



Update on D* Reconstruction at $\sqrt{s} = 13.6$ TeV Run3 pp data with O2 Framework

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Outline

- Introduction
- Life-time & Decay of D mesons
- Previous Results (7 & 13 TeV, pp)
- Reconstruction strategy of D mesons
- Analysis Details
- QA of D0
- Results of D*

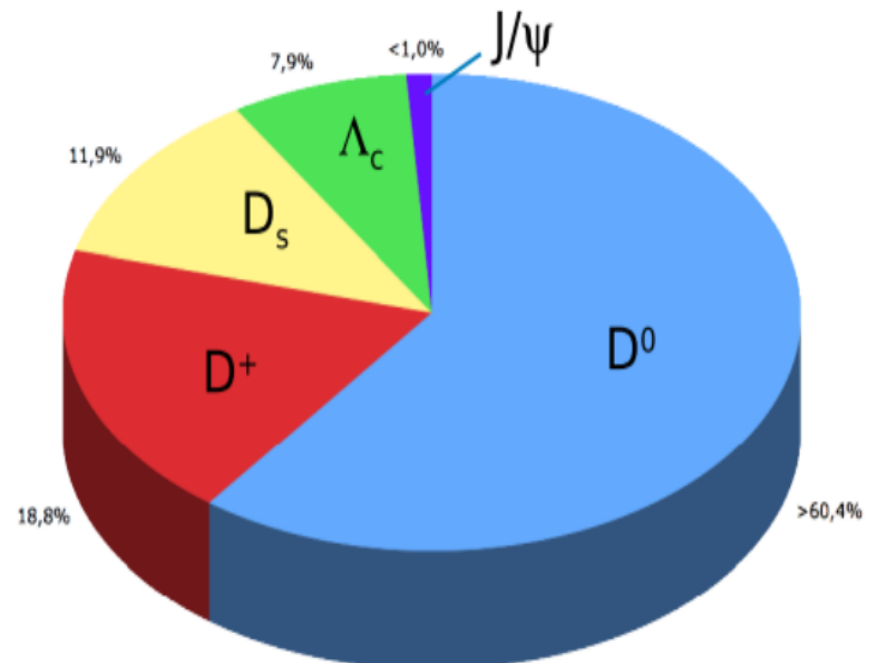


Introduction

- Study on production of HF particles and their correlation with charged hadrons can give us the insight into production and fragmentation mechanism of charm and beauty quarks.
- For pp: create a reference for study on heavier system
- For pPb or PbPb: allow to study nuclear effect.
- Heavy-flavour (c,b) quarks are excellent tool for study of degree of thermalization of the initially created matter.

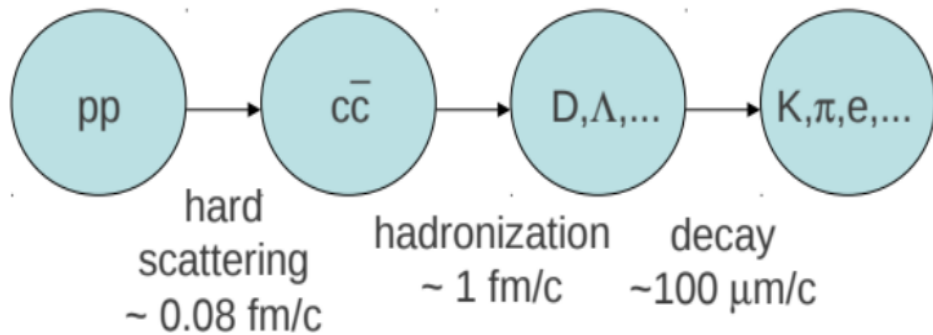
Introduction

- The dominant fraction of charm quarks emerges in open charm hadrons, e.g. D mesons,
- While hidden charm hadrons, e.g. J/ψ , carry $\sim 1\%$ of total charm yield.

