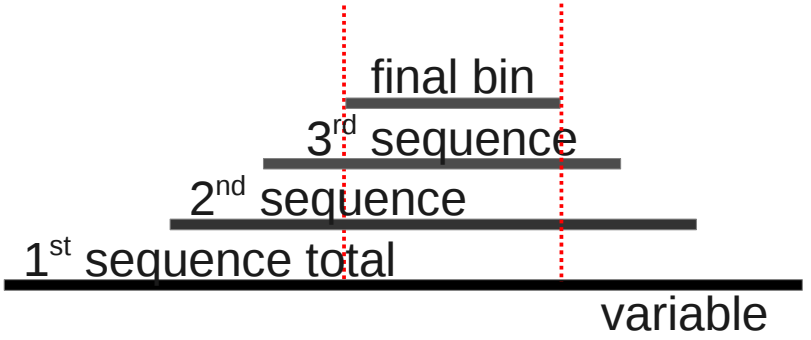
diff control plots

Signal extraction with fits

- signal fcn: Crystal Ball funcion ~ gauss with power law tail
- bgd fcn: Granet function ~ $(\Delta m\text{-}m_{\pi 0})^{p1} * \exp[-p_2 (\Delta m\text{-}m_{\pi 0}) - p_3 (\Delta m\text{-}m_{\pi 0})^2]$

- the code for fits was completely rewritten

- in each bin of the studied variable
  … a sequence of χ^2 fits is made



- then a fit made with unbinned extended likelihood (NLL, i.e. $-ln(L)$)

- $$L = \frac{e^{-(\mu_S + \mu_{BG_{RC}})} (\mu_S + \mu_{BG_{RC}})^{N_{RC}}}{N_{RC}!} \prod_{i=1}^{N_{RC}} \left[\frac{\mu_S}{\mu_S + \mu_{BG_{RC}}} CB(\Delta m_{RC}^{(i)}, \vec{p}_{CB}) + \frac{\mu_{BG_{RC}}}{\mu_S + \mu_{BG_{RC}}} G(\Delta m_{RC}^{(i)}, \vec{p}_G) \right] *$$

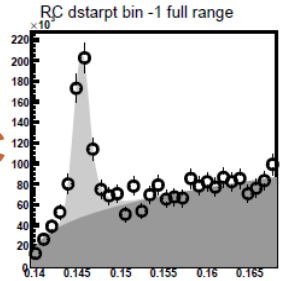
$$* \frac{e^{-(\mu_{BG_{WC}})} (\mu_{BG_{WC}})^{N_{WC}}}{N_{WC}!} \prod_{j=1}^{N_{WC}} \left[G(\Delta m_{WC}^{(j)}, \vec{p}_G) \right]$$

