Moments Analysis

update, before blessing (reflects changes to CDF6973)

Alessandro Cerri, Hung-Chung Fang, Ramon Miquel, Marjorie Shapiro, Laurent Vacavant

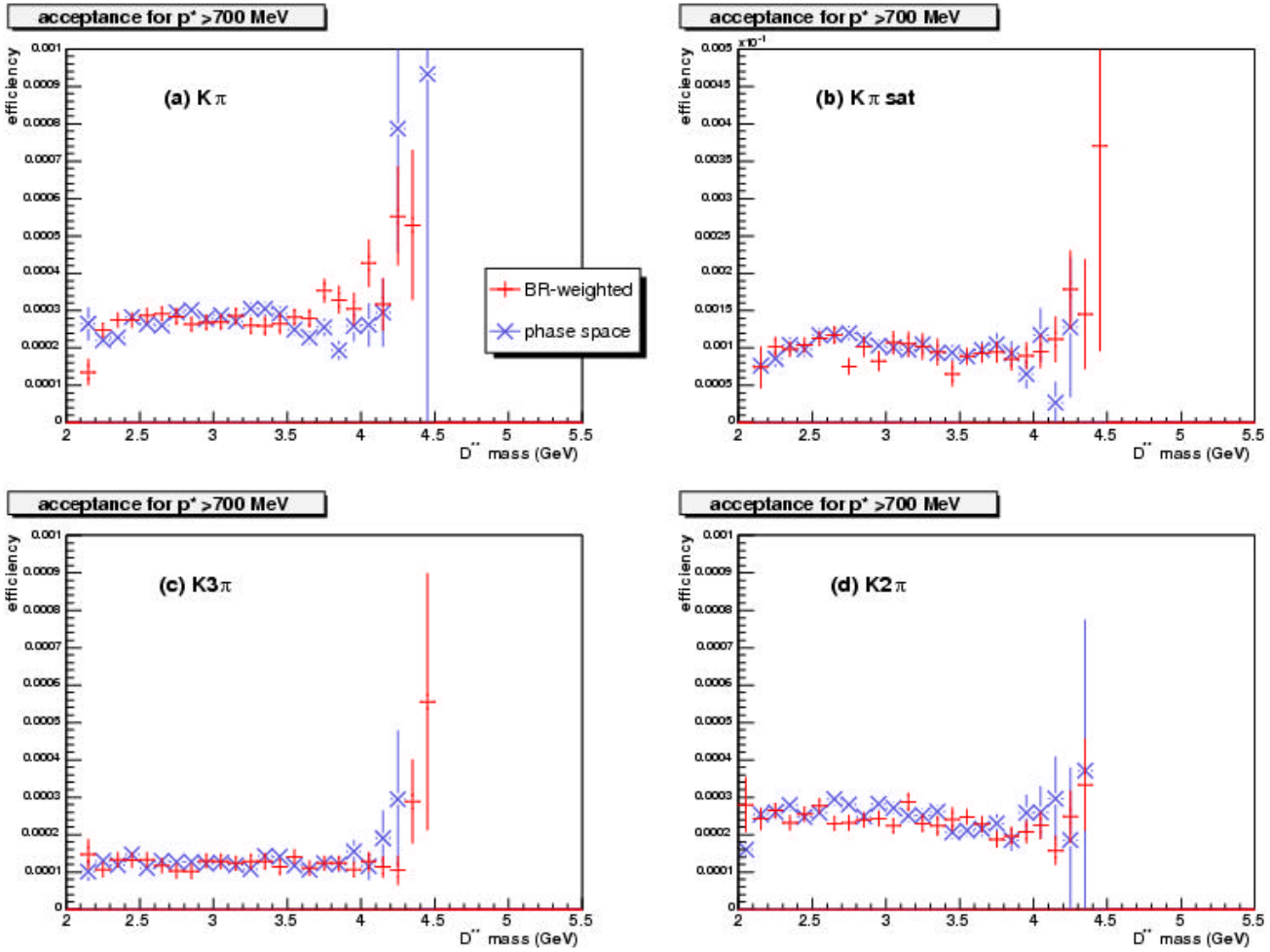
Systematic Errors

- During preblessing we were asked to see if we could improve our systematics
- We want to make sure that everybody is comfortable with it
- Systematics dominated by efficiency:
  - MC statistics
  - MC/Data corrections
- M** cut
- This implies changes also in the central values

