13th International Workshop on Deep Inelastic Scattering
Madison, April 27th – May 1st , 2005

Analysis of the anti-charmed baryon state at H1

Karin Daum – Wuppertal

on behalf of

Outline:

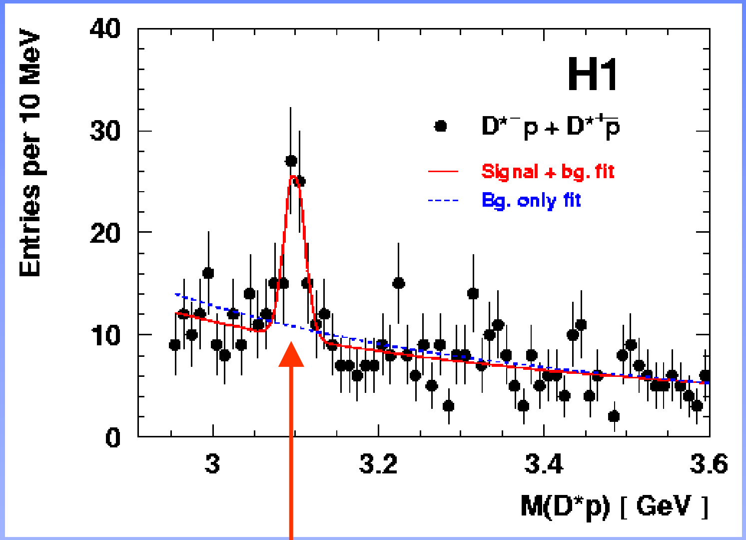
- Observation of the D*p(3100) [1] resonance at H1
- Summary from searches for D*p(3100)
- Model assumptions for the analysis
- Acceptance corrected ratios σ(D*p(3100))/σ(D*)
- Conclusions

[1] Since the spin is unknown "D*p(3100)" rather than "Θ_c" will be used

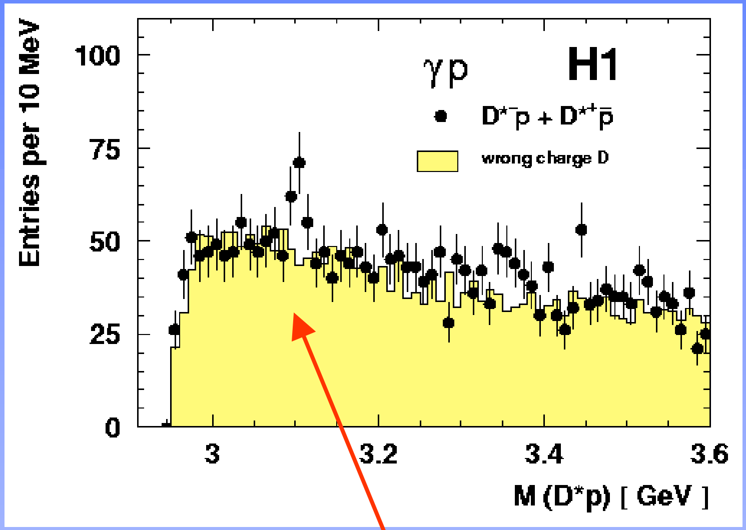
Observation of the D*p(3100) resonance @ H1

A.Atkas et al., Phys. Lett. B588(2004)17. HERA-I, 75 pb^{-1}

DIS: 1 $GeV^2 < Q^2 < 100\ GeV^2$



Photoproduction: $Q^2 < 1\ GeV^2$



Background fluctuation probability
4×10^{-8} (Poisson) ⇒ 5.4 σ (Gauss)

Confirmed by independent photoproduction sample

Preliminary @ ICHEP2004:
R(D*p(3100)/D*) = 1.46±0.32 %

Bare rate uncorrected

Results of D*p(3100) searches

H1 observation in ep $\rightarrow c\bar{c}$ X

Negative results for θ_c from:

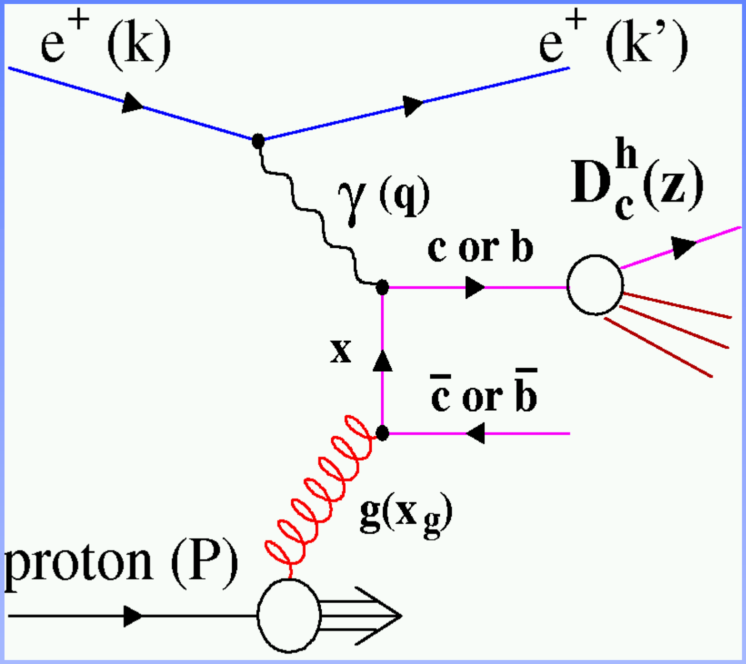
ALEPH	$e^+e^- \rightarrow Z^0 \rightarrow c\bar{c}$
FOCUS	$\gamma N \rightarrow c\bar{c}$ X
CDF	$p\bar{p} \rightarrow c\bar{c}$ X
BELLE	$e^+e^- \rightarrow \Upsilon(4s) \rightarrow B^0\bar{B}^0$
ZEUS	ep $\rightarrow c\bar{c}$ X

Different physics processes investigated (except ZEUS)

Detailed analysis of D*p(3100) from H1 needed

Model assumptions for the analysis

Basic production process*
of charmed hadrons: BGF



* LO QCD

pseudo-rapidity	η = - log(tan(Θ/2))
D*-inelasticity	z =(P·p_{D*})/(P·q)

Assumption:

c-quarks from the hard sub-process interacts with QCD vacuum to create charmed hadrons
e.g. D*, Λ_c, D*p(3100)

(ordinary fragmentation process)

Technical procedure for correcting data:

- Use RAPGAP 3.1
- Mimic D*p(3100) by appropriate modification of mass and decay modes of D_1 and D_2
- No spin assignment done, i.e. isotropic decay

The model will be normalised to the total D*p(3100)/D* yield when comparing with data

Acceptance corrected R_{cor}(D*p(3100)/D*)

Kinematic region: $1 < Q^2 < 100$ GeV² & $0.05 < y_e < 0.7$

1. In the visible D* range as given in our publication: preliminary

- Visible D*p range: Pt(D*p)>1.5 GeV, $-1.5 < \eta(D^*p) < 1$
- Visible D* range: Pt(D*)>1.5 GeV, $-1.5 < \eta(D^*) < 1$, z(D*)>0.2
  (applied to inclusive D* and to D*s from D*p(3100) decay)

$$R_{cor}(D^*p(3100)/D^*) = 1.59 \pm 0.33\%\,^{+0.33}_{-0.45}\,\%$$

95% Upper limit from ZEUS for DIS : <0.59 %

in different phase space: $Q^2 > 1$ GeV² & $y_e < 0.95$
pt(D*)>1.35 GeV, $|\eta(D^*p)| < 1.6$,
$pt(D^*)/\Sigma E_t^{\Theta > 10} > 0.12$

Systematic errors include uncertainties due to:
D*, D*p selection, veto for D_1D_2, background shape, dE/dx-measurement,
Variation of D*p(3100) fragmentation and pseudo-rapidity η

Acceptance corrected R_{cor}(D*p(3100)/D*)

Kinematic region: $1<Q^2<100$ GeV^2 & $0.05<y_e<0.7$

1. In the visible D* range as given in our publication:

preliminary

- Visible D*p range: Pt(D*p)>1.5 GeV, $-1.5<\eta$(D*p)<1
- Visible D* range: Pt(D*)>1.5 GeV, $-1.5<\eta$(D*)<1, z(D*)>0.2
  (applied to inclusive D* and to D*s from D*p(3100) decay)

$$R_{cor}(D^*p(3100)/D^*) = 1.59\pm0.33\%\,^{+0.33}_{-0.45}\,\%$$

2. Extrapolated to the full D* phase space in D*p(3100) decay:

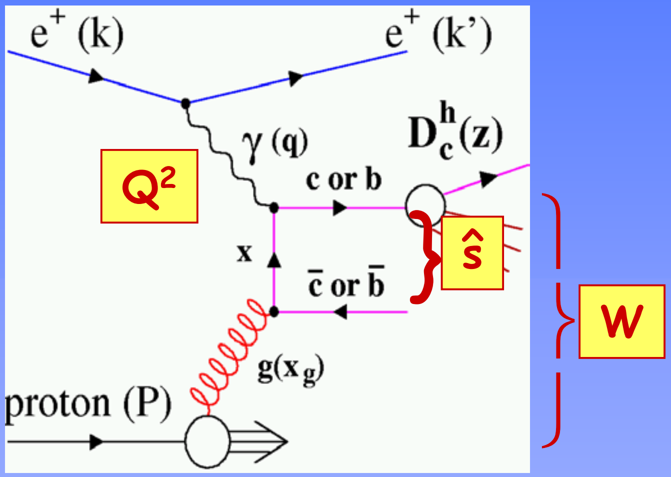
- Visible D*p/D* range: Pt>1.5 GeV, $-1.5<\eta<1$
  (applied to D* for inclusive D* and to D*p for D*p(3100))

$$\sigma(D^*p(3100))/\sigma(D^*) = 2.48\pm0.52\%\,^{+0.85}_{-0.64}\,\%$$

Systematic errors include uncertainties due to:
D*, D*p selection, veto for D_1D_2, background shape, dE/dx-measurement,
Variation of D*p(3100) fragmentation and pseudo-rapidity η

$\sigma(D^*p(3100))/\sigma(D^*)$ vs. event kinematics

Kinematic region: $1<Q^2<100\ GeV^2$ & $0.05<y_e<0.7$



ŝ calculated from D*/D*p in γp-system:

$$\hat{s}_{obs} = \frac{p_t^{*2}/x_{obs} + m_c^2 x_{obs}}{z(z/x_{obs} - 1)}$$

Invariant mass ŝ depends on:

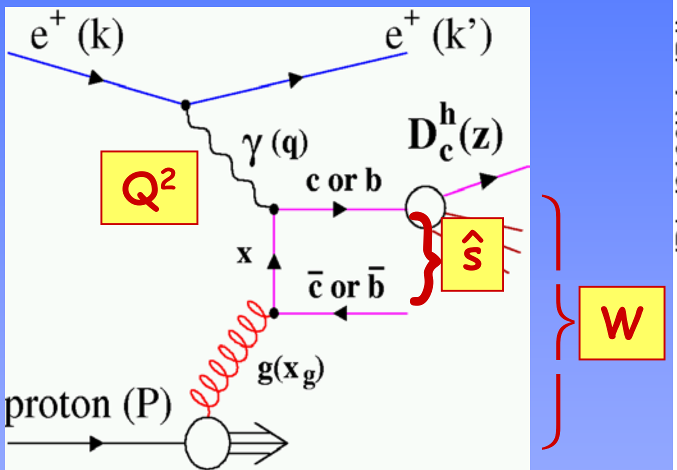
- P_t^* **of D*, D*p in γp-system**
- inelasticity z **of D*, D*p**
- fragmentation value x_{obs} **of D*, D*p**

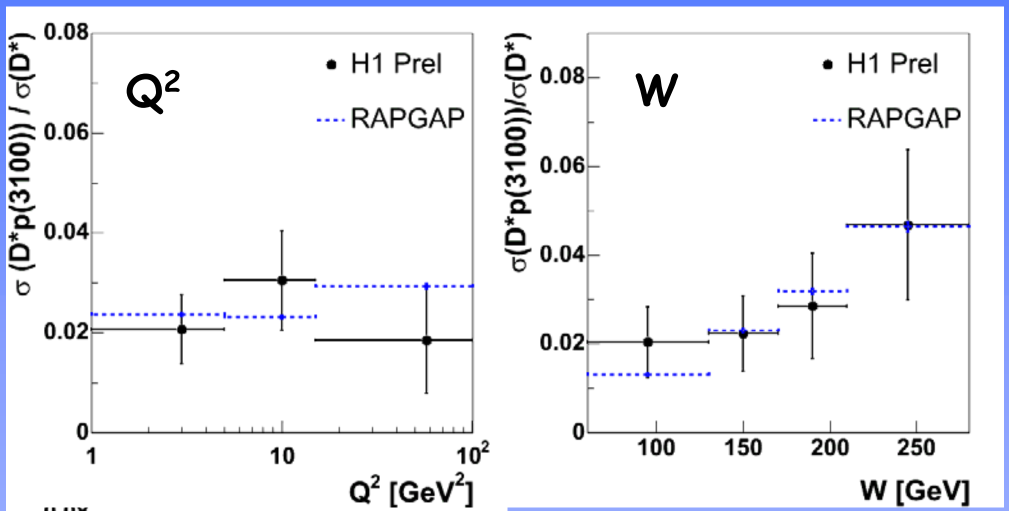
(I'll come to the fragmentation issue later)

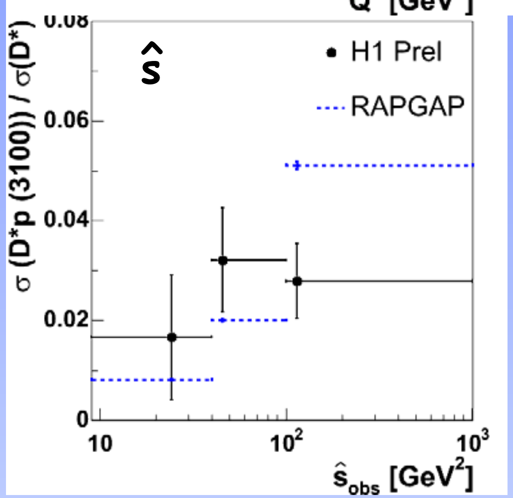
σ(D*p(3100))/σ(D*) vs. event kinematics

Statistical errors only

Kinematic region: $1 < Q^2 < 100\ \mathrm{GeV}^2\ \&\ 0.05 < y_e < 0.7$







ŝ calculated from D*/D*p in γp-system:

$$\hat{s}_{obs} = \frac{p_t^{*2}/x_{obs} + m_c^2 x_{obs}}{z(z/x_{obs} - 1)}$$

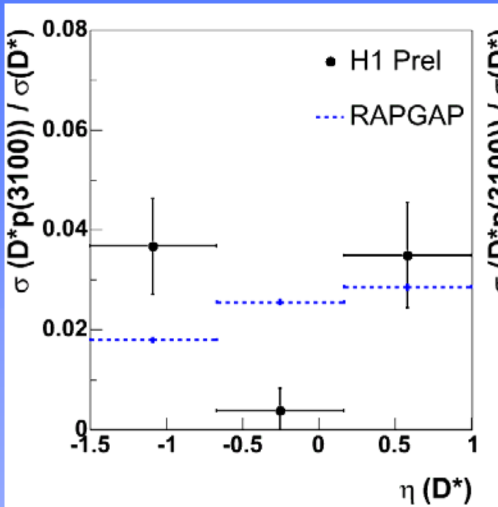
- W, Q²: MC follows data
- ŝ: MC differs from data

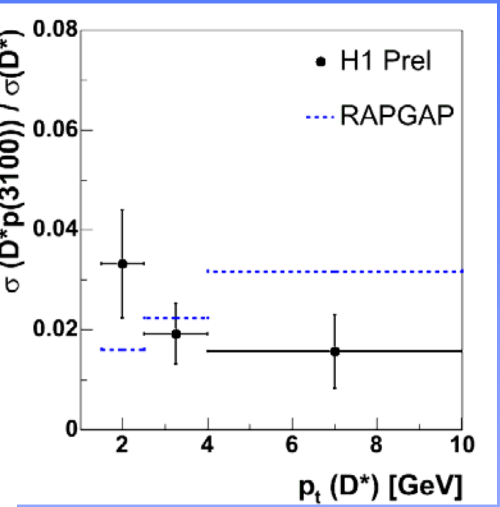
$\sigma(D^*p(3100))/\sigma(D^*)$ for D^* observables

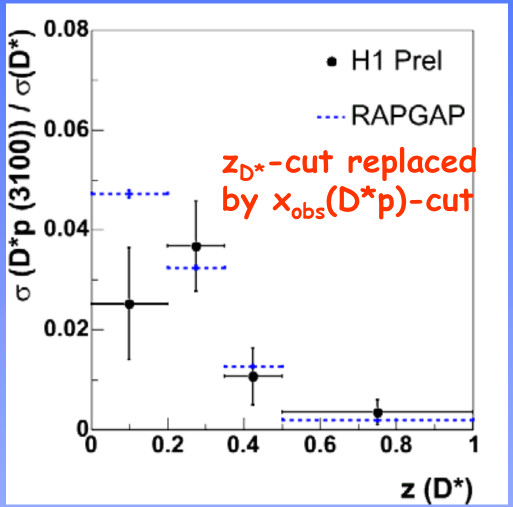
Statistical errors only

Kinematic region: $1<Q^2<100\ GeV^2\ \&\ 0.05<y_e<0.7$

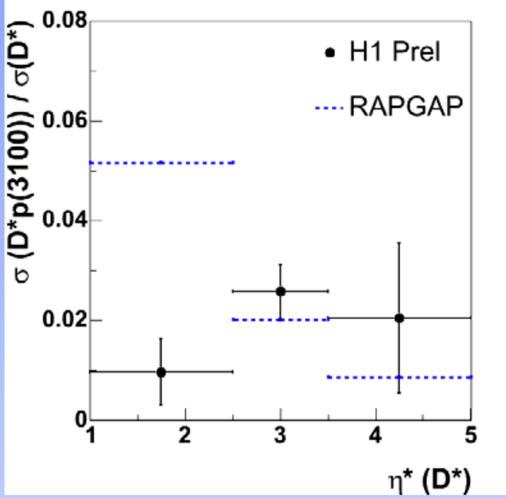
Lab. frame







γp-frame



Compared to normal D^* production D^* from $D^*p(3100)$ are:

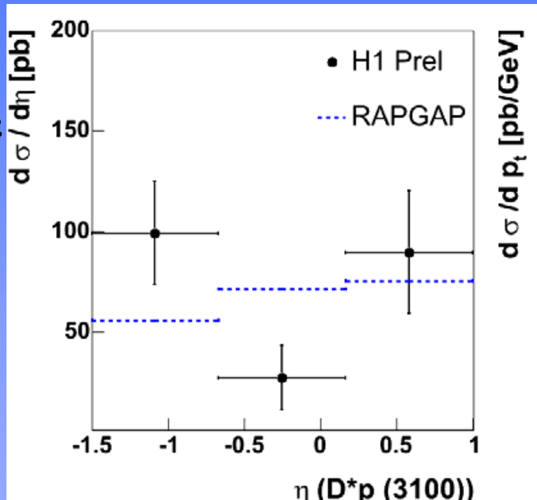
- Suppressed for central η in the lab.
- Significantly softer in pt(D^*) and z(D^*)
- Closer to photon direction in γp
- The simple MC approach does not describe the data

