

Charm/Bottom Separation (proof of principle)

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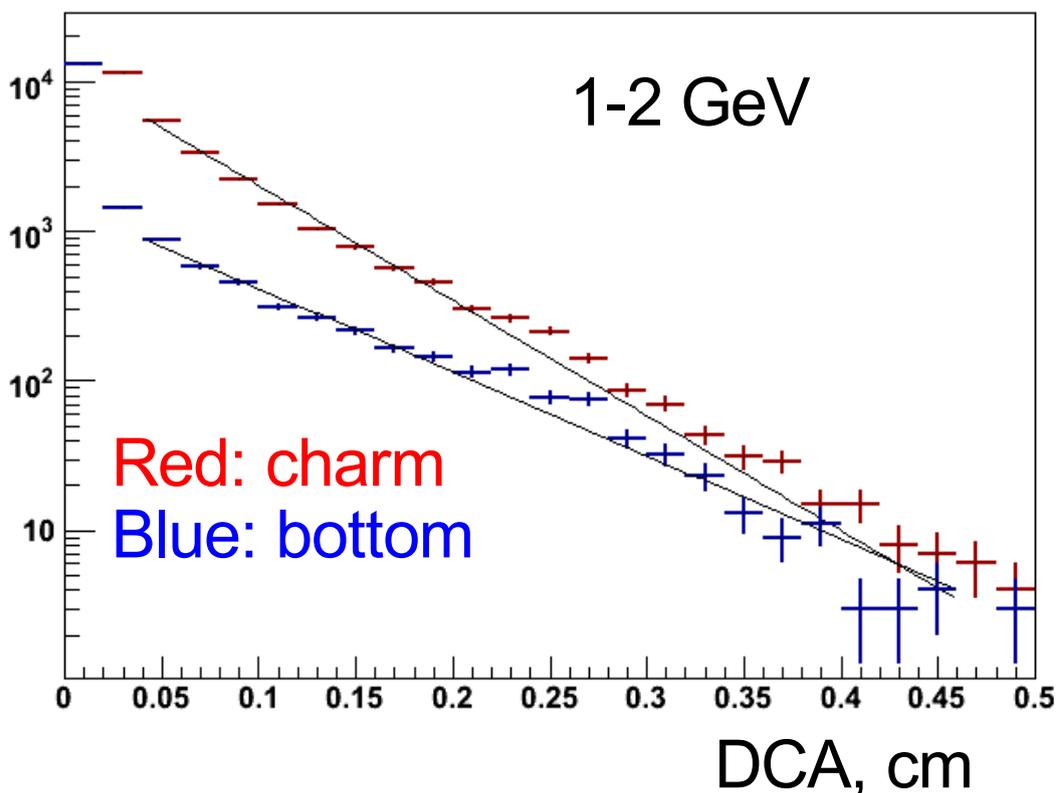
This study assumes that:

- a) we know charm and bottom pT distribution
 - b) signal electrons embedded in every event, so there is not much background
 - c) we know detector's DCA resolution.
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- Single electrons from B and D meson decays merged with PYTHIA p+p events
(PISA files and simulated DSTs are in /phenix/hl/data09/lebedev/newsim)
 - Full reconstruction, simulated DSTs produced, DCA for identified electrons from KalFit