Efficiency vs m**

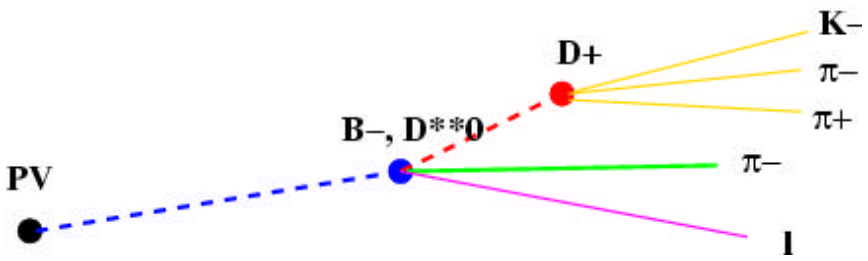
- Bulk measured from MC
- Low statistics at the edges (large m**) harmful

→ Increase MC statistics

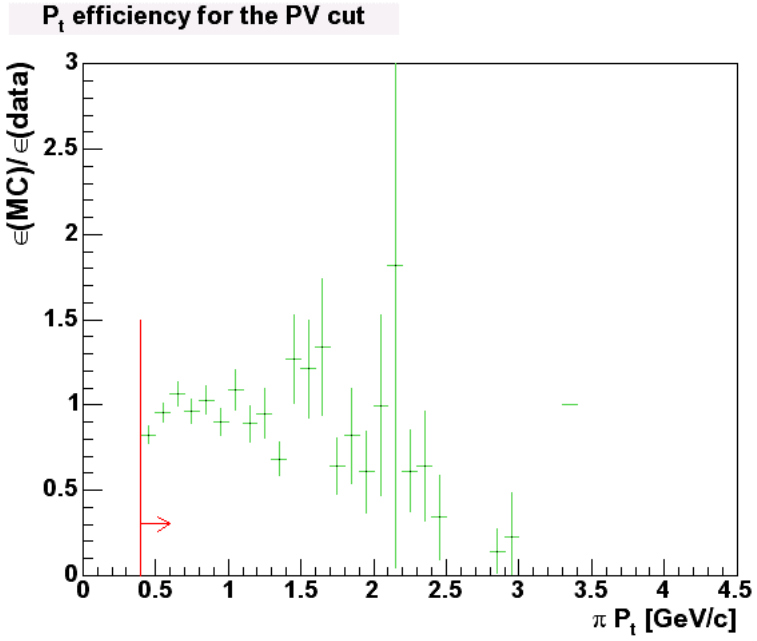


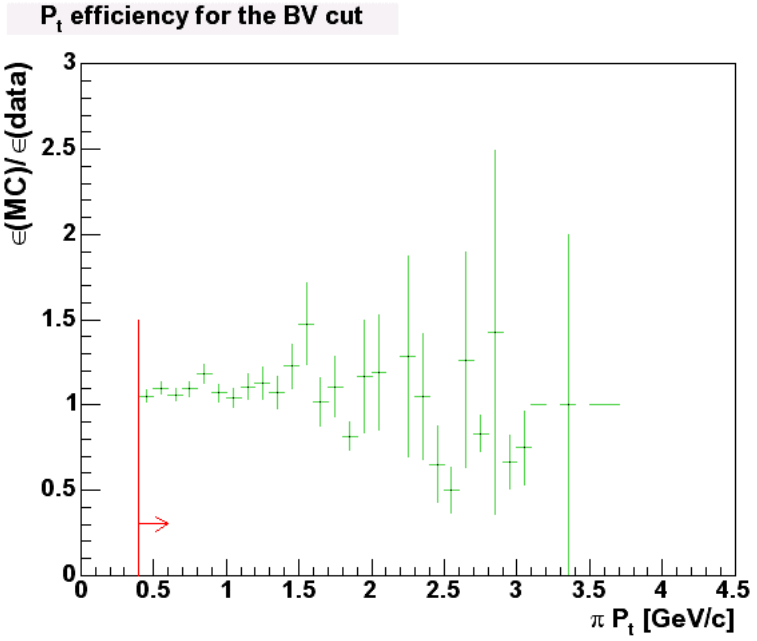
MC/Data corrections

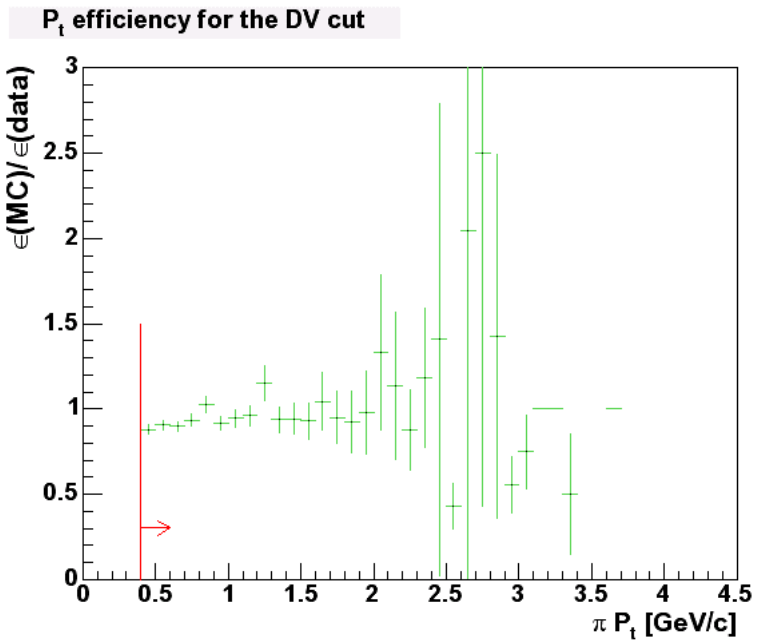
- Dominant source of systematics!
- π^* reproduces π^{**} topology but too small statistics:
  - Use more D* candidates (one week ago we were using only $D^0 \rightarrow K\pi$)
  - Cross check on non-triggering D^0 daughters

