$D^0 \rightarrow K\pi$ and $\Lambda_c \rightarrow pK\pi$

as benchmark channels

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Contents

- Analysis strategy & MC methods
- D^0 results for pp and PbPb
- Λ_c results
- Issues and outlook

Analysis strategy

- Tracks are reconstructed from RAW data
  - „RAW to ESD”

- Decays are reconstructed from tracks
  - „ESD to AOD/delta AOD”

production cuts

- Decays are analysed
  - „AOD to mass plot”

analysis cuts

MC strategy

- Full MC requires for each considered detector geometry:
  - Lots of CPU time (detector response plus all three steps from RAW data to mass plot)
  - Lots of programming (e.g. different tracking algorithms for different layouts)
- Favour lightweight MC techniques:
  - Only repeat the D/Lambda candidate selection with the tracking resolution achievable with the upgrade

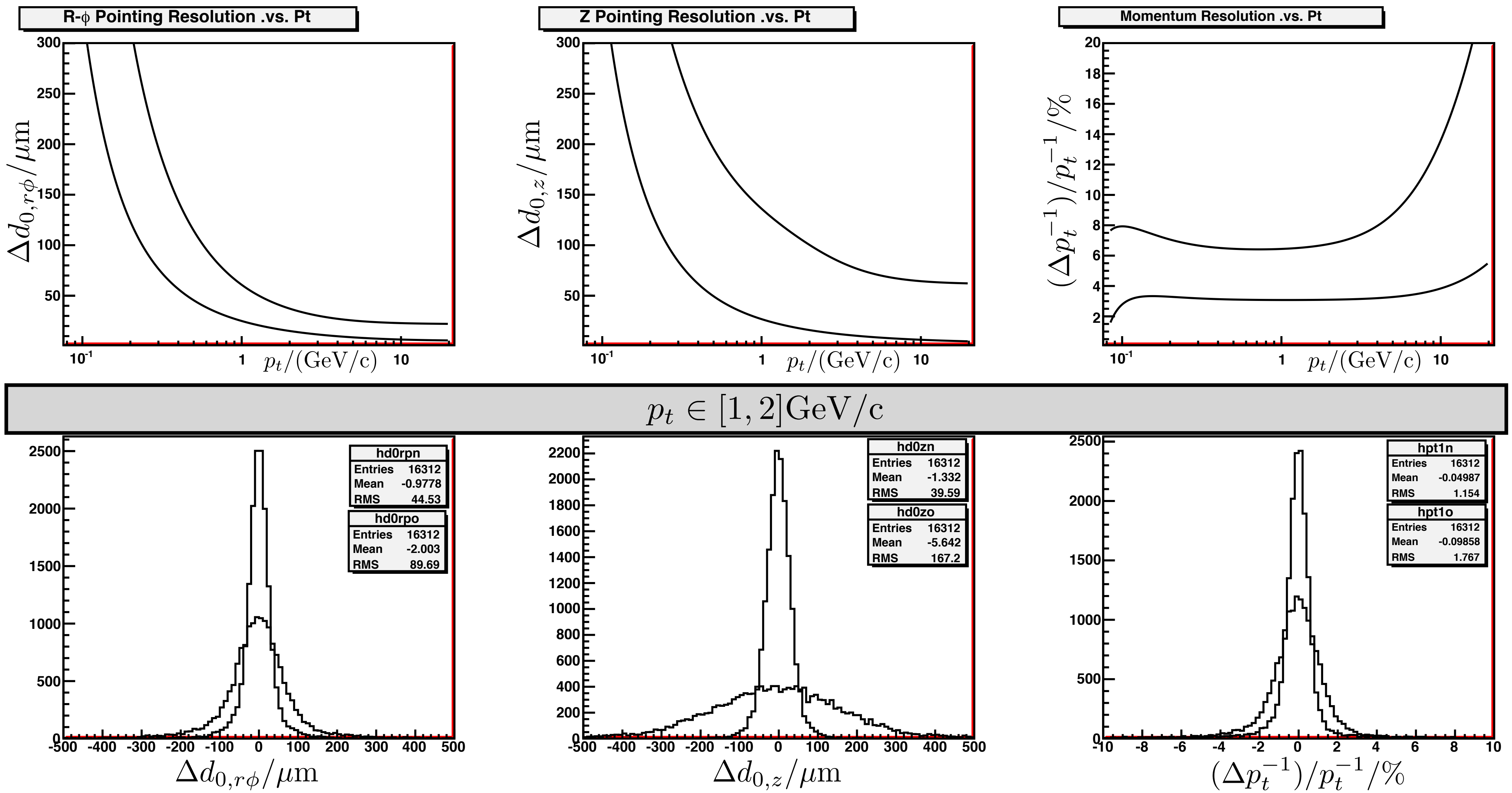
long term

short term

Hybrid MC methods

- „Hybrid approach":
  - Use existing MC productions, including the detector response (of the „old" ITS)
  - Smear the tracks by reducing the difference to MC by the fraction of resolutions
  - Recalculate the decay properties
- „MC smearing":
  - Similar to hybrid, but based on the pure MC info (no fractions, but gaussian smearing)
  - Even faster than „hybrid": no detector response sim. needed

