



# D0 Cut Optimization

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Heavy Flavour Meeting

# Data

- Full preview 2 dataset with  $\sim 70\text{M}$  events (minimum bias).
- Based on LBNL picoDSTs.
- D0 event tree from Alex, using 2D vertex finding + linear approximation.
- Mixed event is using 13 bins in z-vertex with  $\Delta z \sim 20\text{ cm}$ .
- Mixed event statistics limited so far (on purpose).

# Strategy

- Vary topological cuts (next slide) on datasets to obtain invariant mass histograms for same- and mixed-events (for ALL possible cut combinations) per  $p_T$  bin.
- Total number of histograms:
  - $N = 6[p_T \text{ bins}] * 6^5 [\text{cut combinations}] = 46,656$
- Normalize associated same- and mixed-event histograms to each other. Perform same-minus-mixed to obtain signal.
- Calculate signal significance for each.

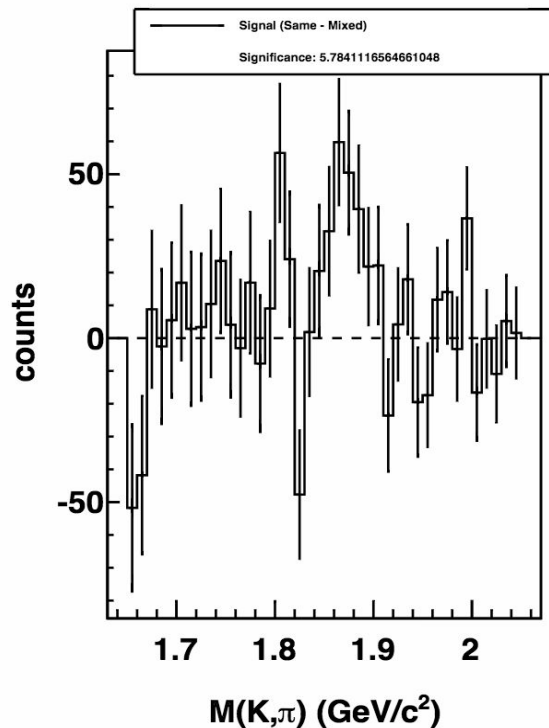
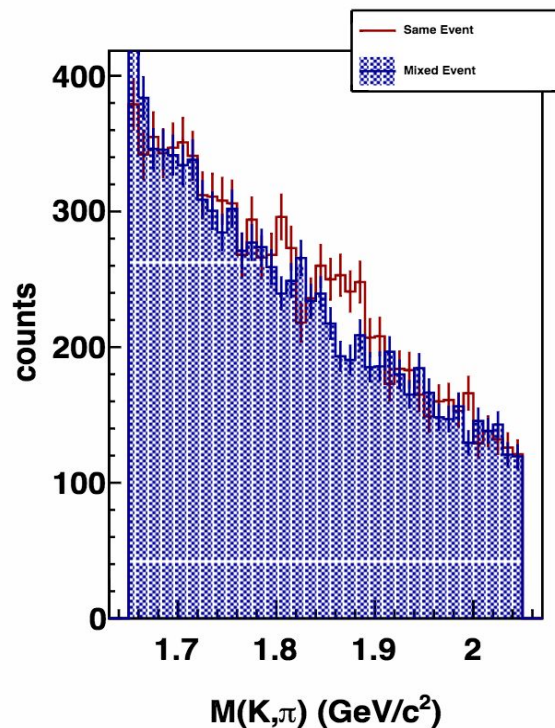
# Cuts Varied

	Set A: $1 < p_T < 1.5$	Set B: $1.5 < p_T < 2.5$
Cut Name	Cut Range - Set A	Cut Range - Set B
Kaon DCA	20 - 95	60 - 135
Pion DCA	20 - 95	60 - 135
Kaon-Pion DCA*	40 - 90	40 - 80
Primary-to-Decay-Vertex Distance	50 - 200	120 - 370
$\cos(\theta)$	0.98 - 0.986	0.986 - 0.996