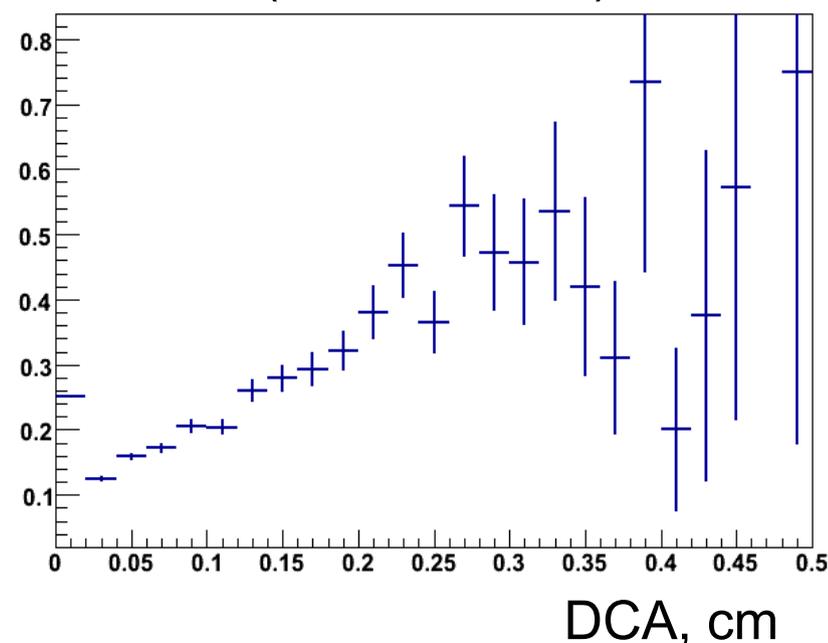
The First Step of Separation

- Get DCA distribution shapes for B and D mesons from simulation
 - Fit separate B or D meson DCA distributions with simple exponential in fixed p_T bins. Single exponent is not the best function to describe DCA distribution (as can be seen from χ^2 values on slide 4), but the simpler the function, the more stable is the fit).

