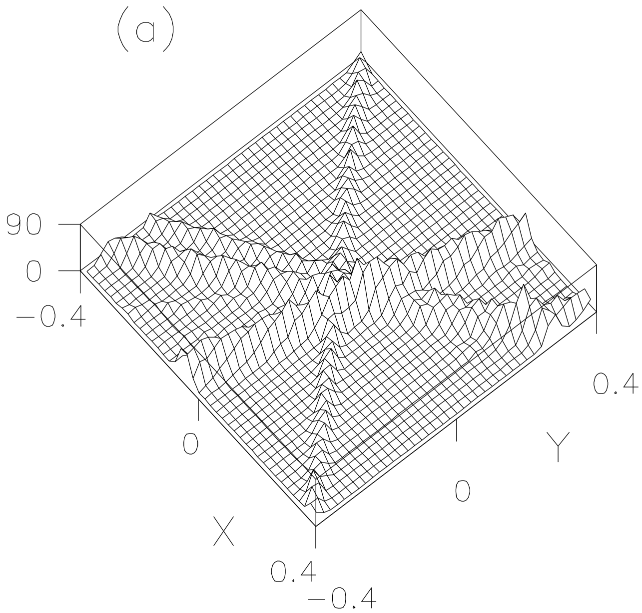
TOPOLOGICAL VERTEXING

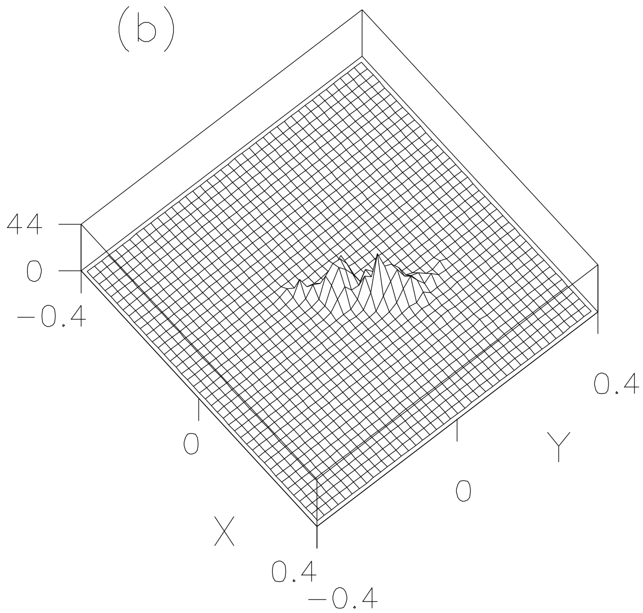
Vertex Finding

Track Functions



$$\Sigma f_i\left(\vec{r}\right)$$

Vertex Function

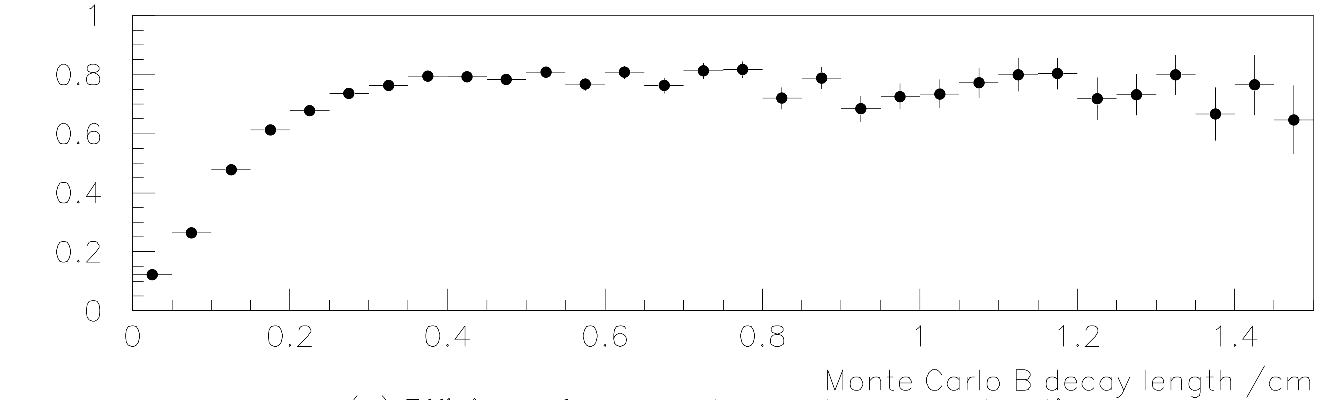


$$V\left(\vec{r}\right) = \Sigma f_i\left(\vec{r}\right) - \frac{\Sigma f_i^2}{\Sigma f_i}$$