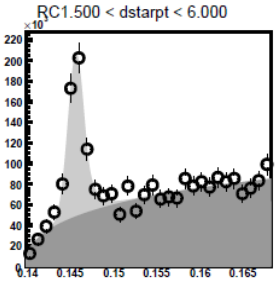
equal

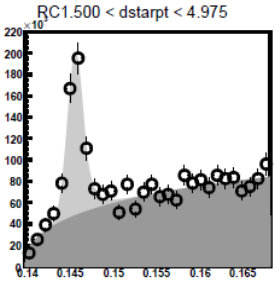
e.g. sequence in $p_T(D^*)$

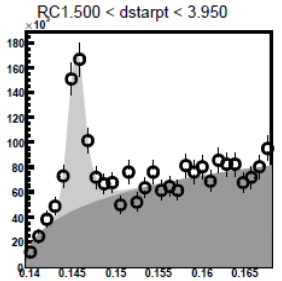
final bin

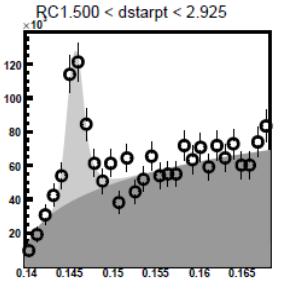
RC

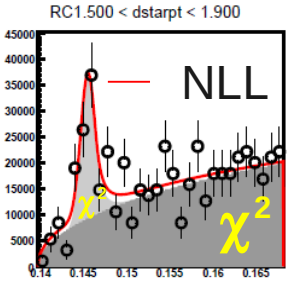




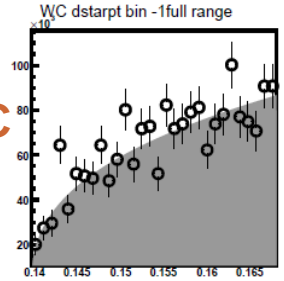


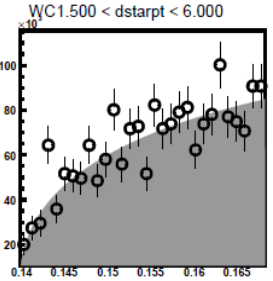


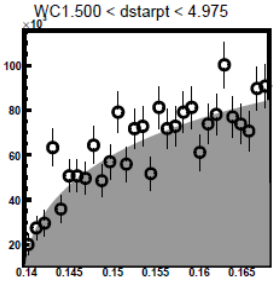


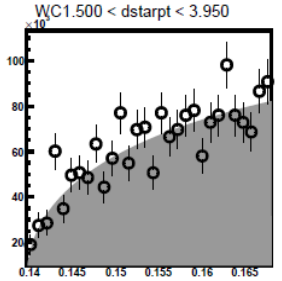


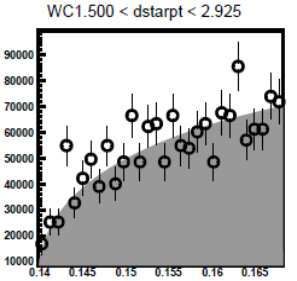
WC

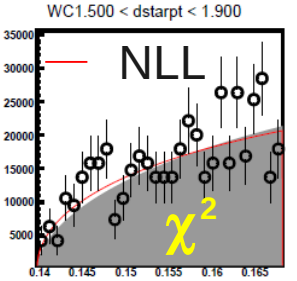


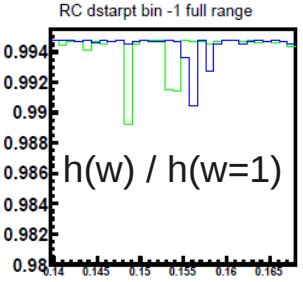


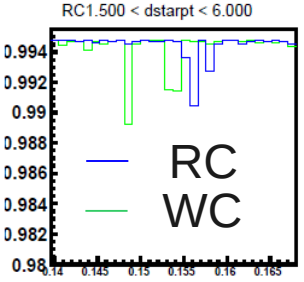


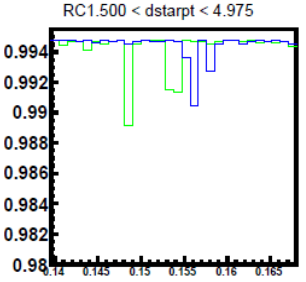


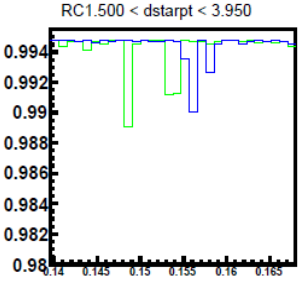


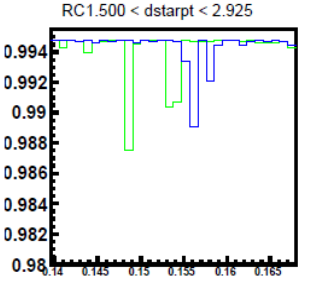


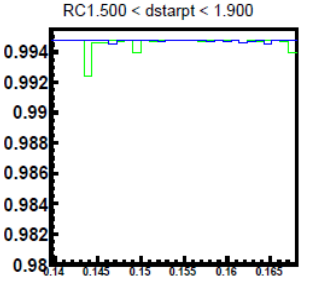












Fit results
χ² = 63.644
NDF = 50.000
χ²/NDF = 1.2729
prob = 0.90697
norm = 413.08
peakpos = 0.14540
sigma = 0.00094103
alpha = 1.2000
n = 3.8186
bgdnorm = 1791.4
p1 = 0.37592
p2 = 0.000052374
p3 = 0.0094641
normwc = 1790.9