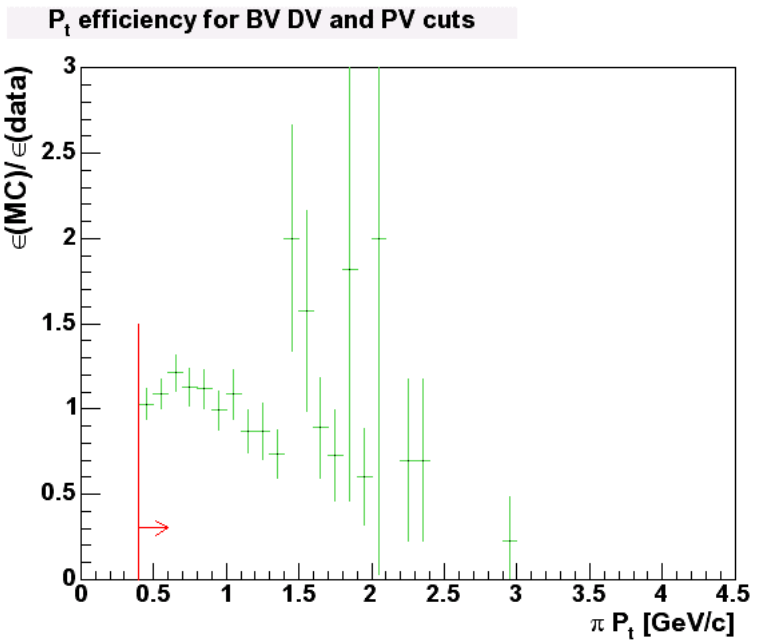


π^*

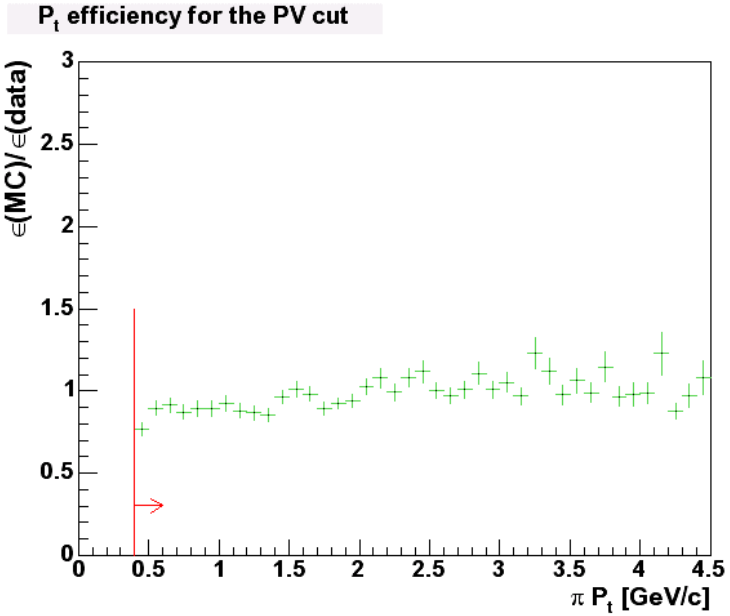

P_t efficiency for the PV cut
∈(MC)/∈(data)
π P_t [GeV/c]

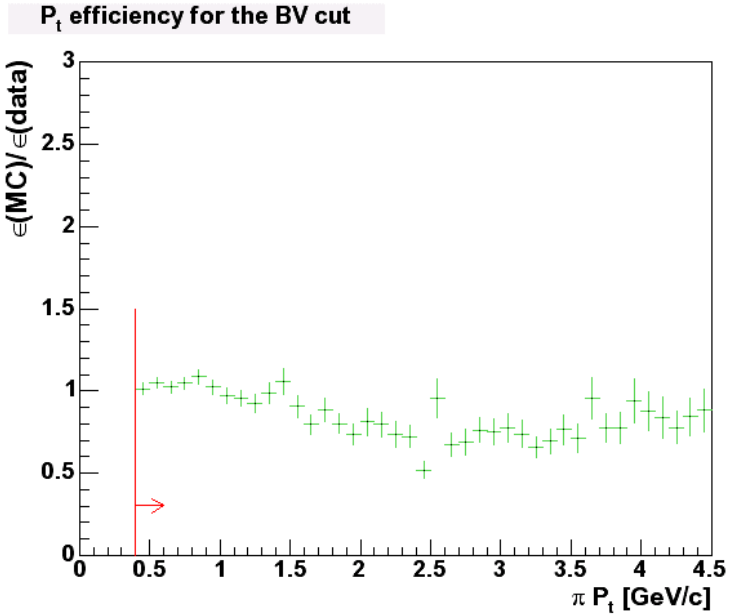

P_t efficiency for the BV cut
∈(MC)/∈(data)
π P_t [GeV/c]

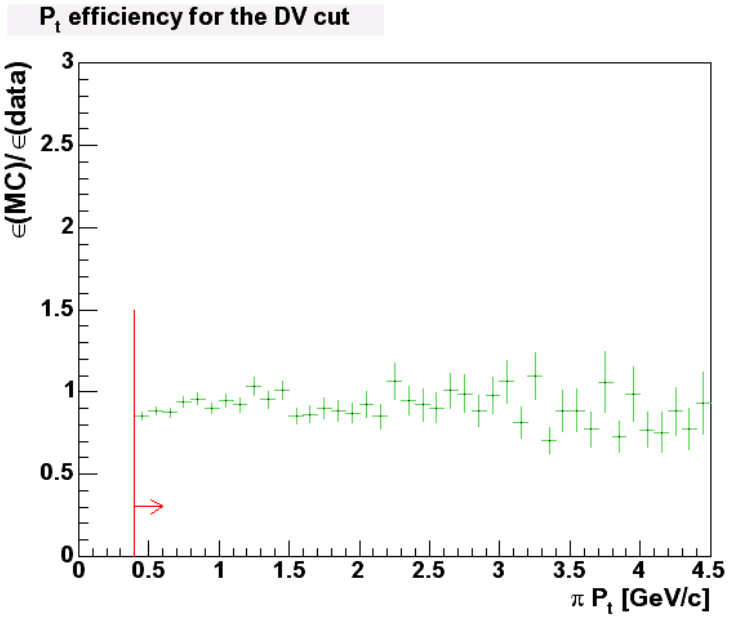

P_t efficiency for the DV cut
∈(MC)/∈(data)
π P_t [GeV/c]