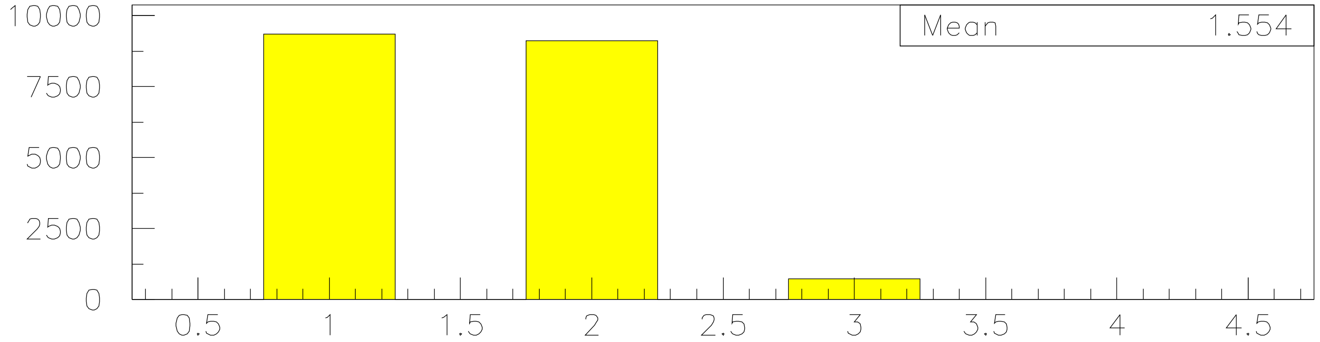
- Track trajectories represented by 3D gaussian probability function $f_i\left(\vec{r}\right)$.
- Use to construct a vertex probablity function $V\left(\vec{r}\right)$
- $V\left(\vec{r}\right)$ represents the track overlap density at $\vec{r}$
- Tracks are associated with resolved maxima in $V\left(\vec{r}\right)$ to form the topological vertex structure