Example for 1-2 GeV electron p_T bin

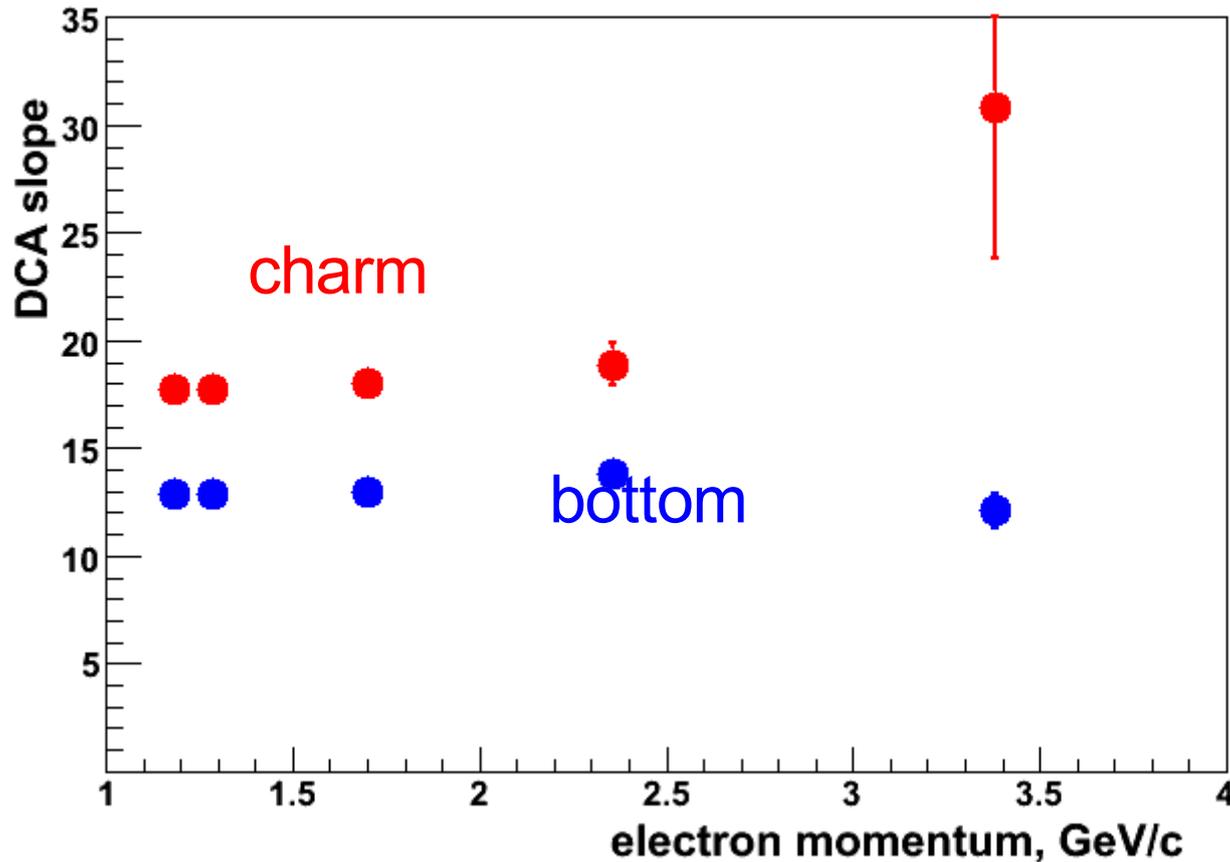


bottom/charm ratio
(blue over red)



DCA Slopes

These are the results of the exponential fits to DCA distributions from previous slide.



- Seems to be pT independent, at least at low pT
- Run out of statistics at high pT for charm, used average slope to do separation at highest pT bin

DCA Slopes Tabulated

charm

pT	slope	error	chi2/ndf