\* These are upper-limit cuts

# Set A: $1 < p_T < 1.5$ [BEFORE]

Significance  
5.784



## Optimized Topological Cuts:

dcaA: 53

dcaB: 86

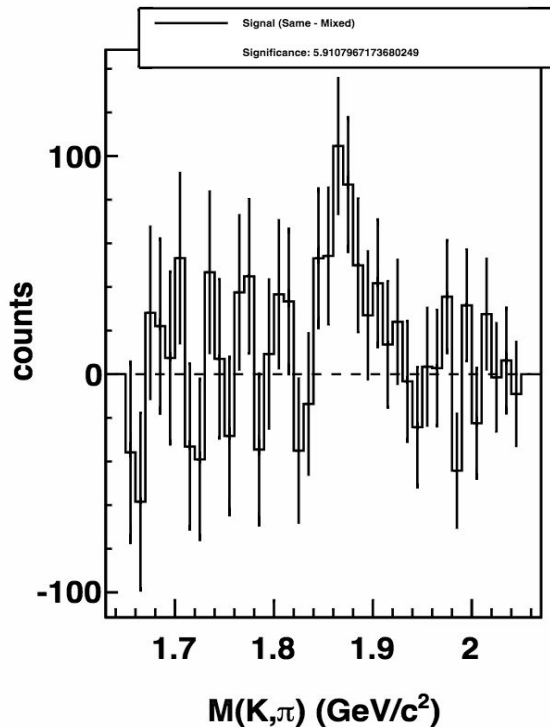
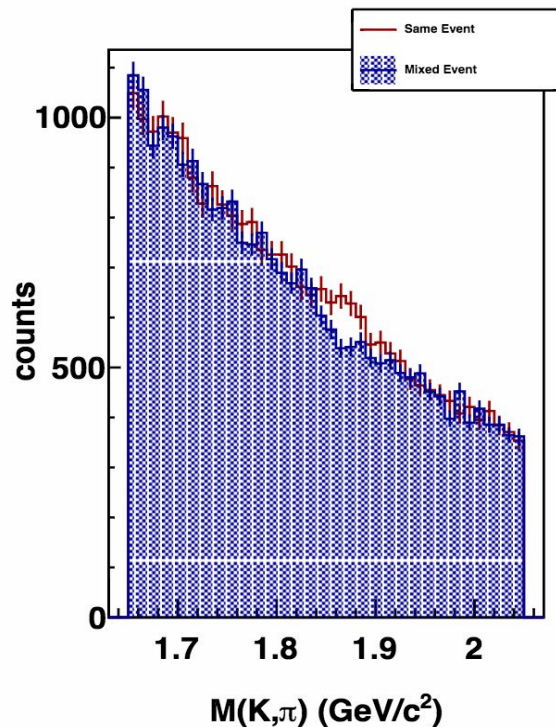
VerdistX: 133

$\cos(\theta) \times 10^4$ : 9800

dcaAB: 53

# Set A: $1 < p_T < 1.5$ [AFTER]

Significance  
5.911



## Optimized Topological Cuts:

**dcaA: 35**

**dcaB: 35**

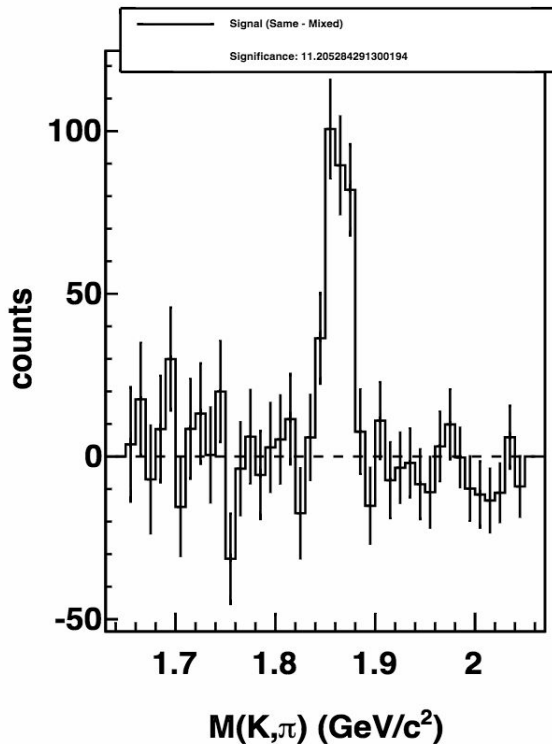
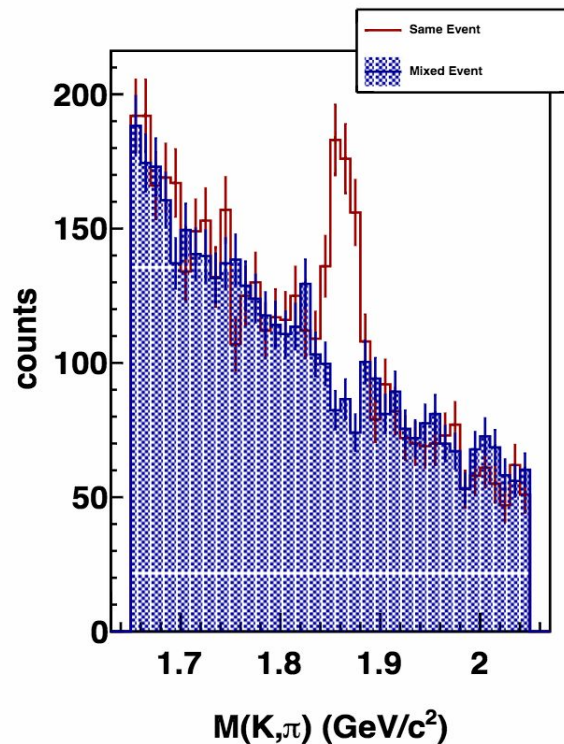
**VerdistX: 110**