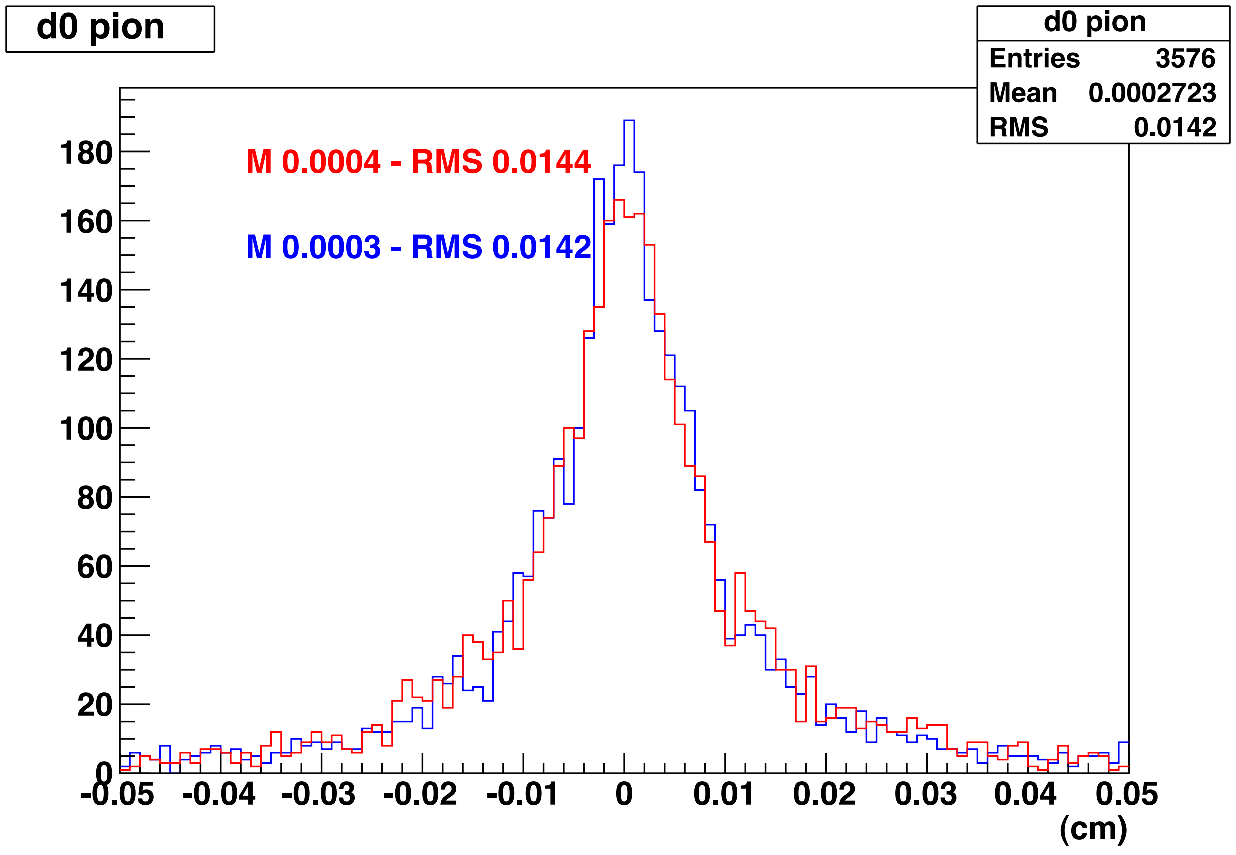
Inputs

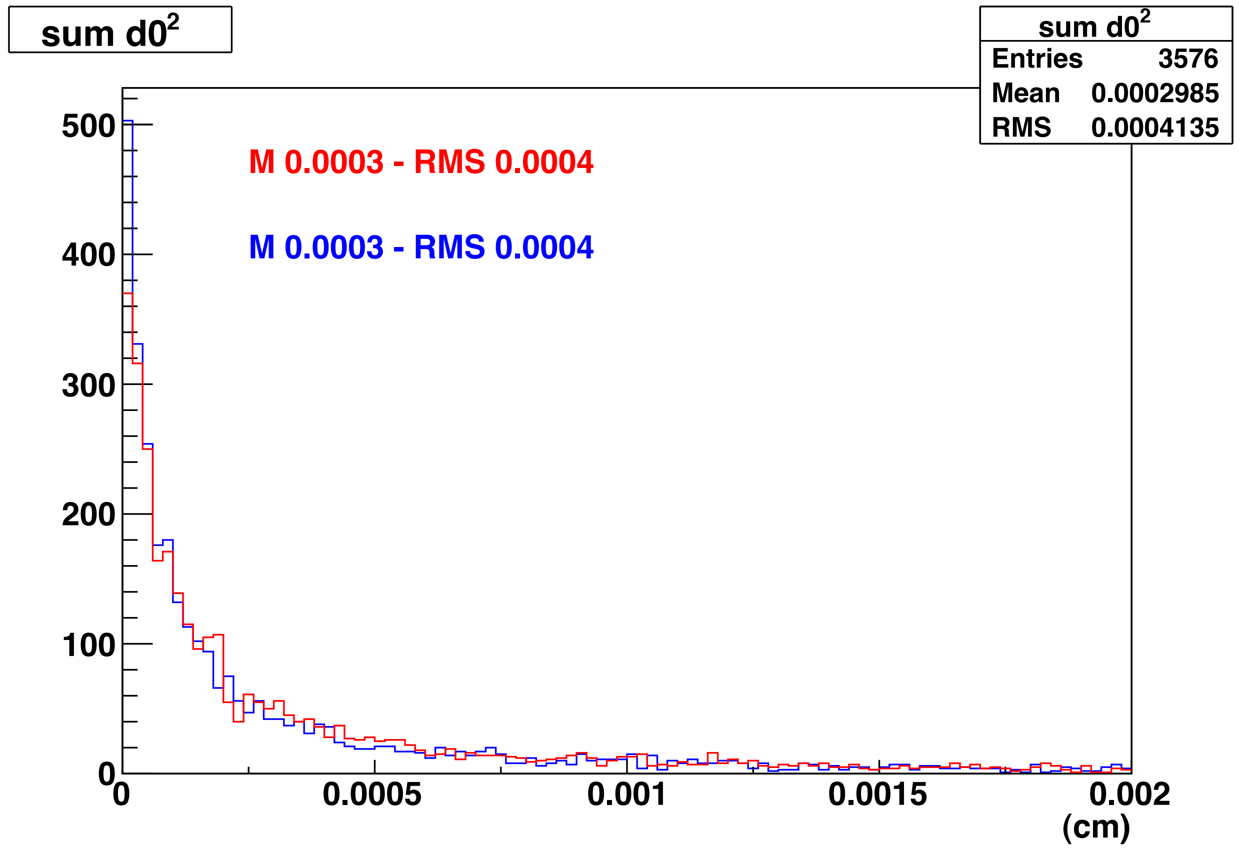


Details and updates will follow in the next talk.

Hybrid MC methods

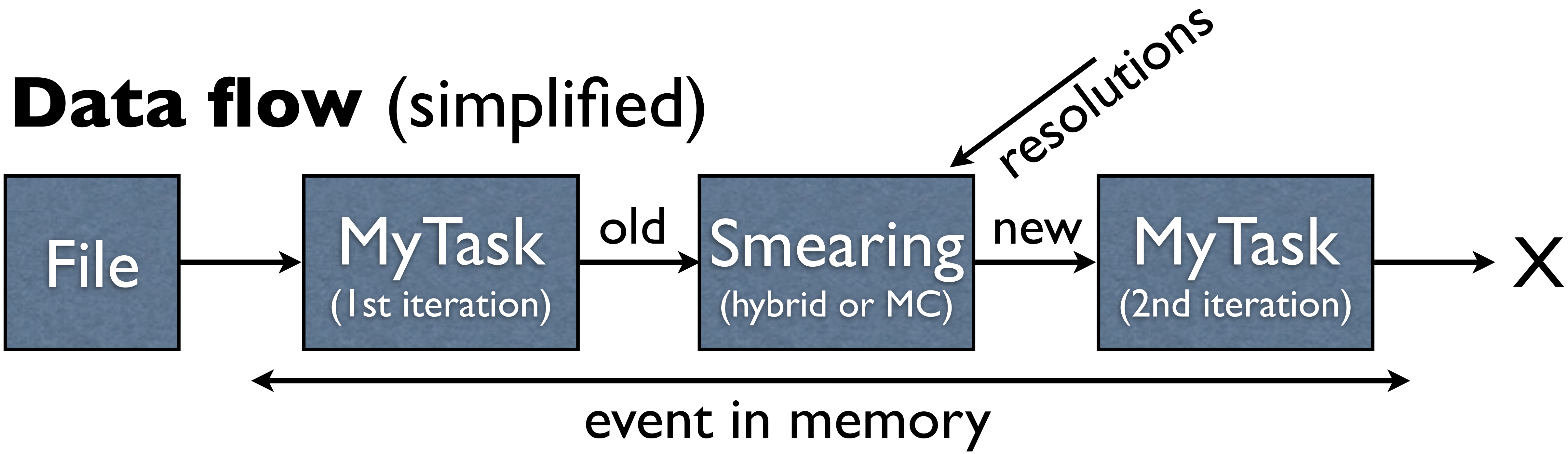
- Comparison between:
  - „Hybrid approach":
  - „MC smearing":





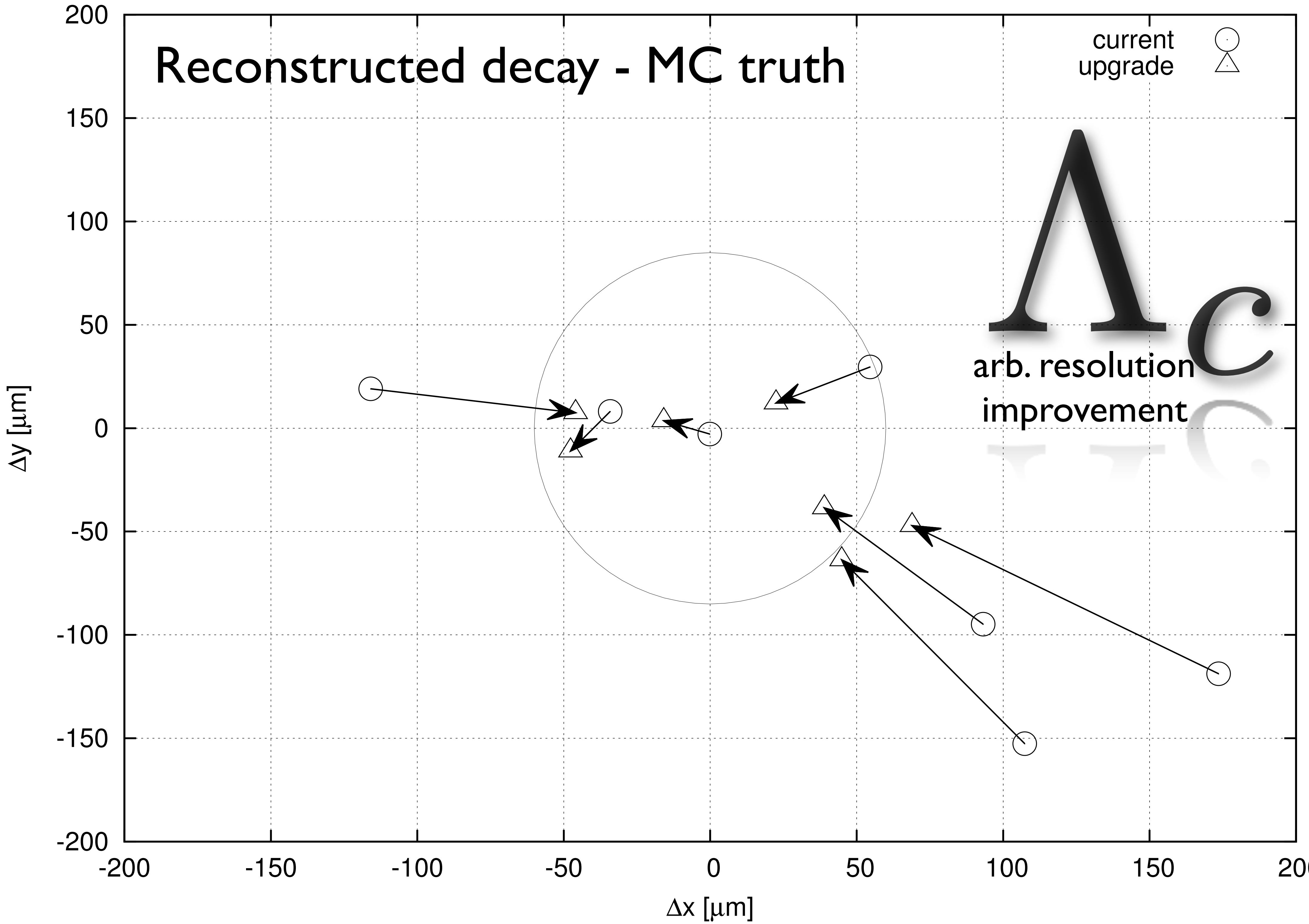
Implementation

Data flow (simplified)



