We tag charm by displaced kaons in the final state
0.01 cm < |VTX| < 3 cm → Cut on the Decay Vertex

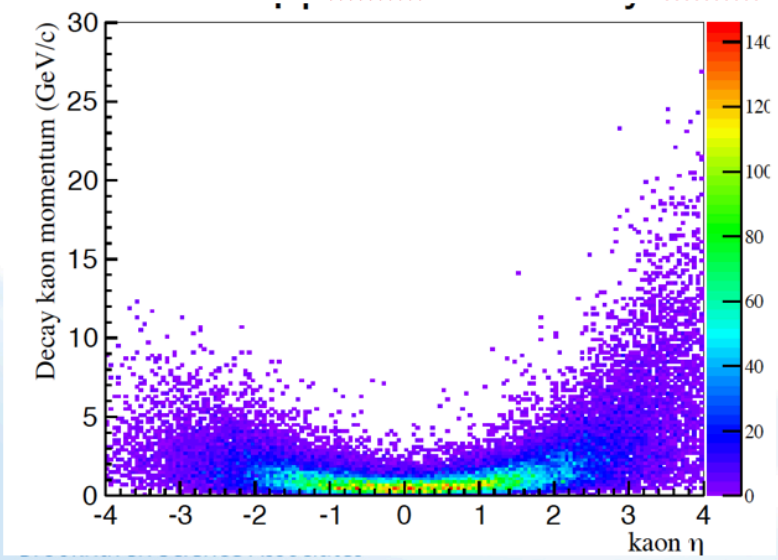
Particle ID for Kaons:

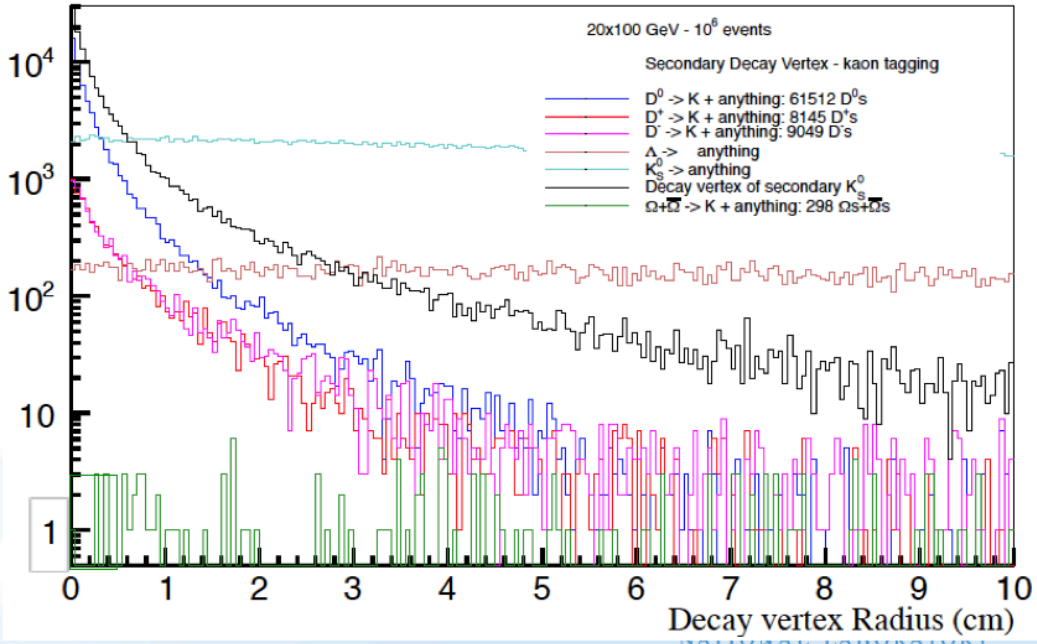
CENTRAL DETECTOR (-1 < Eta < 1):
dE/dx -> 0.2 GeV < P < 0.8 GeV
RICH -> 2 GeV < P < 5 GeV

FORWARD (1 < Eta < 3.5):
RICH -> 2 GeV < P < 40 GeV

REAR (-3.5 < Eta < 1):
RICH -> 2 GeV < P < 15 GeV

same sample as for F_L
but increased systematic uncertainty 7%





BACKGROUND

We look at background from DIS events with kaons that pass the whole selection but are not coming from a charm decay

We study the fraction of background events over signal as:
Background fraction [Background/Signal] (selected_bkd_events/selected_Charm_Events)

5 GeV x 50 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 18822
Total number of background events (in the final selection) = 179
Background fraction [Background/Signal] = 0.95%

5 GeV x 100 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 26273
Total number of background events (in the final selection) = 258
Background fraction [Background/Signal] = 0.98%

20 GeV x 100 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 39624
Total number of background events (in the final selection) = 460
Background fraction [Background/Signal] = 1.16%

Conclusion:
The B/S fraction is expected in the order of ~1% with a slight energy dependence

What about kinematical dependence?