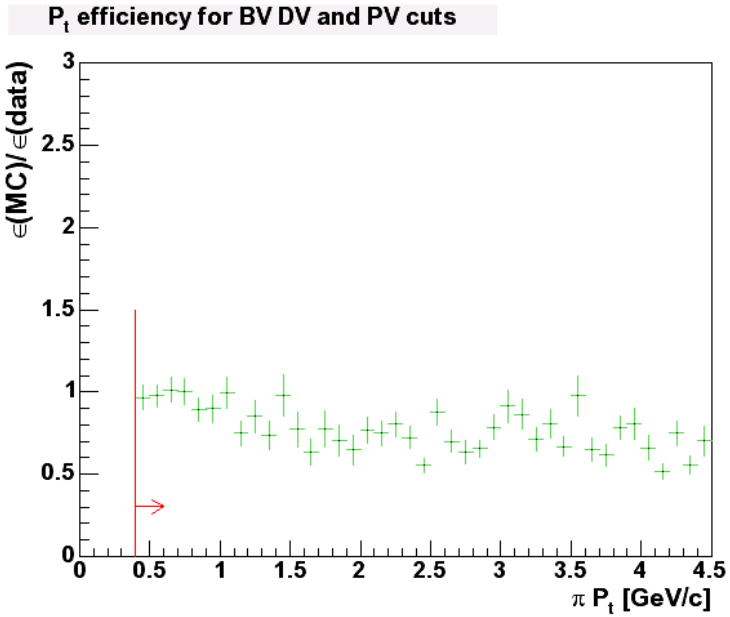

P_t efficiency for BV DV and PV cuts
∈(MC)/∈(data)
π P_t [GeV/c]