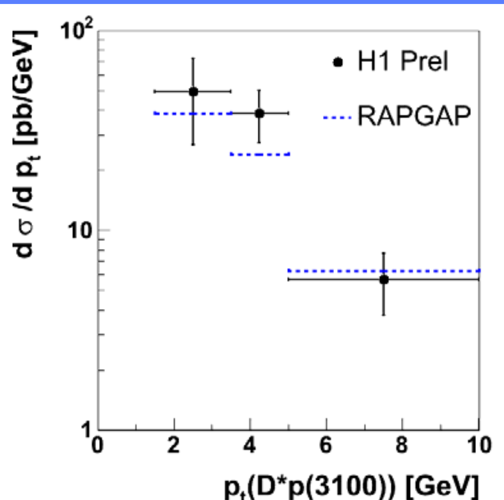
σ(D*p(3100)) for D*p observables

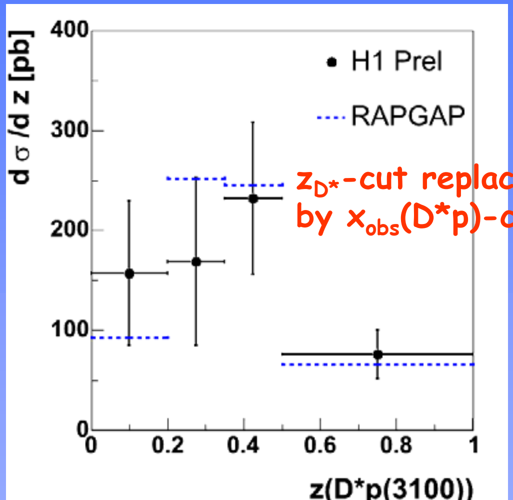
Statistical errors only

Kinematic region: $1<Q^2<100$ GeV^2 & $0.05<y_e<0.7$

Lab. frame

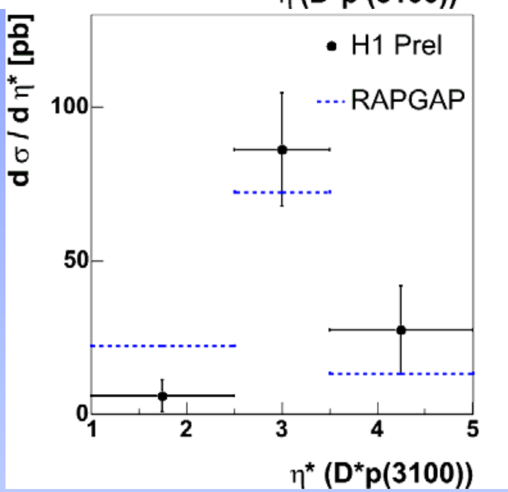






z_{D^*}-cut replaced by x_{obs}(D*p)-cut

γp-frame



D*p(3100) production is:

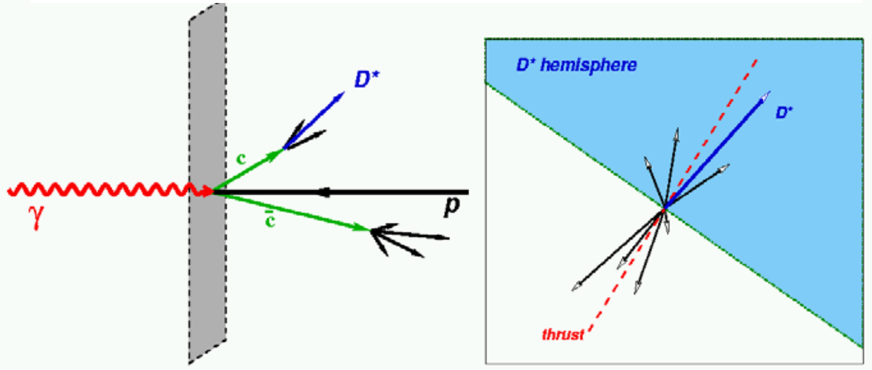
- Suppressed for central η in the lab.
- Close to photon direction in γp
  (These features are not described by the simple MC approach)
- MC approach in reasonable agreement with pt- and z-distributions of D*p(3100)

Fragmentation function of D*p(3100), D*

Analysis[1] performed in γp:

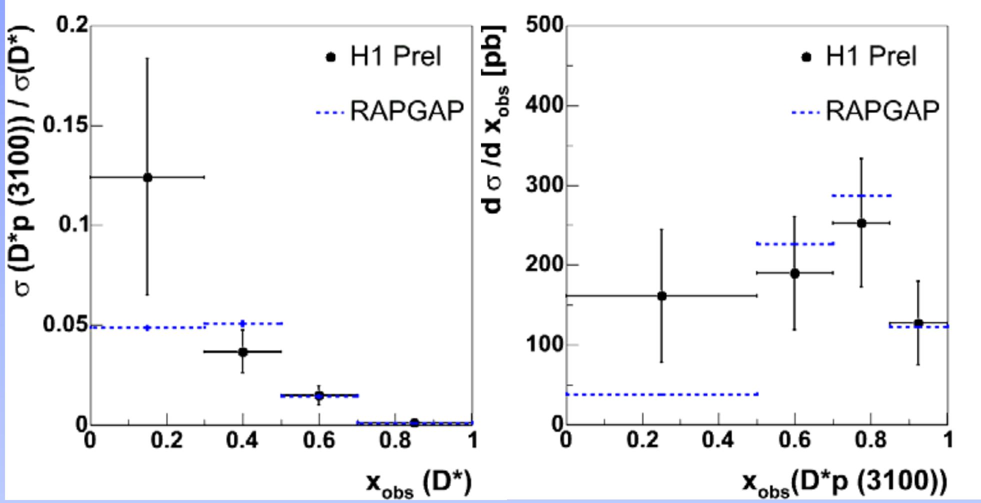
- Project all particles in the γ hemisphere into plane perpendicular to γ direction
- Divide event into 2 hemispheres defined by the D* direction
- Sum up all particles in D* hemisphere $\Rightarrow$ c-quark (including QCD-effects)

$$x_{obs}(D^*p, D^*) = \frac{(E-p_z)_{lab}(D^*p, D^*)}{\sum_{\text{Hemisphere}}(E-p_z)_{lab}}$$



[1] Similar to analysis of Zuzana Rurikova, HFWG, Session 2

z_{D^*}-cut replaced by $x_{obs}(D^*p)$-cut



Statistical errors only

- D* from D*p(3100) gets very little energy from c-quark
- D*p(3100) fragmentation is hard (as expected from its mass)

Conclusions

- Preliminary results on acceptance corrected ratio D*p/D* in DIS in the visible D* region is

$$R_{cor}(D^*p(3100)/D^*) = 1.59 \pm 0.33\% \,^{+0.33}_{-0.45}\,\%$$

- D*s from D*p(3100) decay are significantly softer than normal D*s
- D*p(3100) production in central η_{lab} suppressed
- D*p(3100) produced close to the photon direction
- D*p(3100) fragmentation is hard

- The simple fragmentation approach with isotropic decay
  - does describe W and Q^2 of D*p(3100) production
  - does not describe D* properties from D*p(3100) decay
  - does reasonably well for properties of D*p(3100), except for η_{lab} and η^*

Backup slides

Physics related slides

Remarks on D*p search by ZEUS

We observe:

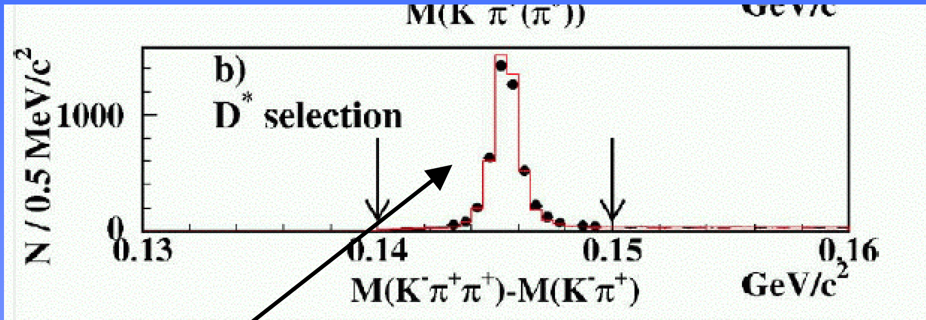
- D* from D*p(3100) decay take only little energy of the event
- Production of D*p(3100)is different in η from inclusive D* production
- The charged and neutral multiplicity in D*p(3100) events tends to be higher than in ordinary D* events

The ZEUS cut pt(D*)/ΣEtΘ>10 for background suppression is designed just to remove high multiplicity events with little energy for the D*

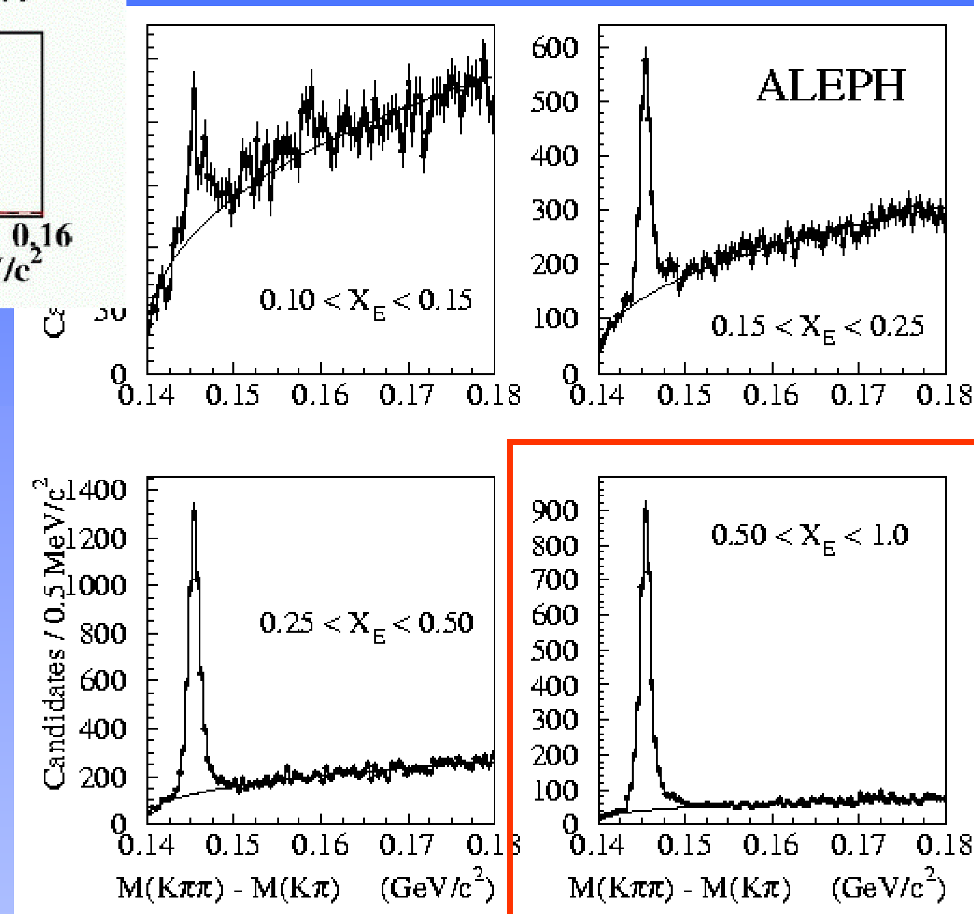
Furthermore:

The kinematic & visible D* regions are not directly comparable

Remarks on D*p search by ALEPH



D*signal form PL B599(2004)1



Distributions suggest that D*'s with large X_E are favoured

Furthermore:
Decay length cut used in PL B599 is a veto for small X_E according to EPJ C16.

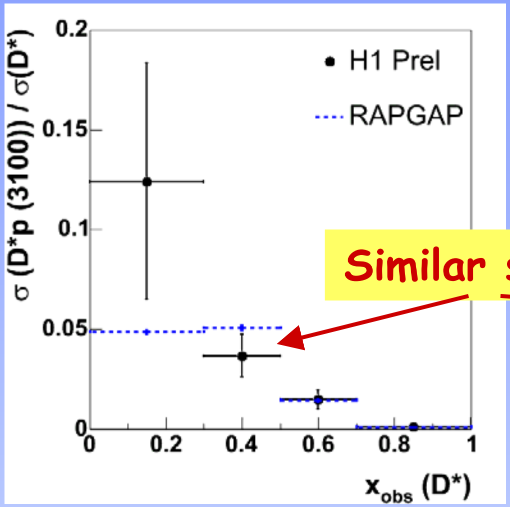
Limit
$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*) < 0.3\%$

D*signals vs. X_E from EPJ C16(2000)597

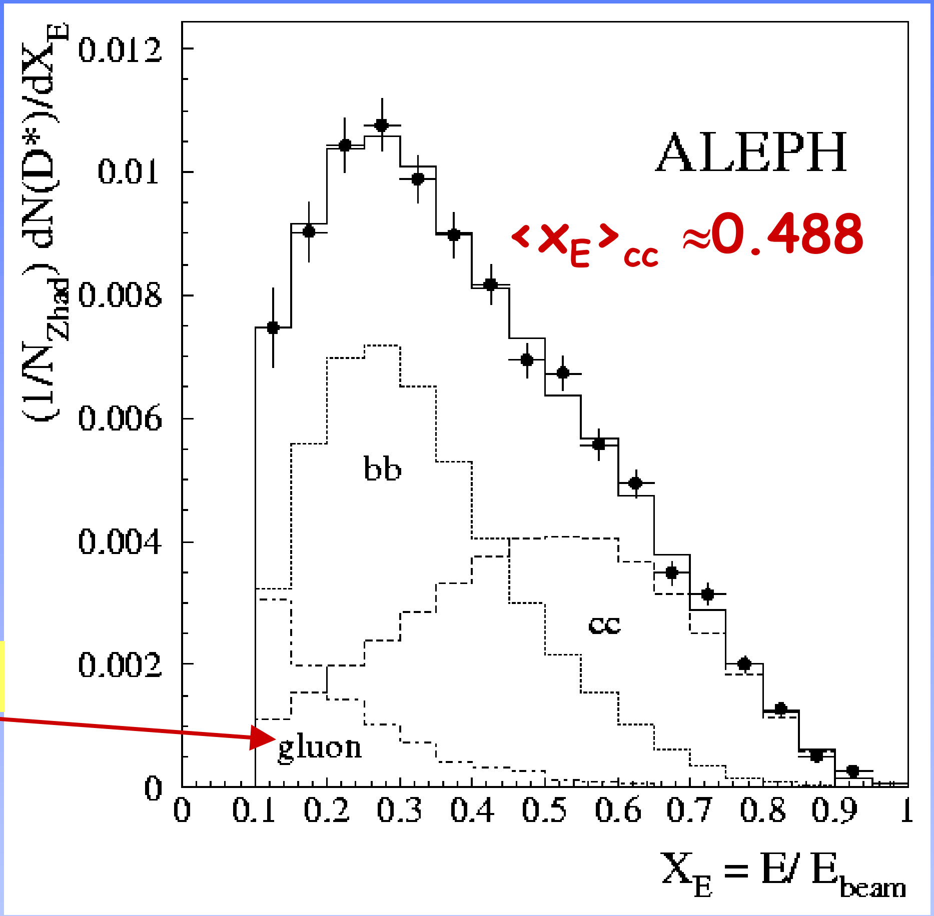
Remarks on D*p search by ALEPH

$R_b \approx 22\%$, $R_c \approx 17\%$

D* @ LEP are produced predominantly by beauty



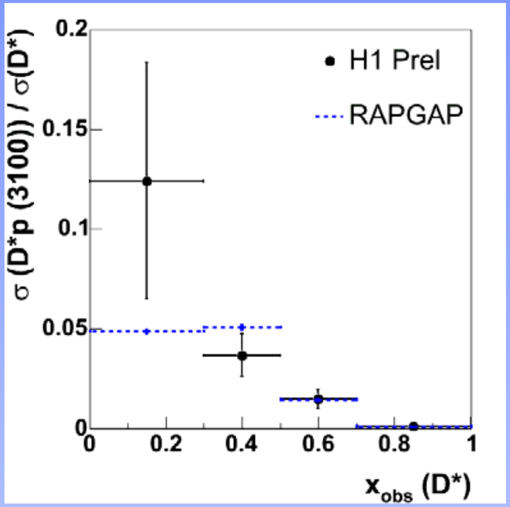
Similar shapes



Remarks on D*p search by ALEPH

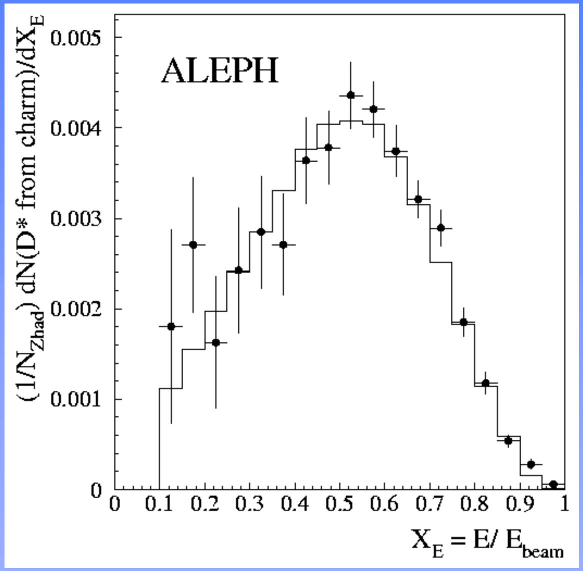
At LEP D* fragmentation function significant softer than at HERA due to QCD evolution

D*'s from Θ_c should lead to a shift in X_E by about −0.3



For x_{obs}(D*)>0.7:
$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)=0.17\pm0.13\%$

D*'s from charm



ALEPH, EPJ C16(2000)597

ALEPH Limit:

$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)<0.3\%$
Likely to be NOT in disagreement

Remarks on D*p search by Belle

Exclusive channel in B^0 decay:

$B(B^0 \rightarrow \Theta_c \bar{p}\pi) \times B(\Theta_c \rightarrow D^*p) / B(\Theta_c \rightarrow D^*p\bar{p}\pi) < 11\%$ @ 90% C.L.

Not in contradiction with H1 result

They indirectly conclude from their limit on

$B(B^0 \rightarrow \Theta_c \bar{p}\pi) \times B(\Theta_c \rightarrow D^-p) / B(\Theta_c \rightarrow D^-p\bar{p}\pi) < 1.2\%$ @ 90% C.L.

assuming the Θ_c decay into pseudoscalar plus proton should be favoured they would not be in agreement with H1

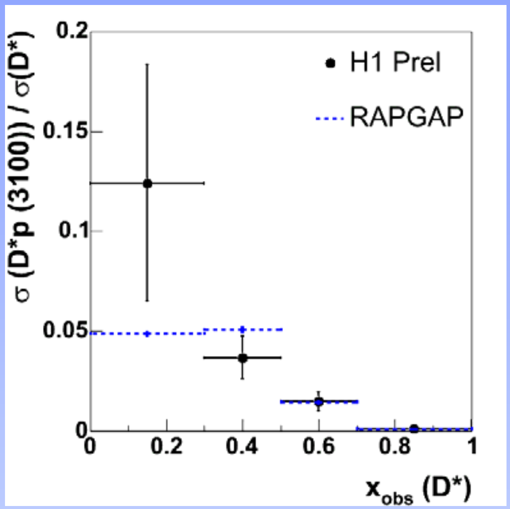
BUT: it is not clear which decay mode is favoured, Depends on spin of the D*p(3100)

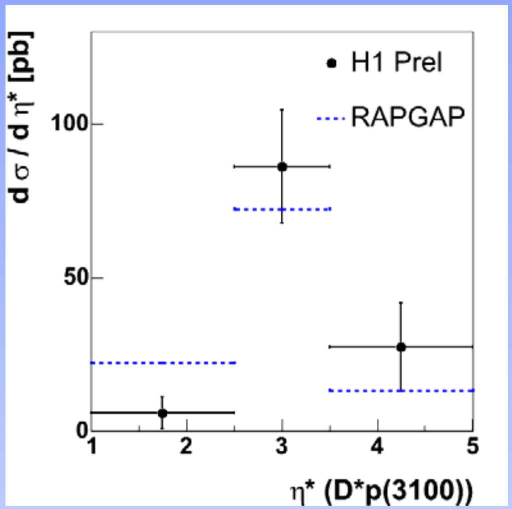
Remarks on D*p search by CDF

Charm production via gluon gluon fusion
Similar to BGF at HERA

CDF charm trigger sensitive to central rapidity in c.m.s.
$|\eta|<0.7$ with 2 svtx tracks with $p_t>2$ GeV

H1 sees:
Soft D*s from D*p(3100) not central in c.m.s.