**$\cos(\theta) \times 10^4$ : 9800**

**dcaAB: 50**

# Set B: $1.5 < p_T < 2.5$ [BEFORE]

Significance  
11.205



## Optimized Topological Cuts:

dcaA: 119

dcaB: 86

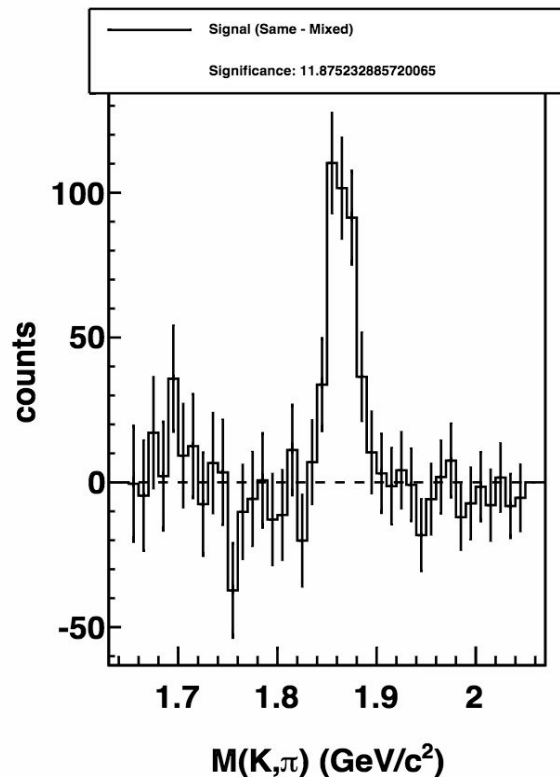
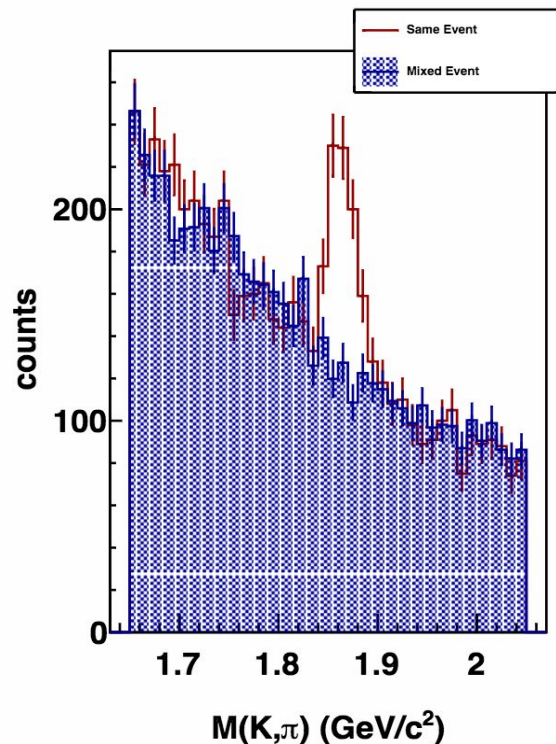
VerdistX: 216