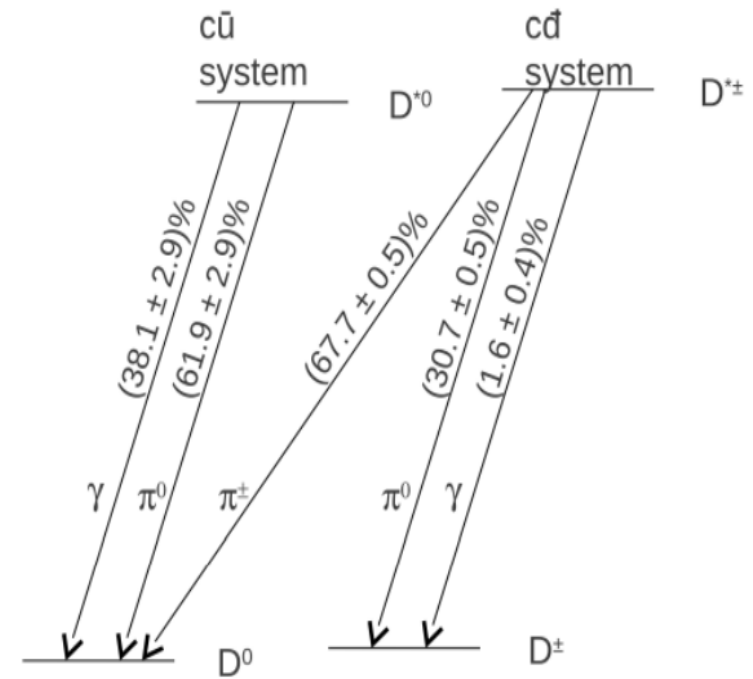


J. Phys. G: Nucl. Part. Phys. 32 (2006) 1295-2040

Life-Time & Decay of D Meson



Charmed Hadron	Valence Quark	$I(J^P)$	Rest Mass (MeV/ c^2)	Life Time / Decay Width
D^0	$c\bar{u}$	$\frac{1}{2}(0^-)$	1864.86 ± 0.13	$c\tau = 122.9 \mu\text{m}$
D^+	$c\bar{d}$	$\frac{1}{2}(0^-)$	1869.62 ± 0.15	$c\tau = 311.8 \mu\text{m}$
D_s^+	$c\bar{s}$	$0(0^-)$	1968.49 ± 0.32	$c\tau = 149.9 \mu\text{m}$
D^{*0}	$c\bar{u}$	$\frac{1}{2}(1^-)$	2006.98 ± 0.15	$\Gamma < 2.1$ MeV
D^{*+}	$c\bar{d}$	$\frac{1}{2}(1^-)$	2010.28 ± 0.13	$\Gamma = 96$ keV
D_s^{*+}	$c\bar{s}$	$0(?^?)$	2112.3 ± 0.5	$\Gamma < 1.9$ MeV
Λ_c^+	cdu	$0(\frac{1}{2}^+)$	2286.46 ± 0.14	$c\tau = 59.9 \mu\text{m}$
Σ_c^{++}	cuu	$1(\frac{1}{2}^+)$	2453.98 ± 0.16	$\Gamma = 2.26$ MeV
Σ_c^+	cdu	$1(\frac{1}{2}^+)$	2452.9 ± 0.4	$\Gamma < 4.6$ MeV
Σ_c^0	cdd	$1(\frac{1}{2}^+)$	2453.74 ± 0.16	$\Gamma = 2.16$ MeV