CHARM EFFICIENCY

We look at the selection efficiency for charm events

We study the charm selection efficiency as:
Charm efficiency = selected_charm_Events / charm_Events_inAcceptance

5 GeV x 50 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 18822
Total number of events with a charm in kinematical acceptance: 67544
Charm efficiency = 27.9%

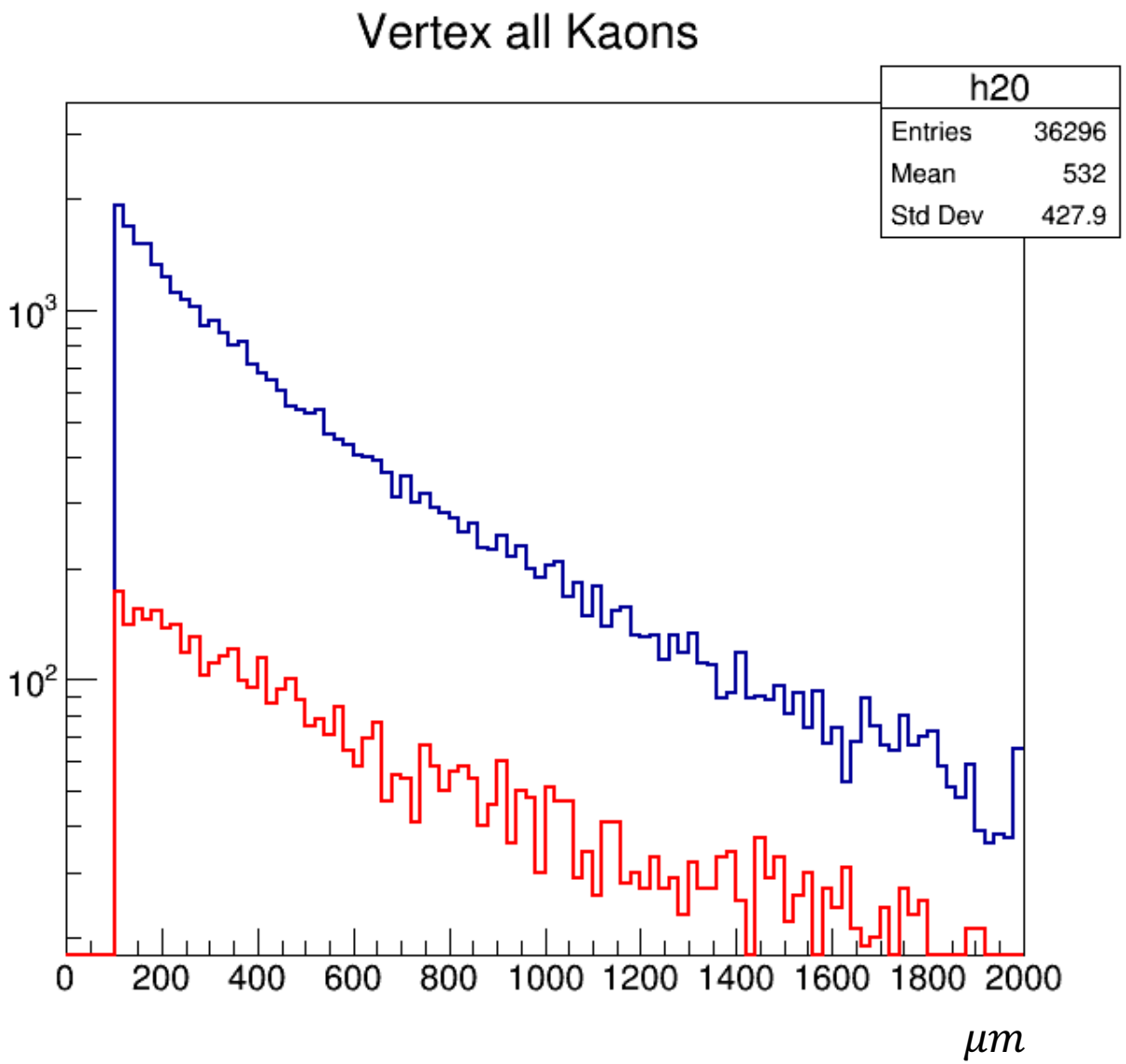
5 GeV x 100 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 26273
Total number of events with a charm in kinematical acceptance: 91930
Charm efficiency = 28.6%

