Fast Simulation Multi-Vertex Study with $B^0 \rightarrow D^*K$

Dave Brown
Aritoki Suzuki

Lawrence Berkeley Laboratory
University of California Berkeley

April 16th 2009

Vertex Separation

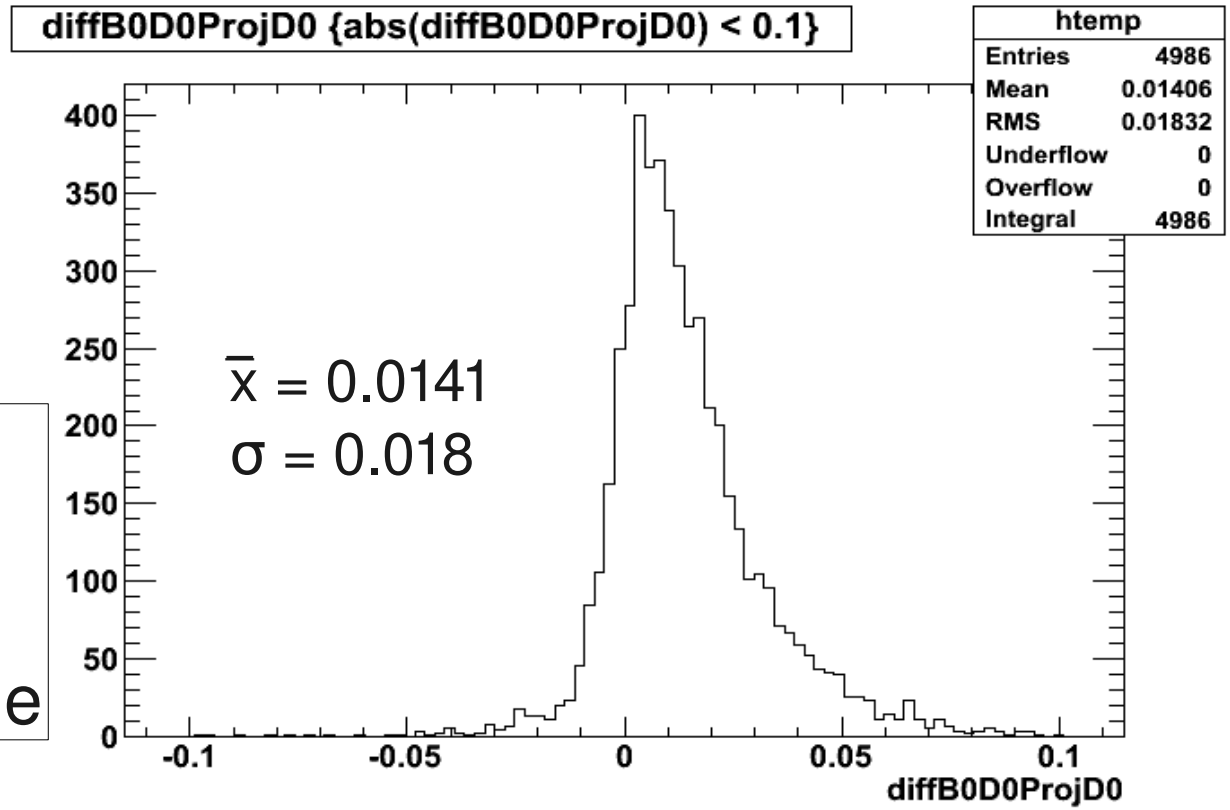
Analysis Decay Chain

$B^0 \rightarrow D^* K$

$D^0 \pi$

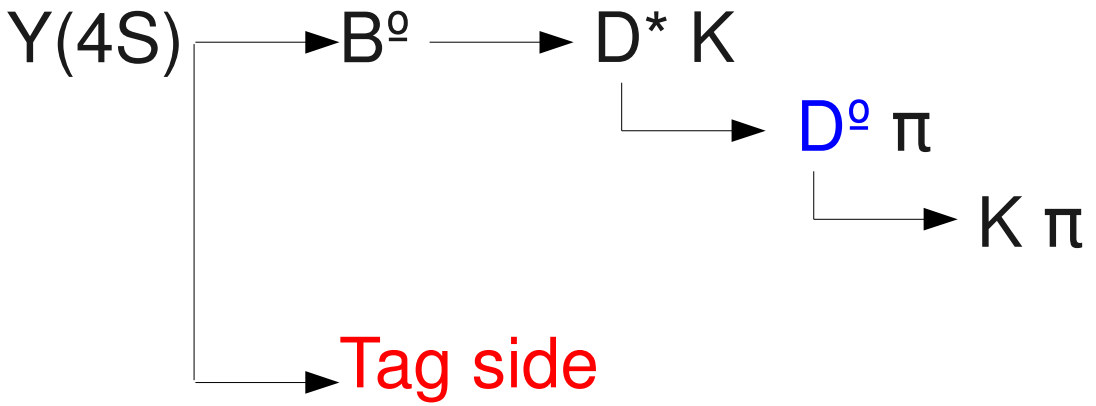
$K \pi$

(Simple Comp – MC)
Vertex Spread
~0.004 cm
for each composite particle



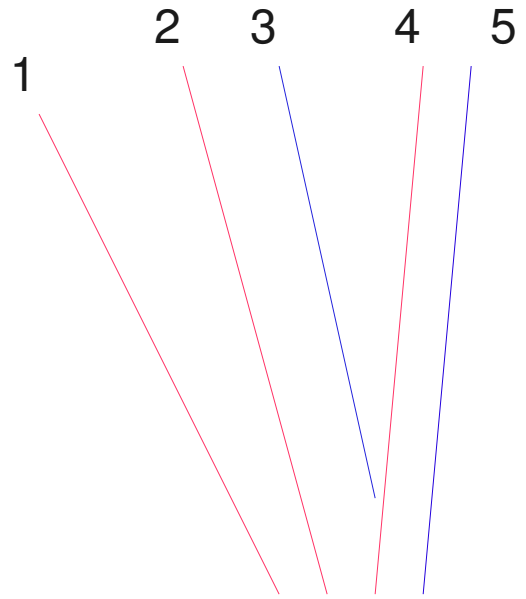
- February talk showed vertex of B° and D° was separated by ~3.5σ of detector resolution.