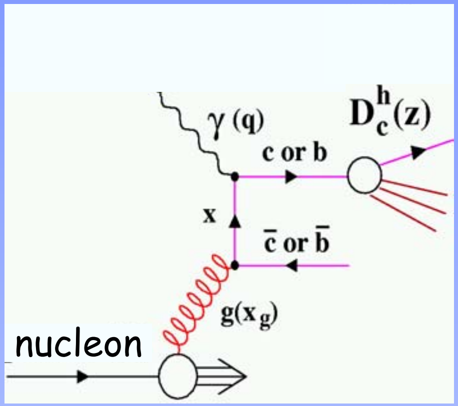




Remarks on D*p search by FOCUS

Fixed target experiment
180 GeV photons on ^{9}Be
$\rightarrow$hadronic mass W~18 GeV

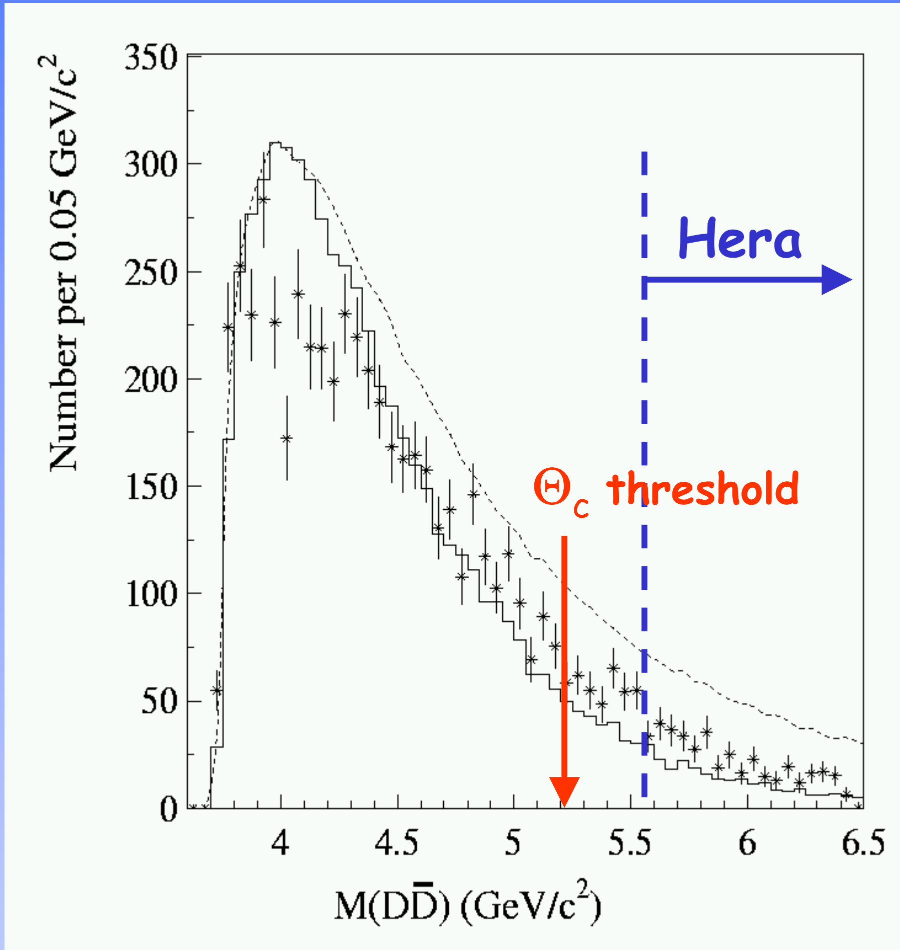
Hera: 60<W<280 GeV



D

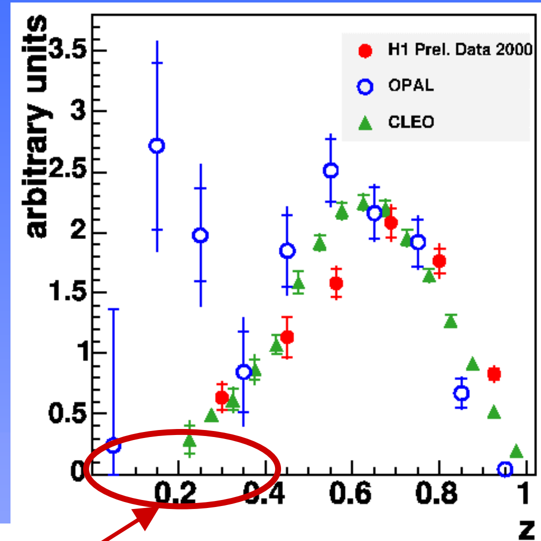
M(DD̄)

D̄



Large phase space suppression for Θ_c in FOCUS
No Monte Carlo used by FOCUS

D* fragmentation

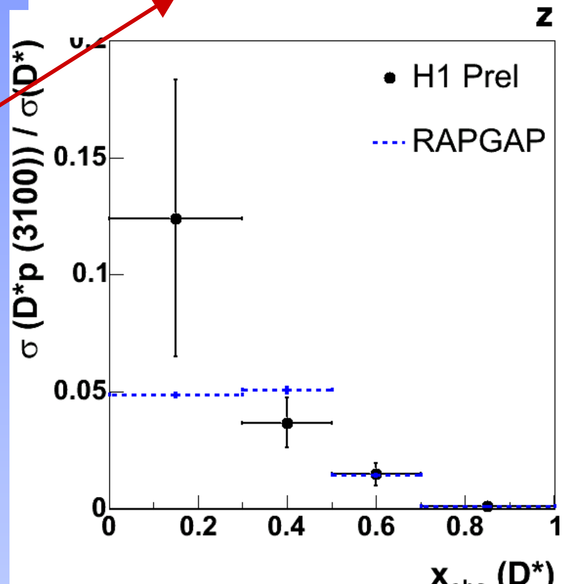


H1 hemisphere method
$<\sqrt{s}> \approx 10$ GeV,
$z = \frac{(E+p_L)_{D^*}}{\sum_{hem}(E+p)}$

OPAL $\sqrt{s} = 91.2$ GeV,
$z = 2E_{D^*}/\sqrt{s}$

CLEO $\sqrt{s} \approx 10$ GeV,
$z = p_{D^*}/p_{max}$

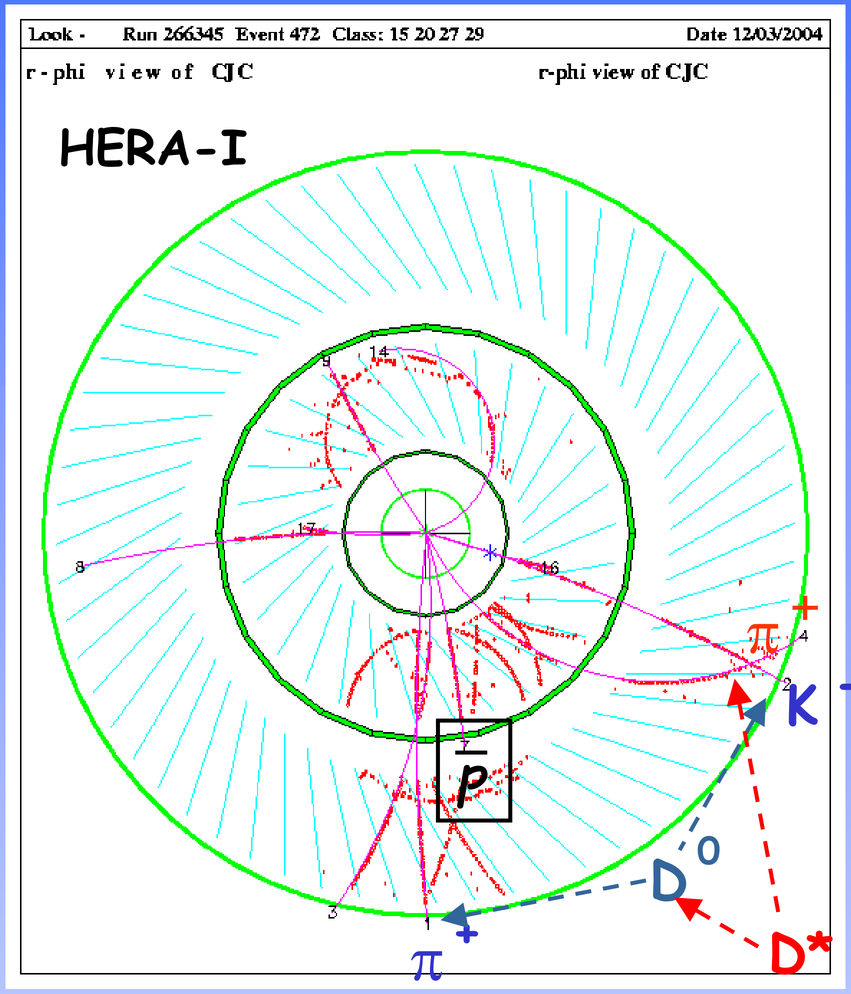
Here D*p(3100) Is contributing

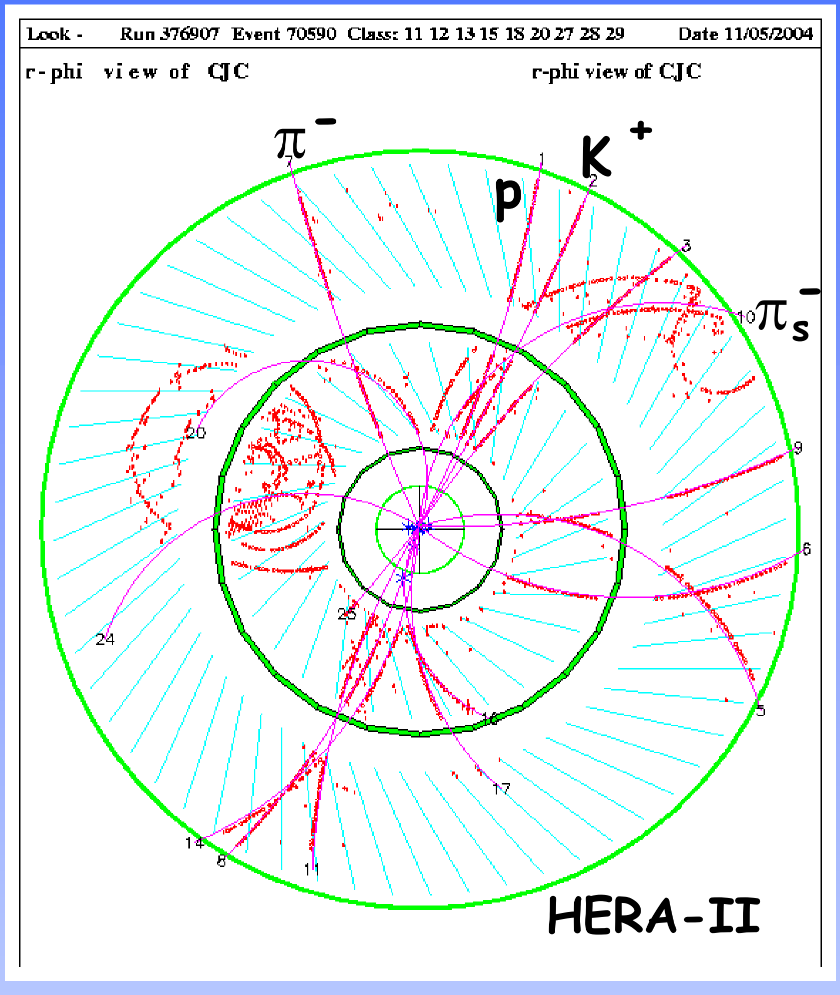


Backup slides

Analysis related slides

Typical D*p candidates





Systematic error for $\sigma(\Theta_c)/\sigma(D^*)$ in visible D* region

Relative systematic errors:

Δdm window 1.5 MeV instead of 2.5 MeV	- 9 %
Fit with our background model instead of $(M(D^*p)-M(D^*))^\alpha$	- 12 %
$z(D^*)>0.1$ instead of $z(D^*)>0.2$	- 21 %
Exclude D_1,D_2 signal region by $\lvert m(D^*\pi)-2.45\rvert>50$ MeV	+ 18 %
Uncertainty in dE/dx	± 10 %
Re-weighting of Θ_c fragmentation function	- 5 %
Re-weighting of $\eta(\Theta_c)$ distribution	- 3 %
Total	- 28 + 21 %

Total systematic error : -0.45+0.33%

Systematic error for $\sigma(\Theta_c)/\sigma(D^*)$ for full D* region

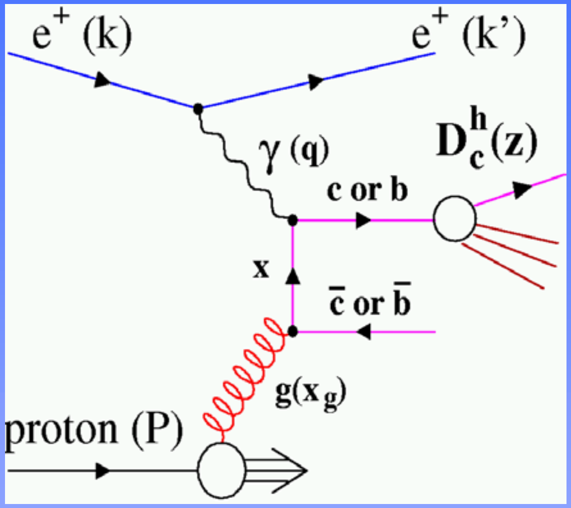
Relative systematic errors:

Δdm window 1.5 MeV instead of 2.5 MeV	- 10 %
Fit with our background model instead of $(M(D^*p)-M(D^*))^\alpha$	- 14 %
z(D*)>0.1 instead of z(D*)>0.2	- 8 %
Exclude D_1, D_2 signal region by $\|m(D^*\pi)-2.45\|>50$ MeV	+ 17 %
Selection with $x_{obs}(\Theta_c)$ instead of z(D*)	- 15 %
Uncertainty in dE/dx	± 10 %
Re-weighting of Θ_c fragmentation function*	+ 28 %
Re-weighting of $\eta(\Theta_c)$ distribution	- 4 %
Total	- 26 + 34 %

Total systematic error : -0.64+0.85%

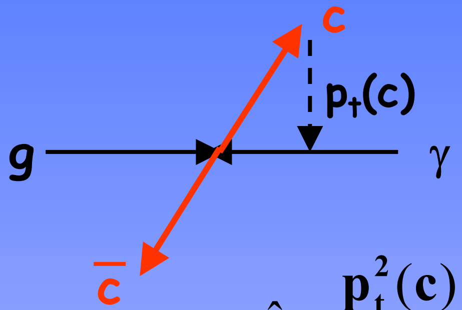
If the $x_{obs}(\Theta_c)$ cut is used instead of the z(D) cut the systematic uncertainty due to fragmentation reduces to 11%

Acceptance corrected Θ_c/D^* yield ratio-III : shat



} $\hat{s}$

γg system



$$\hat{s} = \frac{p_t^2(c) + m_c^2}{z(z - 1)}$$

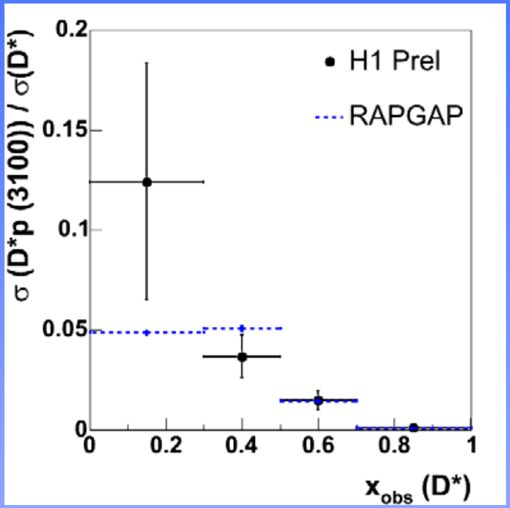
But: we observe charmed hadrons instead of quarks

Normal procedure: Replace quantities of c-quark by those of D*

We measure also fragmentation variable x_{obs} → we can do better

$$\hat{s} = \frac{p_t^2(D^*)/x_{obs}(D^*) + m_c^2\, x_{obs}(D^*)}{z(D^*)(z(D^*)/x_{obs}(D^*) - 1)}$$

Remarks on $\sigma(\Theta_c \rightarrow D^*p)/\ \sigma(D^*)(x_{obs})$



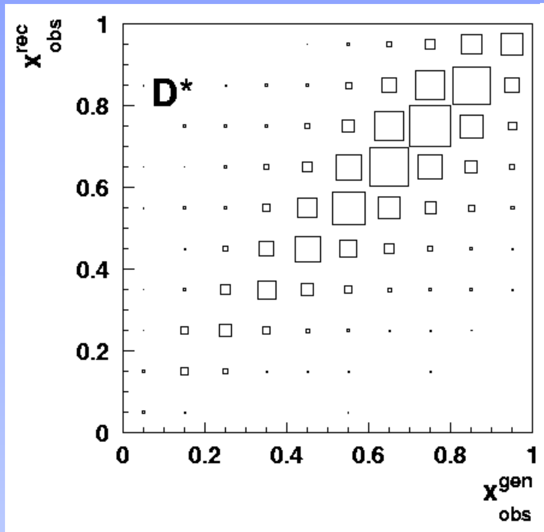
$x_{obs}(D^*)$ very soft !

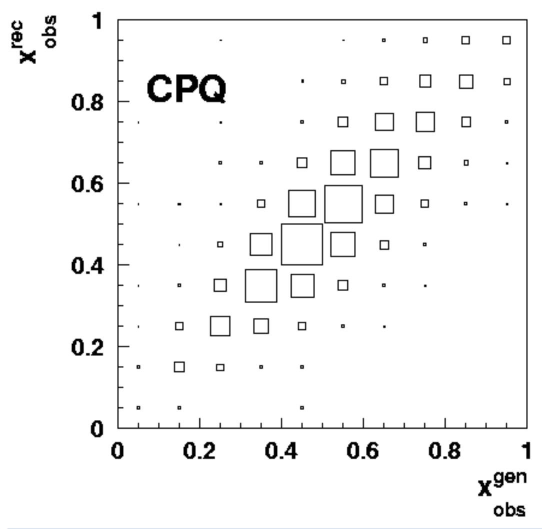
For $x_{obs}(D^*)>0.5$:

$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)=1.08\pm0.31\%$

For $x_{obs}(D^*)>0.7$:

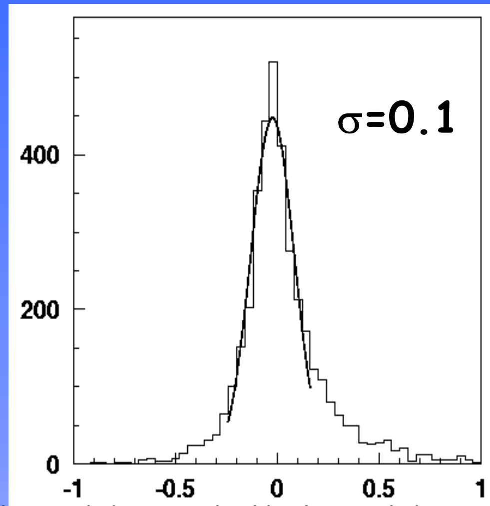
$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)=0.17\pm0.13\%$