Fit results
χ² = 62.575
NDF = 51.000
χ²/NDF = 1.2270
prob = 0.87165
norm = 402.15
peakpos = 0.14540
sigma = 0.00094275
alpha = 1.3402
n = 3.8186
bgdnorm = 1803.4
p1 = 0.41062
p2 = 4.1259
p3 = 0.0010000
normwc = 1796.8

Fit results
χ² = 60.531
NDF = 51.000
χ²/NDF = 1.1869
prob = 0.83038
norm = 384.89
peakpos = 0.14541
sigma = 0.00093851
alpha = 1.3228
n = 3.8186
bgdnorm = 1778.0
p1 = 0.41034
p2 = 4.1259
p3 = 0.0099999
normwc = 1788.7

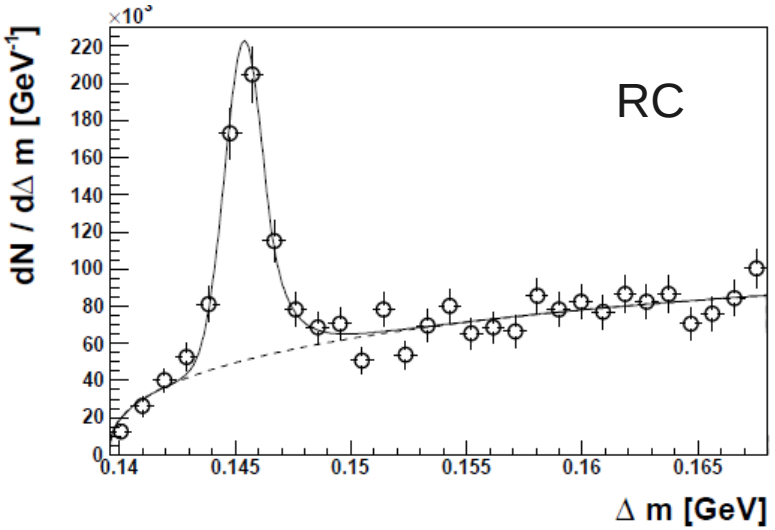
Fit results
χ² = 63.032
NDF = 51.000
χ²/NDF = 1.2359
prob = 0.87972
norm = 341.10
peakpos = 0.14538
sigma = 0.00097149
alpha = 1.2001
n = 3.8186
bgdnorm = 1713.3
p1 = 0.41565
p2 = 4.1259
p3 = 0.0000073563
normwc = 1734.8

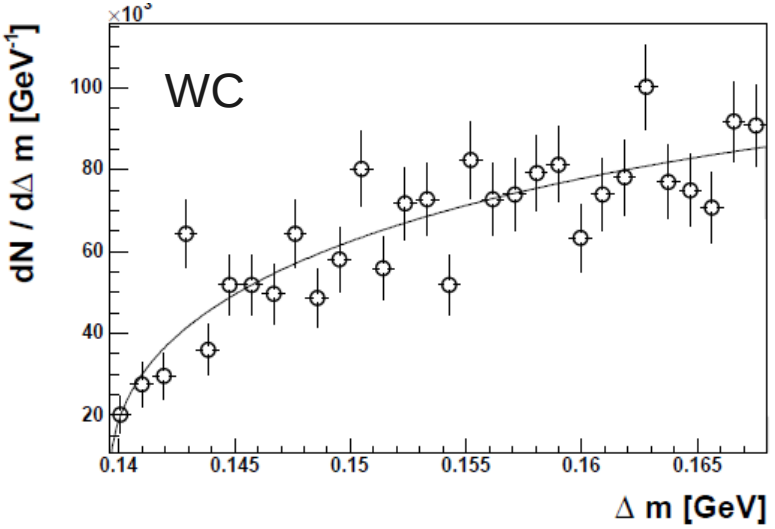
Fit results
χ² = 62.596
NDF = 51.000
χ²/NDF = 1.2274
prob = 0.87204
norm = 240.01
peakpos = 0.14544
sigma = 0.00098453
alpha = 1.2000
n = 3.8186
bgdnorm = 1463.6
p1 = 0.40872
p2 = 4.1259
p3 = 0.0099833
normwc = 1489.0

Fit results
χ² = 63.330
NDF = 51.000
χ²/NDF = 1.2418
prob = 0.88477
norm = 59.212
peakpos = 0.14534
sigma = 0.00079819
alpha = 1.2340
n = 3.8186
bgdnorm = 379.36
p1 = 0.54891
p2 = 4.1030
p3 = 0.0064688
normwc = 410.55