$\cos(\theta) \times 10^4$ : 9905

dcaAB: 185

# Set B: $1.5 < p_T < 2.5$ [AFTER]

Significance  
11.875



## Optimized Topological Cuts:

**dcaA: 120**

**dcaB: 75**

**VerdistX: 170**

**$\cos(\theta) \times 10^4$ : 9880**

**dcaAB: 64**



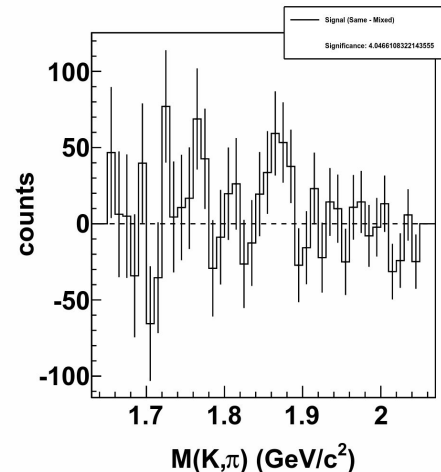
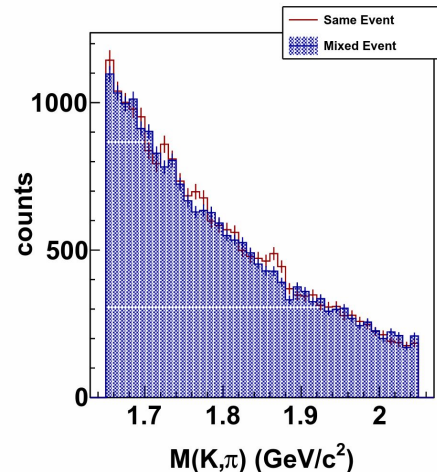
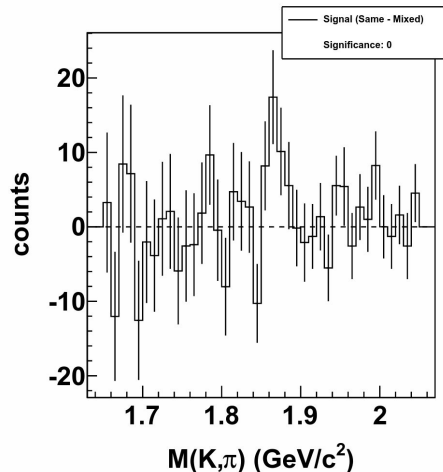
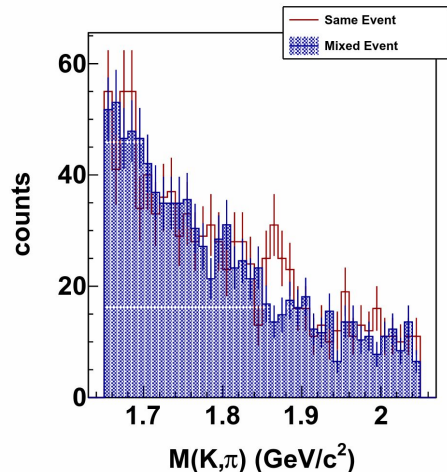
# Summary and Conclusions

- Performed systematic scan of D0 topology cuts for optimal signal significance per- $p_T$ -interval. Cut resolution increased about (apparent) relative minimum.
- D0 signal noticeably strongest in range:  $1.5 < p_T < 2.5$ .
- Further increasing cut resolution yields small improvements.
- Similar plans for D+/-