20 GeV x 100 GeV (10M events simulated)
Total number of selected events (charm in acceptance and with a kaon detected): 39624
Total number of events with a charm in kinematical acceptance: 138672
Charm efficiency = 28.6%

Conclusion:
The charm selection efficiency is expected in the order of ~28% with no significant energy dependence

What about kinematical dependence?

VERTEX displ.



Q2>10, x>0.05
Norm.

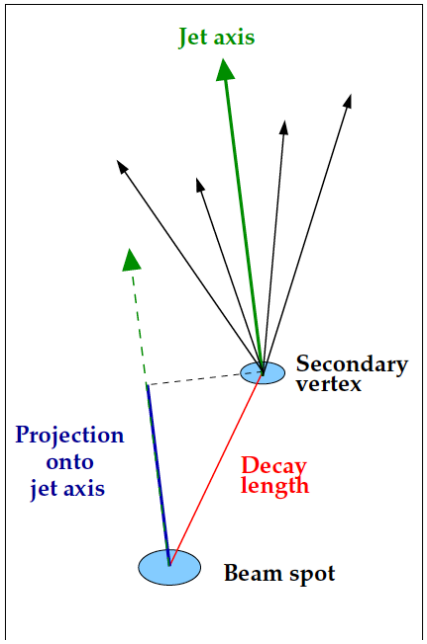
BGF (charm)
Total-K : 82.695
Cut: 36.296

Eff: 44%

Minbias:
Total-K: 113.174
cut: 7.293

Eff: 6.4%

ZEUS - vertex-tagging



- Reconstruct jet
- Reconstruct vtx
- Decay length projection on jet axis
- (-) if in wrong semisphere
- Decay length significance S=d/δd
- M_{vxt} (assuming all tracks are charged pions)
- Subtract LF from wrong sign
- S in Mvtx bin

$$
\begin{aligned}
d &= \vec{d}_{2D} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|} \\
&= \begin{pmatrix} \Delta X \\ \Delta Y \end{pmatrix} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|} \\
&= \begin{pmatrix} X_{vtx} - X_{bsp} \\ Y_{vtx} - Y_{bsp} \end{pmatrix} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|}.
\end{aligned}
$$