-*ln(L)* result only

visible N(D*) in 2006e-/2007e- data





$$f(x;\alpha,n,\bar{x},\sigma) = N \cdot \begin{cases} \exp(-\frac{(x-\bar{x})^2}{2\sigma^2}), & \text{for } \frac{x-\bar{x}}{\sigma} > \alpha \\ A \cdot (B + \frac{x-\bar{x}}{\sigma})^{-n}, & \text{for } \frac{x-\bar{x}}{\sigma} \leqslant \alpha \end{cases}$$

$$A = \left(\frac{n}{|\alpha|}\right)^n \cdot \exp\left(-\frac{|\alpha|^2}{2}\right)$$

$$B = \frac{n}{|\alpha|} - |\alpha| \ ,$$

Fit results

~~χ^2 = 0.000000000000000000-2147~~

~~NDF = 4075.0~~

~~χ^2/NDF = 0.000000000000000000-2147~~

~~prob = 1.0000~~

norm = 395.83

peakpos = 0.14538

sigma = 0.00084361

alpha = 1.2000

n = 4.8610

bgdnorm = 1846.2

p1 = 0.38908

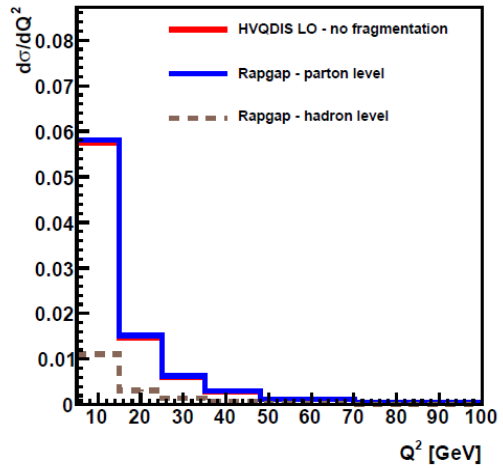
p2 = 4.1259

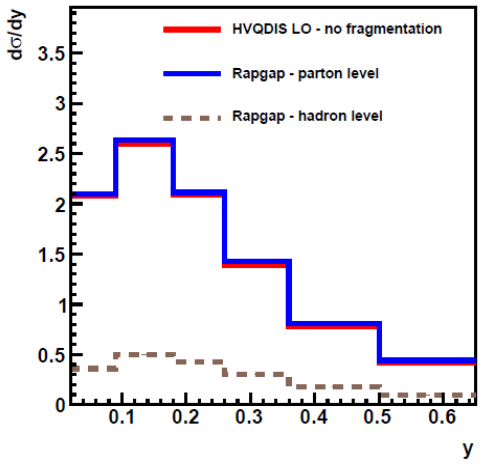
p3 = 0.0010000

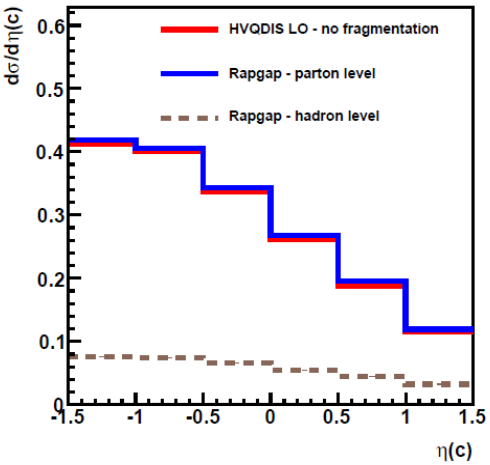
normwc = 1842.0

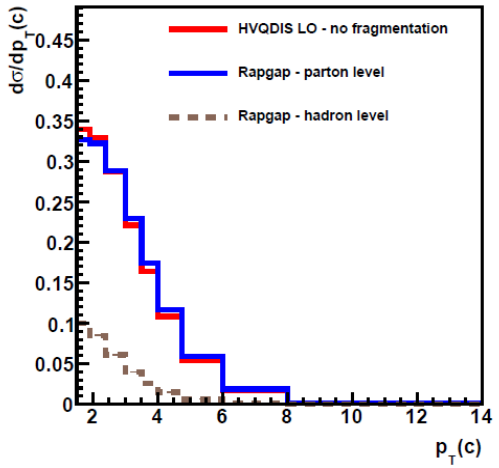
QCD NLO with HVQDIS

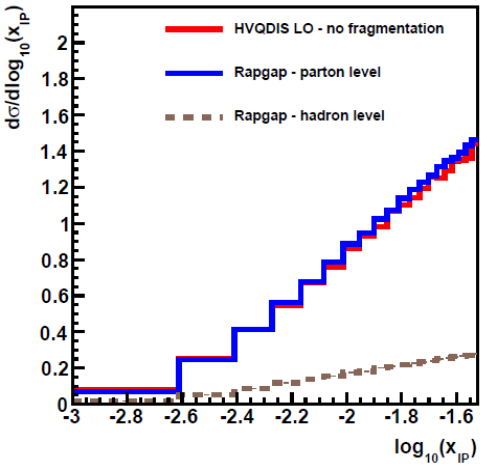
- Rapgap without showers gives the same as HVQDIS in LO … validation of diffractive interface to HVQDIS (which is for non-diff)