- → We can improve our single vertex algorithm to multiple vertex algorithm.

Tag-side Vertex



- Filtered out signal side charged tracks using mc-truth to perform vertex fit on tagside.
- Fitted with Cascade algorithm
- Fit was done with two vertex algorithm
  → Compared performance with single vertex algorithm

Two-Vertex Algorithm

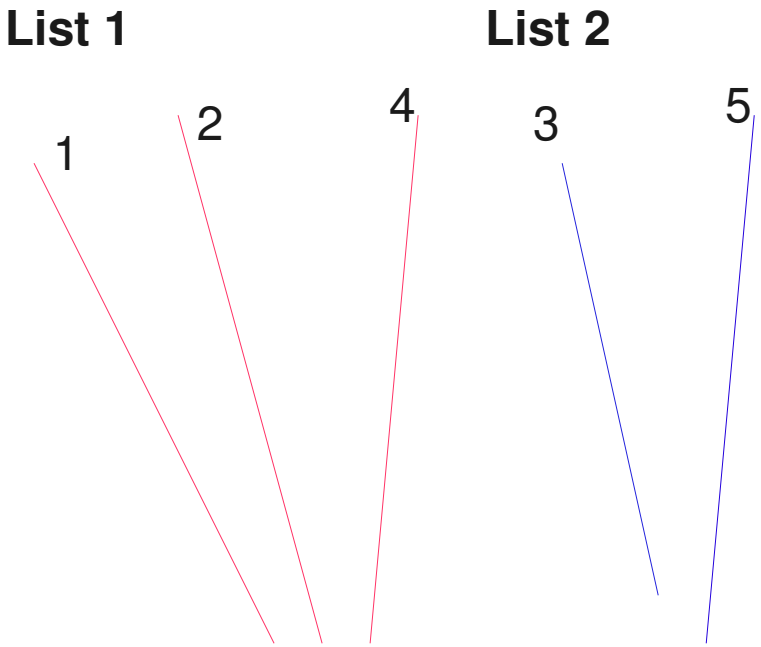


Initialization Stage

- Compute Chi-Sq Prob as 1-vertex
- Remove 1-track and recompute Chi-Sq
  - Repeat for track 1 → 5
- Find worst matching track for that iteration
  - Move it to list 2
- Repeat until no gain in probability is observed