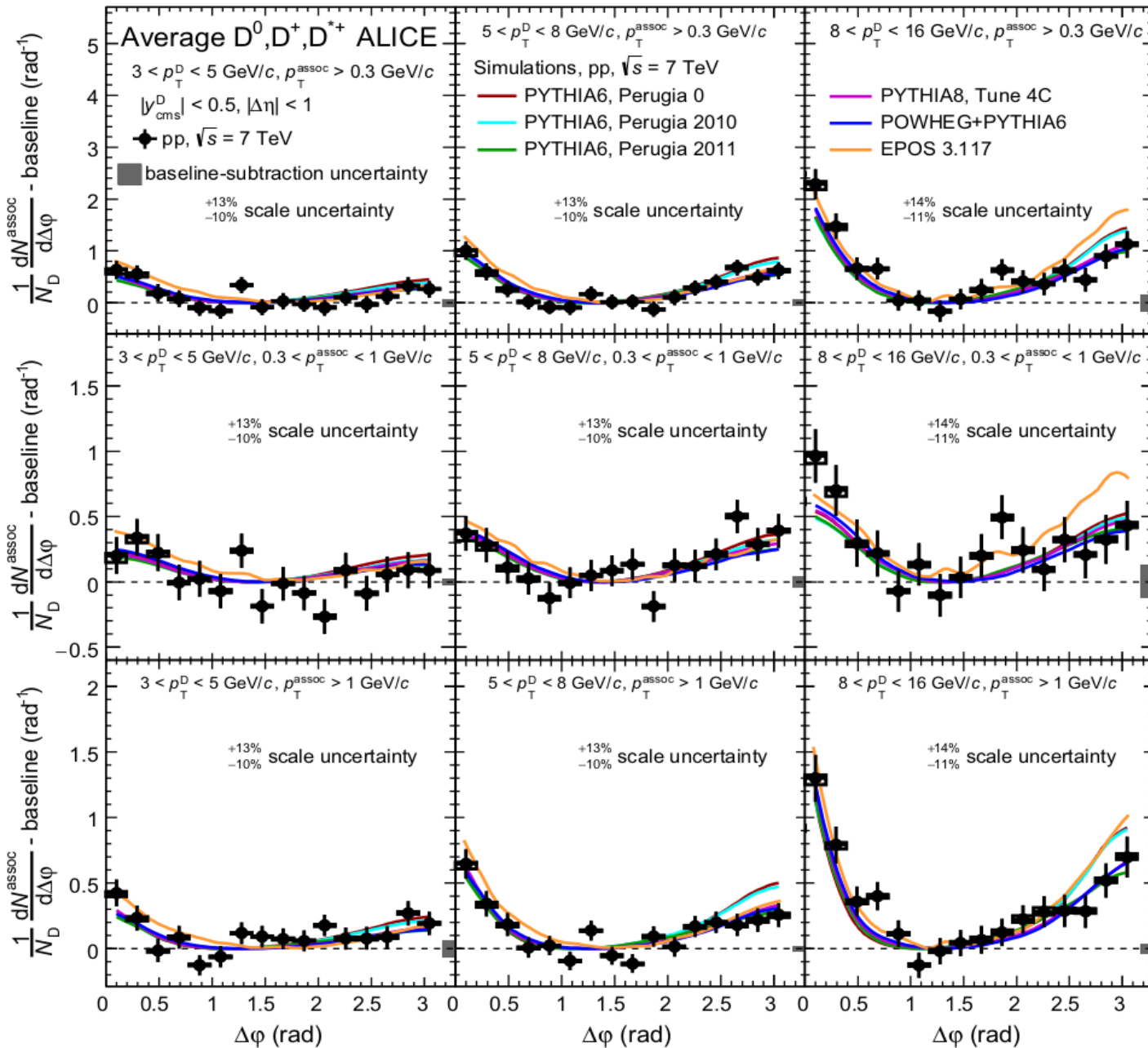
$$\mathcal{B.R.}(D^0 \rightarrow K^- \pi^+) = 3.88 \pm 0.05\%$$

$$\mathcal{B.R.}(D^+ \rightarrow K^- \pi^+ \pi^+) = 9.13 \pm 0.19\%$$

$$\mathcal{B.R.}(D_s^+ \rightarrow K^+ K^- \pi^+) = 5.49 \pm 0.27\%$$

J. Beringer et al., Phys. Rev. D 86 010001 (2012)

Previous Results (7 TeV, pp)