Reconstruction of shat

hadron level

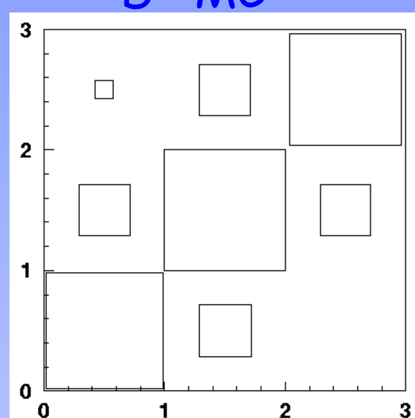


$\log_{10}(shat_{rec}(p_t)) - \log_{10}(shat_{gen}(p_t))$

Bins in shat:
9-40-100-1000 GeV²

D* MC

purity: 83.1%, 73.6%, 81.9%

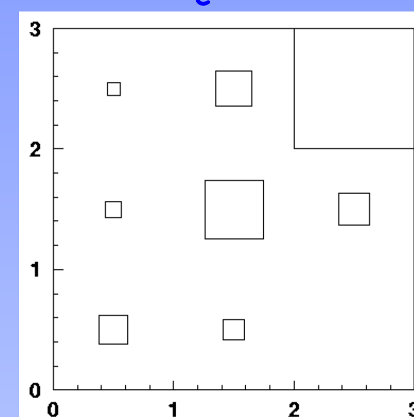


80.8 73.4 81.6%

stability

Θ_c MC

purity: 91.7%, 71.2%, 64.5%

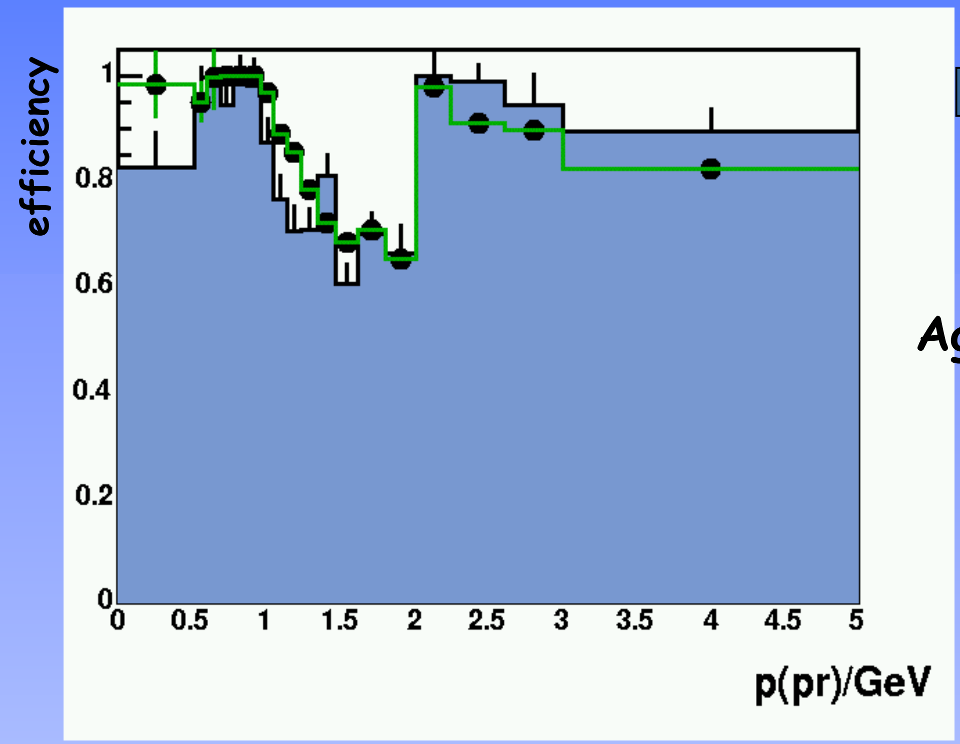


64.8 67.1 93.2%

stability

Systematics: dE/dx

Check of dE/dx selection efficiencies for protons using Λ^0 in data and SPQ MC



SPQ MC

• Data

Agreement between data and MC ~±5%

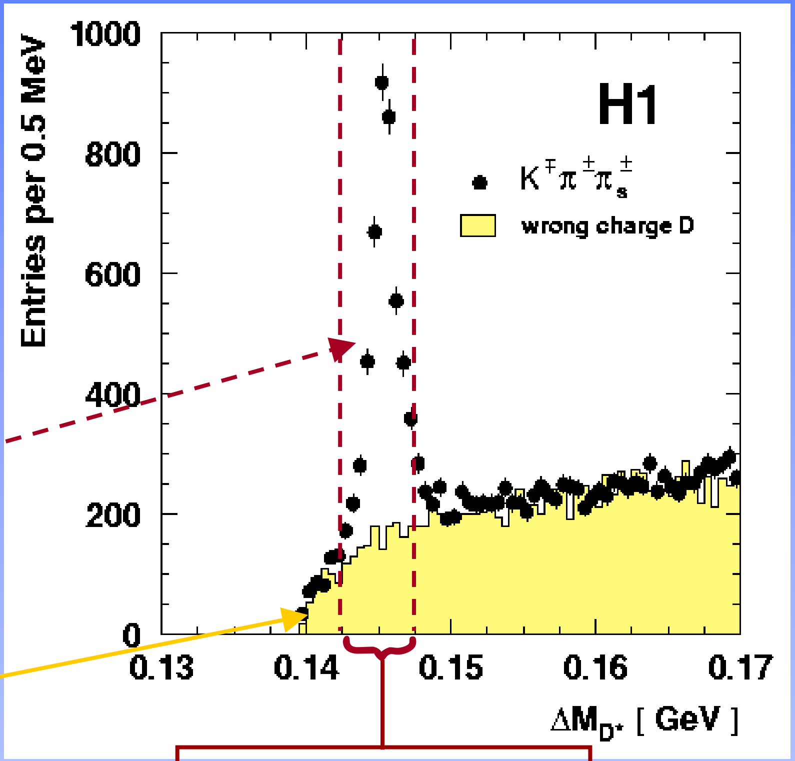
p_t and η distributions for protons from Λ^0 may be different for those from Θ_c

$\Rightarrow$ use systematic error of ± 10%

D* Signal

Golden channel
$D^{*+} \rightarrow D^0 \pi_s \rightarrow (K\pi)\pi_s$
(low BR but clean signal)
$M(D^*)-M(D^0)$ = 145.4 MeV

96-00 data 75 pb^{-1} DIS: $Q^2>1$ GeV^2



Mass difference technique:
$\Delta M_{D^*} = M(K\pi\pi_s) - M(K\pi)$

Good Signal/Background

3400 D*'s in DIS to start with

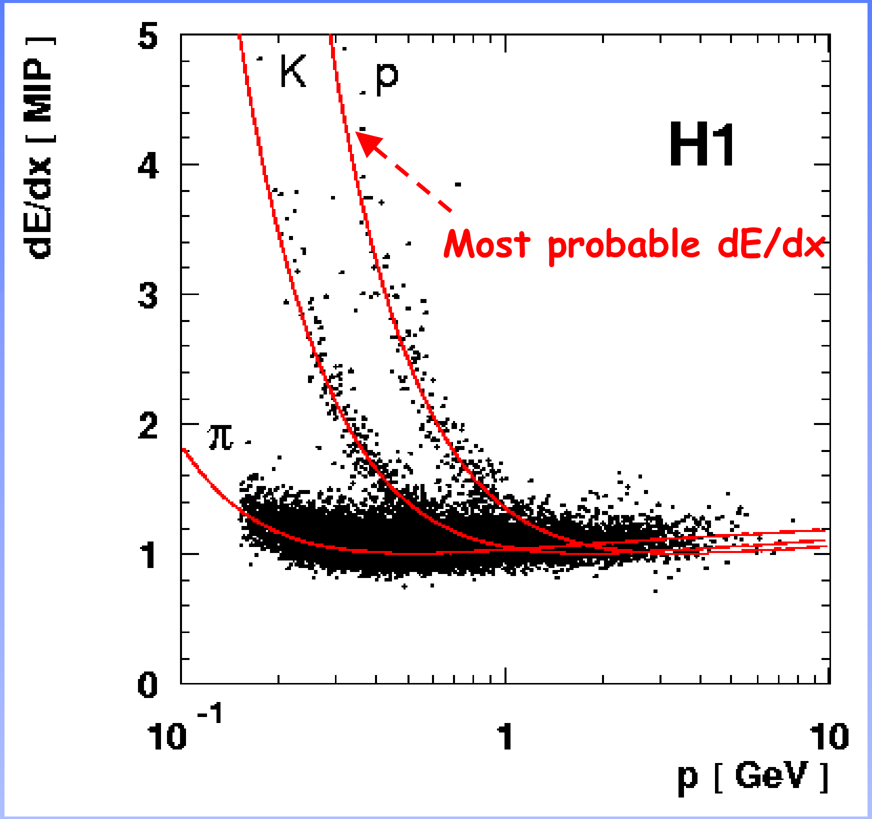
Non charm induced background
"wrong charge D" :
fake D^0 $(K^+\pi^+/K^-\pi^-)+\pi_s$

D* signal region subsequently used

Proton selection

Particle identification via dE/dx

- 3-5% accuracy
- 8% MIP resolution



Use dE/dx for background suppression

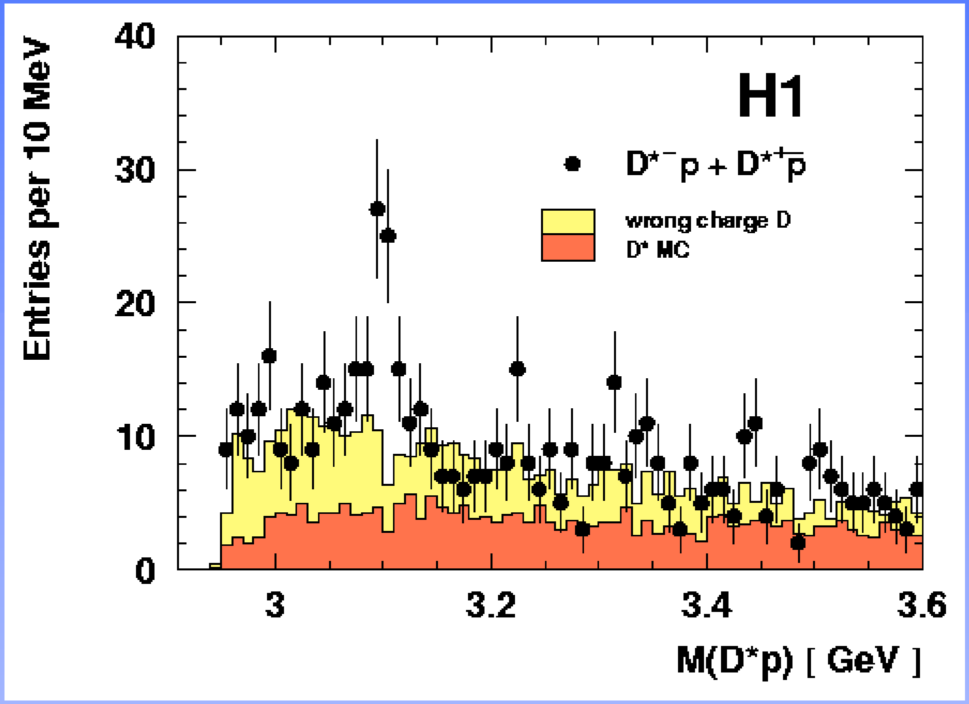
Opposite sign D*p mass distribution

Apply mass difference technique

$M(D^*p)=m(K\pi\pi\ p)-m(K\pi\pi)+M_{PDG}(D^*)$

- no enhancement in D* Monte Carlo
- no enhancement in wrong charge D

Background well described by D* MC and "wrong charge D" from data

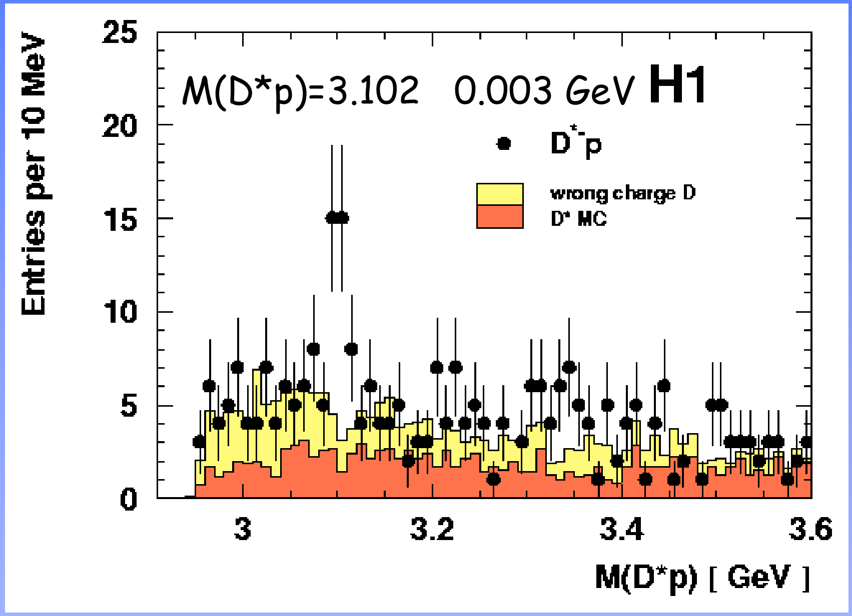


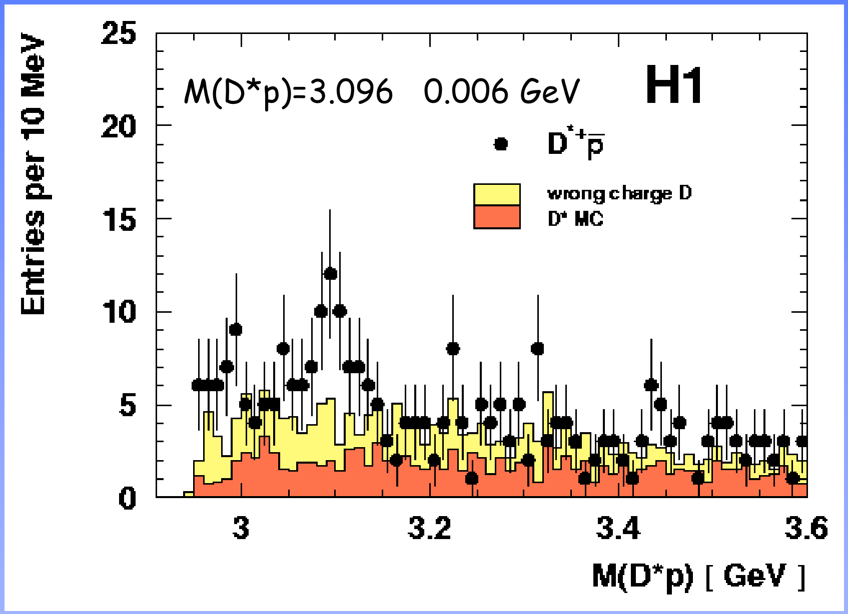
narrow resonance at M=3099± 3(stat.) ± 5 (syst.) MeV

- signal visible in different data taking periods

Signal in both $D^{*-}p$ and in $D^{*+}\bar{p}$

$M(D^*p) = m(K\pi\pi p) - m(K\pi\pi) + m(D^*)$





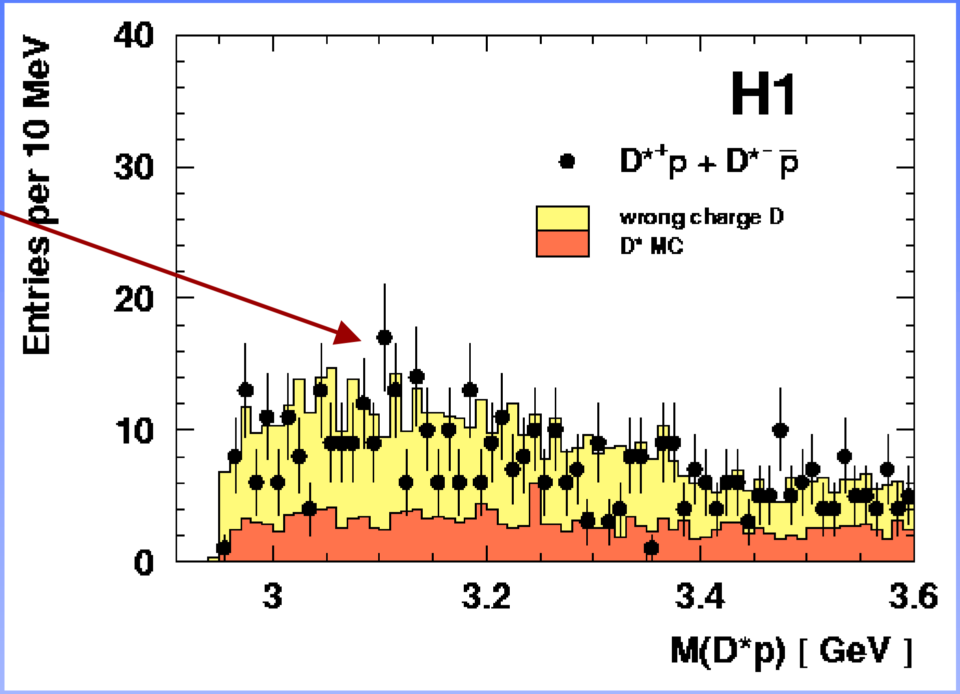
25.8 ± 7.1 *Events*

23.4 ± 8.6 *Events*

Signal of similar strength observed for both charge combinations at compatible M(D*p)

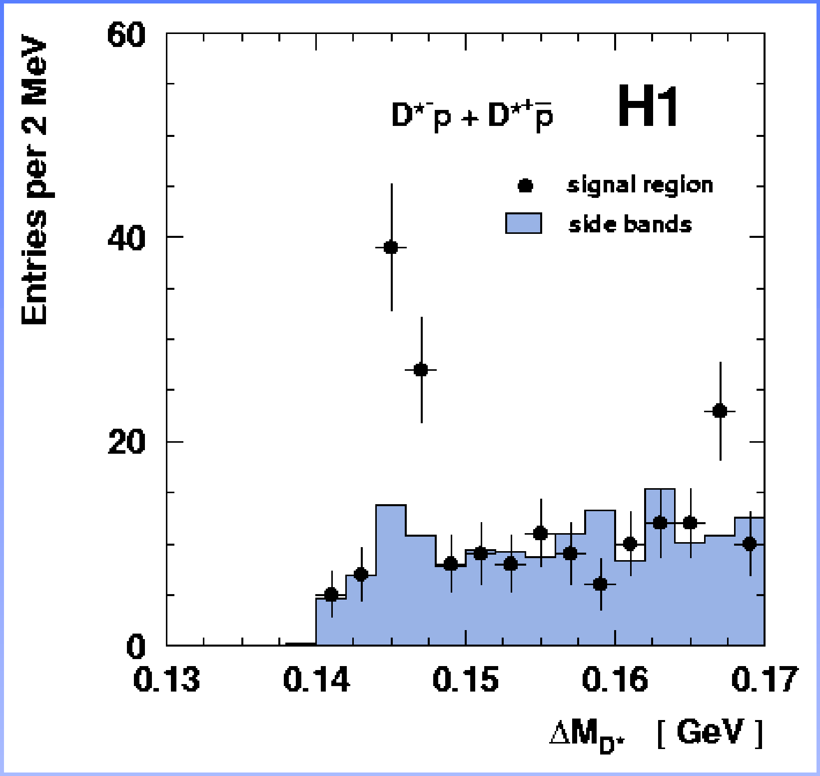
Signal in like sign D*p combinations?

No significant peak in like sign D*p

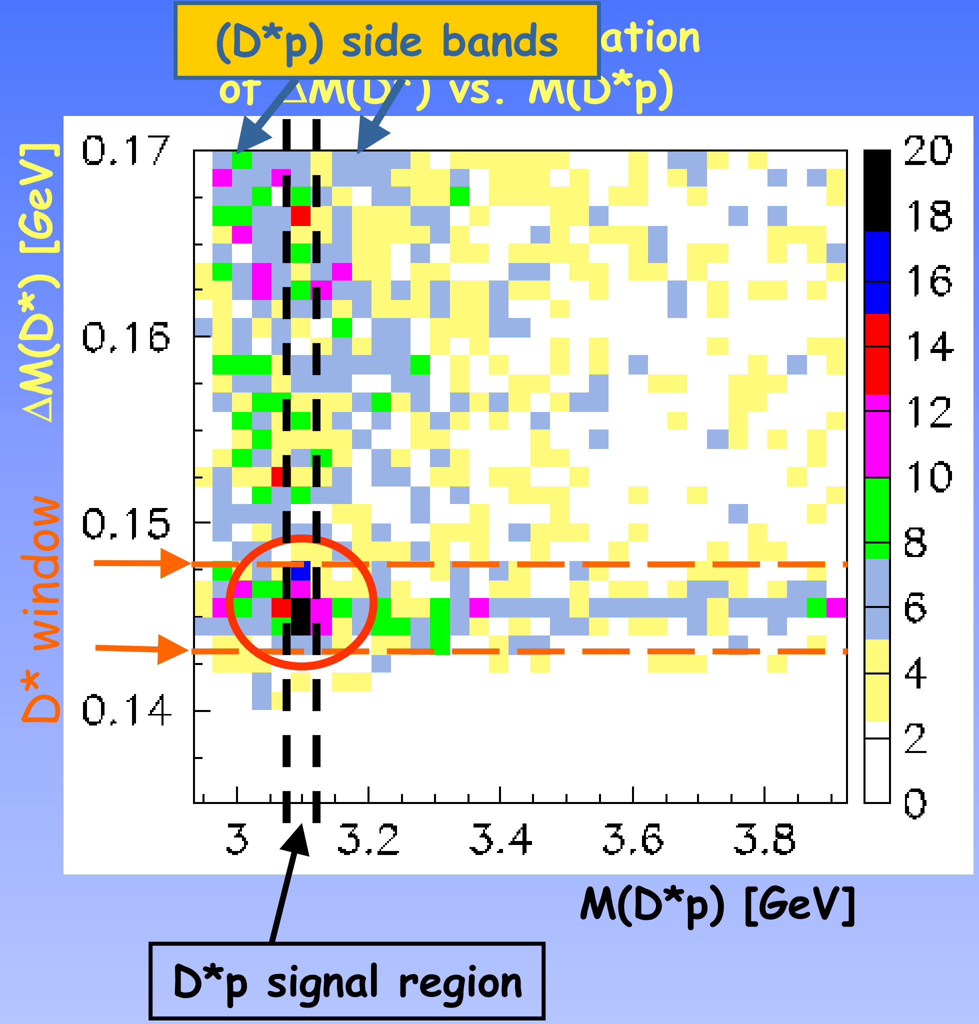


Reasonably described by D* MC and wrong charge D from data

Does the resonance come from D*'s?