Intermediate Stage

- If no initial sort happens, do random shuffling

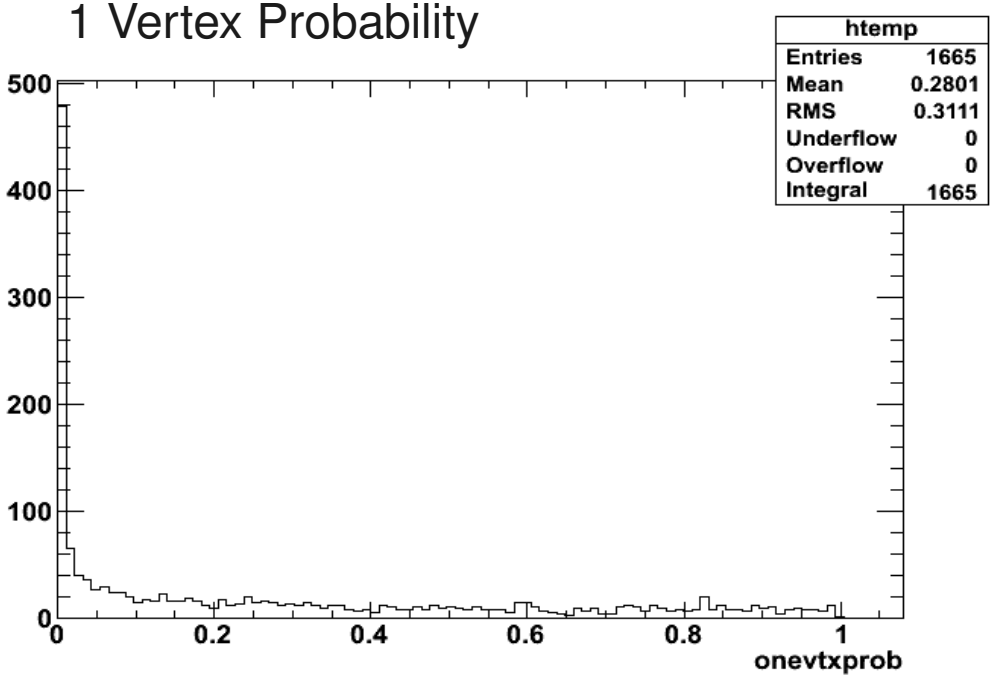


Re-Sorting Stage

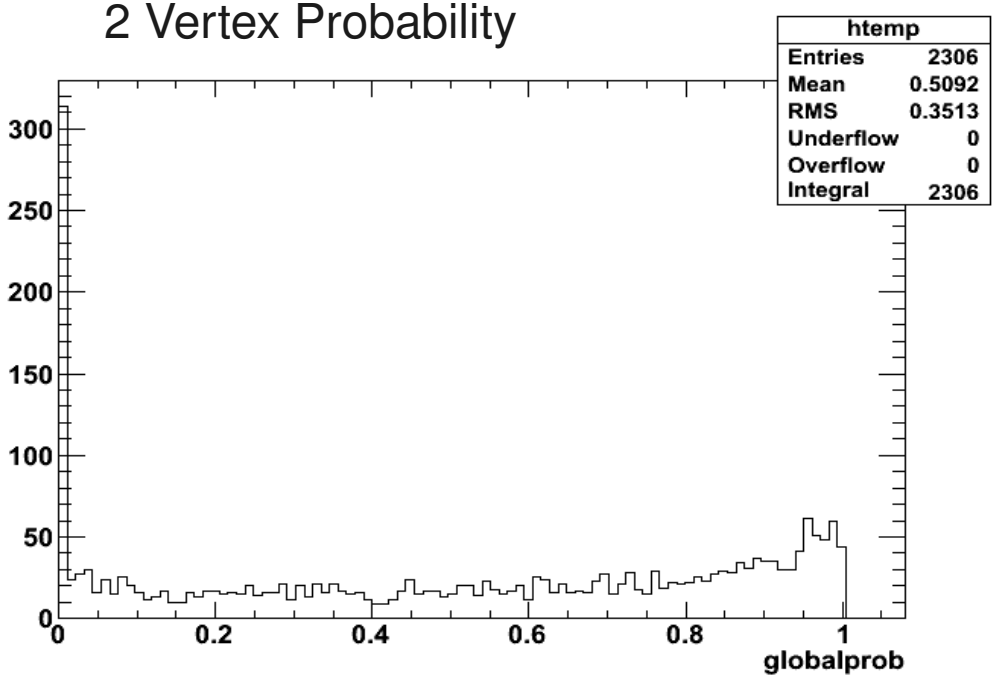
- Move vertex from one list to other
- Compute global Chi-Sq
- Find worst matching track for that iteration
  - Move it to other list
- Repeat until no gain in probability is observed
  - Or Max iteration (10x per event) is reached