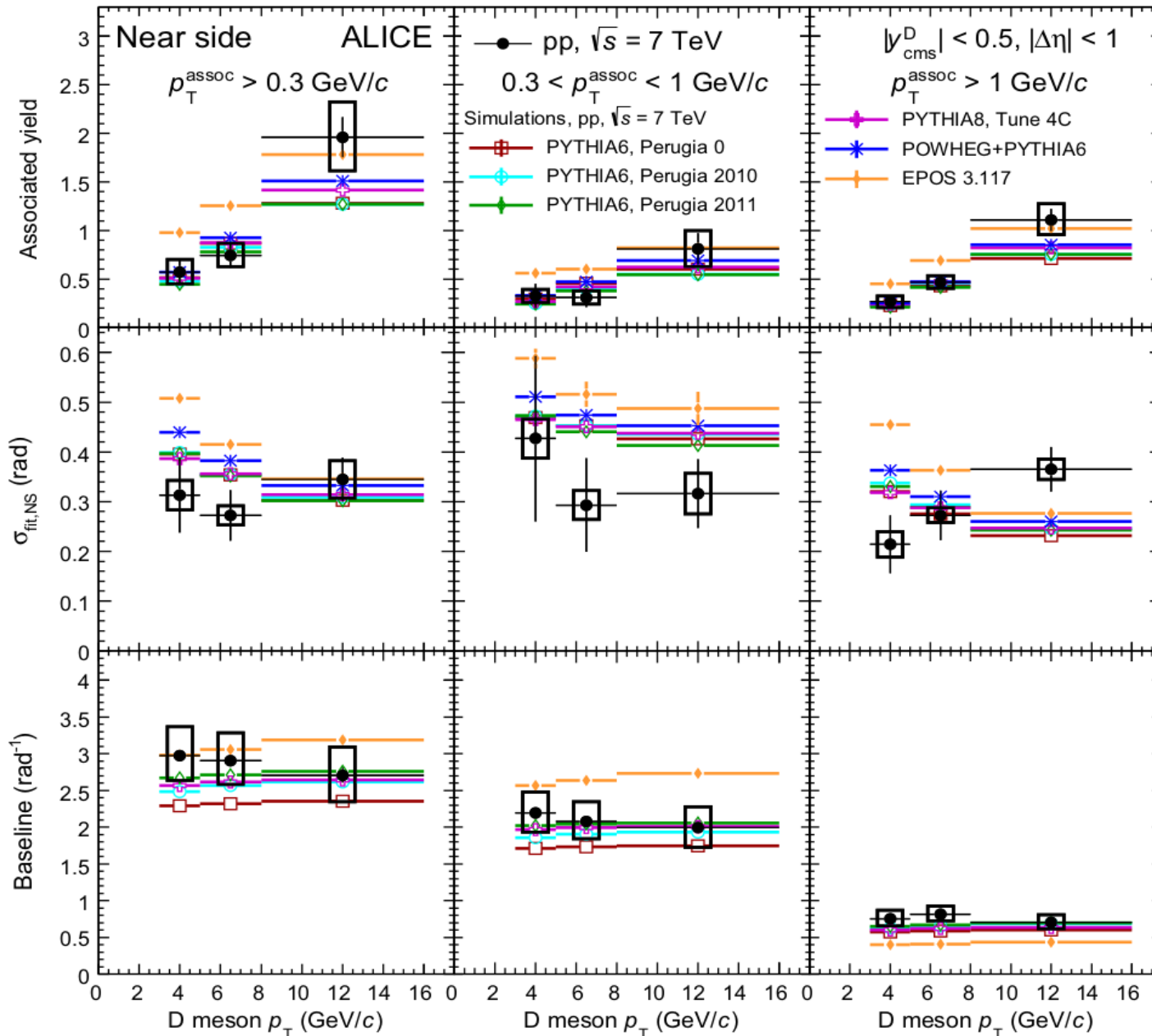


- Near Side peak is qualitatively well described by PYTHIA & POWHEG+PYTHIA6 while EPOS3 is giving little higher and wider near side peak