All non-trigger D* daughters



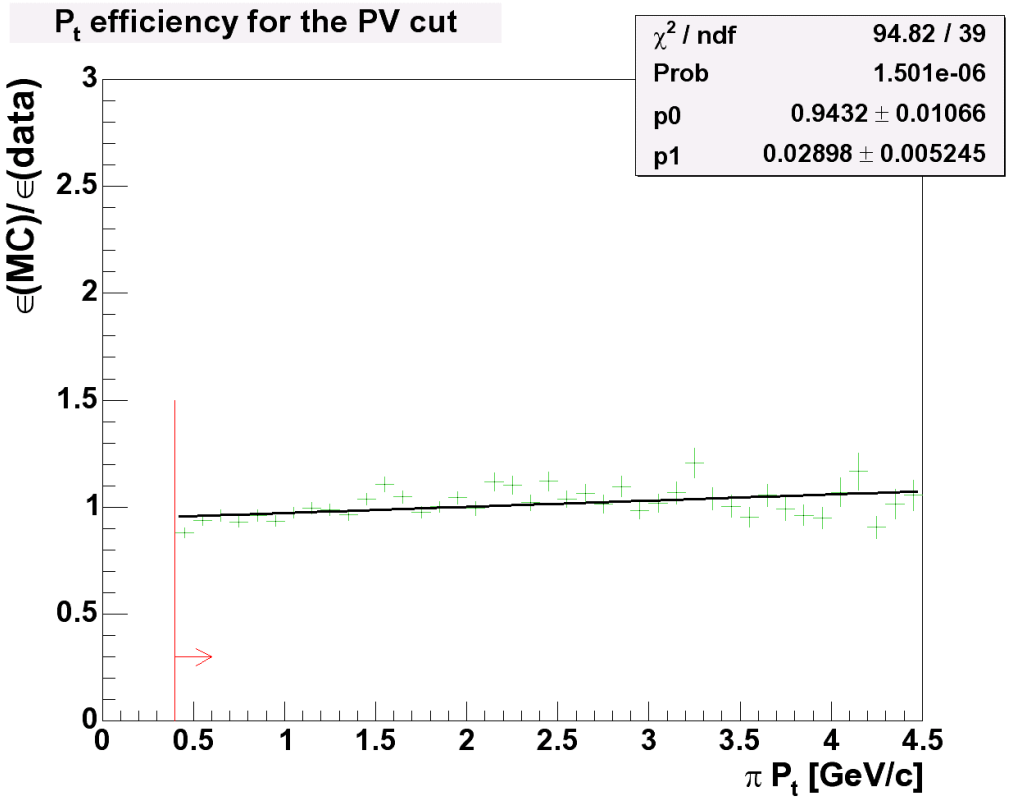


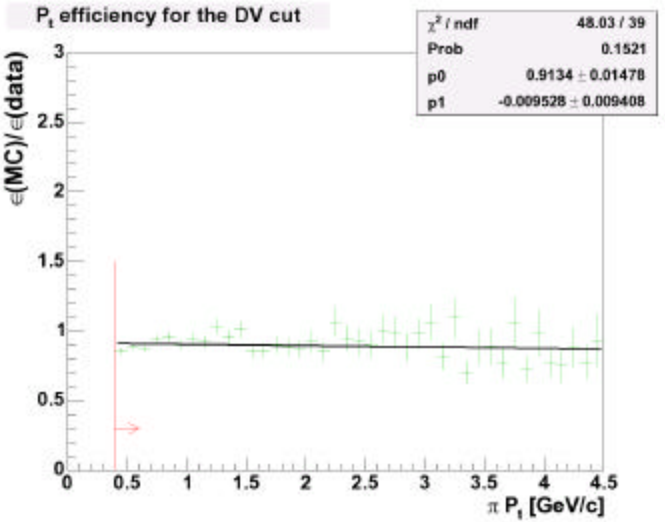


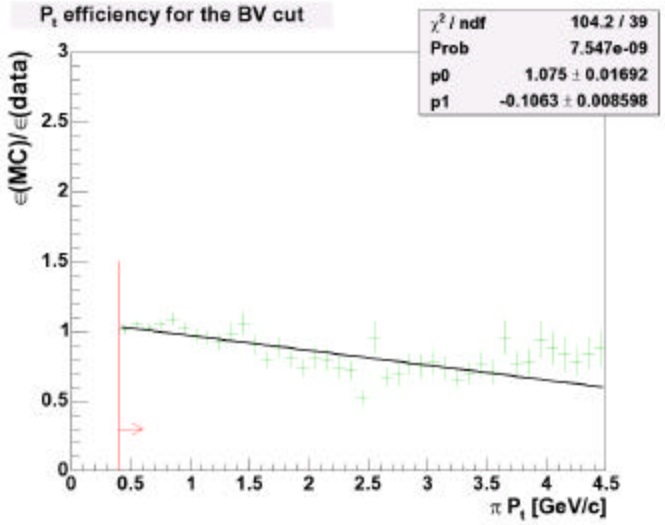


Proposed change