1-2	17.70	0.17	11.2
1-1.5	17.7	0.18	9.8
1.5-2	18.0	0.42	2.2
2-3	18.9	0.96	2.2
3-4	30.8	7.0	2.4

bottom

pT	slope	error	chi2/ndf
1-2	12.9	0.23	3.6
1-1.5	12.9	0.30	2.5
1.5-2	13.0	0.36	1.9
2-3	13.8	0.38	2.8
3-4	12.1	0.81	1.2

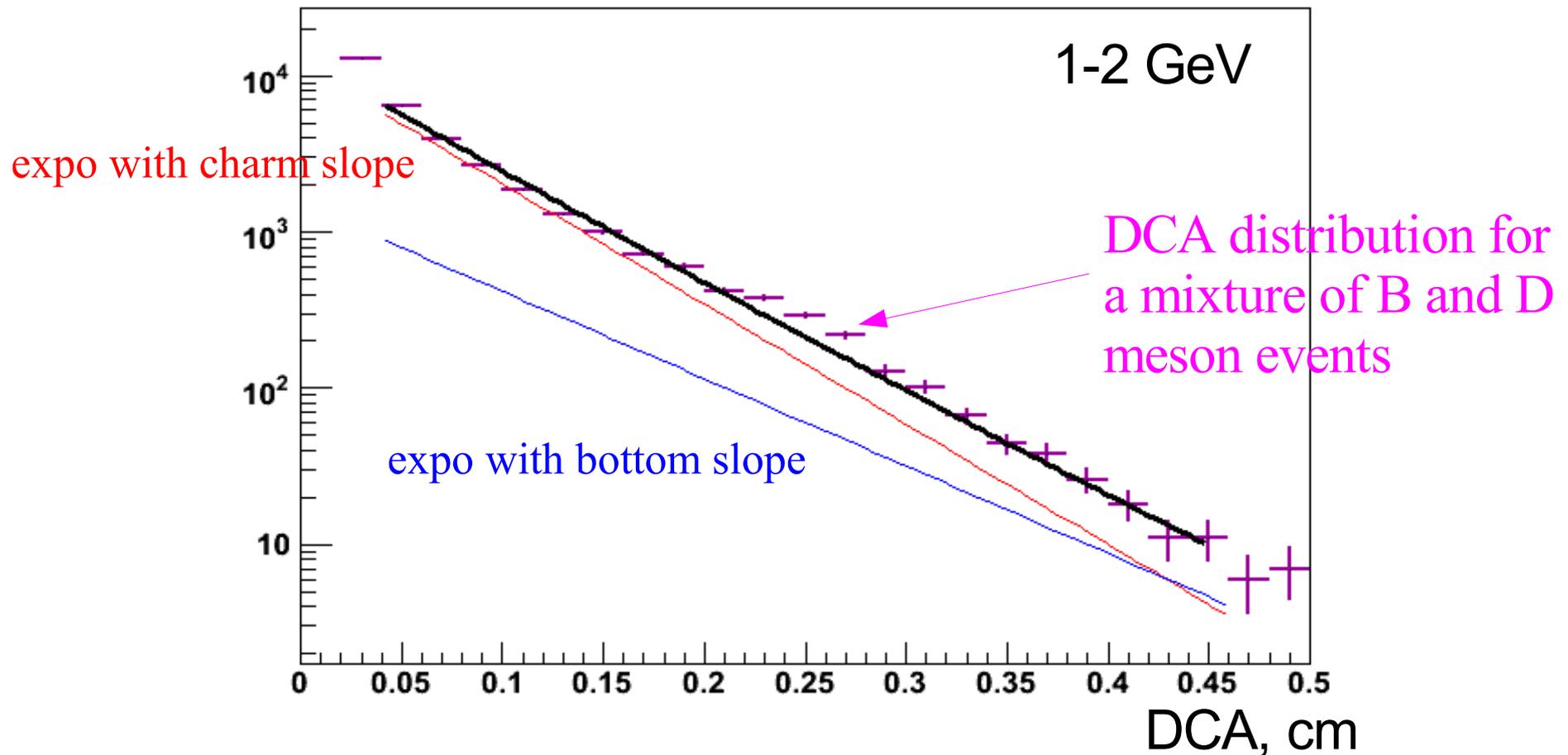
- Bottom distribution is better described by exponential, maybe because charm has two components?
- chi2/ndf for combined (B+D) fit is close to charm results