- EPOS3 is overestimating away side peak in D meson $8 < p_T < 16 \text{ GeV}/c$

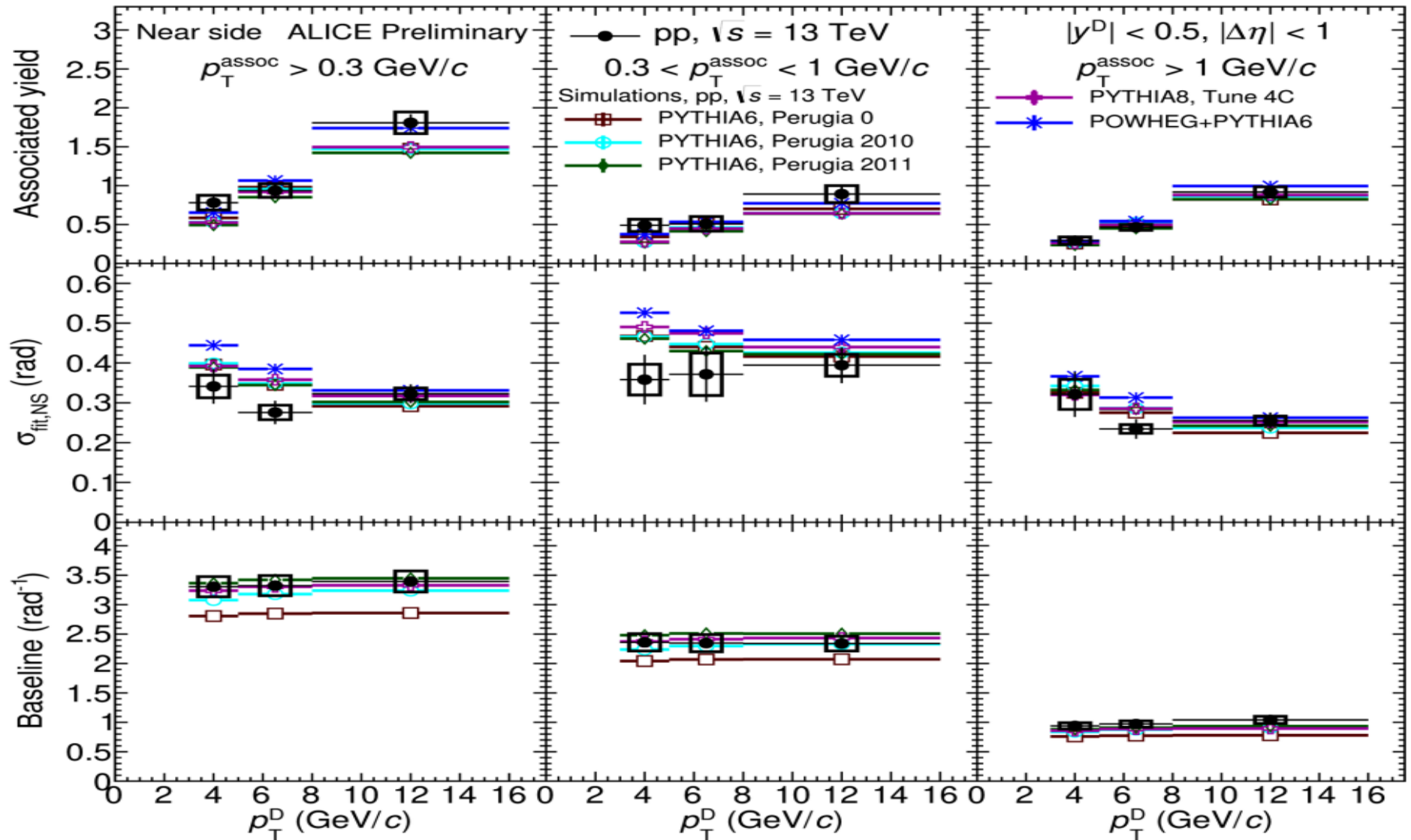
Eur. Phys. J. C (2017) 77 :245

Previous Results continue...