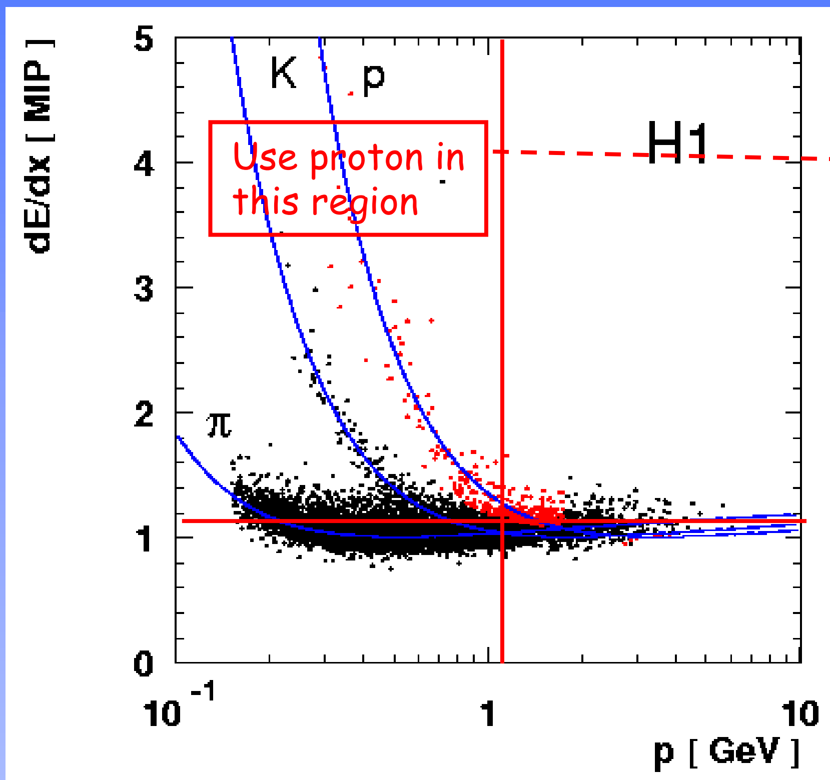


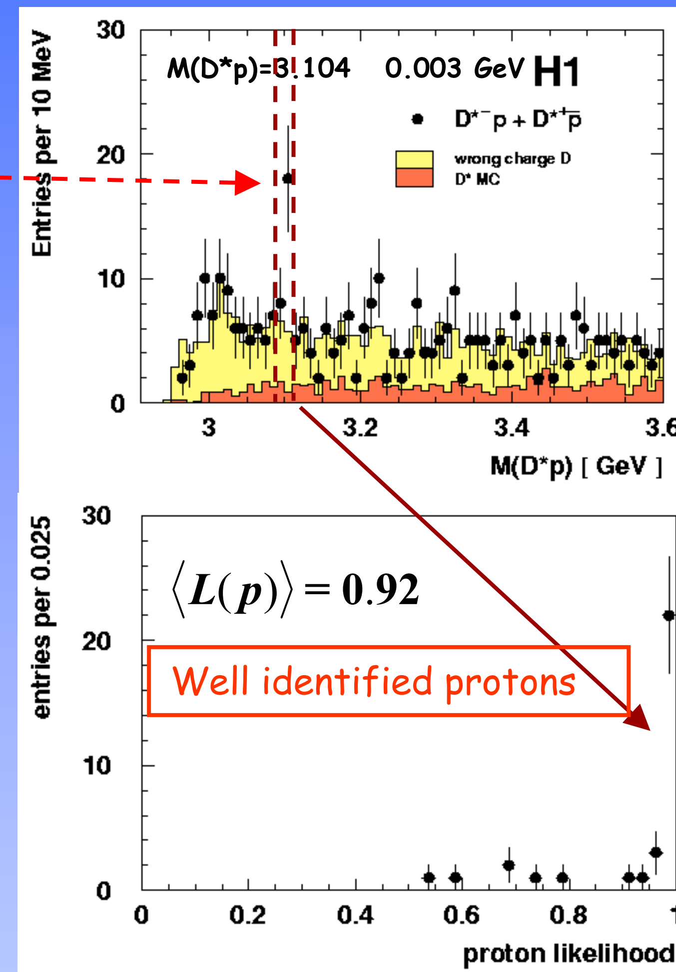
Side band scaled to the width of the signal window in M(D*p)



→ the (D*p) signal region is richer in D*

Is the D*⁻p[1)] signal due to protons?





$M(D^*p) = m(K\pi\pi p) - m(K\pi\pi) + m(D^*)_{PDG}$

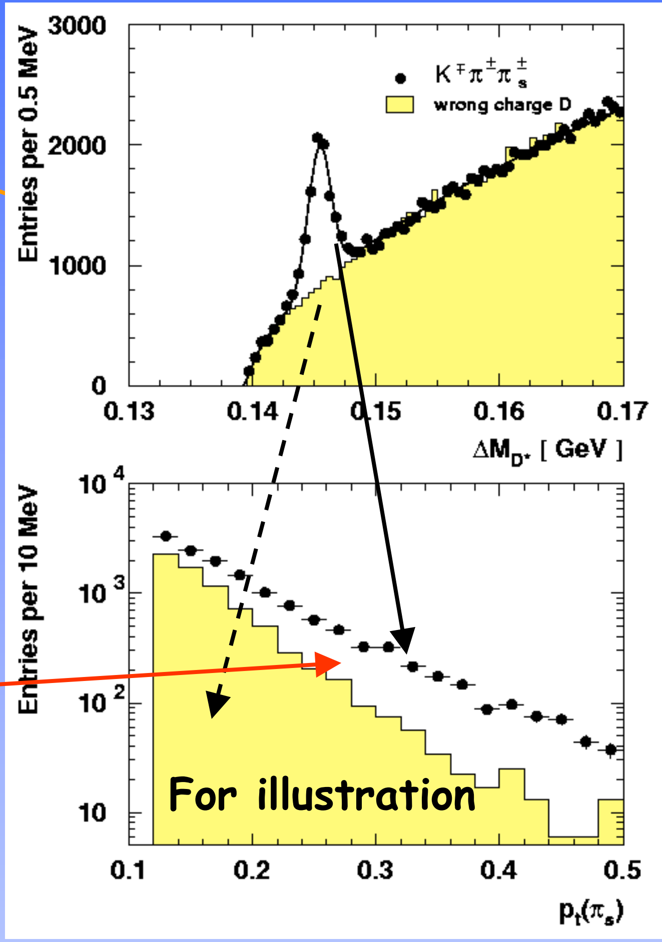
1) Charge conjugate always implied

Physics changes on-resonance ?

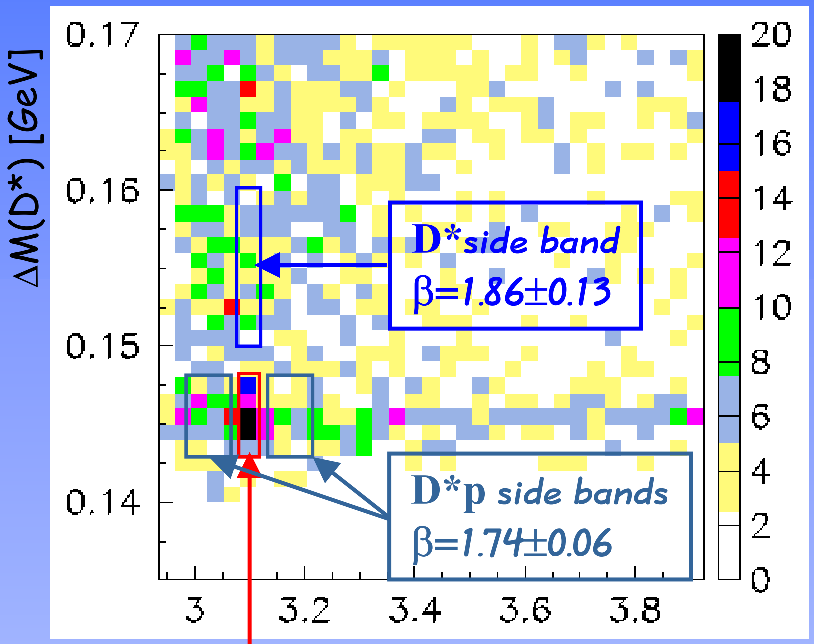
- Single particle momentum spectra are steeply falling
$\rightarrow$This feature is preserved in the combinatorial background of invariant mass analyses

Harder spectrum for particles from decay due to mass release

Harder spectrum for particles from decay of charmed hadrons due to hard charm fragmentation



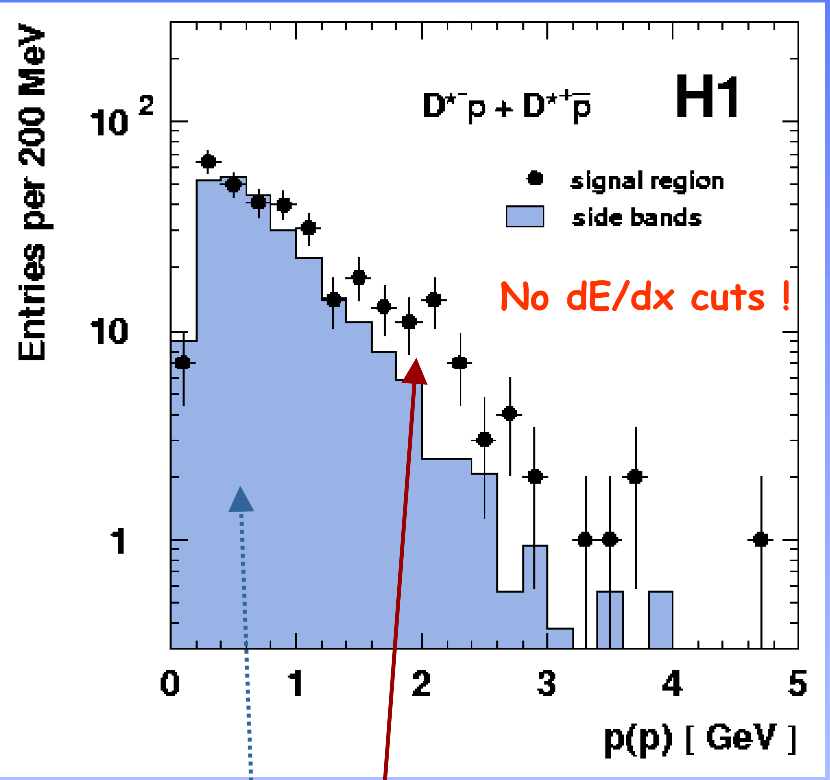
Physics changes on-resonance ?



M(D*p) [GeV]

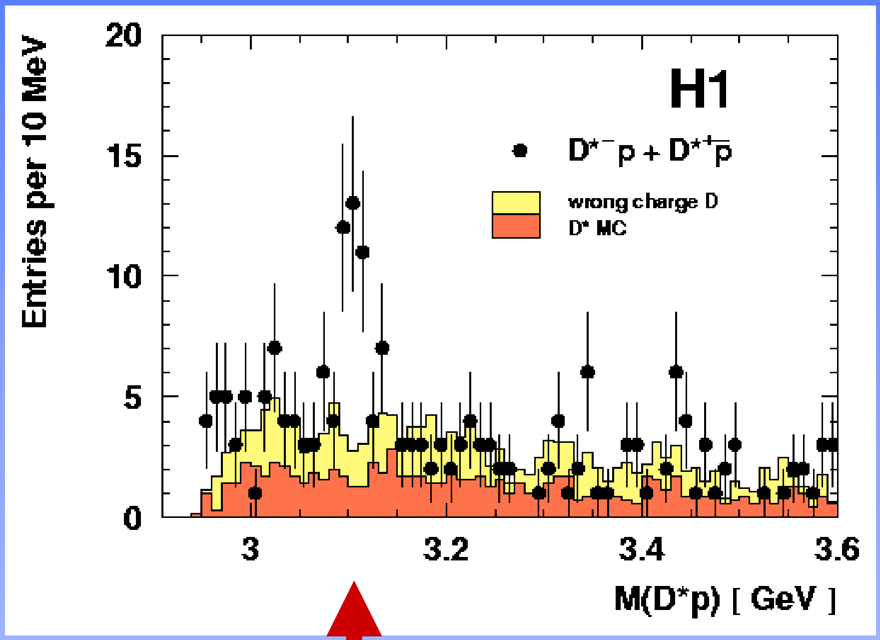
Signal region
β=1.27±0.09

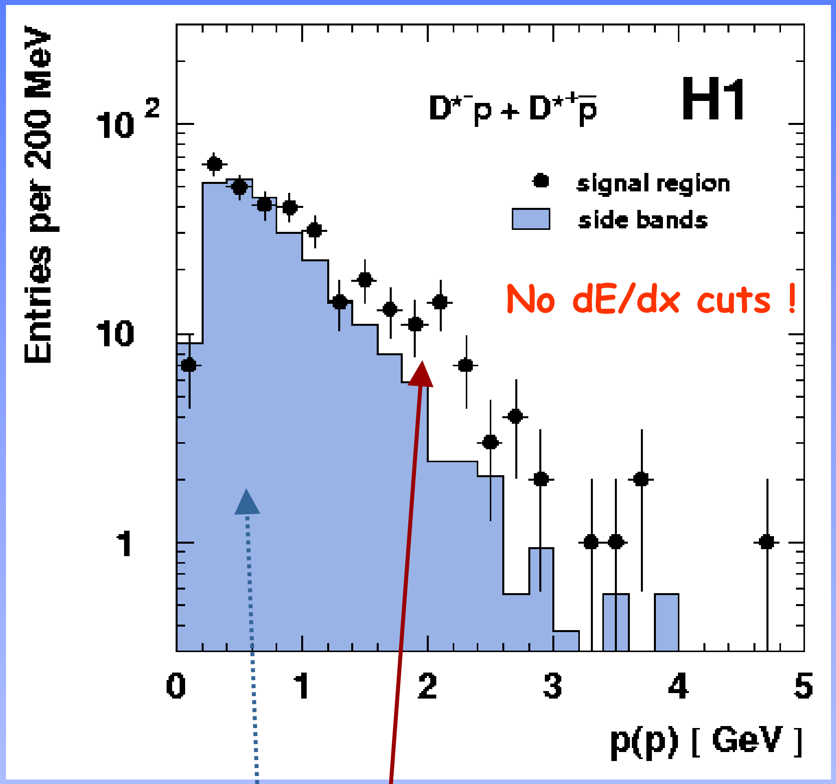
Fit slope with $\alpha\cdot\exp\{-\beta p(p)\}$



The momentum spectrum of the particles in the signal region is harder than in the M(D*p) side bands

Physics changes on-resonance ?





At large p(p) (>2 GeV)
Signal clearly visible
without dE/dx

The momentum spectrum of the particles in the signal region is harder than in the M(D*p) side bands

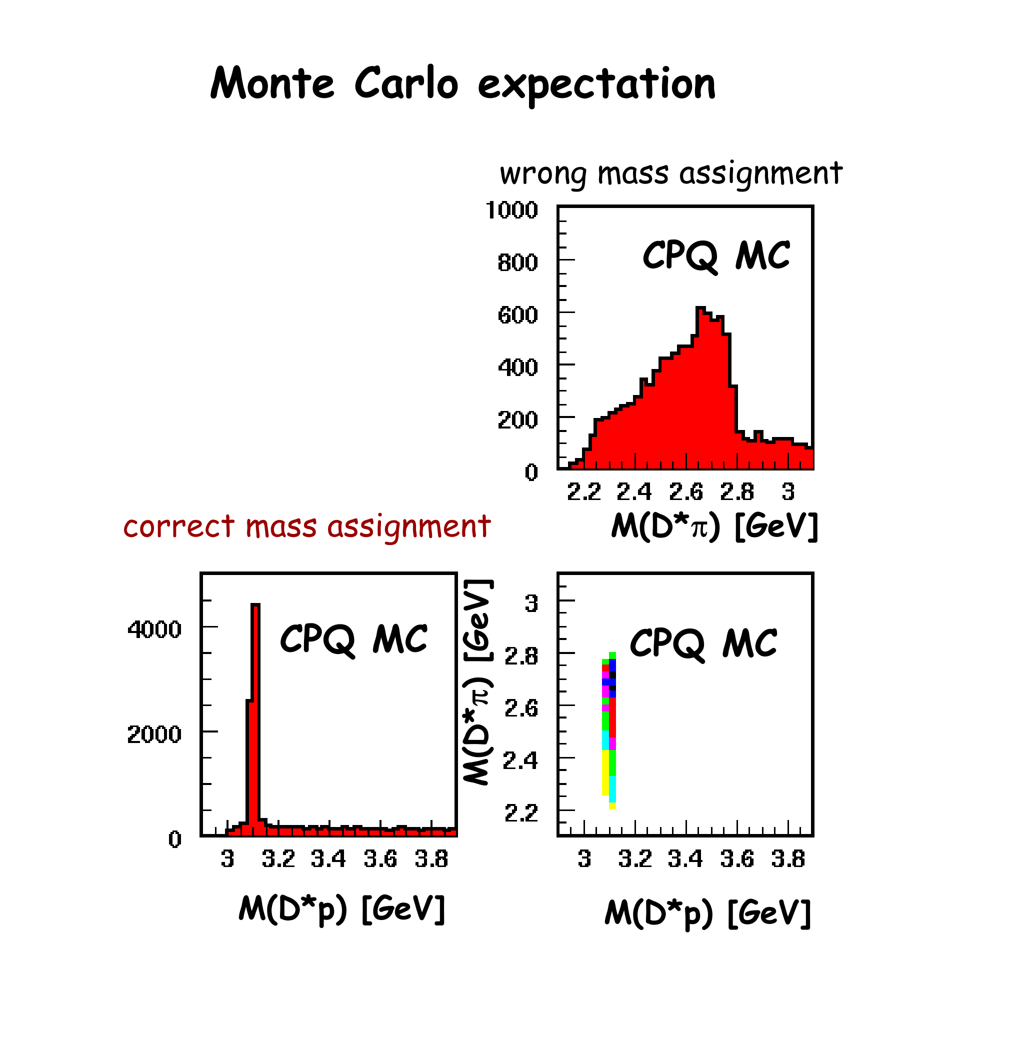
Kinematic tests

2-Body Decay

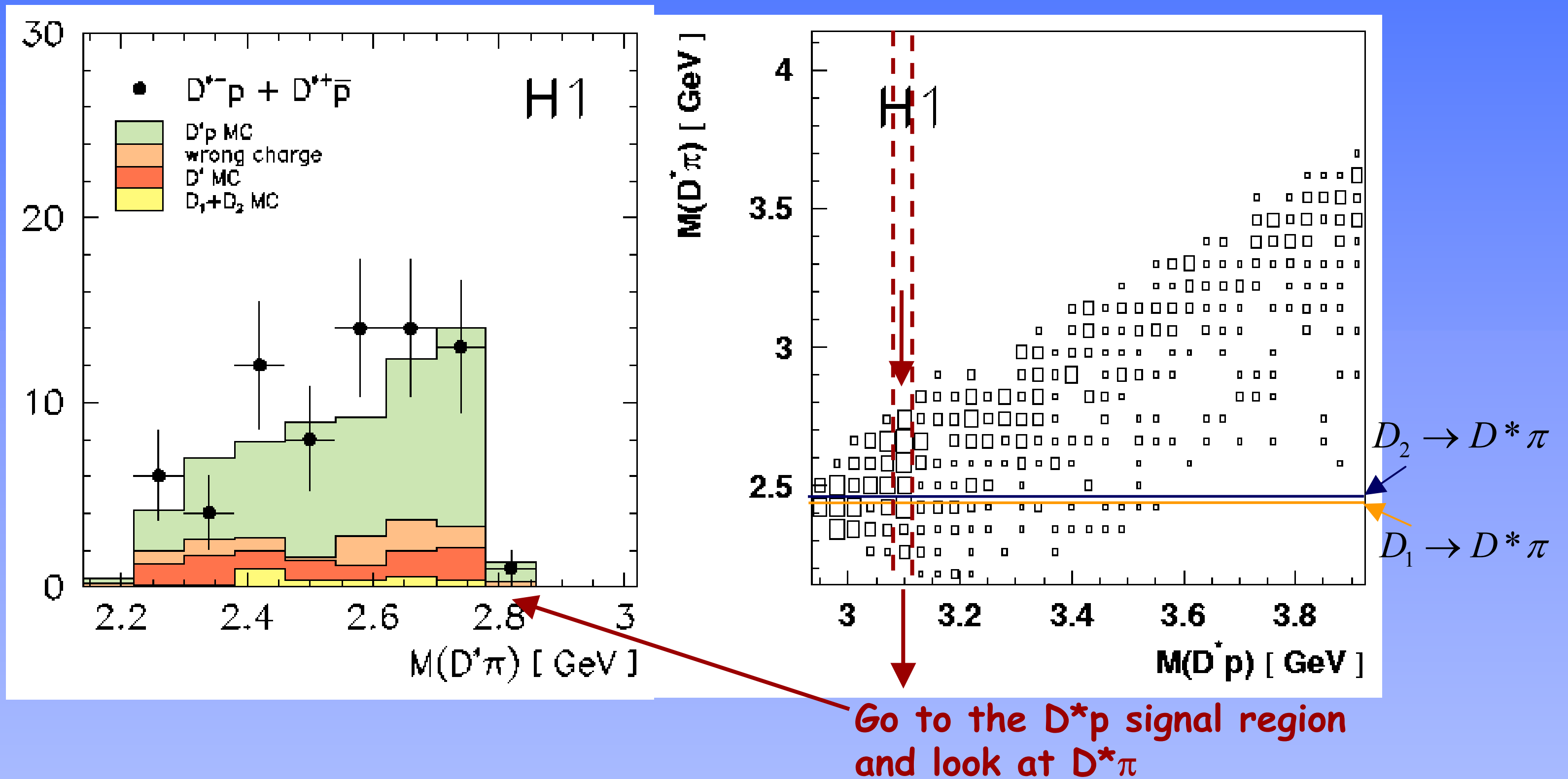
$$M^2 = (P_1 + P_2)^2$$
$$= (m_{D*}^2 + m_X^2 + 2E_{D*}E_X - 2\vec{p}_{D*}\vec{p}_X)$$

Mass M independent of decay angle Θ* only for correct mass assignment

Band like structure visible in the M(D*p)-M(D*x) plane in data?