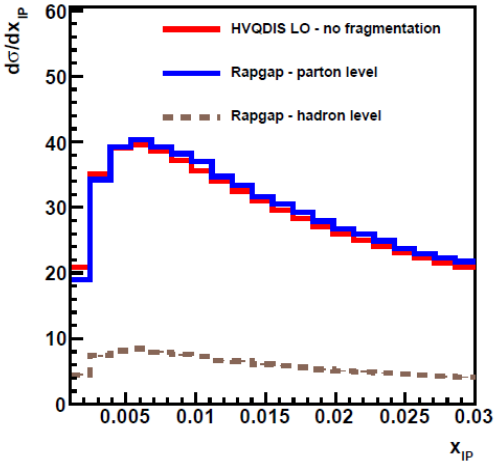






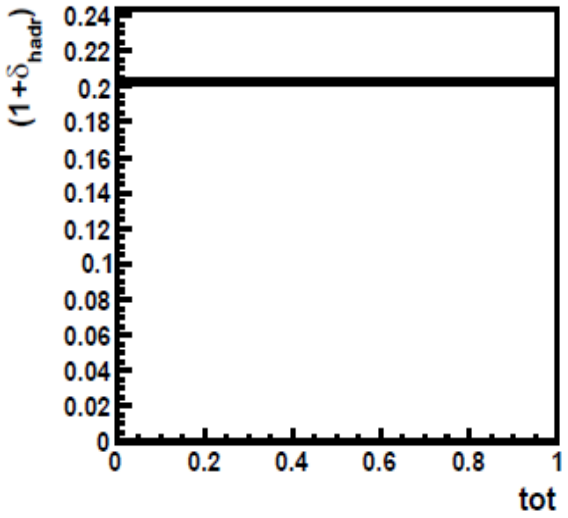


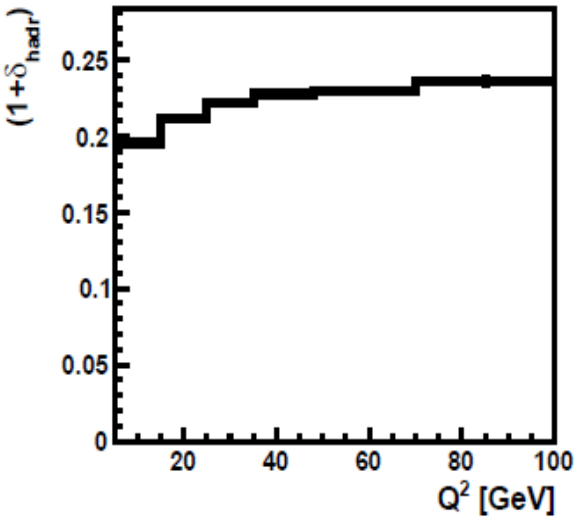


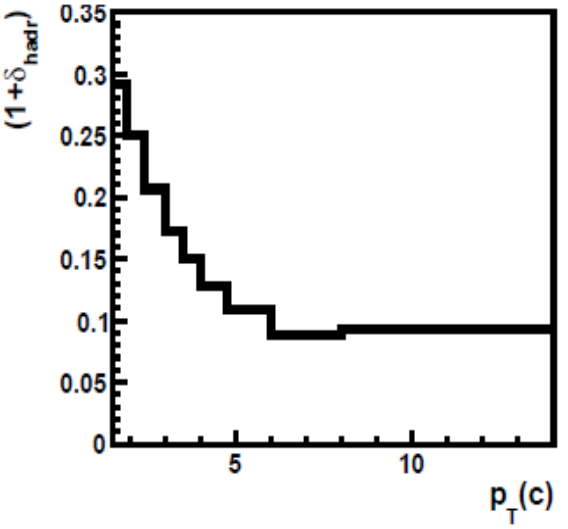


Fragmentation