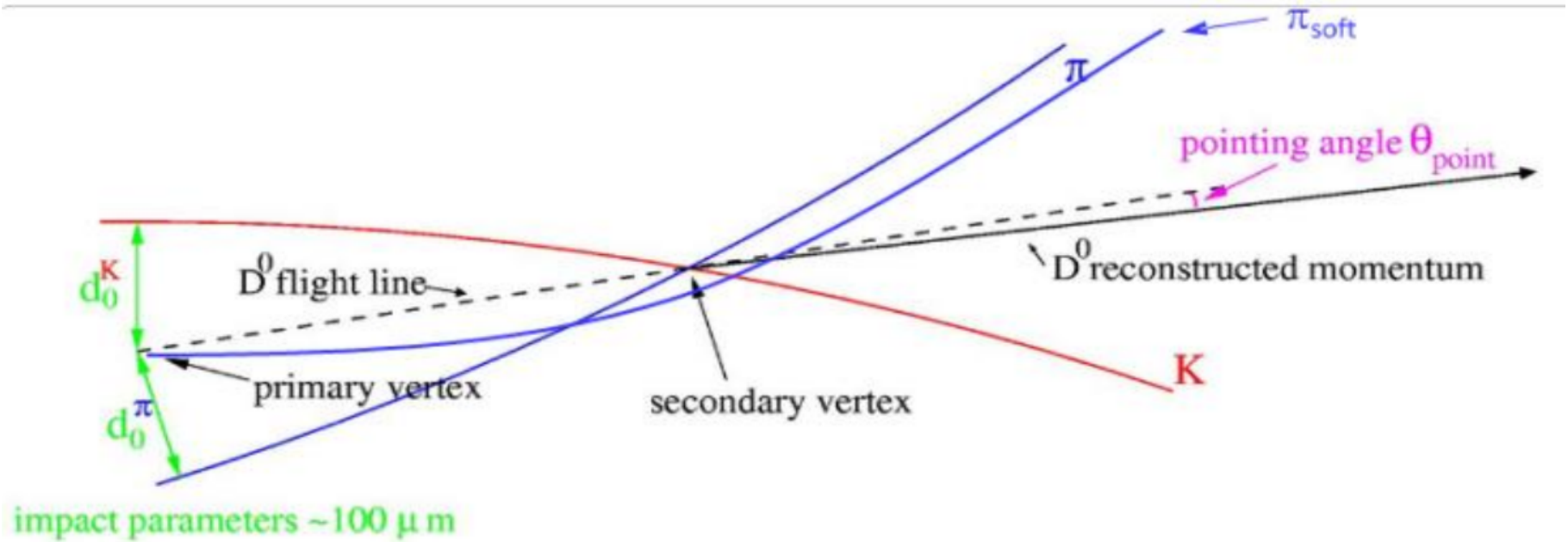
- Associated yield is well described by PYTHIA & POWHEG+PYTHIA6 at low & mid D meson p_T but at D meson $8 < p_T < 16 \text{ GeV}/c$, EPOS3 describes data better.
- Near side width is not well described by all the model considered here.
- Baseline does not show any dependence with D meson p_T .

13 TeV Results



ALI-PREL-152763

Reconstruction of D0



- (1) [trackIndexSkimCreator.cxx](#) (generate pairs on loose selections)
- (2) [candidateCreator.cxx](#) (secondary vertex reconstruction)
- (3) [candidateSelector.cxx](#) (PID, topological and kinematical selection)
- (4) [taskDstar.cxx](#) (invariant mass plot and QA plots)

Link for [PR](#) to join conversation.