TOPOLOGICAL VERTEXING

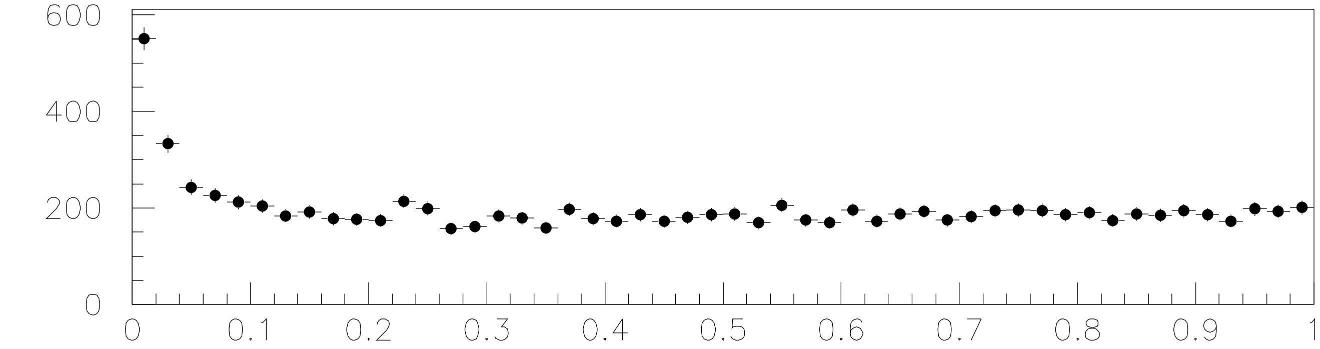
Vertex Finding Efficiency



(a) Efficiency for secondary vertex reconstruction



(b) Hemisphere reconstructed vertex multiplicity

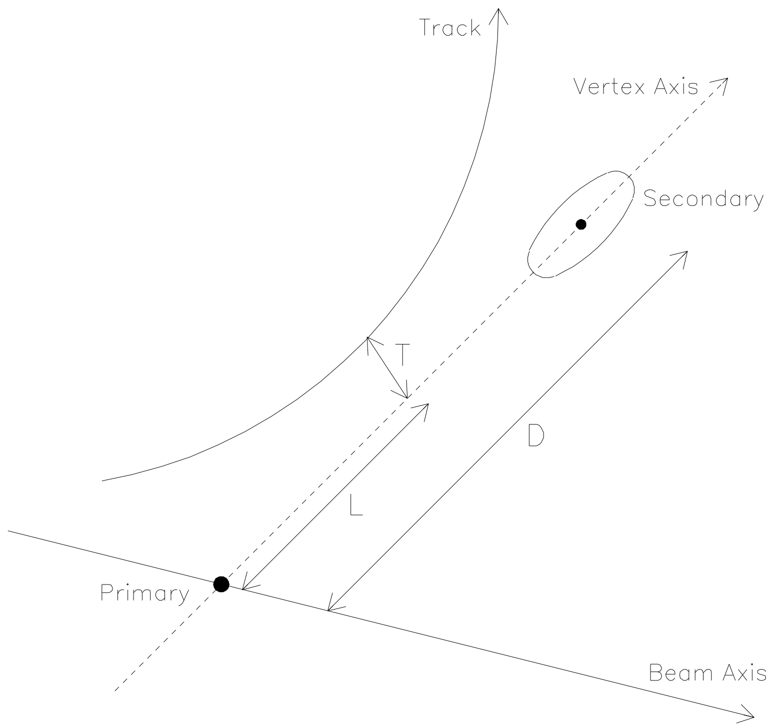


(c) Probability of secondary vertex fit

- Secondary vertex used as "seed" vertex in next stage
- If > 1 secondary, select vertex furthest from IP
- Reject secondaries consistent with $K^{\circ}_{s} \rightarrow \pi^{+}\pi^{-}$

TOPOLOGICAL VERTEXING

Secondary Vertex Reconstruction



Add tracks to "seed" vertex to reconstruct the B decay:

- Vertex axis formed by a straight line joining IP to seed
- Transverse impact parameter T and distance L to point of closest approach of track to vertex axis are calculated
- Tracks with T<0.1 cm and L/D>0.3 are most likely to be associated with B decay. These tracks are added to the seed vertex to form the reconstructed B vertex.
- This reconstructed secondary vertex contains tracks from both the B and cascade D decays. Distance from the IP to the vertex fit is the reconstructed decay length.

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B Mass Tag

- The invariant mass M is calculated from secondary vertex tracks (assuming π mass for each track)
- The transverse momentum P_T of these tracks to the vertex axis is determined.
- This is used to calculate the "P_T added mass":

$$M_{P_T} = \sqrt{M^2 + P_T^2} + |P_T|$$

  $\Rightarrow$ Represents the minimum mass decay hadron could have to produce vertex with M and P_T

- Direction of vertex axis varied with 1.5σ limits of IP and seed vertex such that P_T minimized
  $\Rightarrow$ reduces fake non-B background
- Use this quantity to select candidate B decays