The Second (Final) Step of Separation

Combine events with B and D mesons together, make DCA distribution for the mixture, and fit it with a sum of two exponents:

$$[0]*\text{exponent_charm} + [1]*\text{exponent_bottom}$$

$[0]/[1]$ = the charm/bottom ratio in a given p_T bin

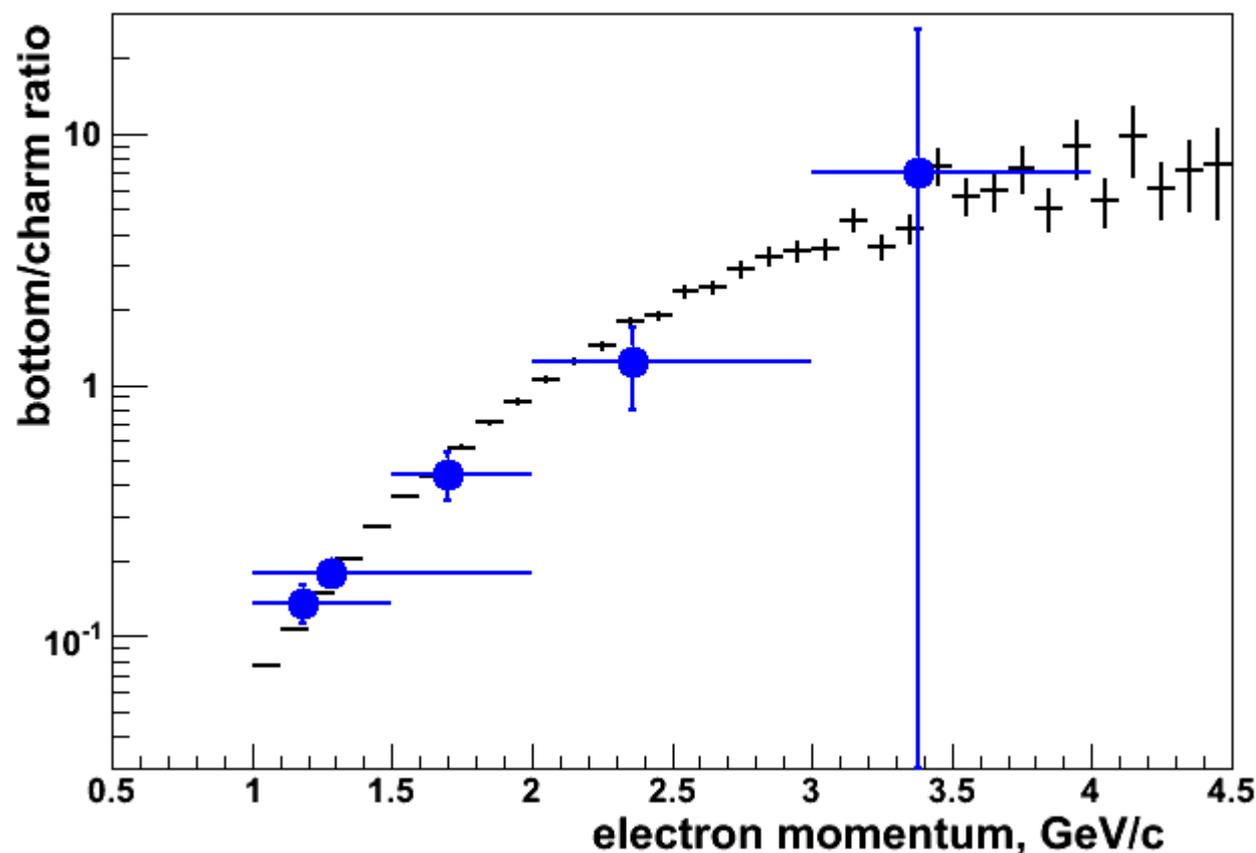


The Result

The procedure described above is done for each electron pT bin, and the results are shown below.

Black: true bottom/charm ratio (from fkin table)

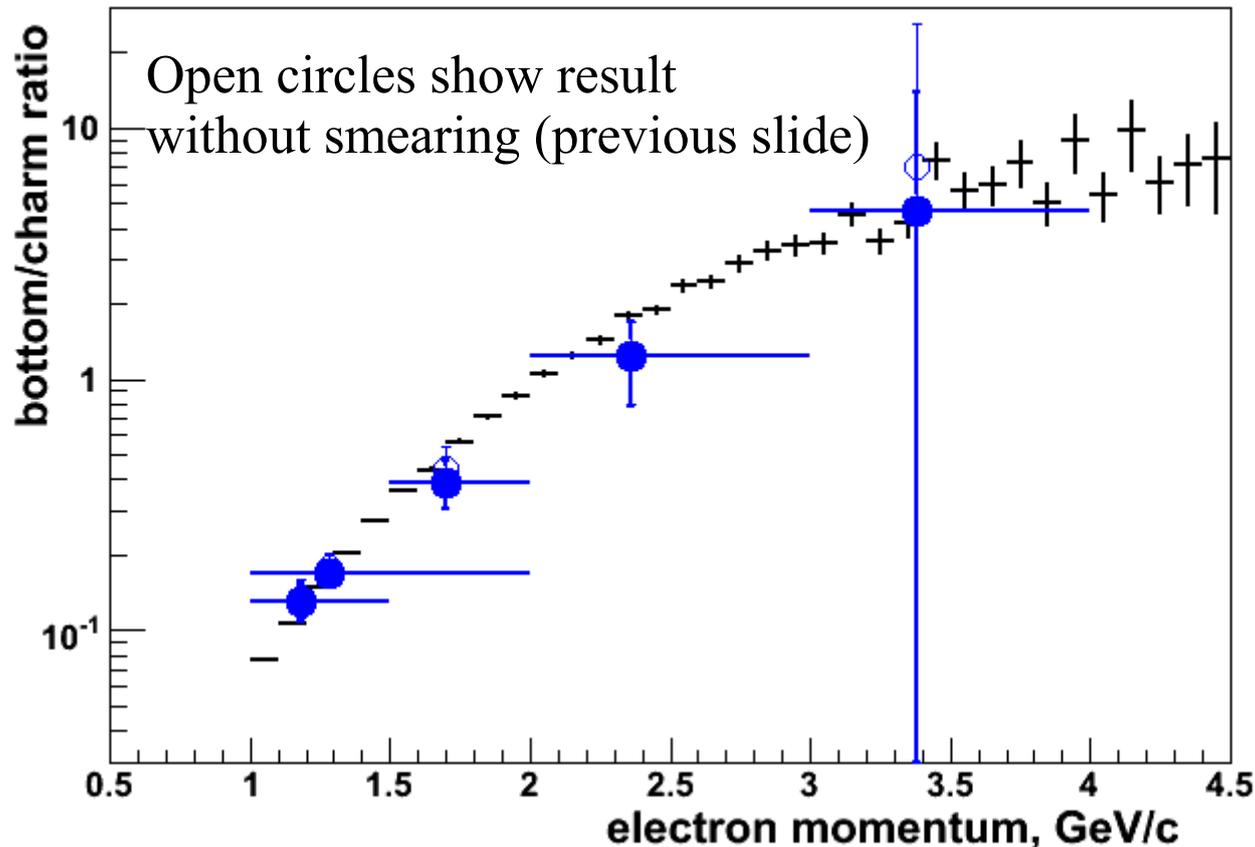
Blue: reconstructed bottom/charm ratio



Horizontal bars show pT range, points are at mean pT.