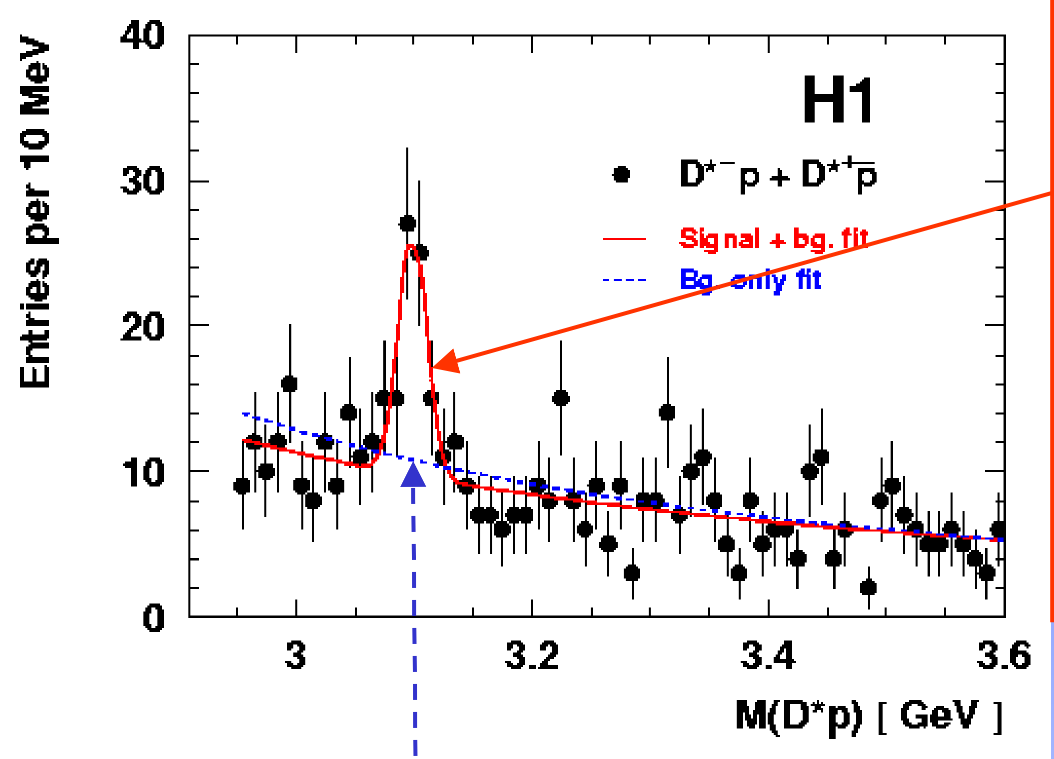


Kinematic test: D*p vs. D*π



π-mass hypothesis excluded from the shape and range of D*π mass distribution !

Significance estimate



signal+background fit:

mass:
3099 ± 3(stat) ± 5(syst.) MeV
width: 12 ± 3 MeV
(cons. with exp. Resolution)

Numbers of signal and bgr
N_b=45.0 ± 2.8
(within ± 2σ =± 24MeV)
N_s=50.6 ±11.2
(1.46 ± 0.32 % of D* yield, uncorrected in acceptance)

For significance estimate:
Fit background only hypothesis
N_b=51.7 +- 2.7
Events in signal region: 95

Background fluctuation probability (52 → 95) :
4 x 10^{-8} (Poisson)
5.4 σ (Gauss)

Search for charmed PQ, $\theta_c \rightarrow D^*p$, in ZEUS

1995-2000 data, 127 pb^{-1}
Selection of D*, p close to H1 cuts

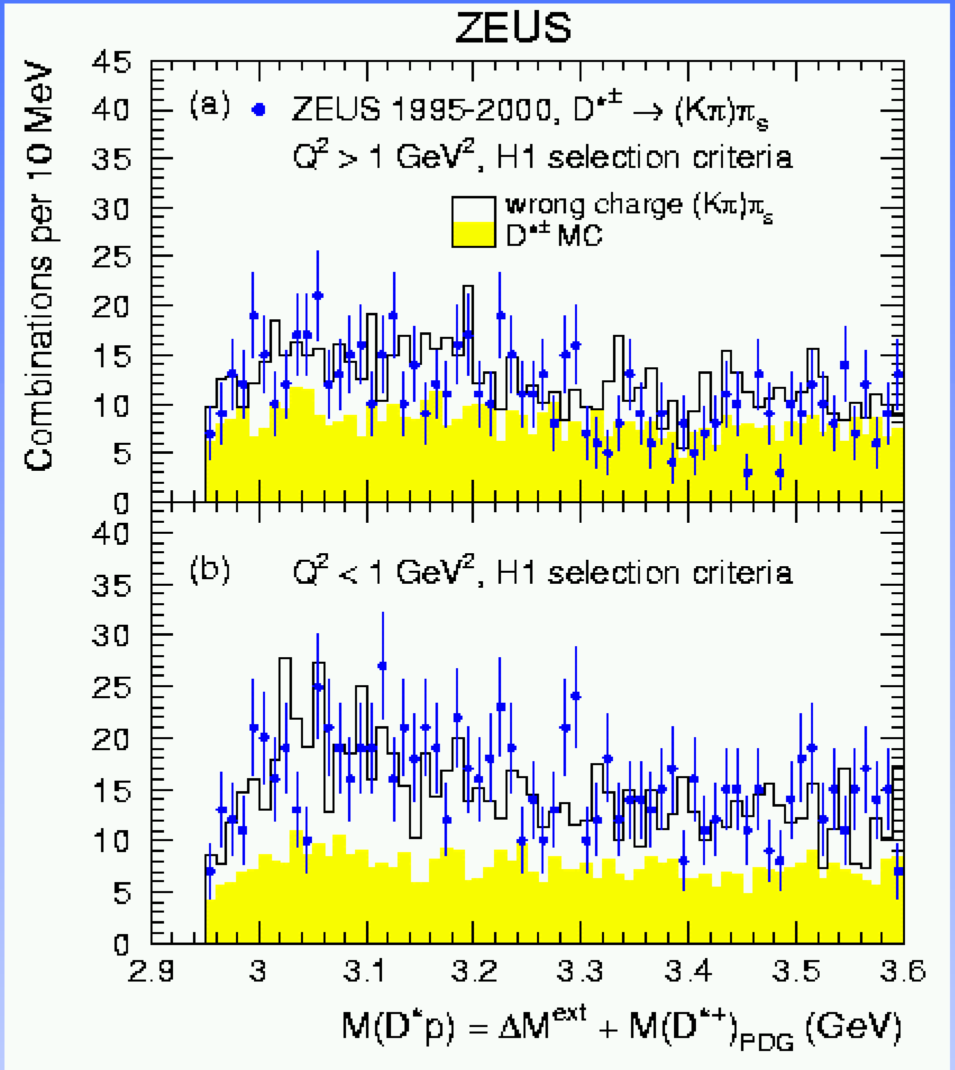
DIS (Q^2>1 GeV): 5920±90 D*'s
γp (Q^2<1 GeV):11670±140 D*'s

No signal seen in D*p

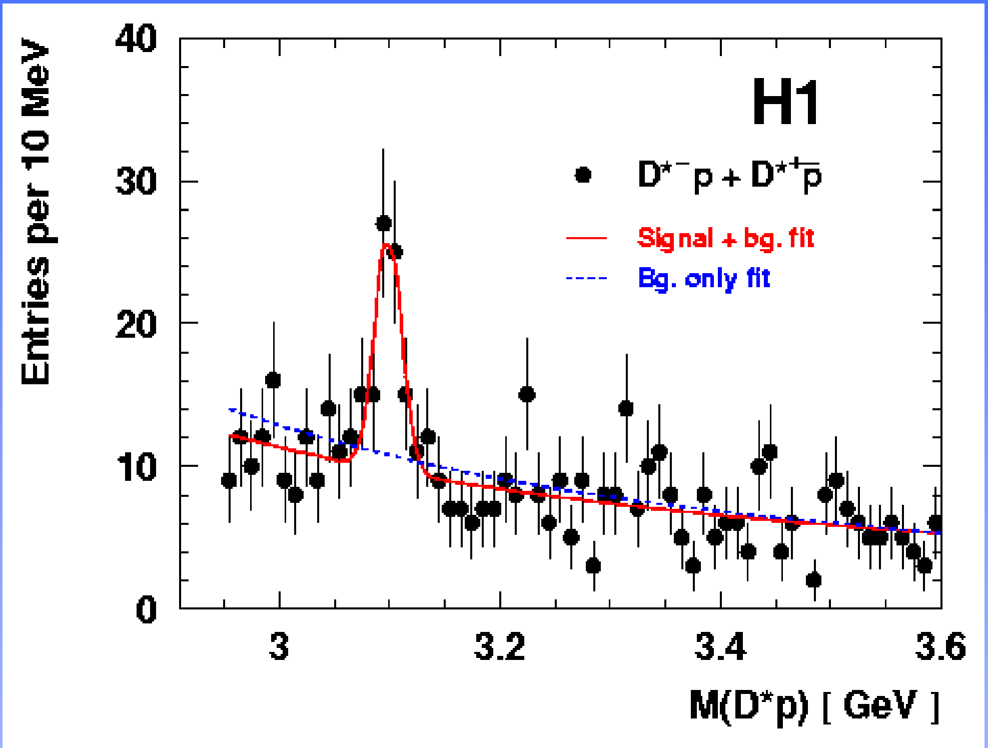
Limits on Θ_c/D^* for DIS:

$R(\Theta_c \rightarrow D^*p/D^*) < 0.51\%$ @95% C.L.

Including some systematic uncertainties
But selection different from H1
Production mechanism of Θ_c same as for D*

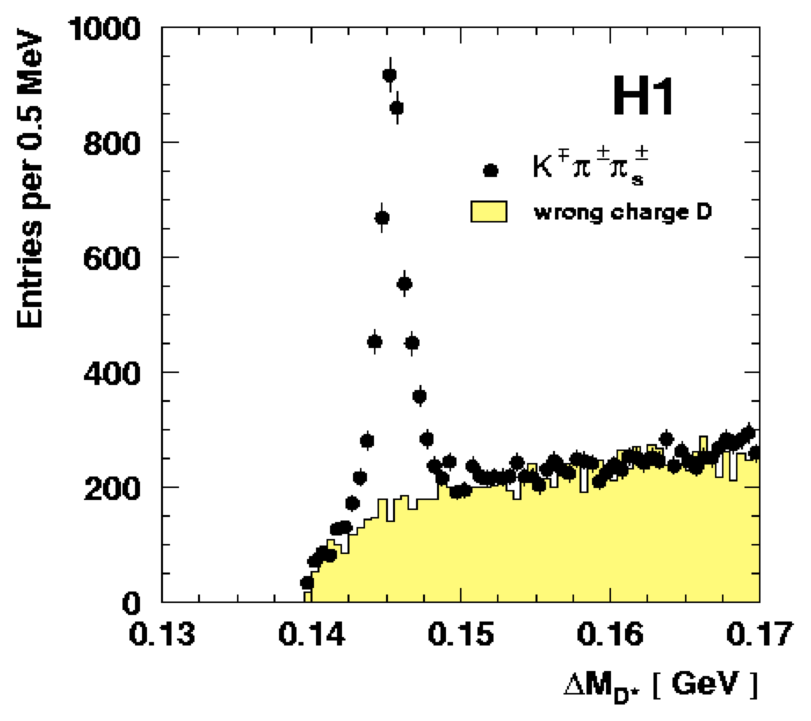


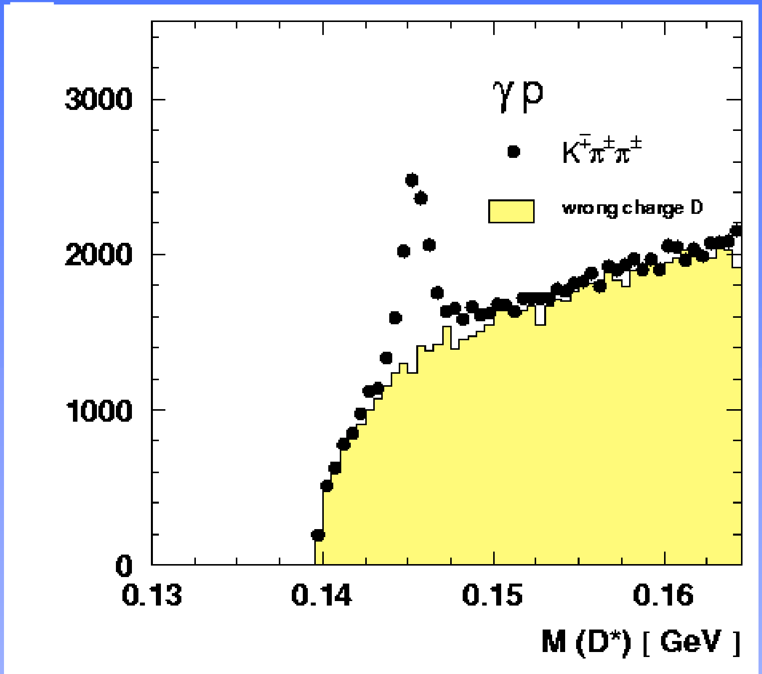
Details of fit



Charges	M[MeV]	s[MeV]	N_S
$D^{*-}p + D^{*+}\bar{p}$	3099 ± 3	12 ± 3	50.6 ± 11.2
$D^{*-}p$	3102 ± 3	9 ± 3	25.8 ± 7.1
$D^{*+}\bar{p}$	3096 ± 6	13 ± 6	23.4 ± 8.6

D* signal in DIS and photoproduction

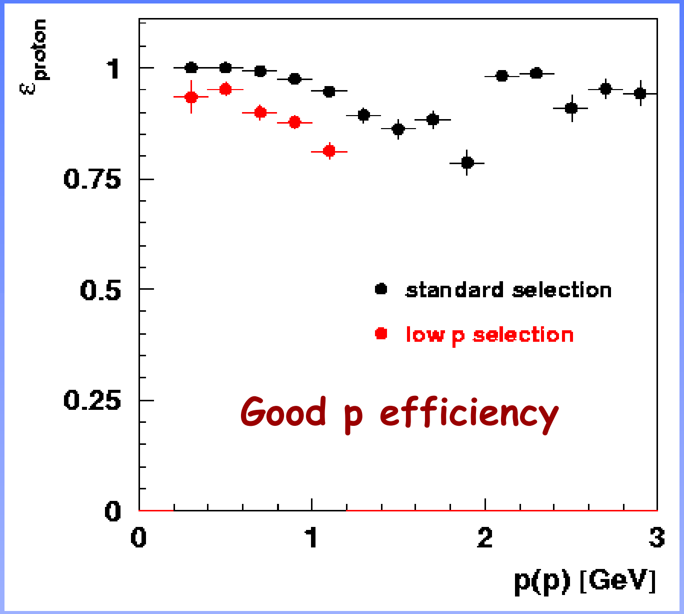




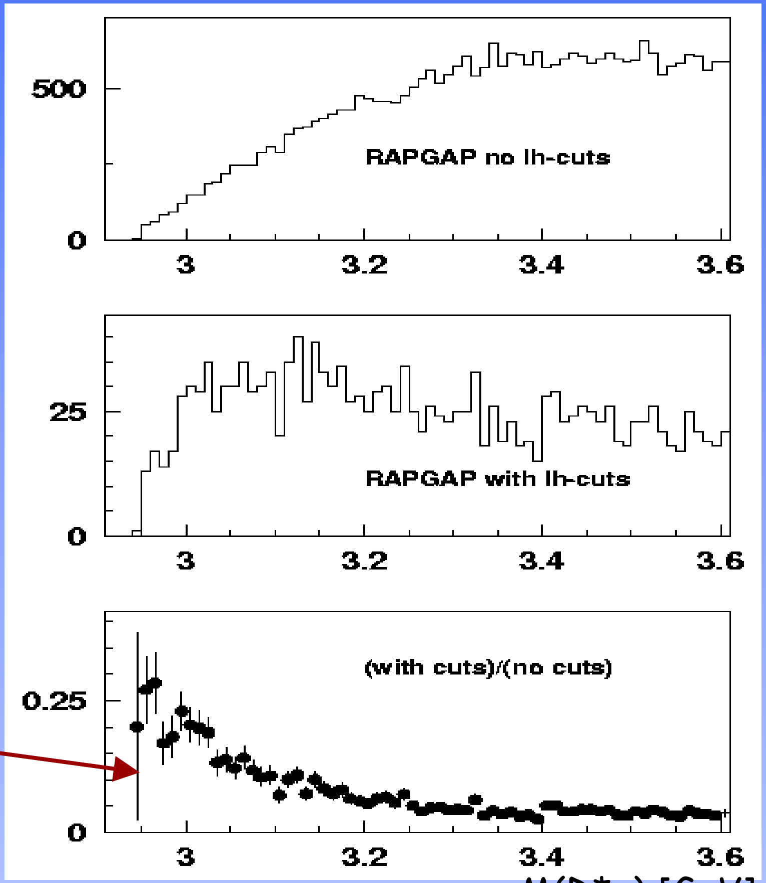
- DIS cleaner signal
- photoproduction: supporting evidence

Acceptance effects?