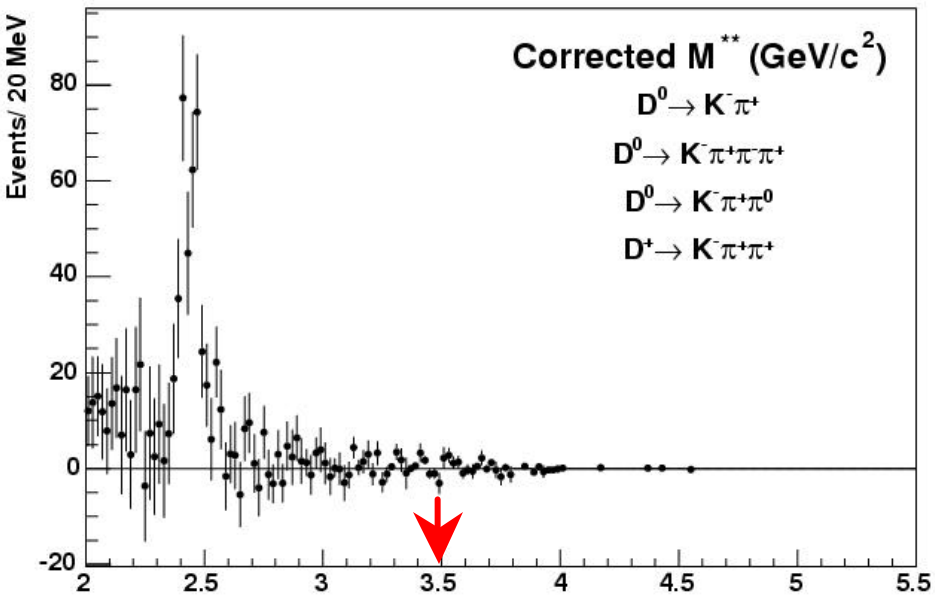
- Use all D* daughters to estimate PV, BV DV alone, based on a linear fit
- Replace with flat line fit to estimate systematics