What if simulation predicts wrong DCA?

Smear DCA for the mixed B+D meson sample by $40\mu\text{m}$, but for use fits to un-smearred DCA distribution (values from slide 4).
(effectively assume that simulation predicts better DCA resolution than reality, e.g. some misalignments exist.)



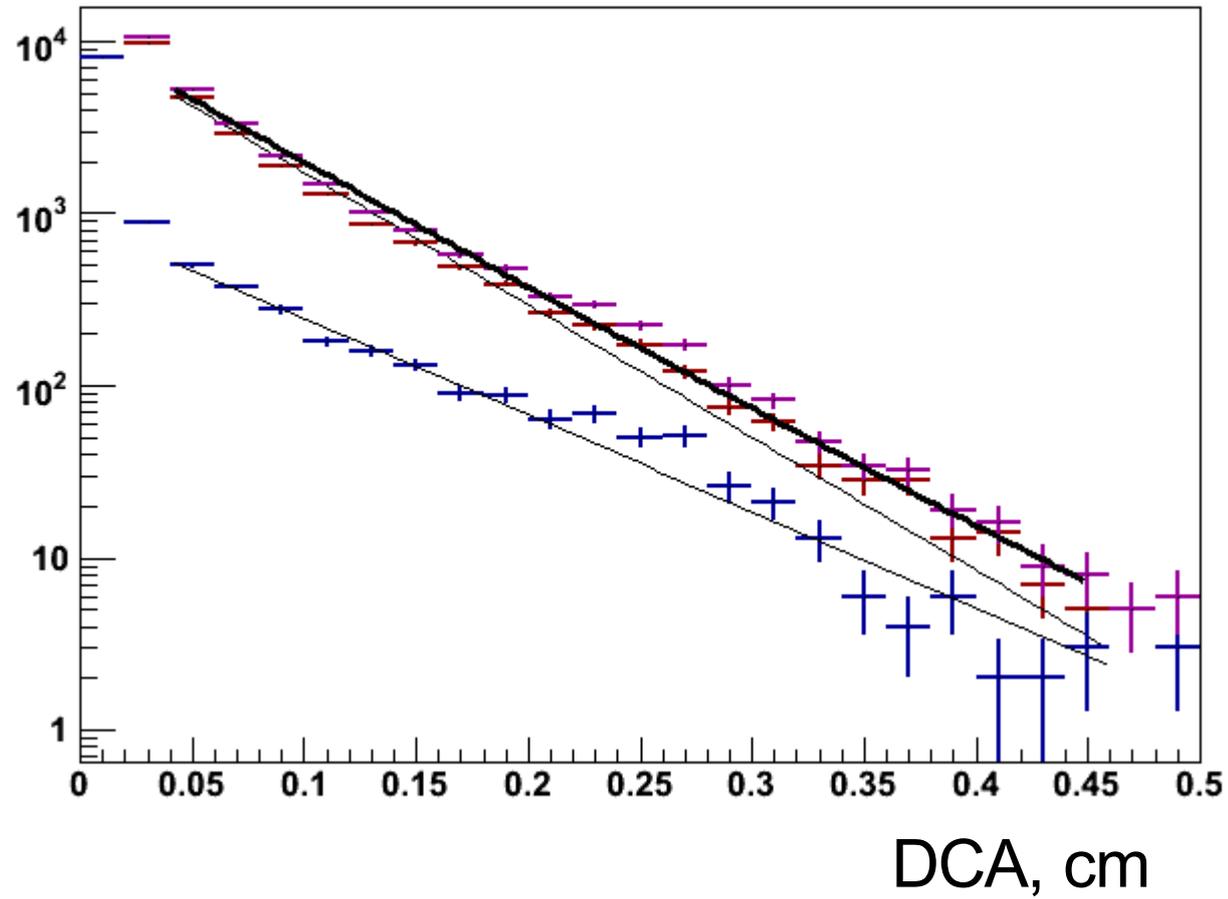
charm/bottom separation is not affected by 40mm additional smearing!