- "Tender" for analysis:
  - Allows using of any analysis task to look at the impact of an upgrade
  - Very clean separation of code

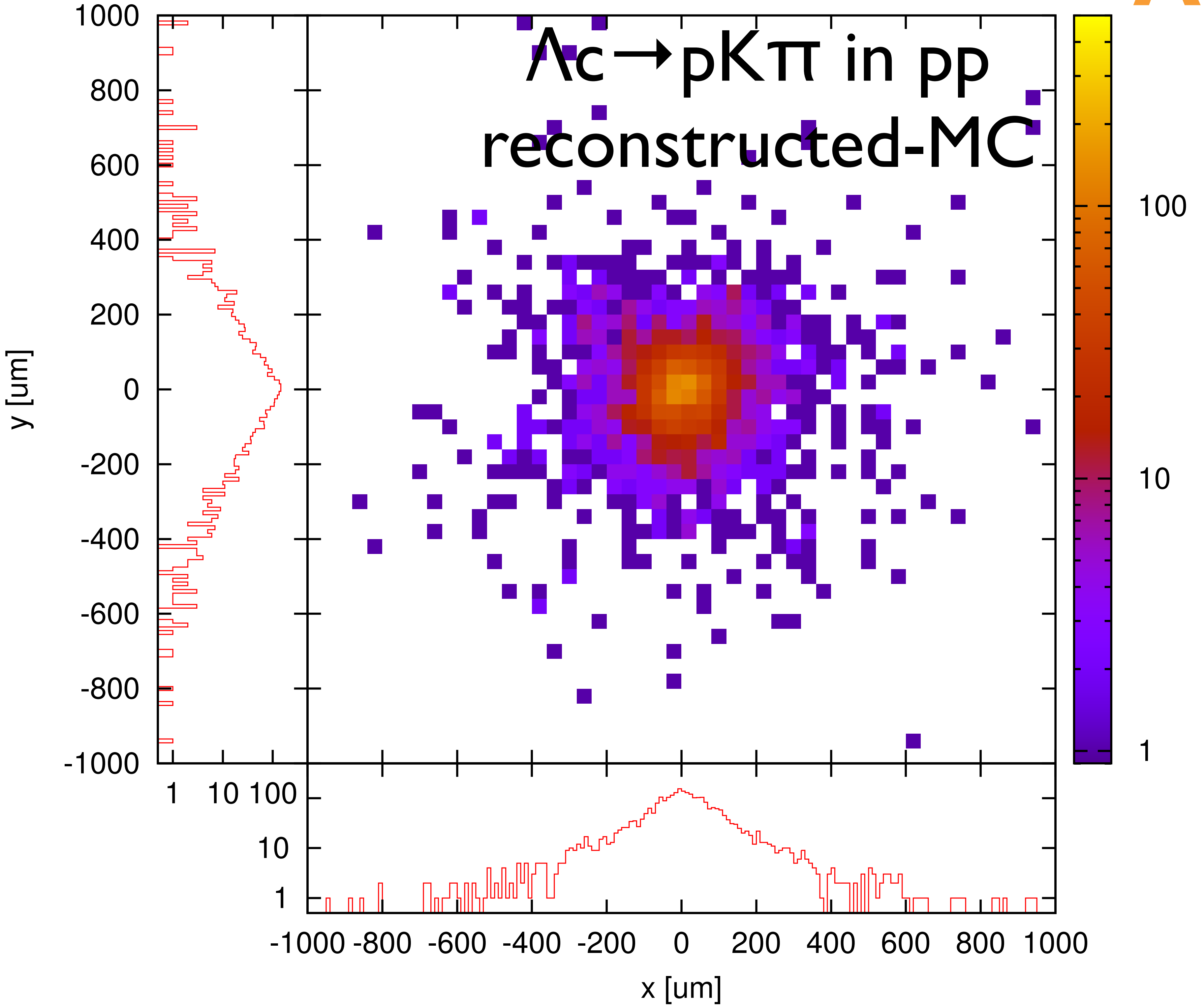
Proof-of-principle



Proof-of-principle II

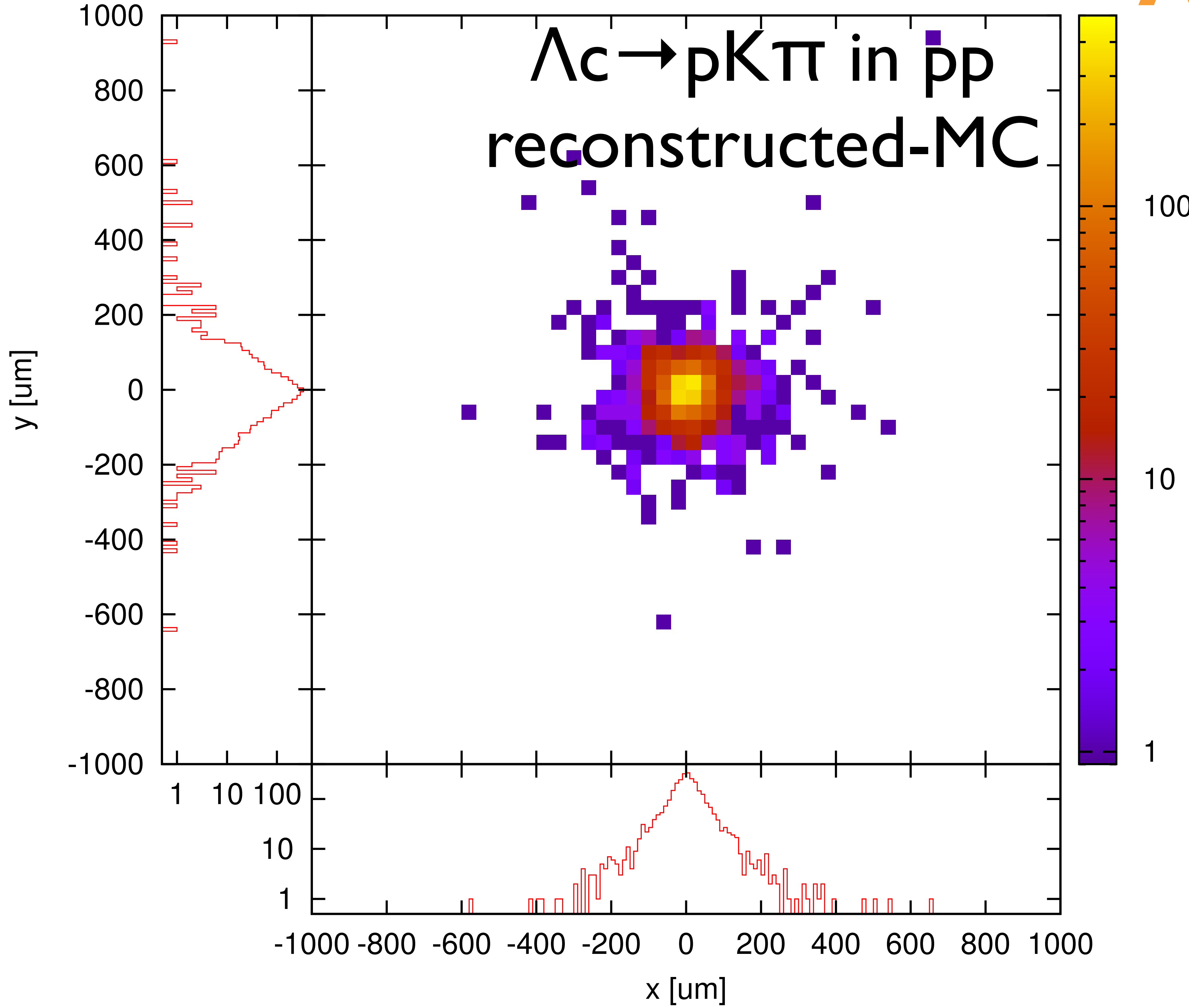
current

ITS



Proof-of-principle II

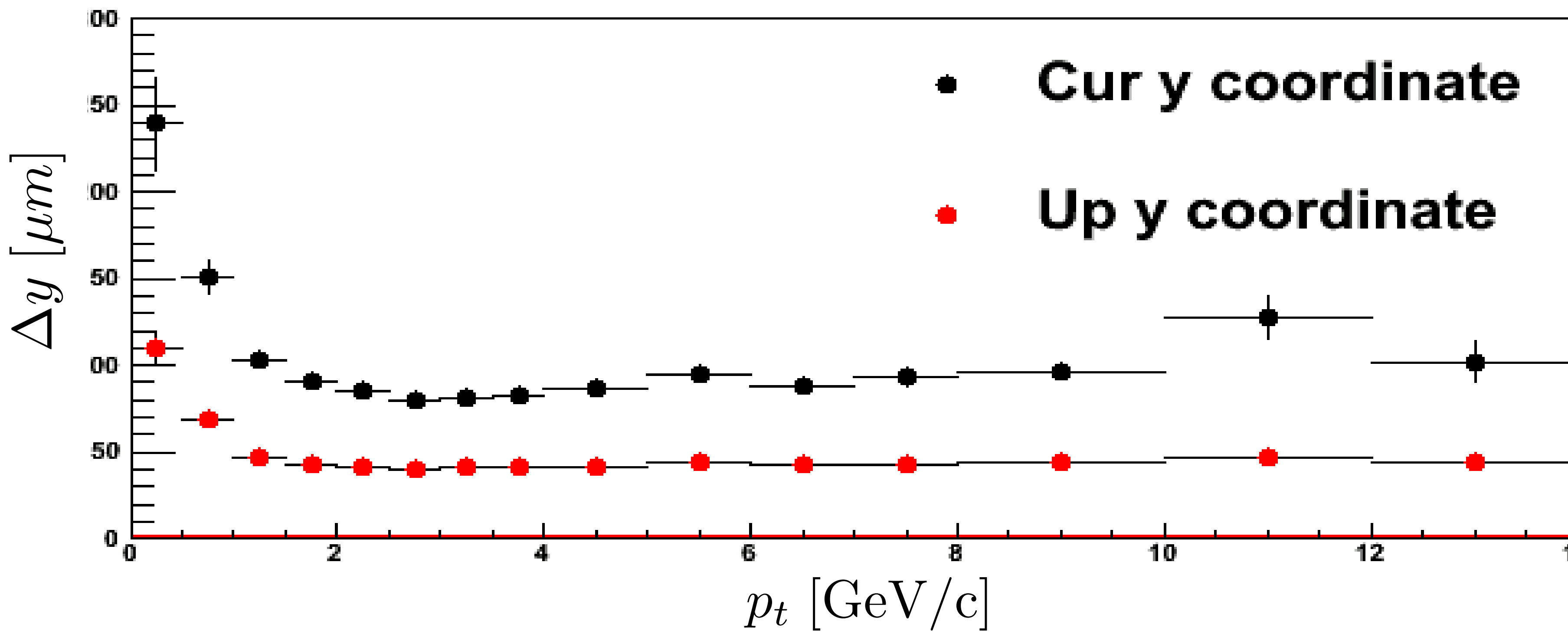
new
ITS
(7 new layers)
(using correct particle species dependent resolutions)