Two-Vertex Algorithm

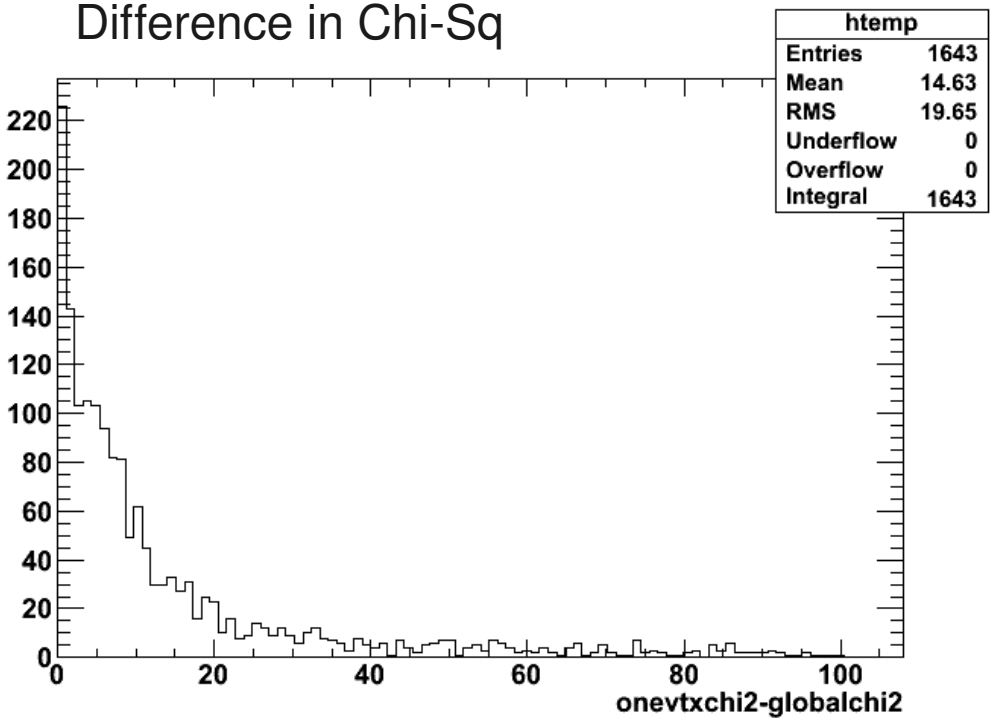
1 Vertex Probability



2 Vertex Probability



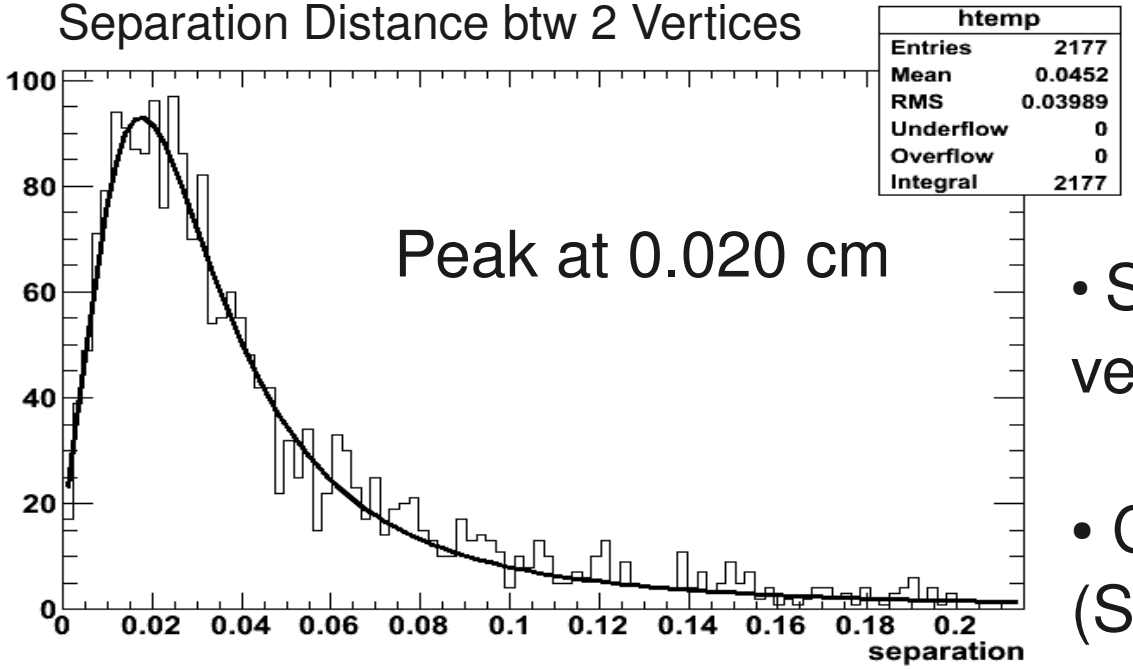
Difference in Chi-Sq



- Increase in number of successful fit
- Increase in Chi-Sq probability
- Better Chi-Sq Performance

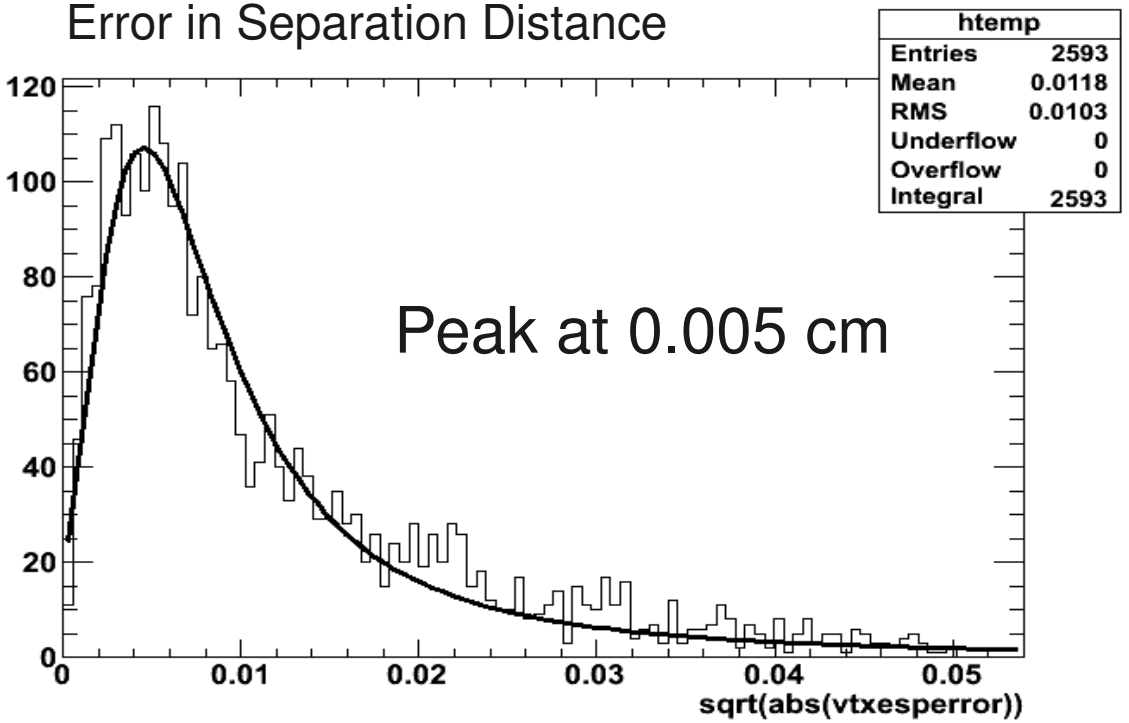
Two-Vertex Algorithm

Separation Distance btw 2 Vertices



- Separation distance between vertex is ~4σ away
- Consistent with (SimpleComp-MC) error

Error in Separation Distance



Conclusion and Plan

- Improvement on Chi-Sq probability distribution
- Separation distance between vertex is ~4σ away

- Add PacVertex Module to svn
- Improve 2-vertex → n-vertex fitting algorithm
- Faster sorting method
- Test multi-vertex algorithm against signal MC

Backup Slides

B°D° Vertex with SuperB Detector Configuration

(SimpleComp - MC)