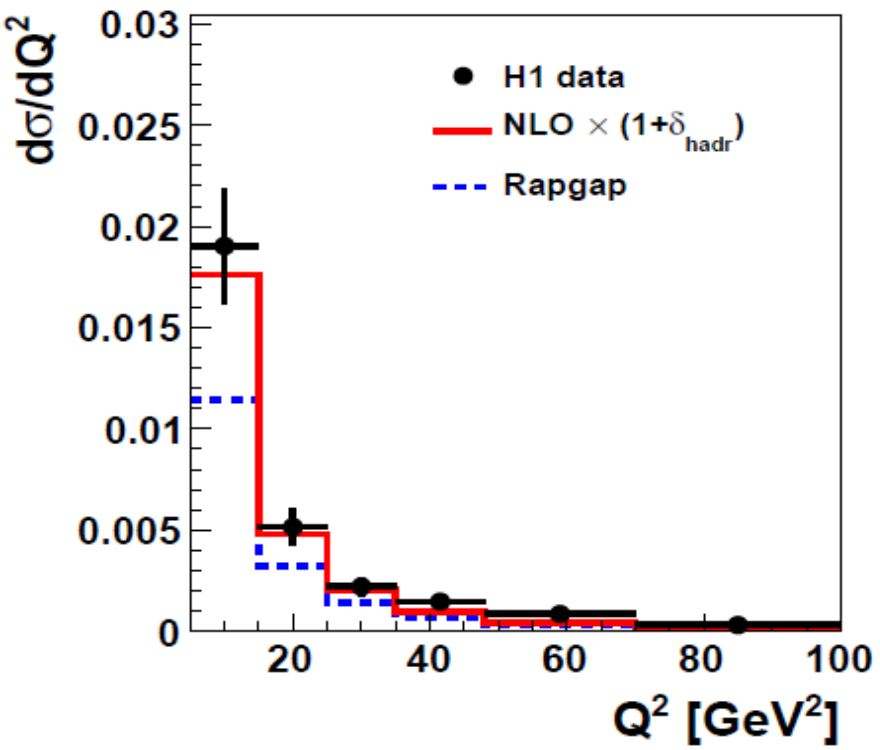
- fragmentation within HVQDIS is not used
- the H1 interface of HVQDIS is not used
- hadronization corrections calculated from MC
  - no QED radiation, parton shower ON