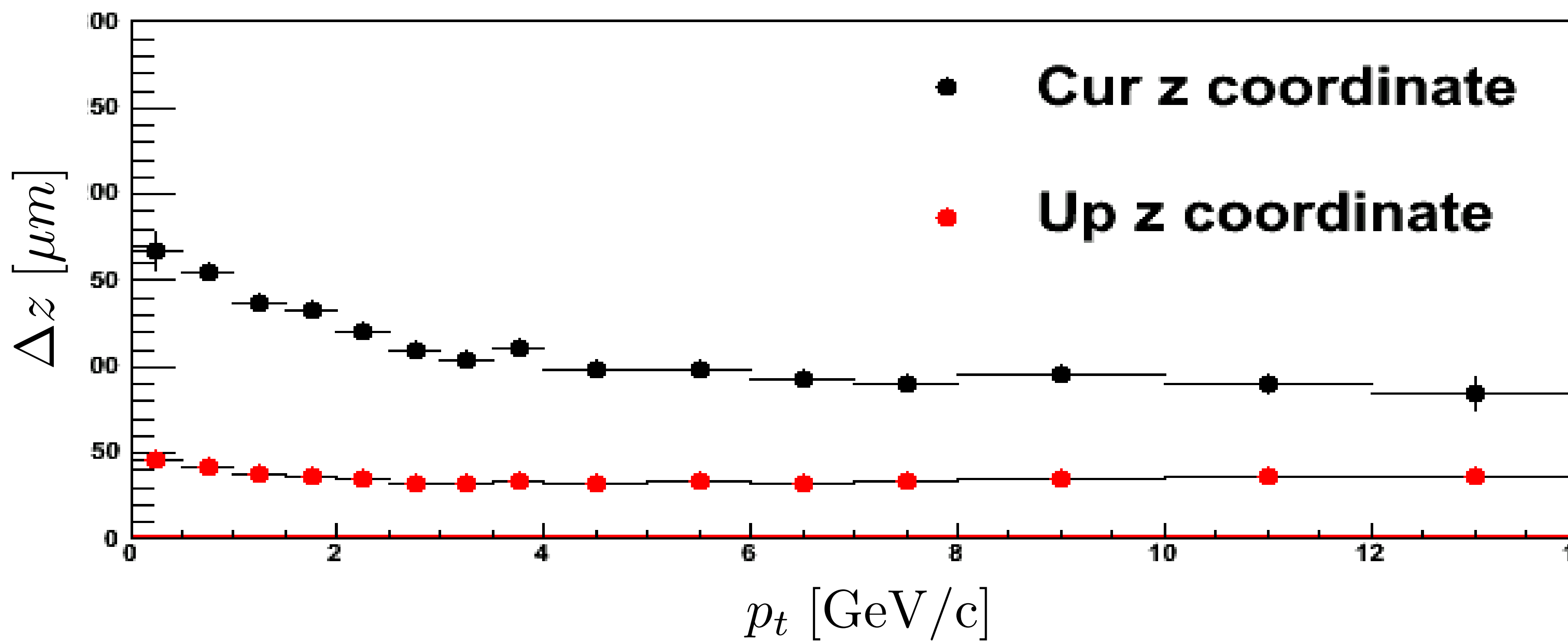


The D^0 case

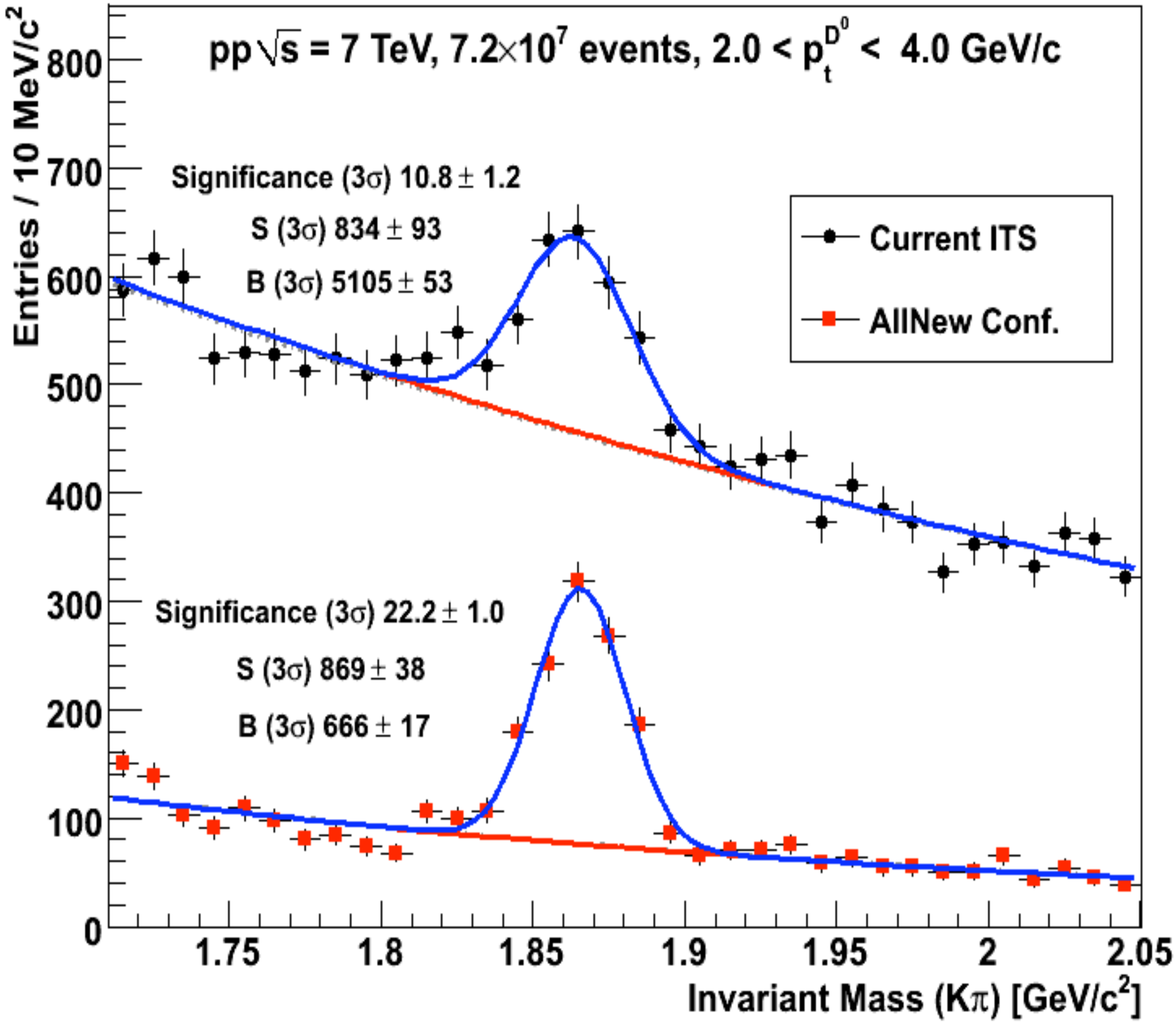
- Already visible with the current ITS (both in pp and PbPb)
- Good candidate to study the improvement of significance
- Access beauty production via identification of secondary D^0 from B decay
- Measure D^0 production down to p_t=0 in pp and PbPb

Sec. vertex res. (pp)