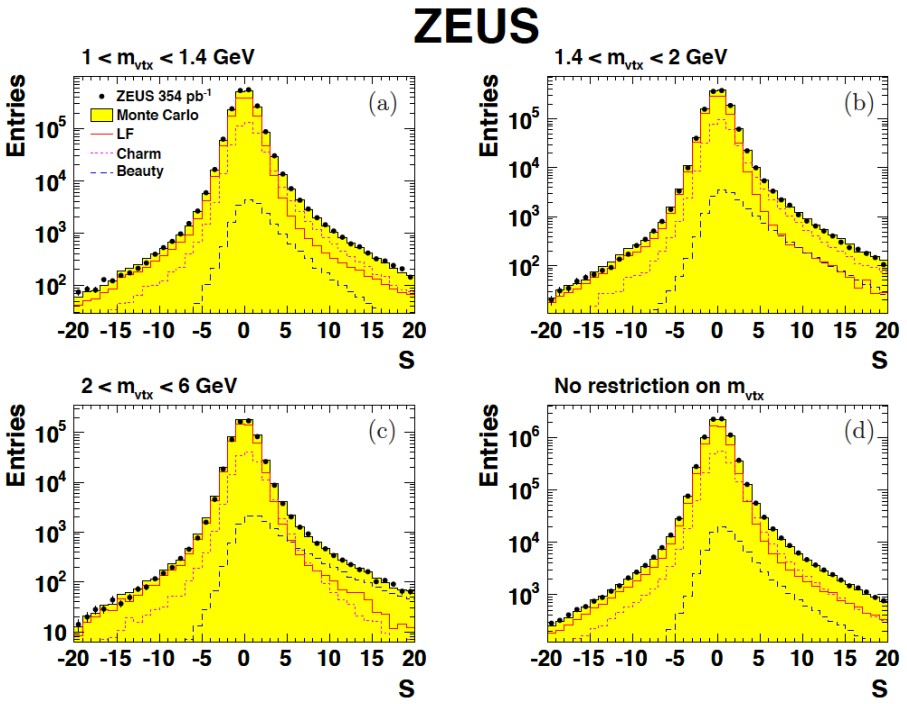


Figure 1: *Distributions of the decay-length significance, S, for (a) $1 < m_{vtx} < 1.4\,\text{GeV}$, (b) $1.4 < m_{vtx} < 2\,\text{GeV}$, (c) $2 < m_{vtx} < 6\,\text{GeV}$ and (d) no restriction on m_{vtx}. The data are compared to the sum of all MC distributions as well as the individual contributions from the beauty, charm and light-flavour (LF) MC subsamples. All samples were normalised according to the scaling factors obtained from the fit (see text).*

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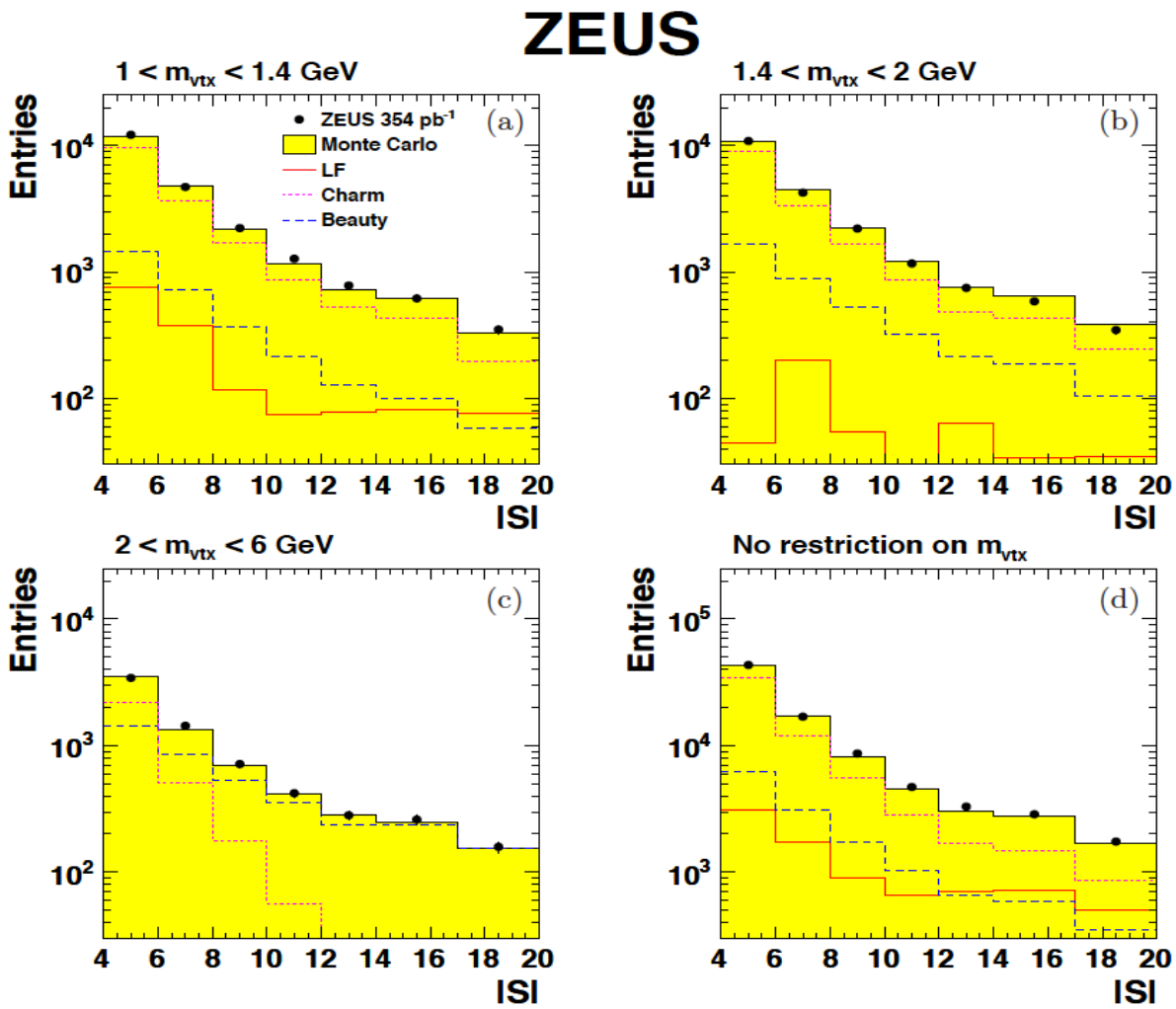
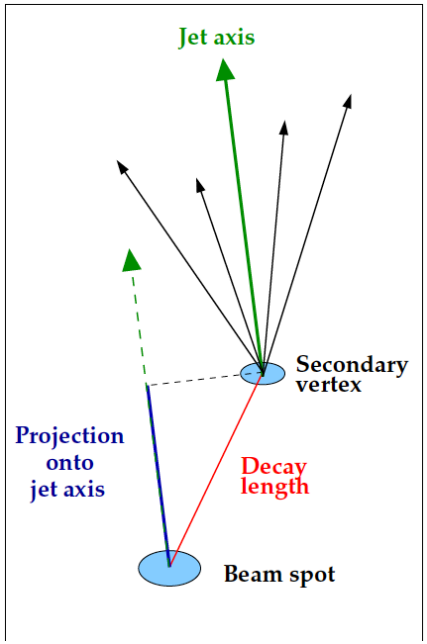
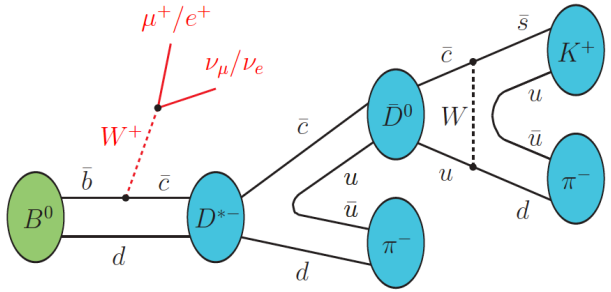