m** cutoff



- Cut-off is a tool to trade off statistics↔systematics
- None of this affects m_1 substantially: m_2 ($\sim m^4$) is more sensitive
- Extrapolation attempted (both functional and with MC histograms):
  - Systematic error with cut-off ~ statistical error without cut-off
  - Introduces model-dependency

We decide to take out completely the cut-off

- Larger (~x1.5 for m_2) statistical uncertainty than what shown last week
- Improved efficiency corrections make it more reasonable than what initially estimated
- Completely model-independent
- 0 systematics from cut-off
- Expect a significant shift on m_2

New Results

systematics

Error	Δm_1 (GeV^2)	Δm_2 (GeV^4)	ΔM_1 (GeV^2)	ΔM_2 (GeV^4)	$\Delta\Lambda$ (GeV)	$\Delta\lambda_1$ (GeV^2)
Statistical	0.16	0.69	0.037	0.25	0.075	0.055
Total systematic	0.08	0.20	0.065	0.12	0.090	0.082
Mass resolution	0.02	0.13	0.005	0.04	0.012	0.009
Efficiency (data)	0.03	0.13	0.006	0.05	0.014	0.011
Efficiency (MC)	0.06	0.05	0.016	0.03	0.017	0.006
p_l^* cut	—	—	0.001	0.00	0.001	0.000
Background scale	0.01	0.03	0.002	0.01	0.003	0.002
Physics background	0.01	0.02	0.002	0.01	0.004	0.002
D^+/D^{*+} BR	0.01	0.02	0.002	0.01	0.004	0.002
D^+/D^{*+} Eff.	0.02	0.03	0.004	0.01	0.005	0.002
Semileptonic BR's	—	—	0.062	0.10	0.064	0.022
ρ_1	—	—	—	—	0.041	0.069
T_i	—	—	—	—	0.032	0.031
α_s	—	—	—	—	0.018	0.007
m_b, m_c	—	—	—	—	0.001	0.008
Choice of p_l^* cut	—	—	—	—	0.019	0.009

Old values

0.02	0.34
0.03	0.29

New Results

moments

OLD

$$m_1 = (5.73 \pm 0.15_{\rm stat} \pm 0.08_{\rm syst})\ {\rm GeV}^2$$
$$m_2 = (0.85 \pm 0.49_{\rm stat} \pm 0.46_{\rm syst})\ {\rm GeV}^4$$

NEW

$$m_1 = (5.83 \pm 0.16_{\rm stat} \pm 0.08_{\rm syst})\ {\rm GeV}^2$$
$$m_2 = (1.30 \pm 0.69_{\rm stat} \pm 0.20_{\rm syst})\ {\rm GeV}^4$$

- m_2 significantly affected, as expected
- Change is within statistical error:

$$(1.30\text{-}0.85)=.45 \sim .48=(0.69^2\text{-}0.49^2)^{1/2}$$

$$M_1 = (0.437 \pm 0.035_{\rm stat} \pm 0.018_{\rm exp} \pm 0.060_{\rm BR})\ {\rm GeV}^2$$
$$M_2 = (0.86 \pm 0.20_{\rm stat} \pm 0.15_{\rm exp} \pm 0.07_{\rm BR})\ {\rm GeV}^4\ ,$$

$$\Lambda = (0.337 \pm 0.066_{\rm stat} \pm 0.037_{\rm exp} \pm 0.059_{\rm BR} \pm 0.060_{\rm theo})\ {\rm GeV}$$
$$\lambda_1 = (-0.141 \pm 0.046_{\rm stat} \pm 0.035_{\rm exp} \pm 0.017_{\rm BR} \pm 0.080_{\rm theo})\ {\rm GeV}^2$$