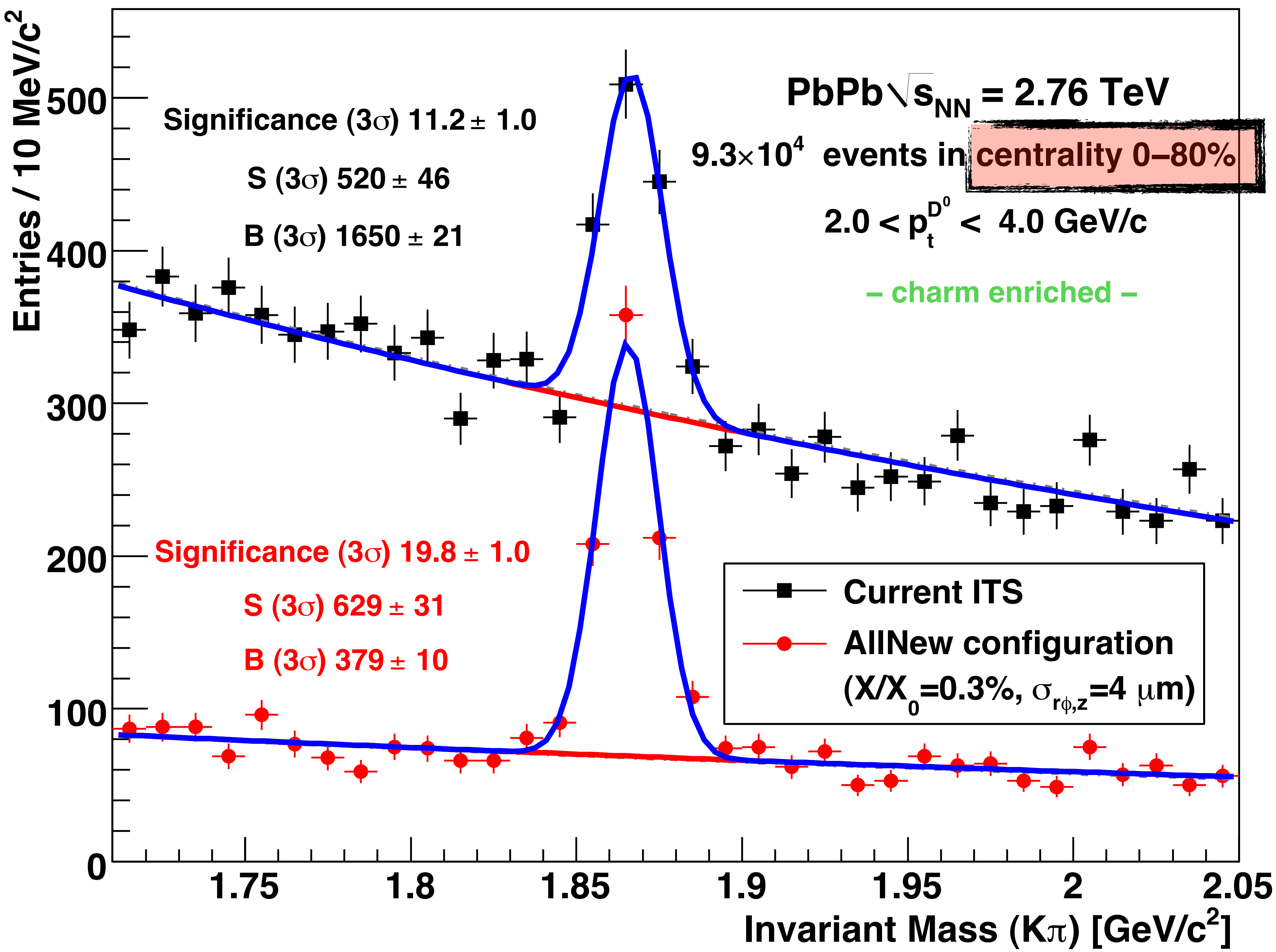




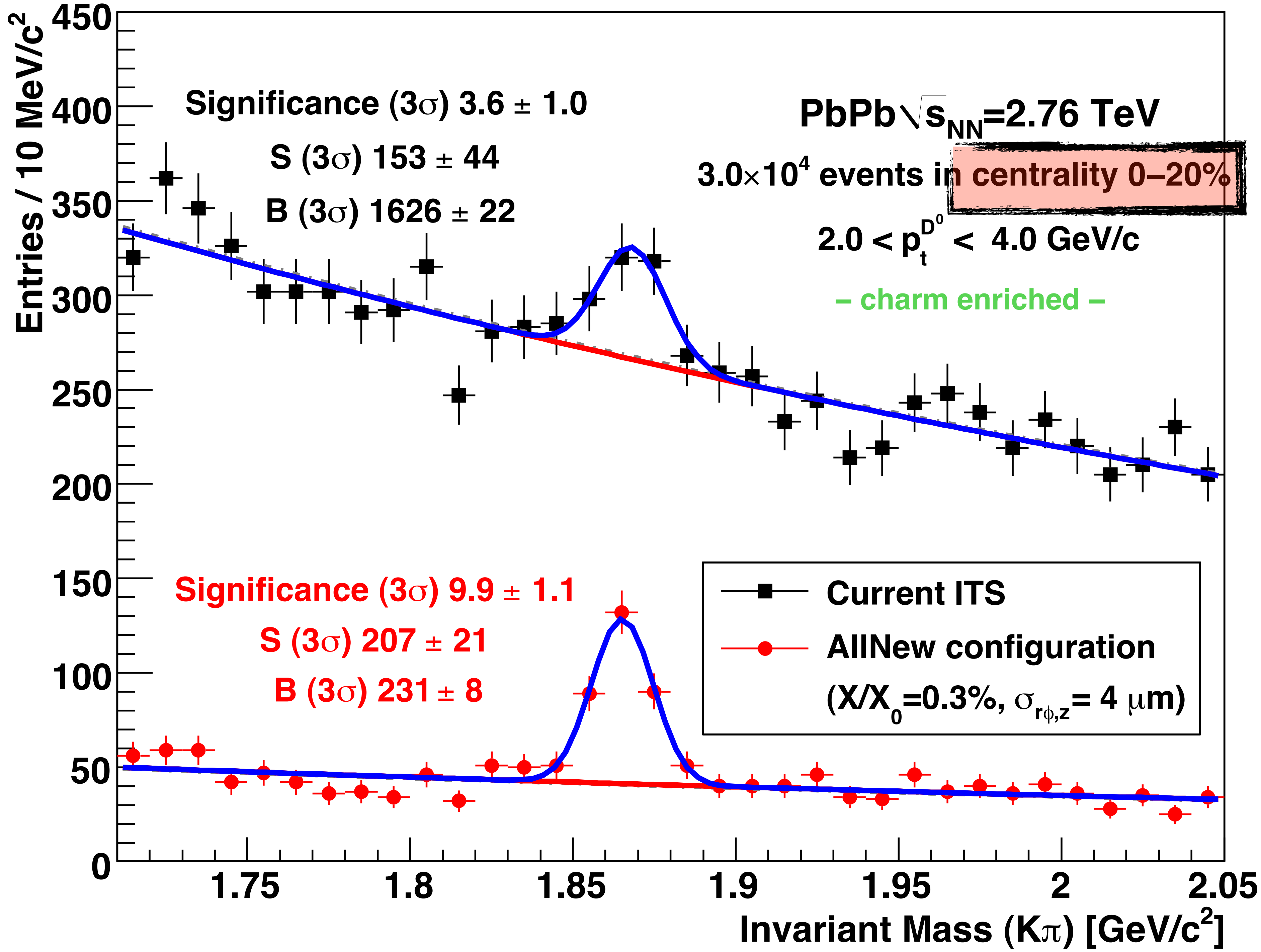
Results D^0 in pp



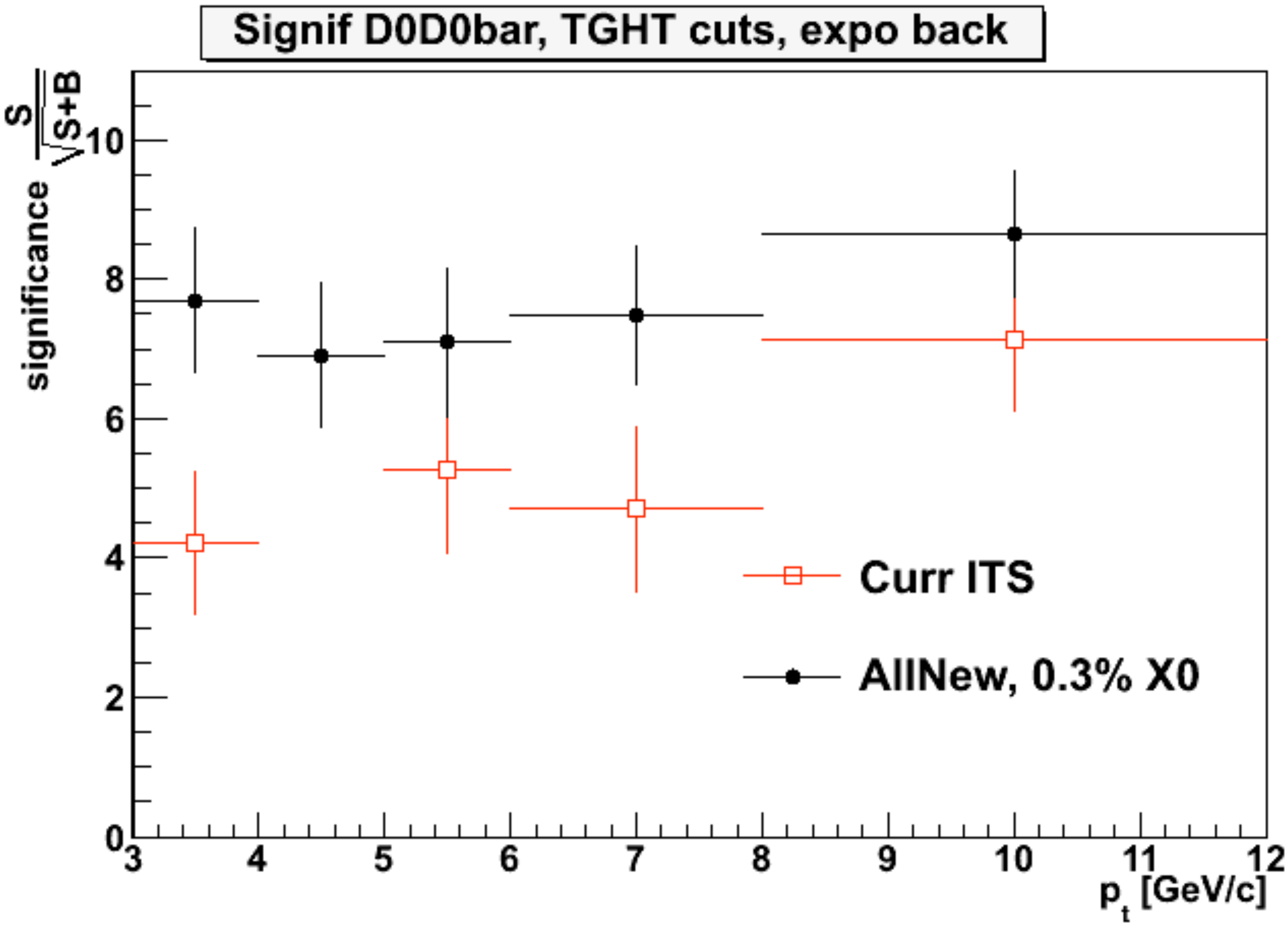
Results D^0 in PbPb



Results D^0 in PbPb

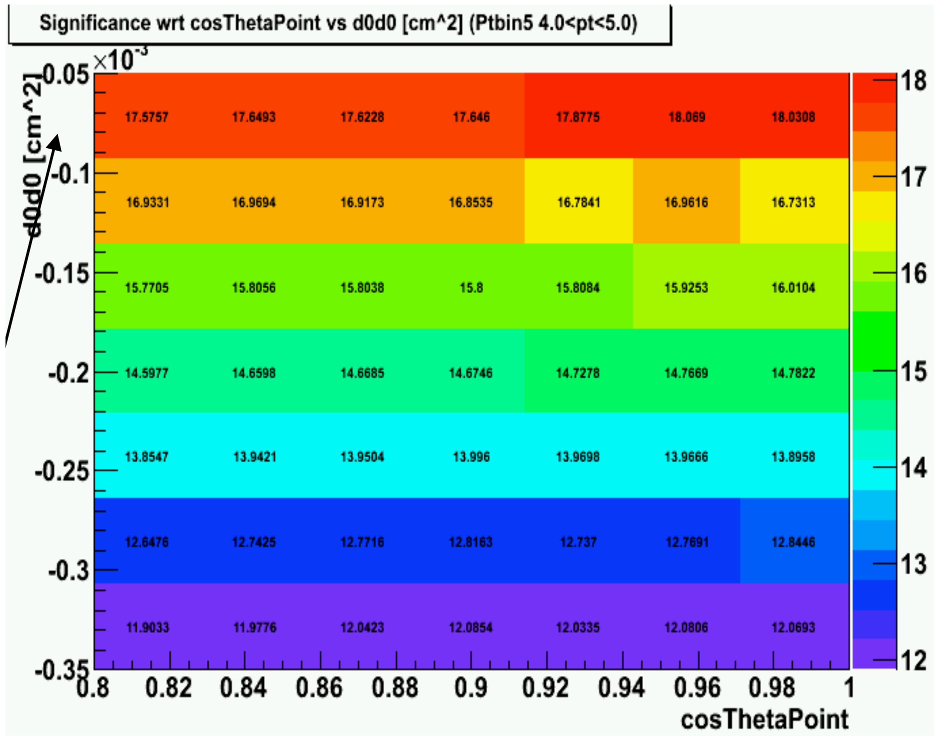


D^0 summary PbPb