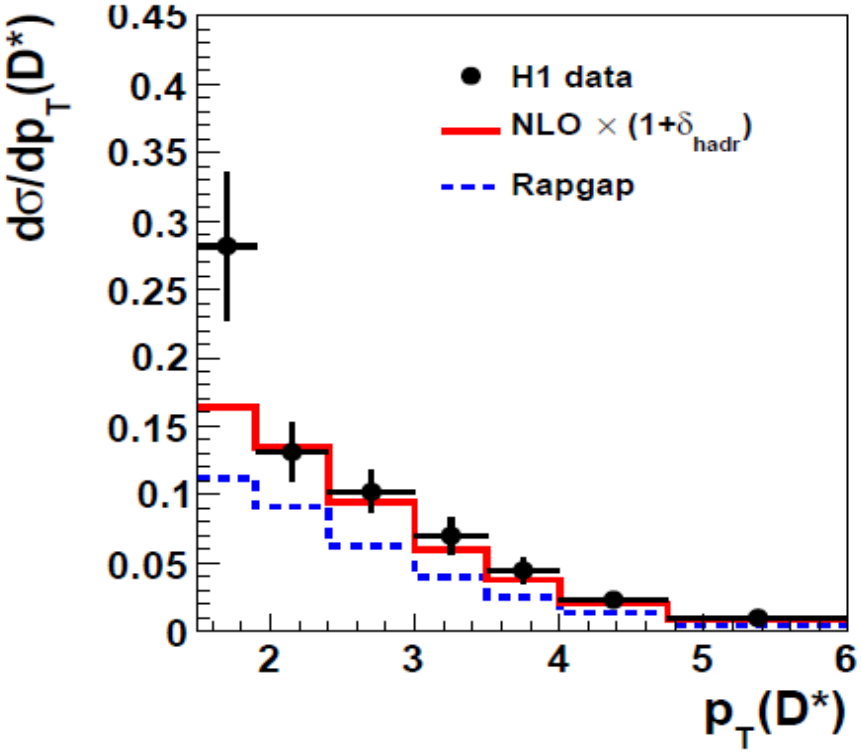






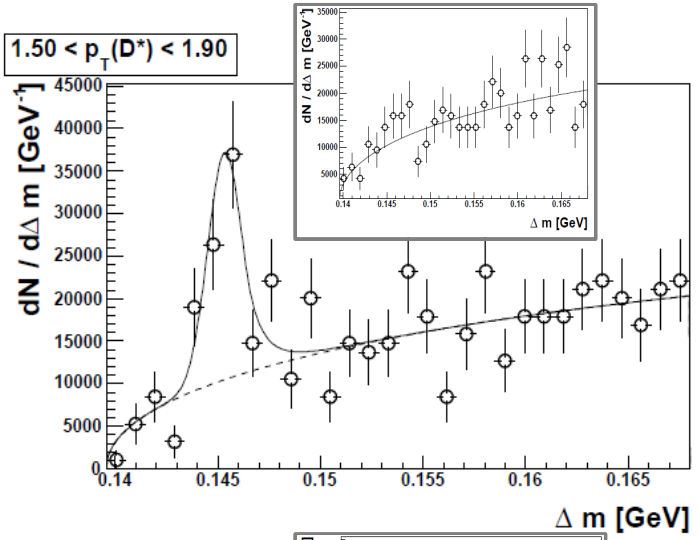
Corrected data^{BBB} x NLO x MC



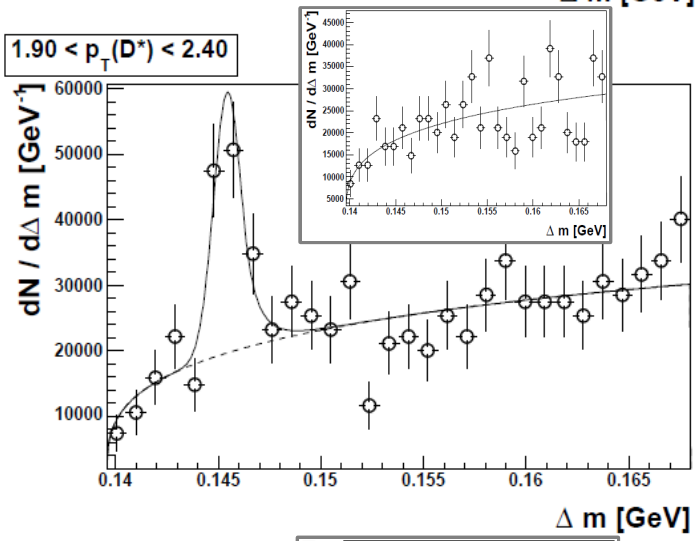


- data x HVQDIS seem OK
- except for the first bin

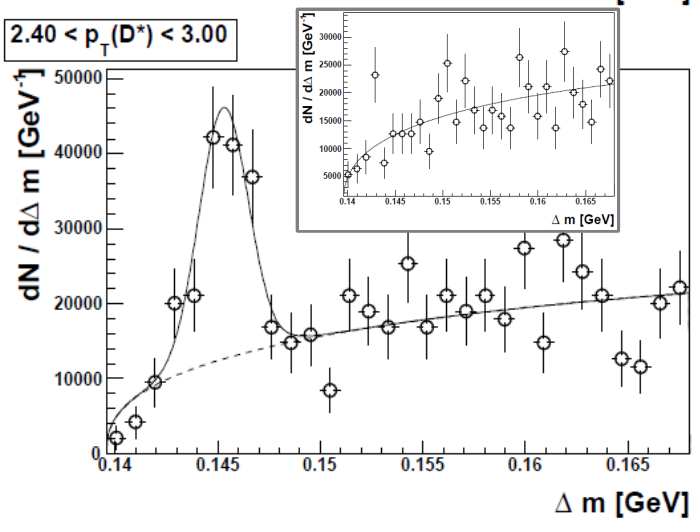
… wrong fit? some problem in acceptances, change cuts?