Analysis Details

- Data set: Run3, pp, $\sqrt{s}=13.6$ TeV
LHC22m_apass4, 137M events
- Event Cuts: kINT7
- PID Cuts on D0 daughters:
(O2physics/Common/Core/TrackSelectionPID.h)
for $0.15 \text{ GeV}/c < p_T < 5.0 \text{ GeV}/c$
if ($N\sigma_{TPC} < 3$ OR $N\sigma_{TOF} < 3$) Accepted
elseif($N\sigma_{TPC} < 5$ AND $N\sigma_{TOF} < 5$) Accepted

Analysis Details (D0 selection)

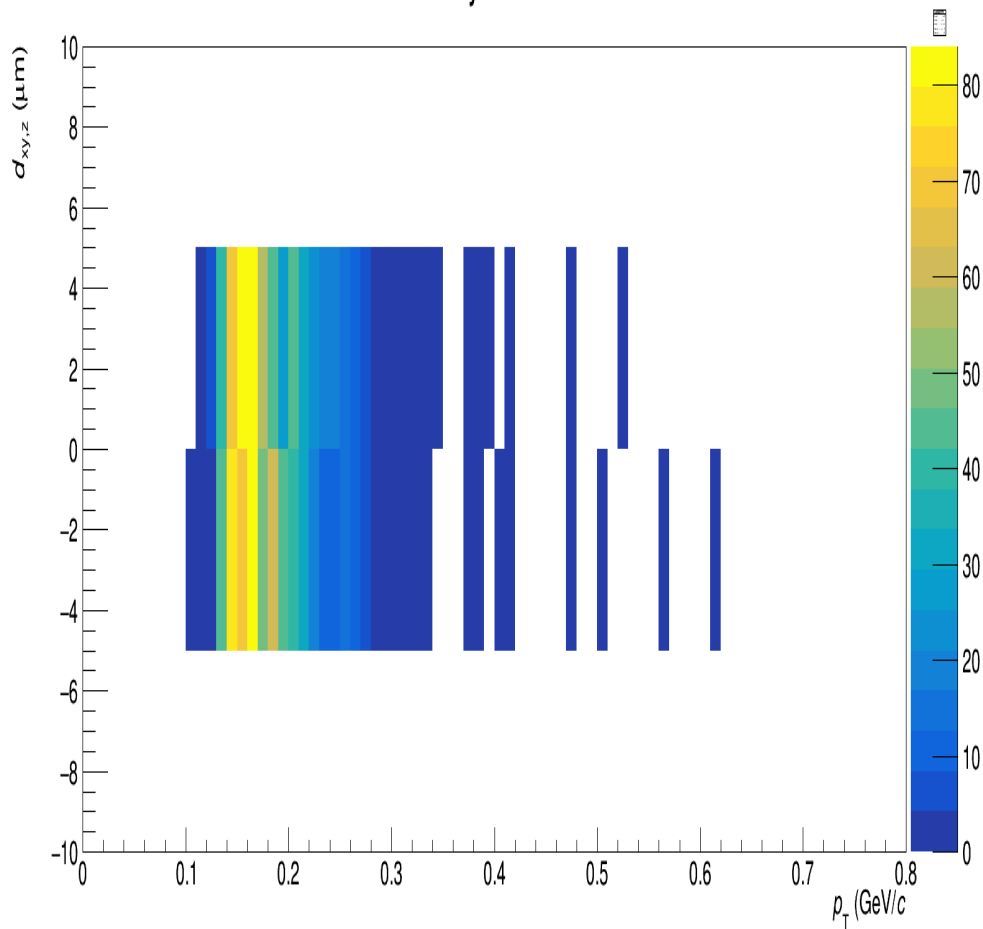
pT Bins (GeV/c)	ΔM (GeV/ c^2)<	DCA (cm)<	$\cos(\theta)$	pT(k) (GeV/c) >	pT(π) (GeV/c) >	d0(k) (cm)<	d0(π) (cm)<	D0d0 (cm ²)<	CPA>	CPA _{xy} >	L<	L _{xy} >	min L
1-1.5	0.4	0.03	0.8	0.4	0.4	0.1	0.1	-2.5e-4	0.8	0	10	10	0.06
1.5-2	0.4	0.03	0.8	0.4	0.4	0.1	0.1	-2.5e-4	0.8	0	10	10	0.06
2-2.5	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-2e-4	0.9	0	10	10	0.06
2.5-3	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-2e-4	0.9	0	10	10	0.06
3-3.5	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-1.2e-4	0.85	0	10	10	0.06
3.5-4	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-1.2e-4	0.85	0	10	10	0.06
4-4.5	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-8e-5	0.85	0	10	10	0.06
4.5-5	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-8e-5	0.85	0	10	10	0.06
5-5.5	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-8e-5	0.85	0	10	10	0.06
5.5-6	0.4	0.03	0.8	0.7	0.7	0.1	0.1	-8e-5	0.85	0	10	10	0.06