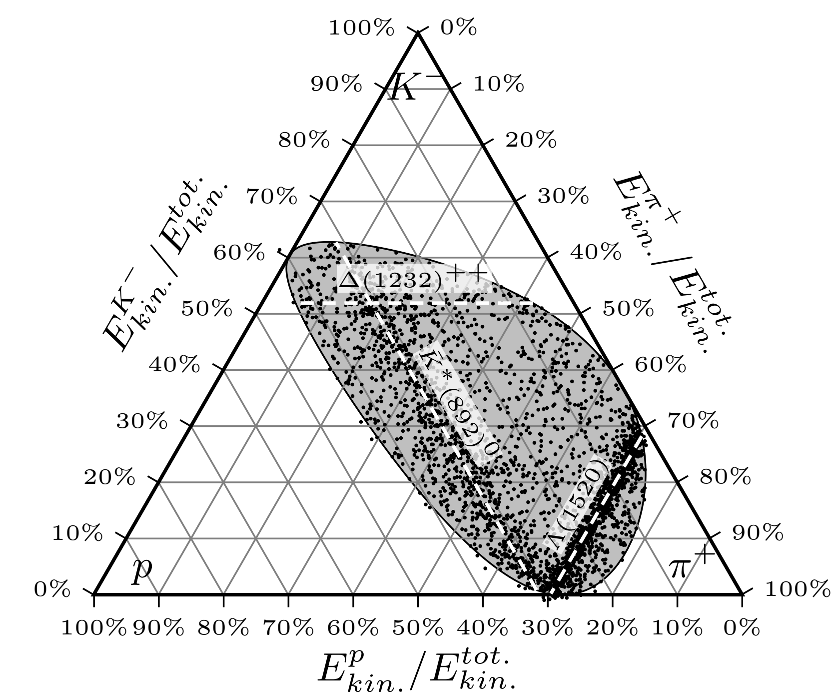
D^0 TODOs

- Re-calibrate the D0 meson analysis selection:
  - Retune current cut values
  - Introduce cuts on variables only accessible with an upgraded ITS (e.g. on z)
- Loosen production cuts for lower momentum bins