Proton efficiency



"Pion survival probability"



M(D*p) [GeV]

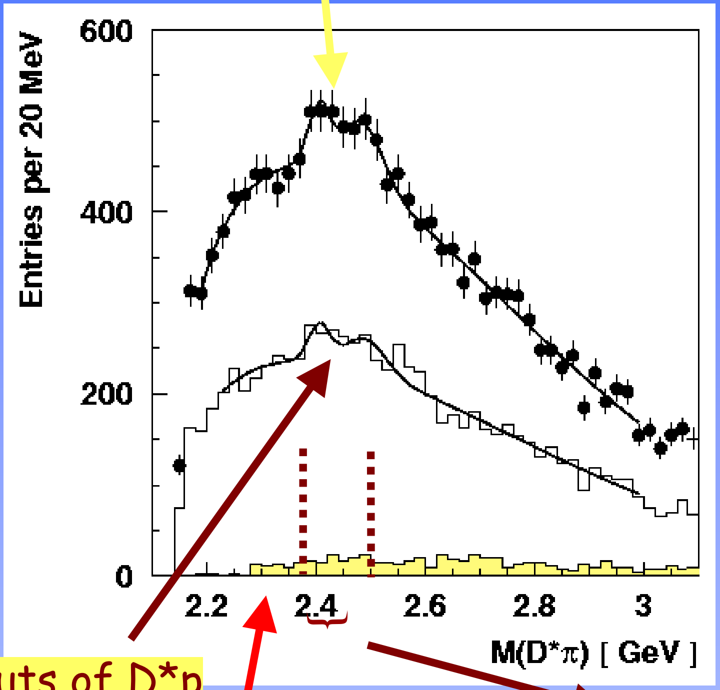
Smooth variation with M(D*p)
Shape reflects opening of phase space

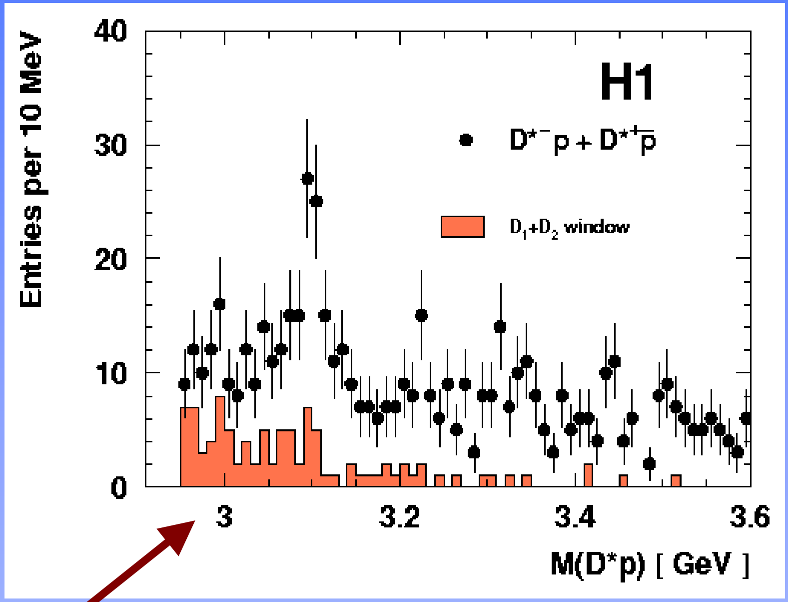
$$M(D^*p) = m(K\pi\pi p) - m(K\pi\pi) + M_{PDG}(D^*)$$

Reflections from decays to D*π ?

loose D* cuts
π selection

$D_1^0, D_2^{0*} \rightarrow D^*\pi$





D* cuts of D*p
π selection

D_1 , D_2 window

D* cuts of D*p
proton selection

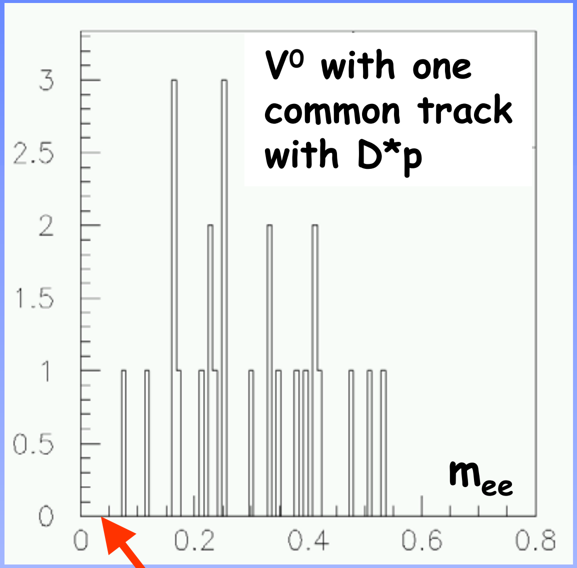
Expect 3.5 decays ($D_1^0, D_2^{0*} \rightarrow D^*\pi$) in D*p signal

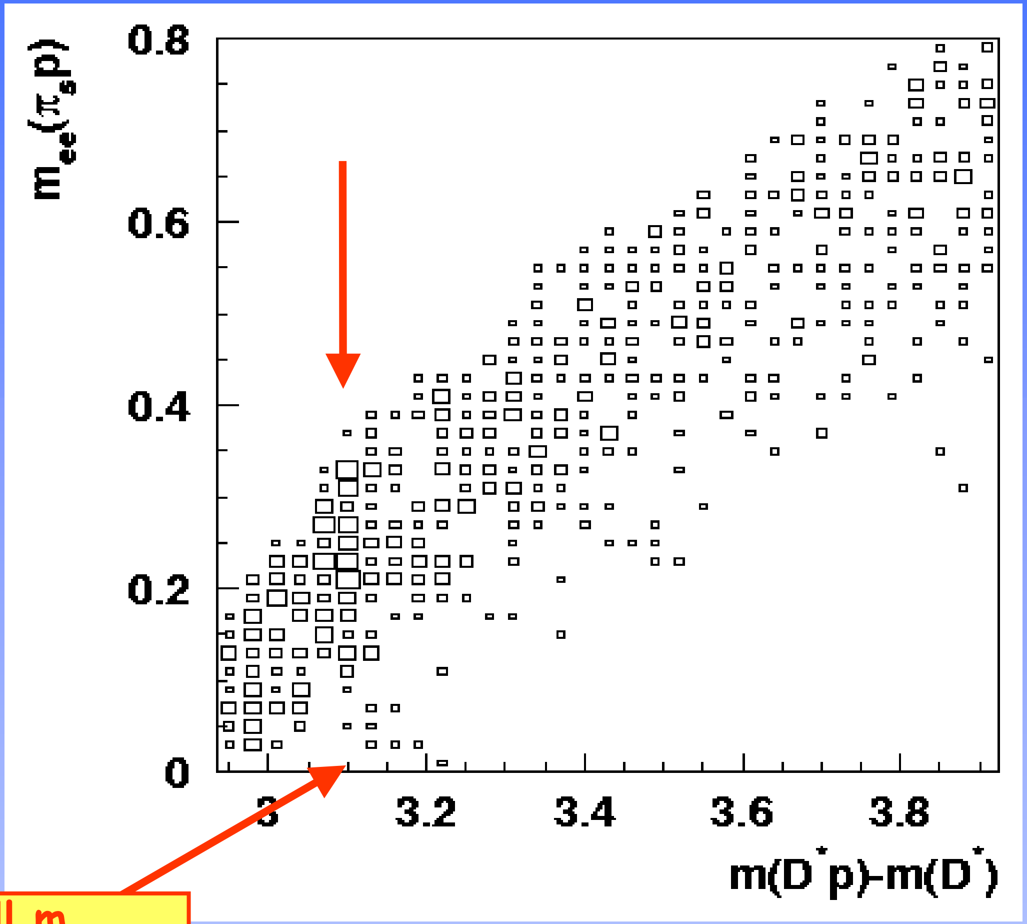
Could signal be due to decay $D^{0*} \rightarrow D^0 \gamma$?

$D^{0*} \rightarrow D^0 \gamma \rightarrow D^0 e^+e^-$

electrons from γ-conversion

- asymmetric in energy
- misidentified as proton and π_s ?





No accumulation at small m_{ee} in D*p signal region or elsewhere

Lots of further kinematic test

- Reflections from a possible signal in D*K mass distribution: ruled out
- Possible contributions from $D^{*0} \rightarrow D^0 \gamma$ with γ-conversion: ruled out
- Possible contributions from D_{S1} /$D_{S2} \rightarrow D^0$ K: ruled out
- Possible peak structures in all possible mass correlations with all possible mass hypotheses of the particles making the D* and the D*p system to search for real or fake resonances, e.g Λ, Δ^0, Δ^{++}, K^0_S, ϕ, f^2

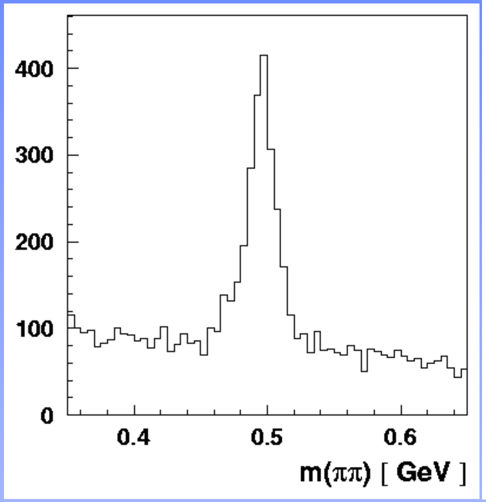
  no enhancements found
- Possible peak structures in all possible mass correlations among the proton candidate the remaining charged particles of the event with all possible mass assignments to search for real or fake peaks,

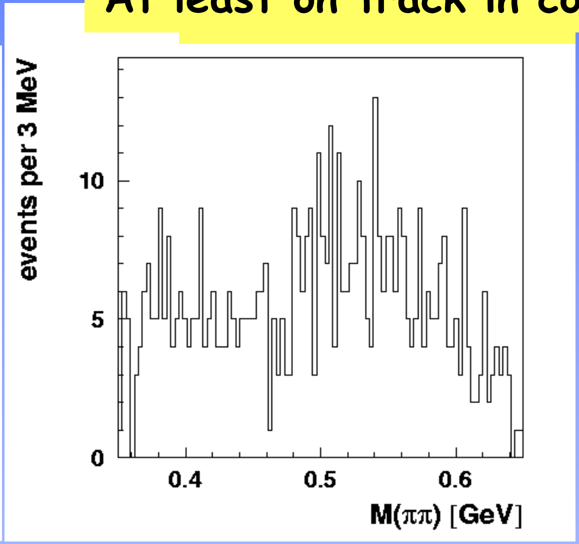
  no enhancements found

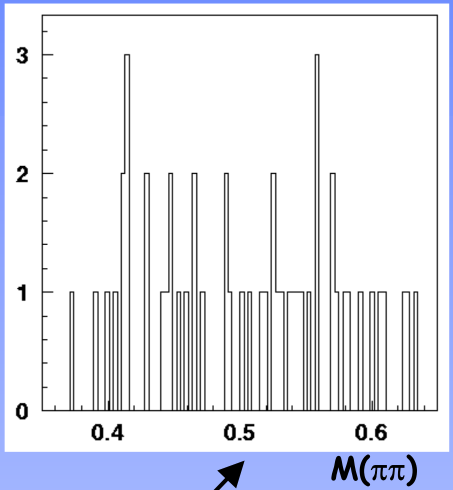
Investigation of D*p and associated K^0's

1.Selection of D* DIS-events (dm<170MeV,r+w charge) with V^0 candidates

At least on track in common







No obvious K^0 signal

D*p signal region

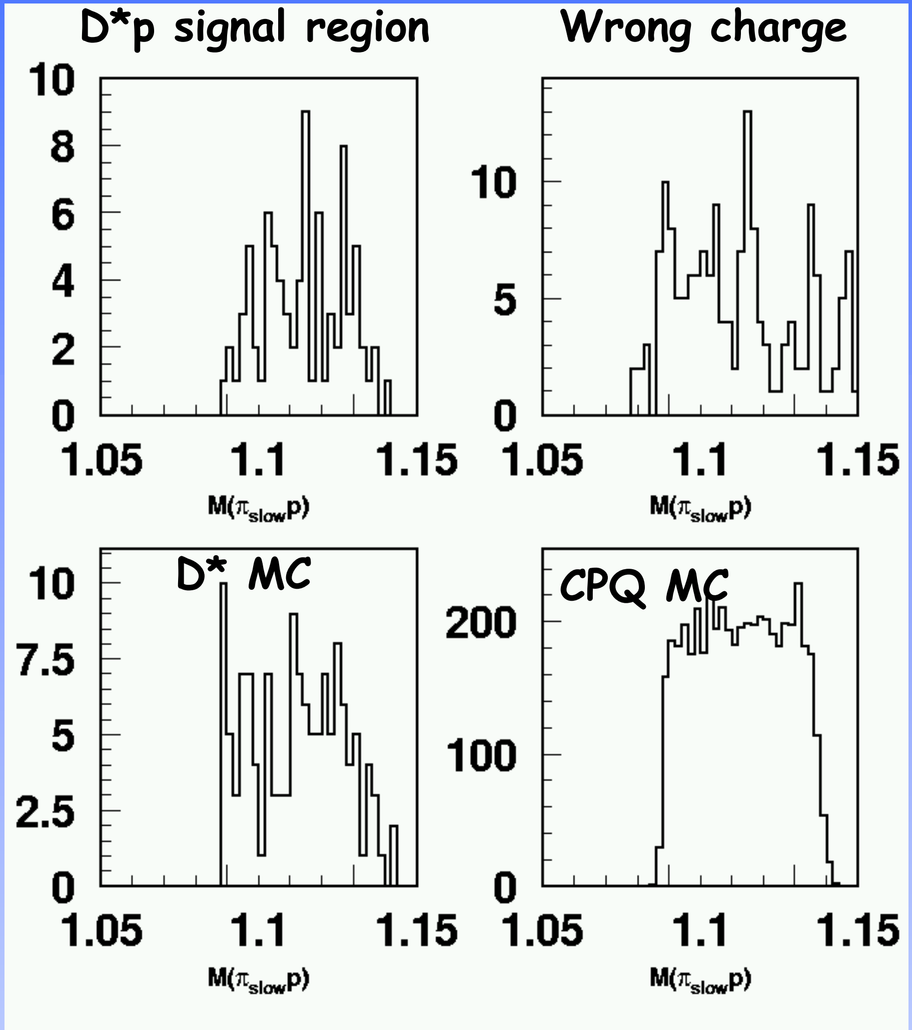
No indication for a K^0 signal

Investigation of D*p and associated Λ^0's

For M(D*p) ≈ 3100 MeV:
$M(\pi_{slow}p)$ close to the Λ^0 mass due to kinematics.

Was studied for publication using primary tracks
Conclusion: No problem

Check with tracks from secondary vertices



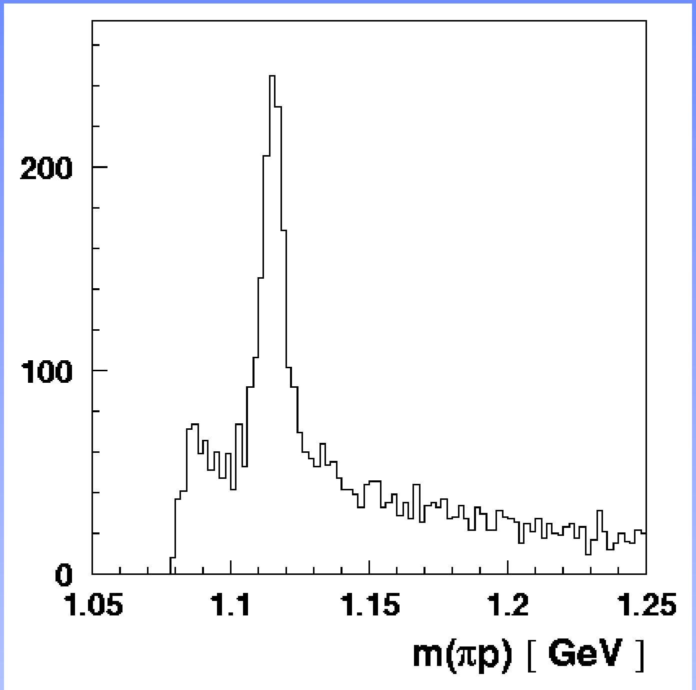
Investigation of D*p and associated Λ^0's

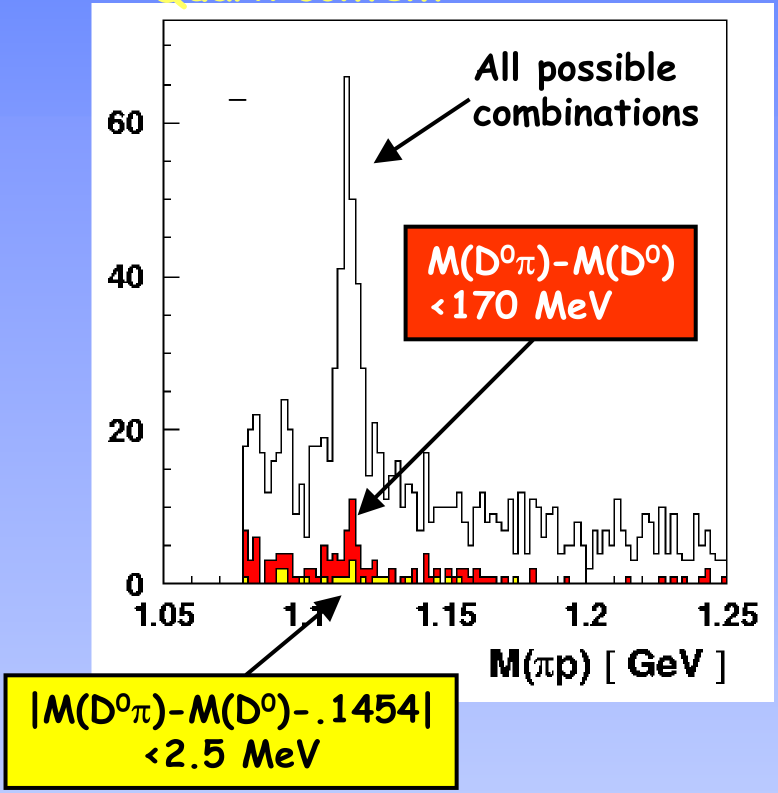
p-selection as for D*p paper

No cut in $M(K^-\pi^+\pi^+p)$ applied

Λ^0 signal in rc/wc D* sample
No DTNV in commom

Select $D^0 \rightarrow K^-\pi^+$ and c.c.
Search for with Λ^0 appropriate
Quark content



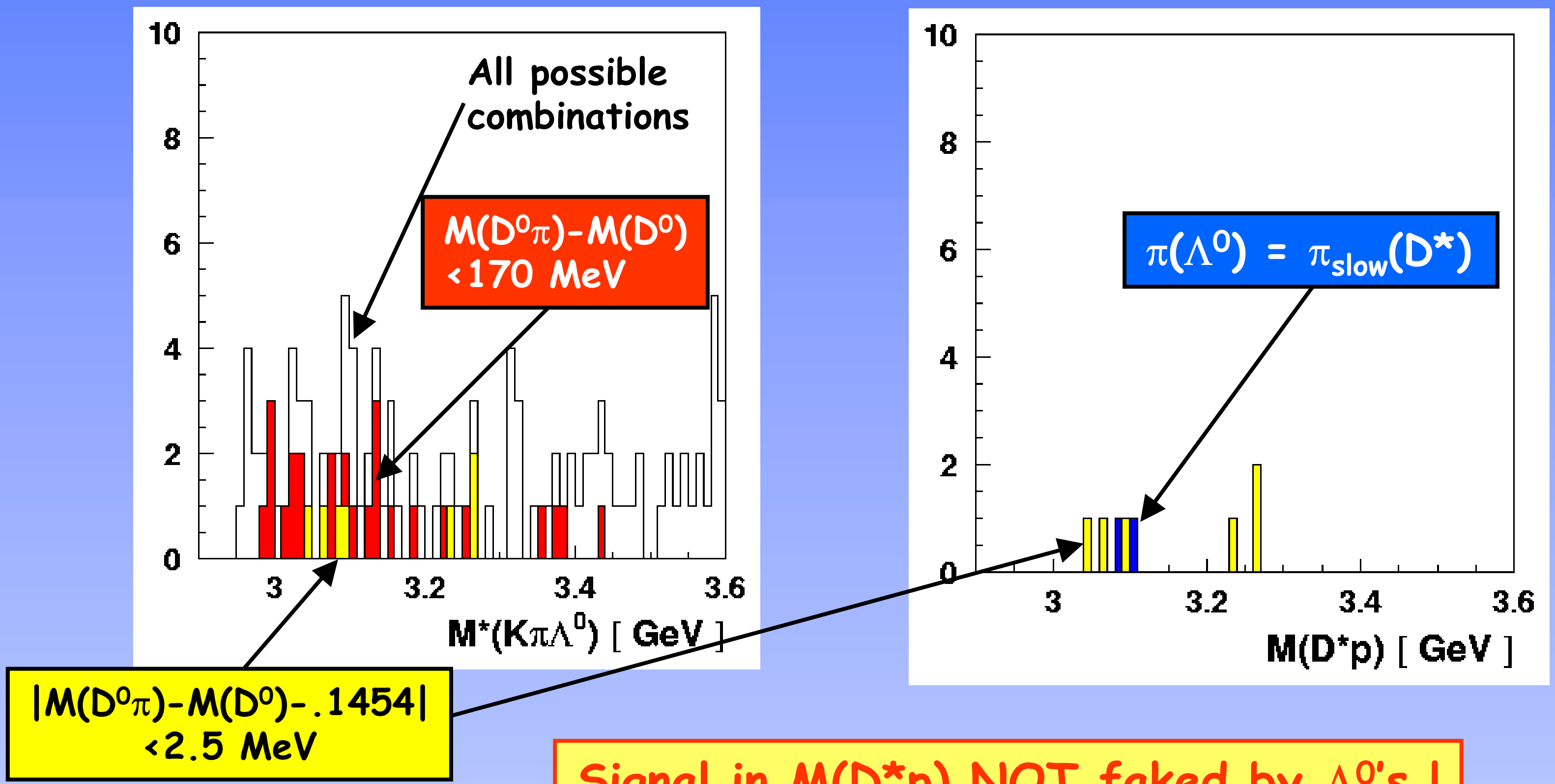


No Λ^0 signal left in dm-window !