Plans for the Future

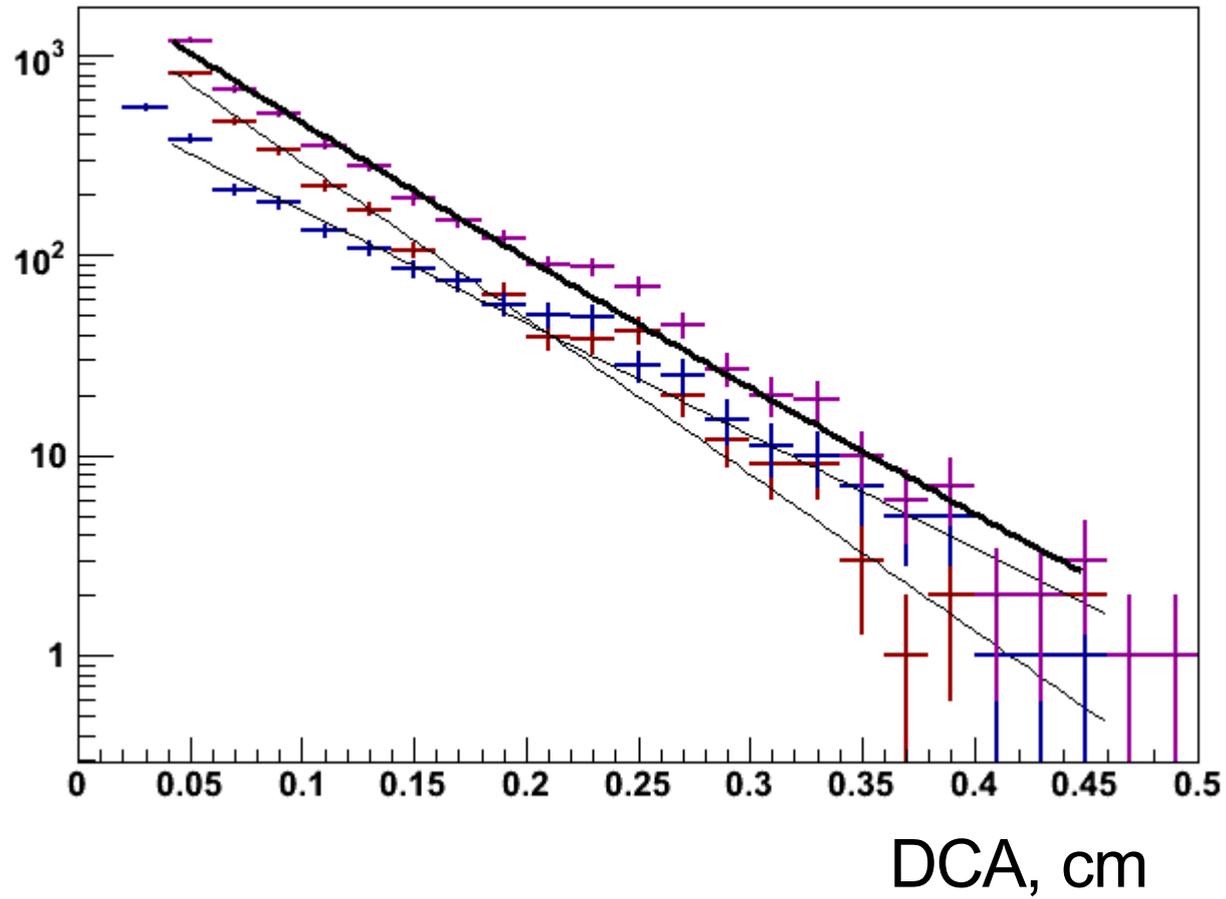
- Generate samples with different pT distributions (e.g. change `ckin(3)` PYTHIA parameter to generate steeper pT distributions) and check how DCA distributions depend on pT
- Do the same study with Hijing Au+Au events
- Try blind analysis