The Λ_c case

- Strong motivation for an upgrade:
  - Very poor signal in pp
  - Currently inaccessible in PbPb (never seen there before)
- Difficult due to its short decay length (59.9 μm)



Expected Λ_c-yields

Table 6.56. Total yield, average rapidity density for $|y| < 1$, and relative abundance, for hadrons with charm and beauty in pp collisions at $\sqrt{s} = 14$ TeV.

Particle	Yield	$\langle dN/dy \rangle_{\|y_{lab}\|<1}$	Rel. Abund.	Particle	Yield	$\langle dN/dy \rangle_{\|y_{lab}\|<1}$	Rel. Abund.
$D^0 + \overline{D}^0$	0.1908	0.0196	61%	$B^0 + \overline{B}^0$	0.00577	0.00084	40%
$D^+ + D^-$	0.0587	0.0058	19%	$B^+ + B^-$	0.00576	0.00083	40%
$D_s^+ + D_s^-$	0.0362	0.0038	12%	$B_s^0 + \overline{B}_s^0$	0.00168	0.00025	6%
$\Lambda_c^+ + \overline{\Lambda_c^-}$	0.0223	0.0026	8%	$\Lambda_b^0 + \overline{\Lambda_b}^0$	0.00106	0.00016	4%

... total yield, average rapidity density for $|y| < 1$, and relative abundance, for hadrons with charm and beauty in Pb–Pb collisions at $\sqrt{s_{NN}} = 5.5$ TeV. The values reported correspond to a centrality selection of 5% σ^{inel}.

Particle	Yield	$\langle dN/dy \rangle_{\|y_{lab}\|<1}$	Rel. Abund.	Particle	Yield	$\langle dN/dy \rangle_{\|y_{lab}\|<1}$	Rel. Abund.
$D^0 + \overline{D}^0$	140.8	13.7	61%	$B^0 + \overline{B}^0$	3.65	0.535	40%
$D^+ + D^-$	44.6	4.12	19%	$B^+ + B^-$	3.65	0.521	40%
$D_s^+ + D_s^-$	26.8	2.52	12%	$B_s^0 + \overline{B}_s^0$	1.06	0.159	6%
$\Lambda_c^+ + \overline{\Lambda_c}^-$	17.9	2.03	8%	$\Lambda_b^0 + \overline{\Lambda_b}^0$	0.67	0.097	4%

ALICE PPR

Γ_2	$pK^- \pi^+$	[a]	(5.0 ± 1.3) %
Γ_3	$p\overline{K}^*(892)^0$	[b]	(1.6 ± 0.5) %
Γ_4	$\Delta(1232)^{++} K^-$		(8.6 ± 3.0) × 10^{-3}
Γ_5	$\Lambda(1520)\pi^+$	[b]	(1.8 ± 0.6) %
Γ_6	$pK^- \pi^+$ nonresonant		[illegible] %

PDG

$|\eta| < 0.9$

$|p_t| > 300$ MeV/c ↕ 25% ↕ 19%

$ct > 30\ \mu m$

7TeV pp MC

$$1(\Lambda_c \rightarrow pK^- \pi^+ \text{or inv.})/4 \times 10^4\ pp$$

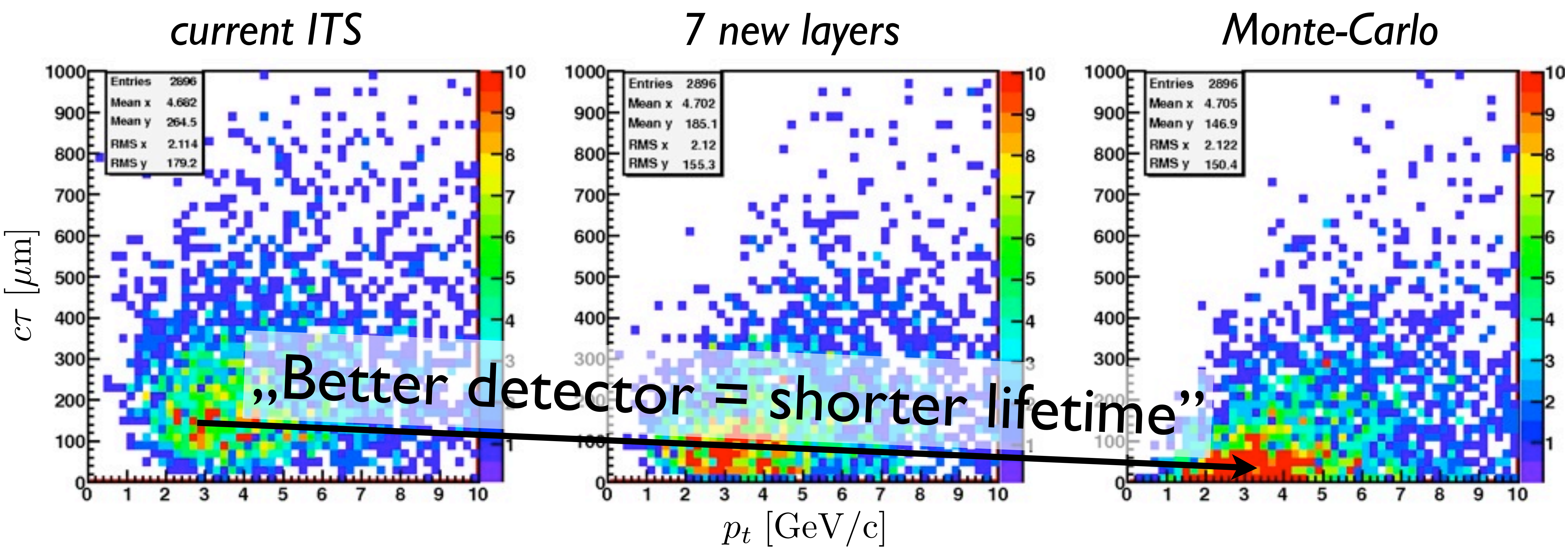
$$1(\Lambda_c \rightarrow pK^- \pi^+ \text{or inv.})/50\ PbPb\ (5\%\ \text{most central})$$

... still assuming 100% detector efficiency & no further cuts!