# Optional Slides

## Past Results

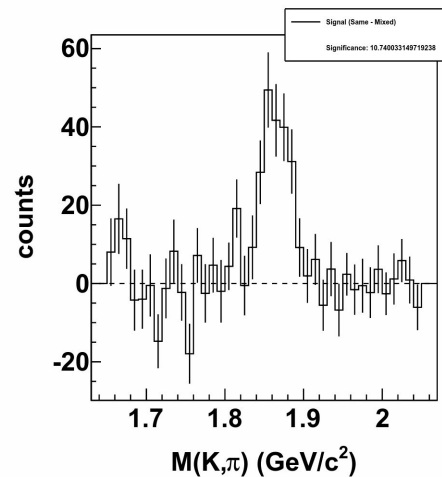
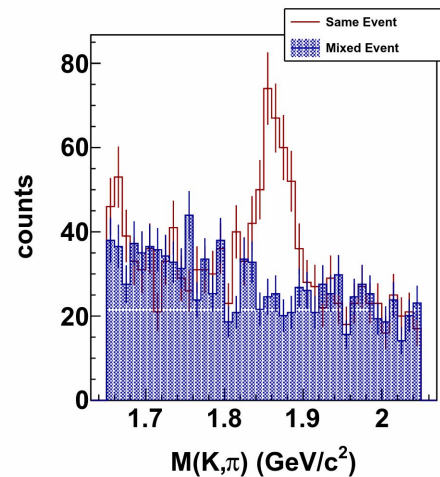
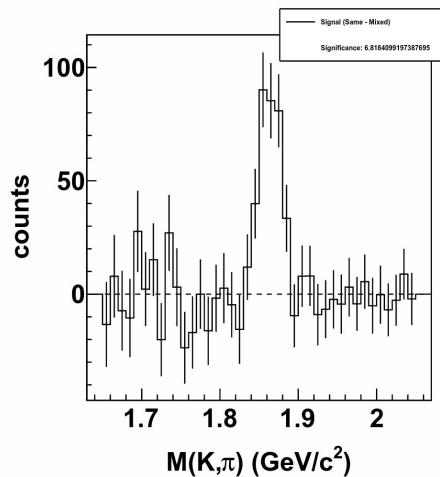
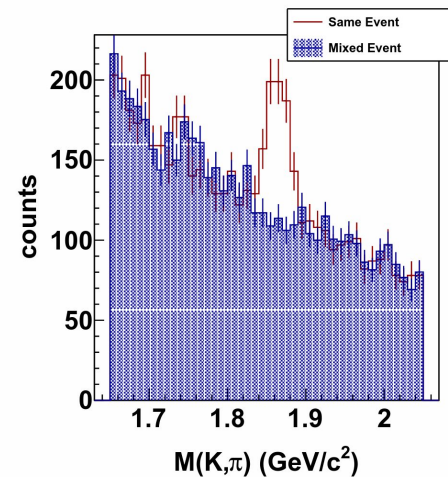
# Initial Scans : Low $p_T$



$p_T: 0.0 - 0.5 \text{ GeV}$   
Significance: 0

$p_T: 0.5 - 1.0 \text{ GeV}$   
Significance: 4.047

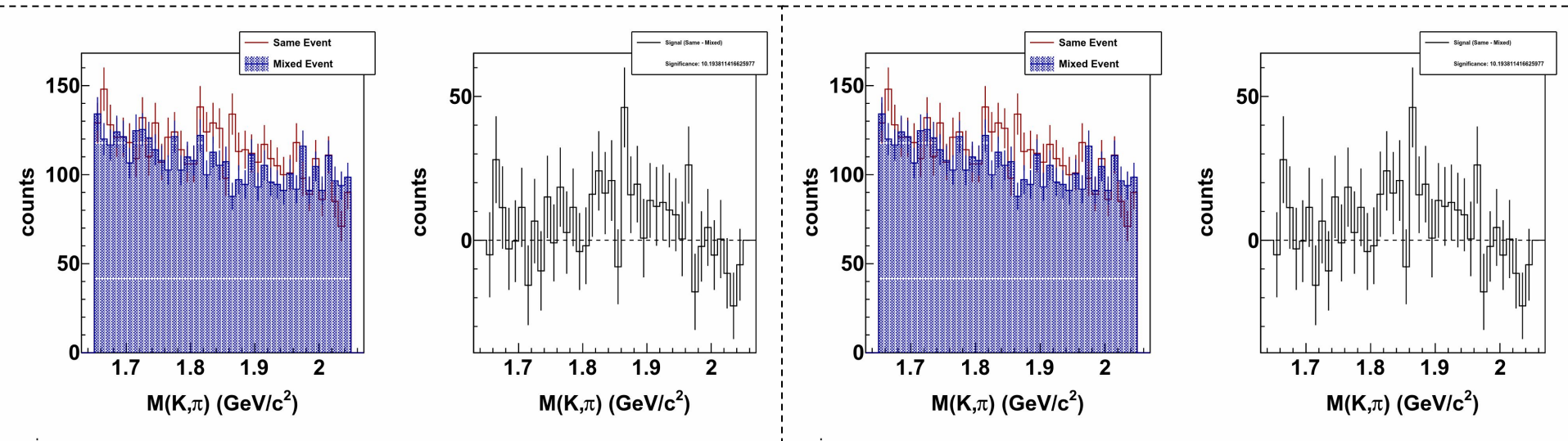
# Initial Scans : Middle $p_T$



$p_T: 1.5 - 2.5 \text{ GeV}$   
Significance: 6.818

$p_T: 2.5 - 5 \text{ GeV}$   
Significance: 10.740

# Initial Scans : High $p_T$



$p_T$  : 5 - 10 GeV  
Significance: **10.194**

$p_T$  : 5 - 10 GeV  
Significance: **10.190**