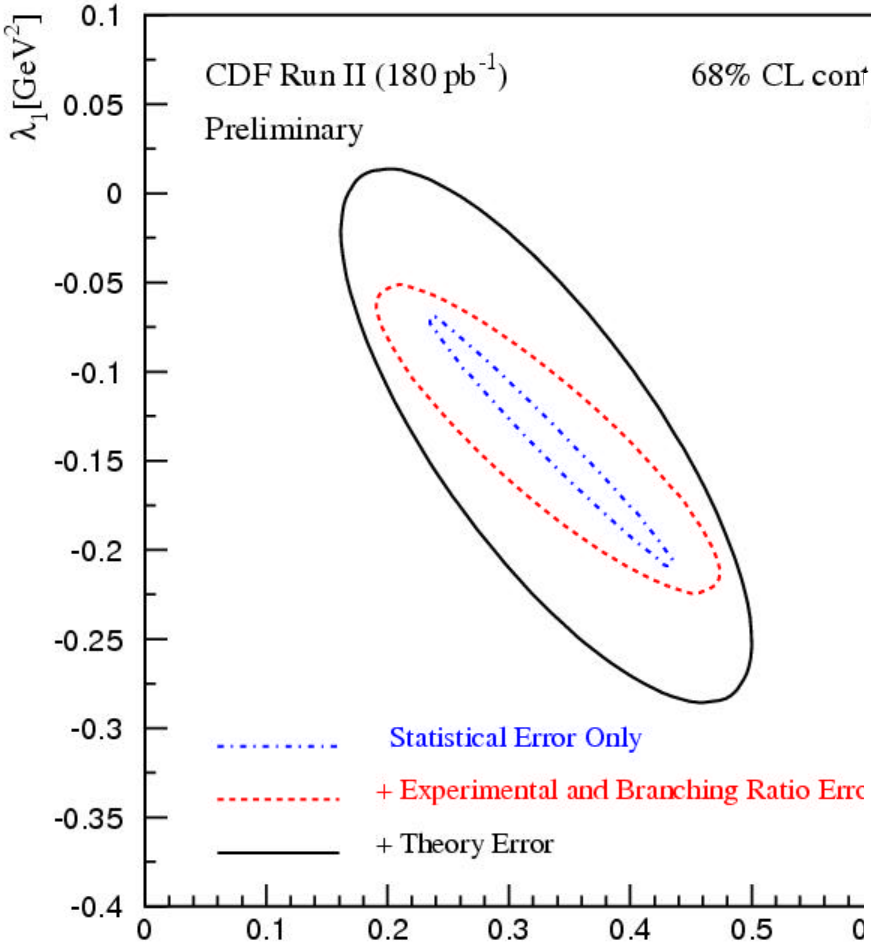
$$M_1 = (0.459 \pm 0.037_{\rm stat} \pm 0.019_{\rm exp} \pm 0.062_{\rm BR})\ {\rm GeV}^2$$
$$M_2 = (1.04 \pm 0.25_{\rm stat} \pm 0.07_{\rm exp} \pm 0.10_{\rm BR})\ {\rm GeV}^4\ ,$$

$$\Lambda = (0.390 \pm 0.075_{\rm stat} \pm 0.026_{\rm exp} \pm 0.064_{\rm BR} \pm 0.058_{\rm theo})\ {\rm GeV}$$
$$\lambda_1 = (-0.182 \pm 0.055_{\rm stat} \pm 0.016_{\rm exp} \pm 0.022_{\rm BR} \pm 0.077_{\rm theo})\ {\rm GeV}^2$$

Λ, λ_1

Histogram y ranges are different!!!

OLD



NEW