Figure 2: *Distribution of the subtracted decay-length significance in four ranges of m_{vtx}. For more details, see the caption of Fig. 1.*

ZEUS - vertex B-tagging



$$
\begin{aligned}
d &= \vec{d}_{2D} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|} \\
&= \begin{pmatrix} \Delta X \\ \Delta Y \end{pmatrix} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|} \\
&= \begin{pmatrix} X_{vtx} - X_{bsp} \\ Y_{vtx} - Y_{bsp} \end{pmatrix} \cdot \frac{\vec{j}_{2D}}{|\vec{j}_{2D}|}.
\end{aligned}
$$



example for such a p^{rel}_t distribution
for electrons from semileptonic decays is displayed

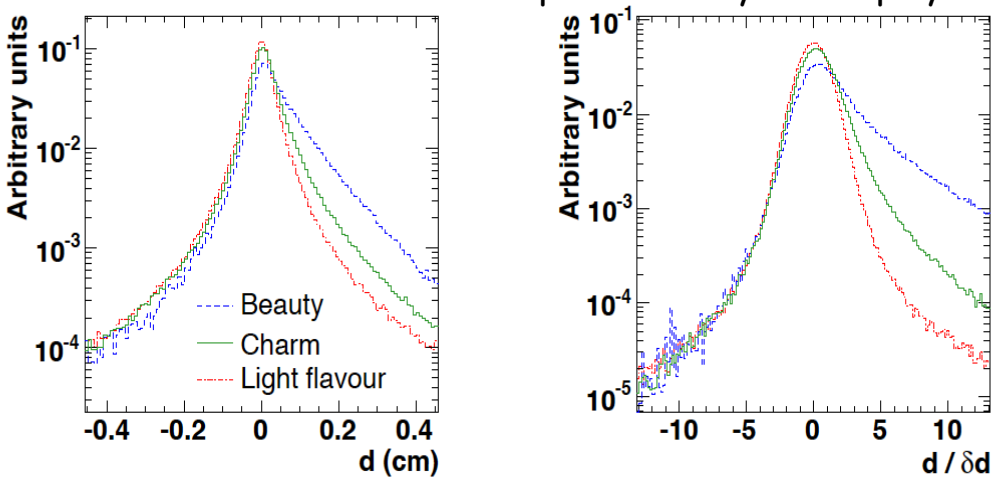


Figure 5.6: 2D decay length, d, projected onto the axis of the associated jet (left) and corresponding decay-length significance, $S = d/\delta d$. The distributions for beauty, charm and light flavours are denoted by the blue, green and red histograms.

"Measurement of beauty and charm Photoproduction using inclusive secondary vertexing with the ZEUS detector at HERA"
Verena Ellen Schoenberg