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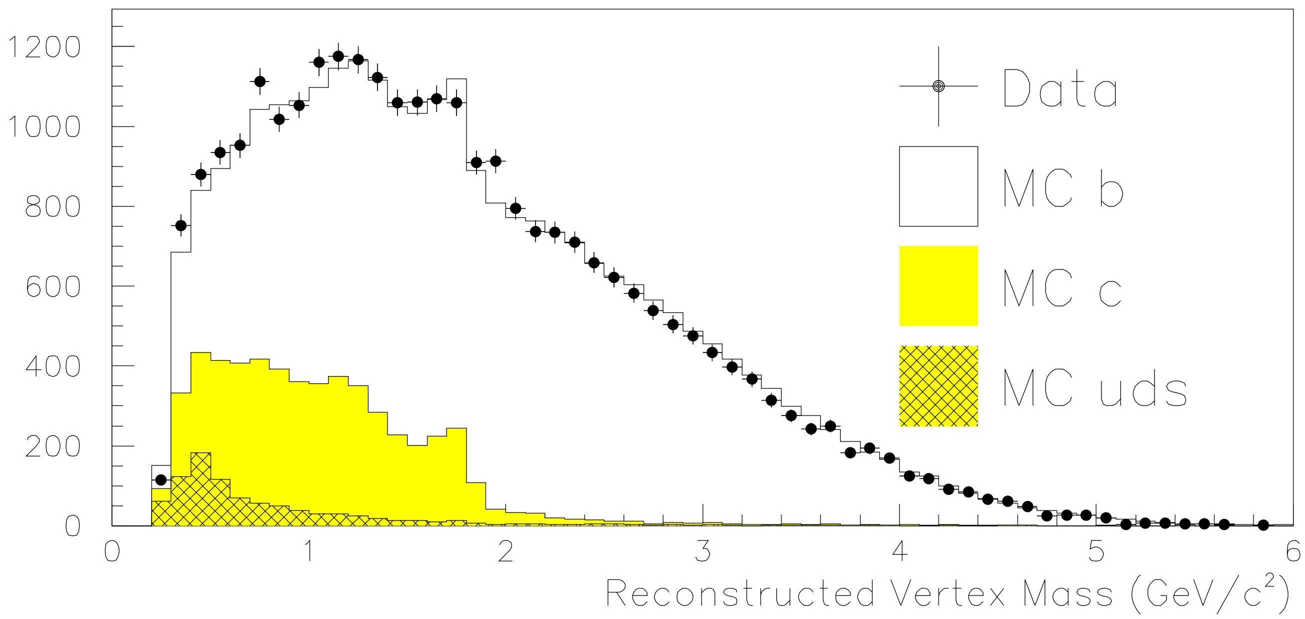
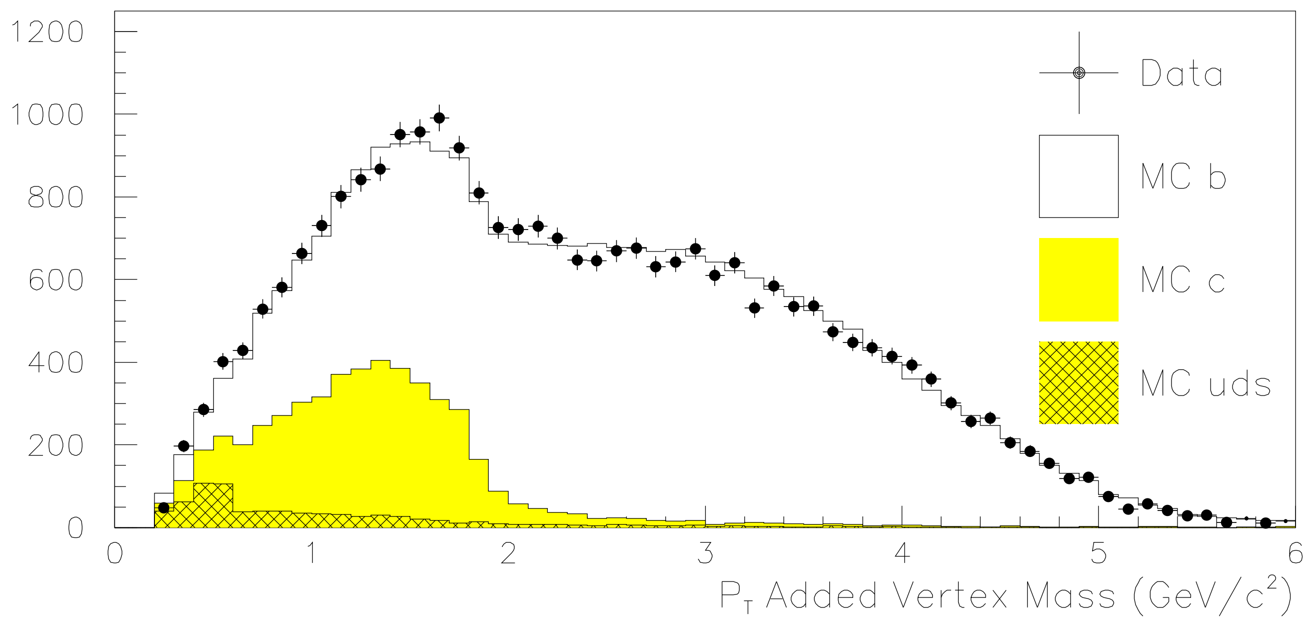