Strong motivation for a trigger

Problems

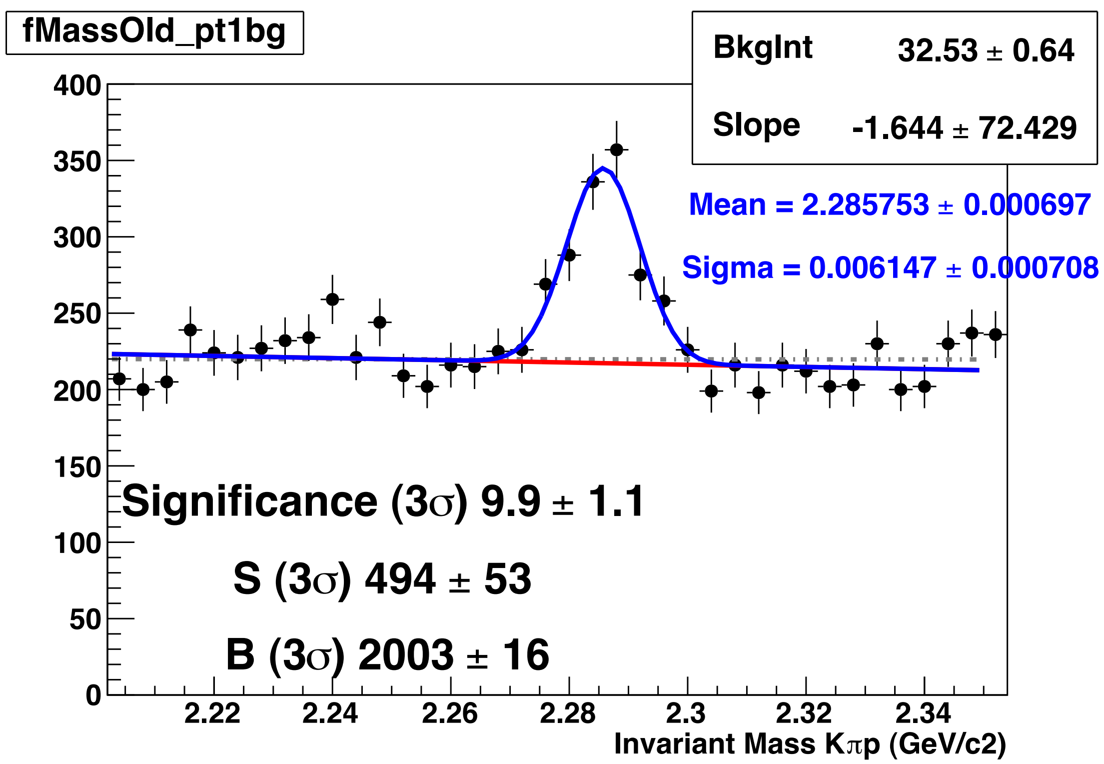
Reconstructed Λ_c after production cuts

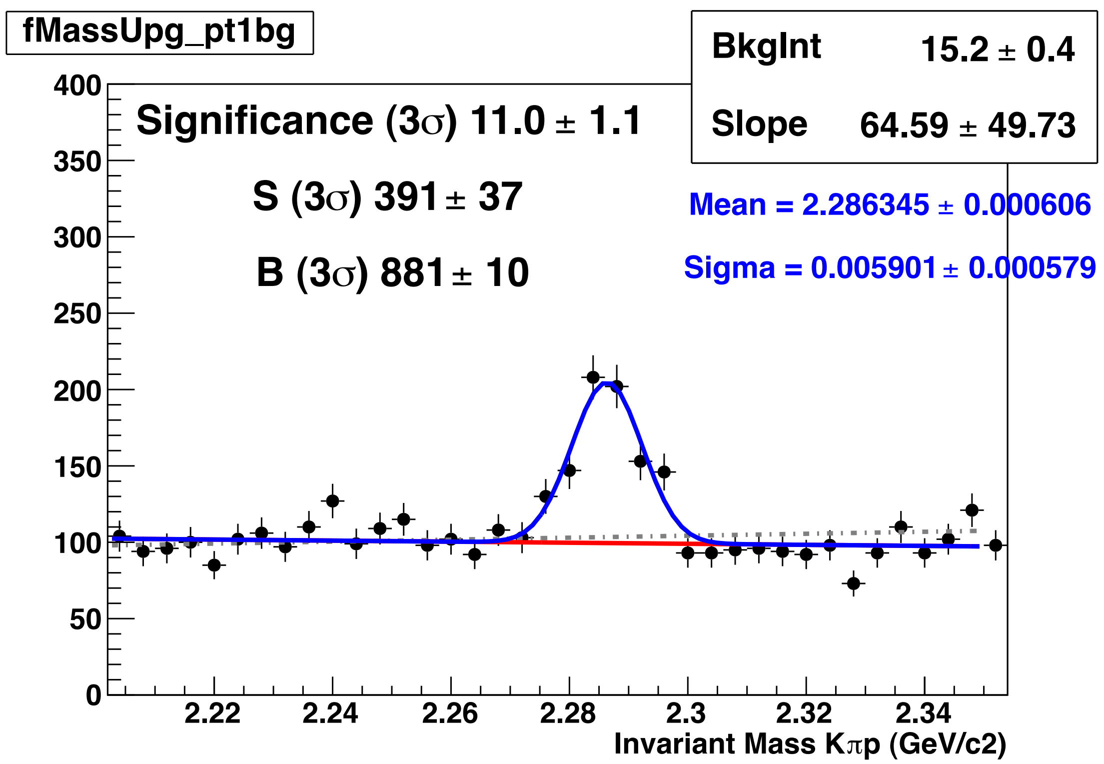


Most of the current candidates would not have passed the cuts, if the detector resolution was ideal!

Λ_c TODOs

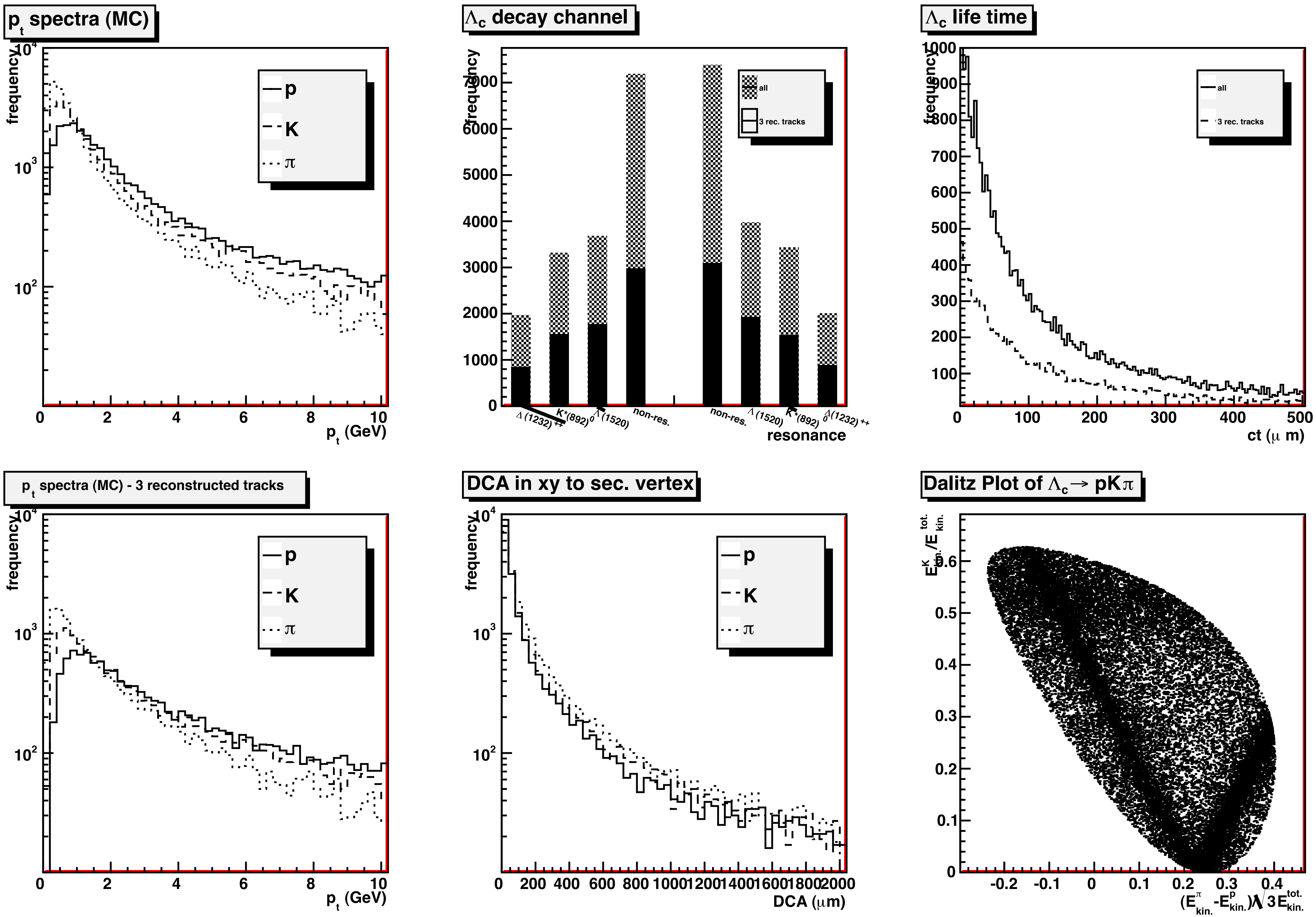
- We loose signal and background:





- Need to redo the reconstruction with looser cuts

Λ_c outlook: PbPb



Conclusion

- **Summary:**
  - Fast MC techniques can be used to assess impacts of resolution improvements on physics observables
  - Already very good results for D^0, Λ_c requires more work, but looks promising
- **TODO:**
  - Redo part of the reconstruction with looser cuts
  - Redo a MC production with cleaner sample