Investigation of D*p and associated Λ^0's

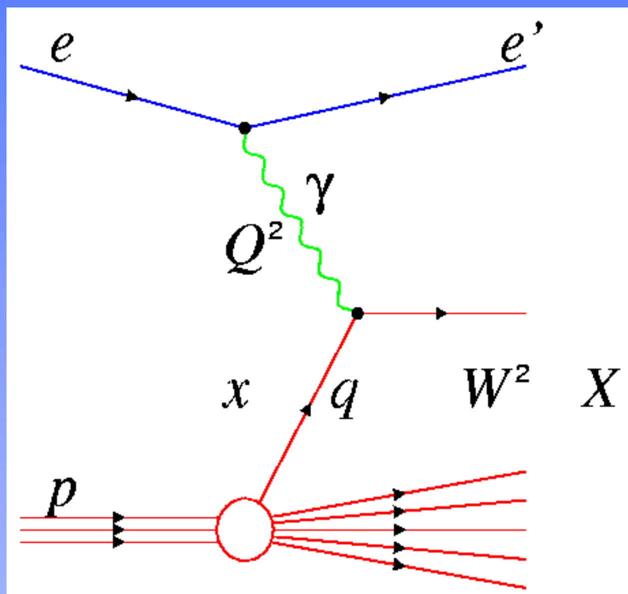
p-selection as for D*p paper

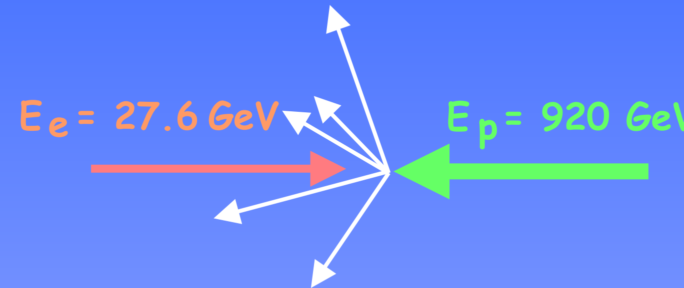
Selection: $|m(\pi p)-m(\Lambda^0)|<9$ MeV



Signal in M(D*p) NOT faked by Λ^0's !

Hera kinematics in ep collisions





$\sqrt{s}$ ~ 300-318 GeV (energy c.m.)

DIS kinematics:

Photon virtuality	$Q^2=-q^2$
Electron inelasticity	y
Scaling variable	x
Hadronic mass	W

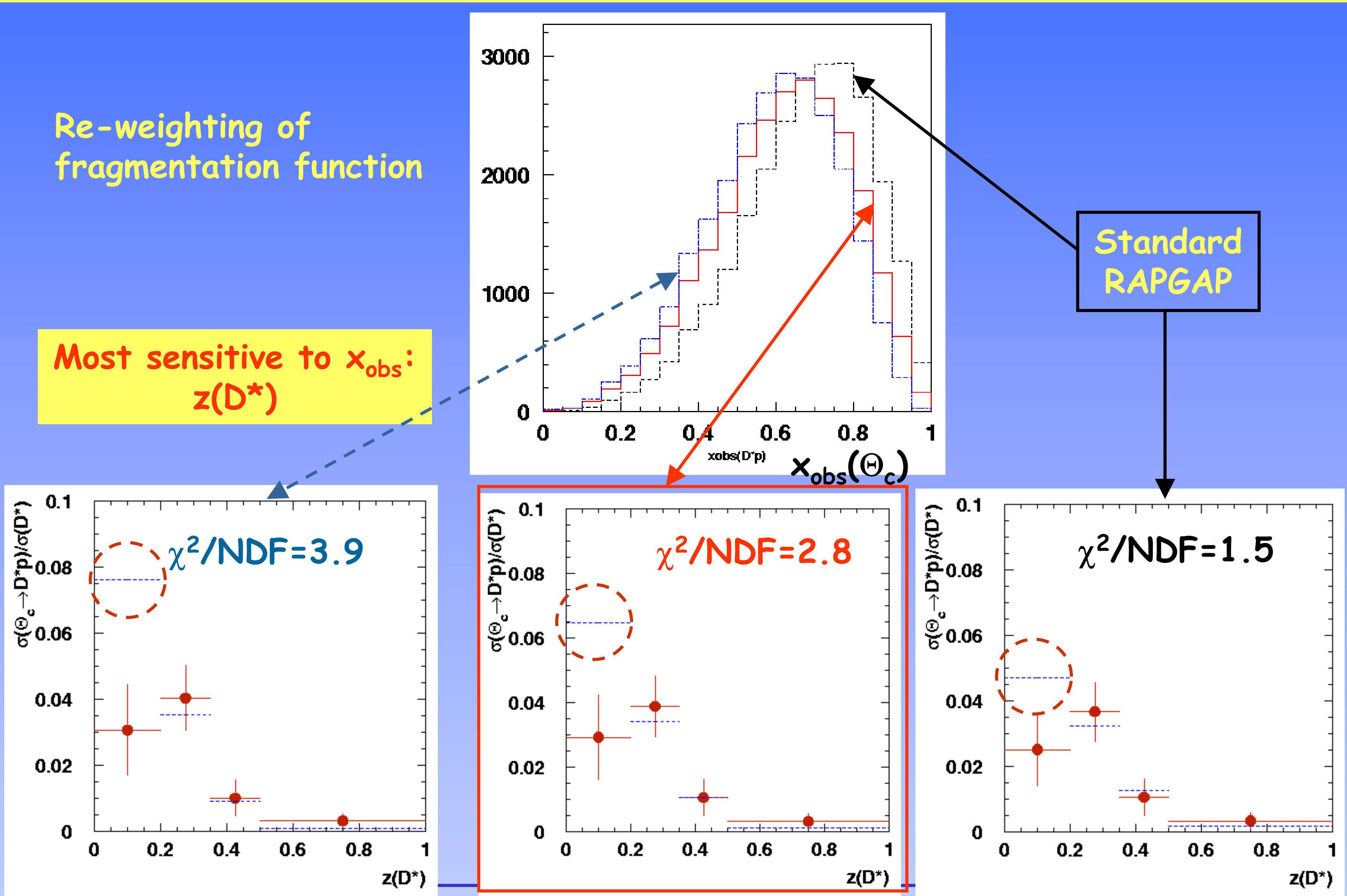
Kinematic regimes

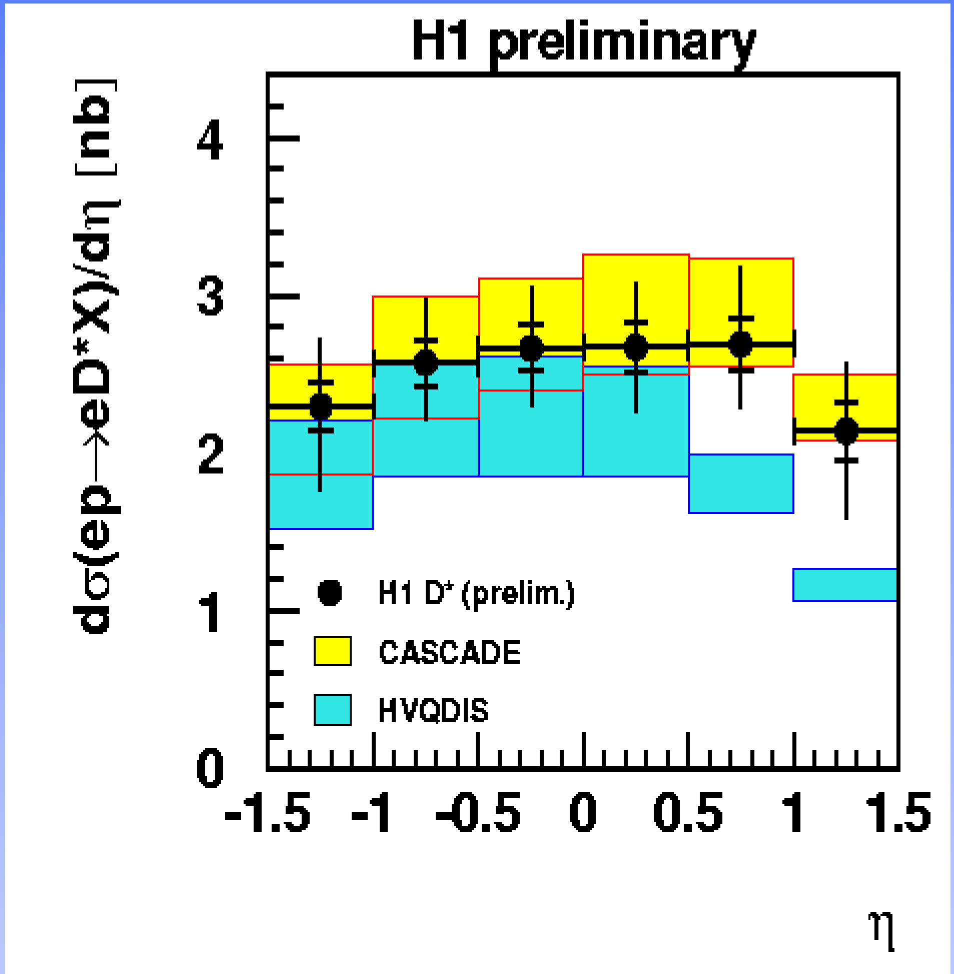
Scattered e detected: Q^2 > 1 GeV Electroproduction (DIS)
Scattered e not detected: Q^2 ~ 0 GeV Photoproduction

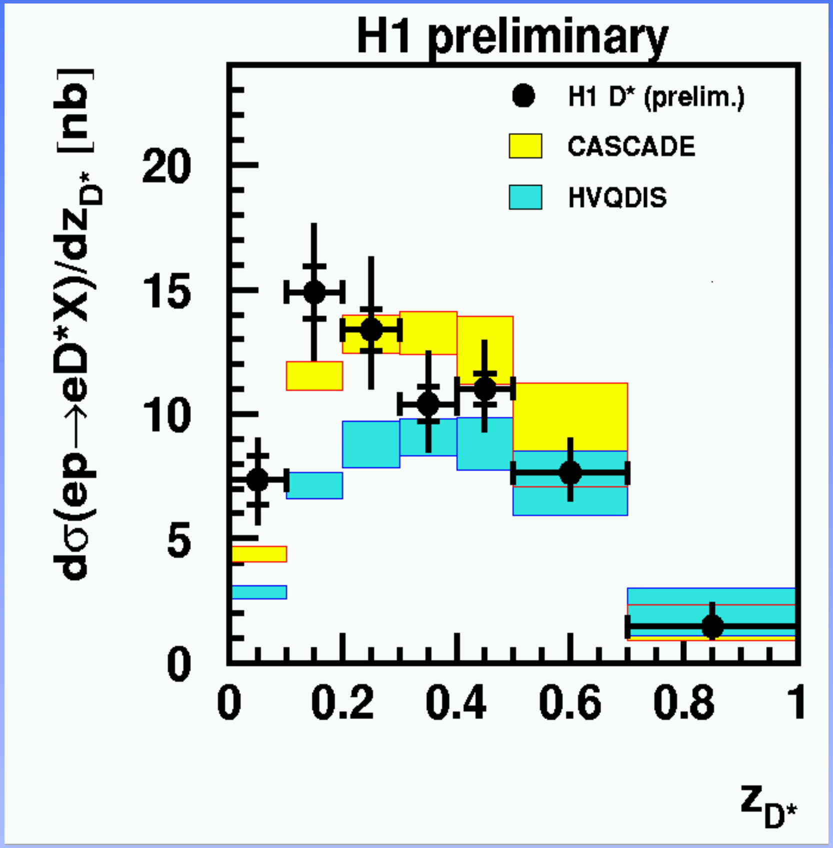
Systematics: variation of Θ_c fragmentation function

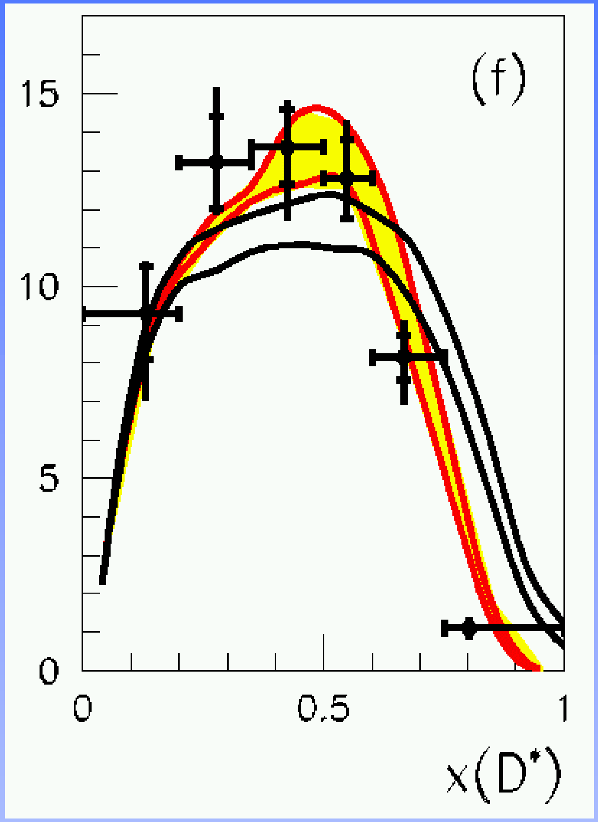
Re-weighting of fragmentation function

Most sensitive to x_{obs}: z(D*)




H1 preliminary
dσ(ep→eD*X)/dη [nb]
4
3
2
1
0
-1.5
-1
-0.5
0
0.5
1
1.5
η
H1 D+ (prelim.)
CASCADE
HVQDIS

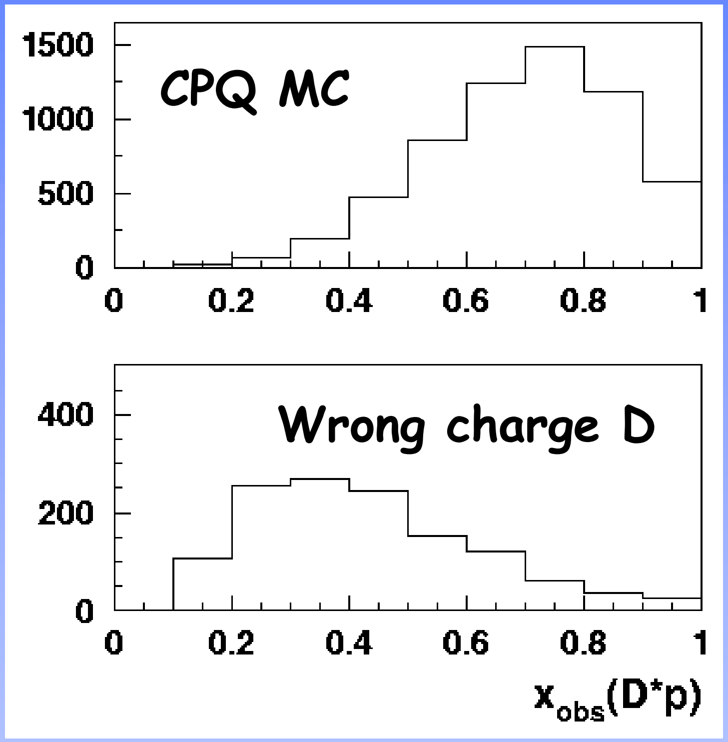

H1 preliminary
H1 D* (prelim.)
CASCADE
HVQDIS
dσ(ep→eD*X)/dz_D* [nb]
z_D*
0
5
10
15
20
0
0.2
0.4
0.6
0.8
1


(f)
15
10
5
0
0
0.5
1
x(D*)

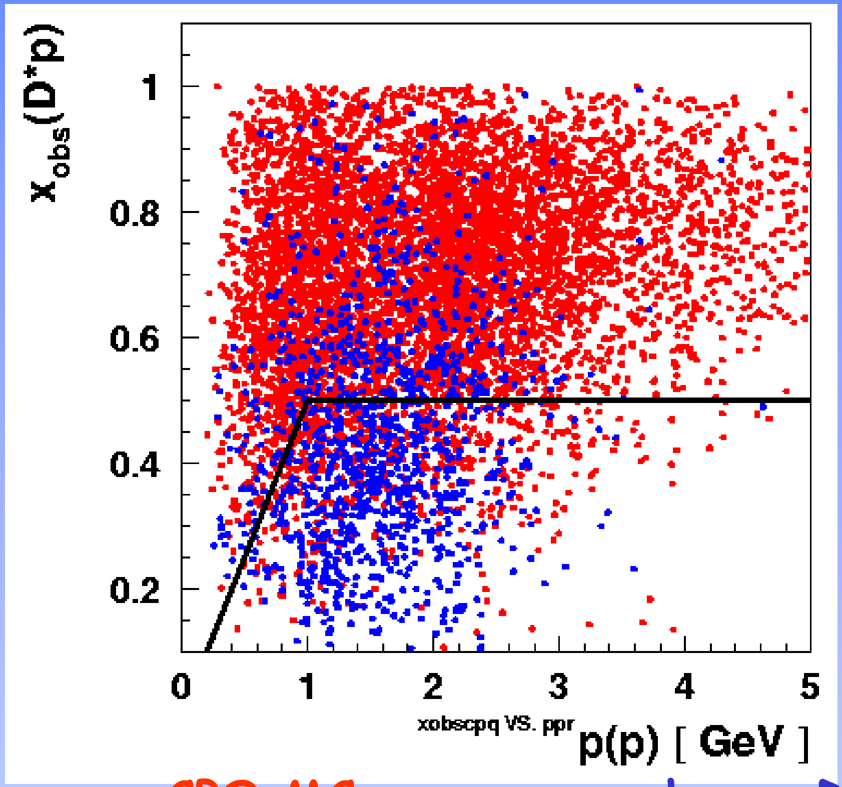
Cut in (D*p) fragmentation variable

New selection for D*p yield estimate: $X_{obs}(\Theta_c)$ > min (0.5 * P (proton), 0.5)

(use for acceptance corrected yields of Θ_c vs Zd , X_{obs})

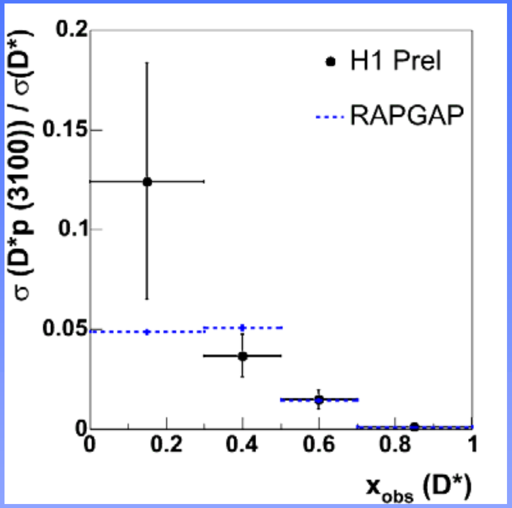


Cut: x_{obs} > min(0.5·p(p),0.5)



• CPQ MC • wrong charge D

Remarks on D*p search by ALEPH



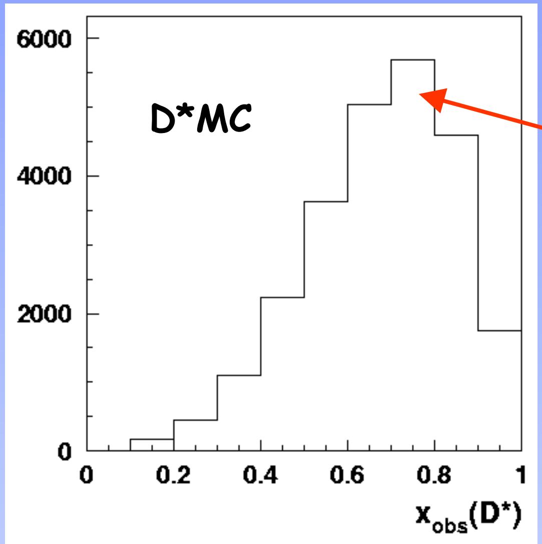
$x_{obs}(D^*)$ very soft !

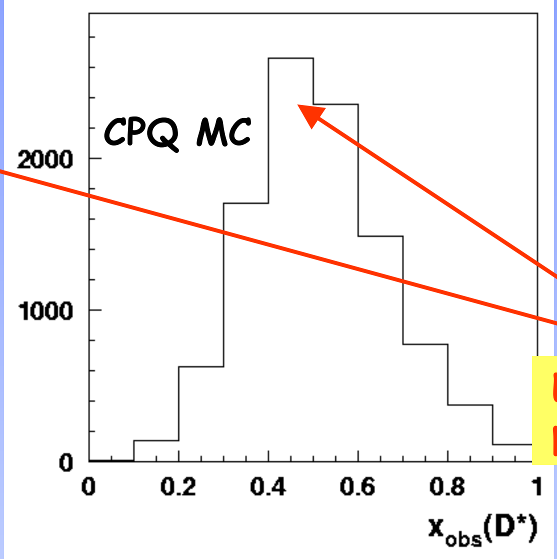
For $x_{obs}(D^*)>0.5$:

$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)=1.08\pm0.31\%$

For $x_{obs}(D^*)>0.7$:

$\sigma(\Theta_c \rightarrow D^*p)/\sigma(D^*)=0.17\pm0.13\%$





Expected shift in peak position ~ -0.3