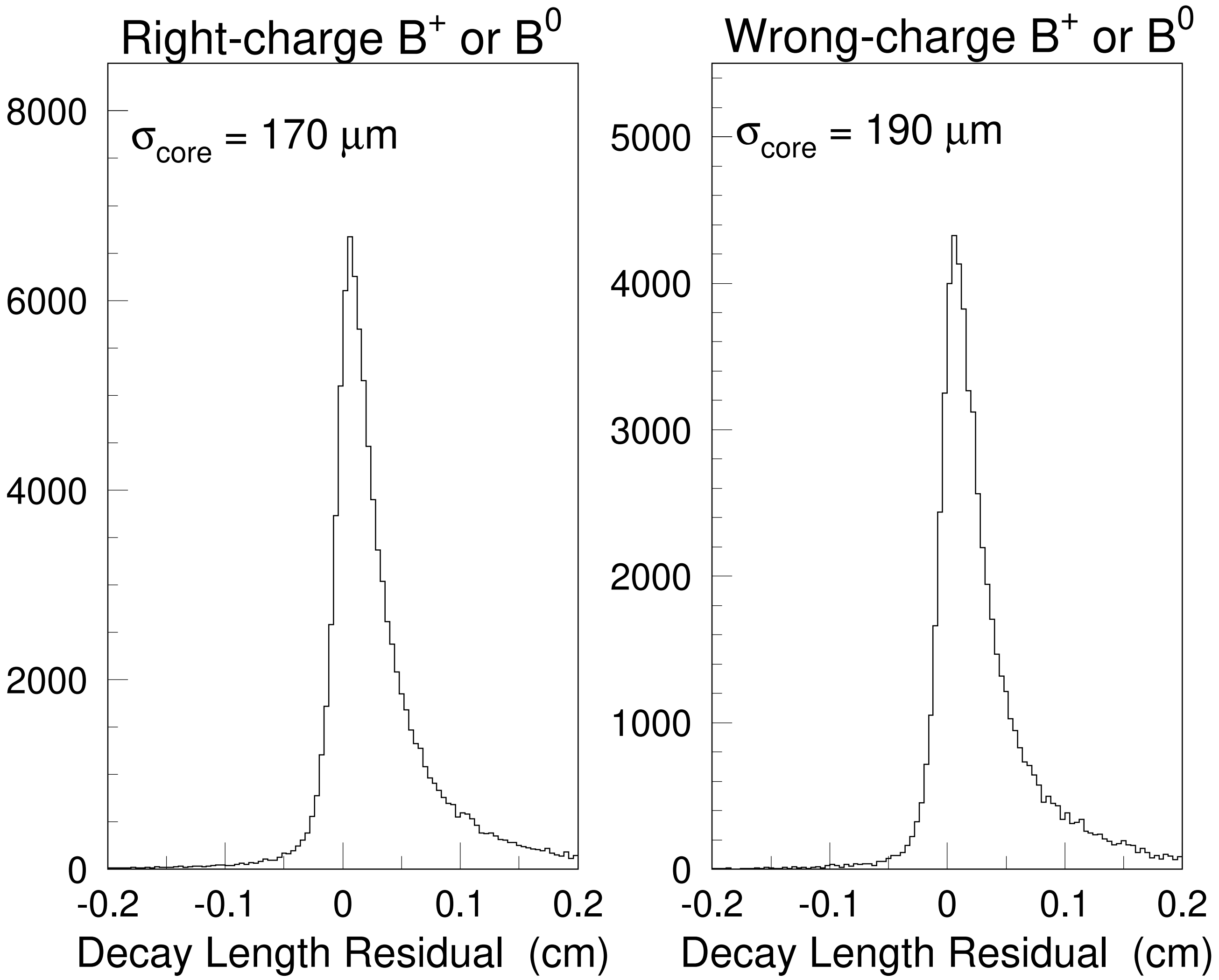




TOPOLOGICAL VERTEXING

Decay Length Resolution



- Decay Length Residual (*REC* - *TRUE*) for B Vertex