Fit results
χ^2 = 0.000000000000
NDF = 904.00
χ^2/NDF = 0.00000000
prob = 1.0000
norm = 60.617
peakpos = 0.14534
sigma = 0.00083610
alpha = 1.2000
n = 5.5335
bgdnorm = 411.41
p1 = 0.47382
p2 = 4.1259
p3 = 0.0099997
normwc = 417.22

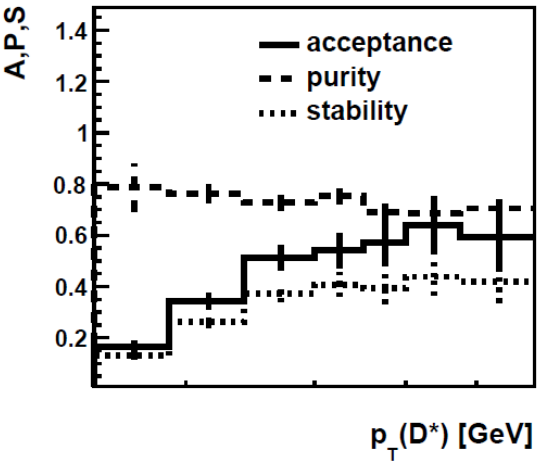


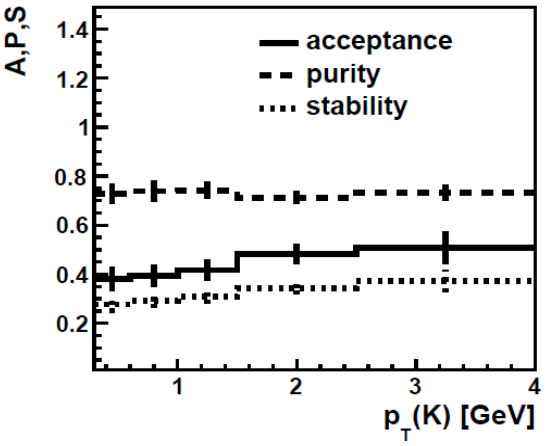
Fit results
χ^2 = 0.000000000000
NDF = 1385.0
χ^2/NDF = 0.00000000
prob = 1.0000
norm = 72.952
peakpos = 0.14544
sigma = 0.00067461
alpha = 1.2000
n = 5.5335
bgdnorm = 676.05
p1 = 0.29544
p2 = 1.6962
p3 = 0.0064043
normwc = 645.00

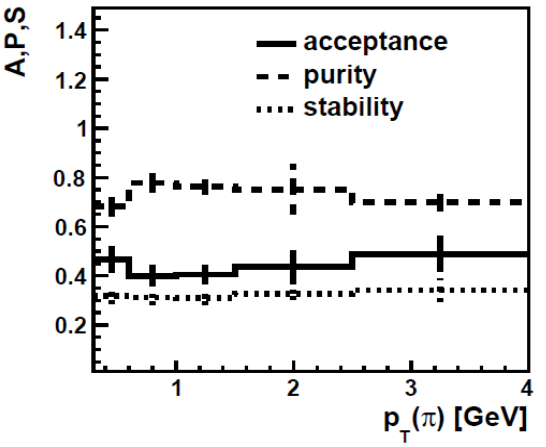


Fit results
χ^2 = 0.000000000000
NDF = 1024.0
χ^2/NDF = 0.00000000
prob = 1.0000
norm = 101.72
peakpos = 0.14528
sigma = 0.0012017
alpha = 2.1179
n = 5.5335
bgdnorm = 461.41
p1 = 0.38695
p2 = 4.1259
p3 = 0.0010000
normwc = 465.00

N(D*) calculated from fits







Summary

- new fitting procedure was introduced
  - finally using the unbinned likelihood
- otherwise nothing has changed
  - trigger efficiencies done
  - cuts and event selection defined, still will be studied
    - $p_T(D^*)$
    - dE/dx
- as soon the above is done, systematic errors will be evaluated
- unfolding