Backup Slides

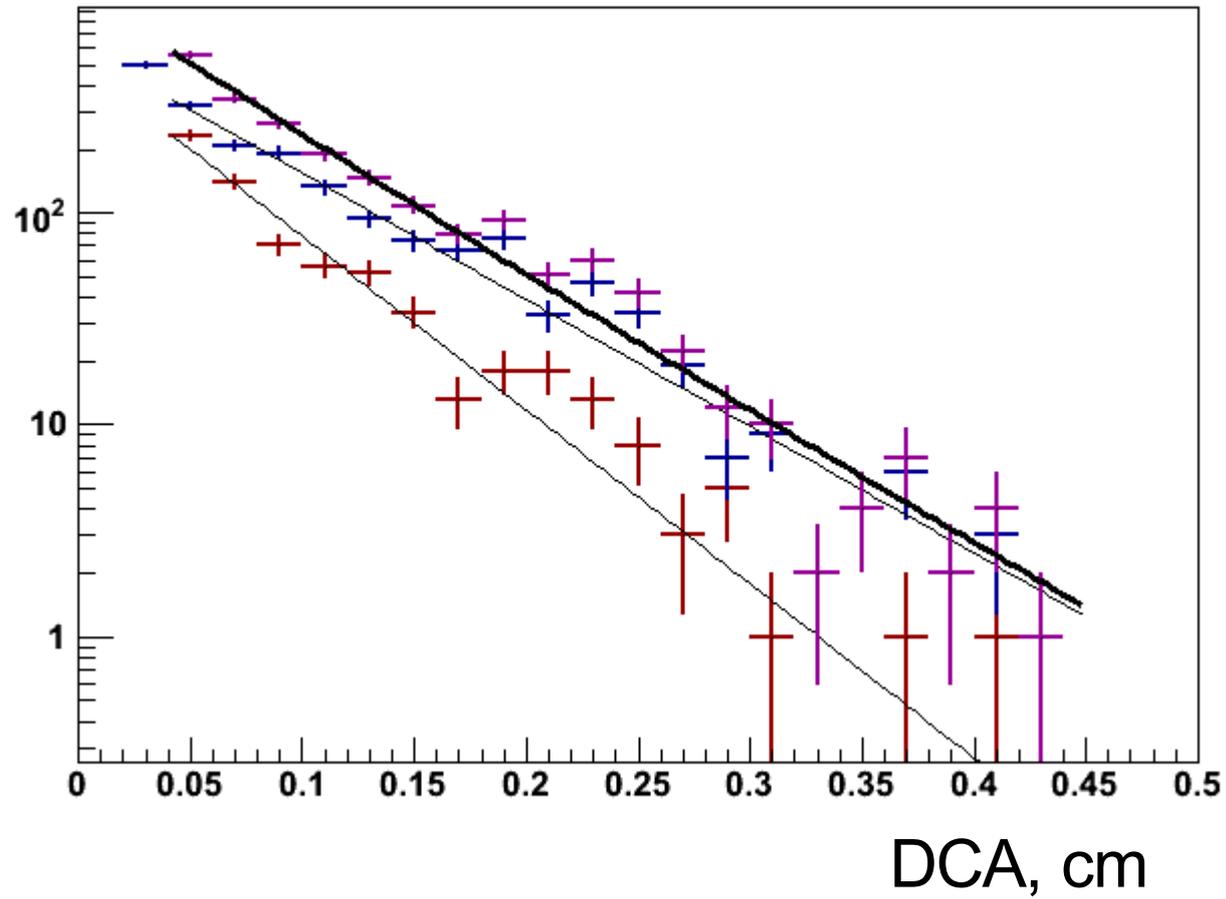
1.0 - 1.5 GeV



1.5 - 2.0 GeV



2.0 - 3.0 GeV



3.0 - 4.0 GeV