Analysis Details (D* selection)

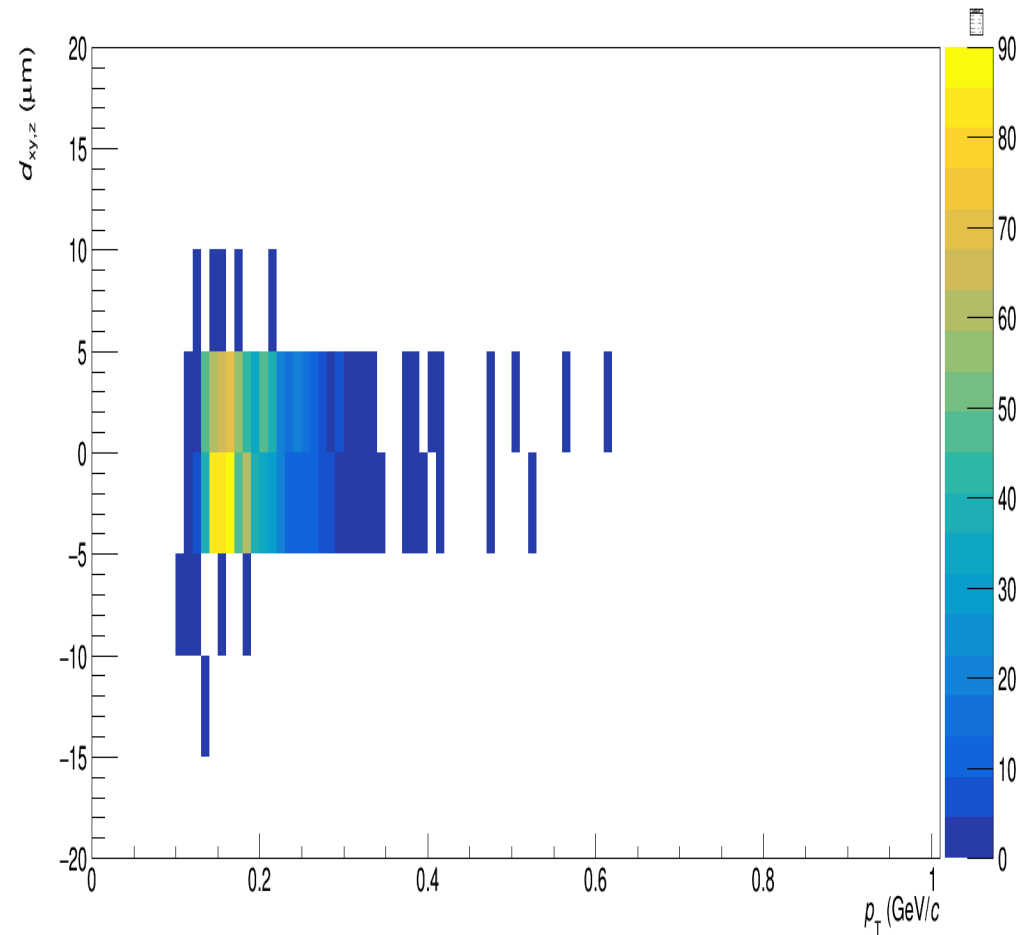
PtSoftPiMin	ptSoftPiMax	d0SoftPi <	d0SoftPiNormalised <	deltaMInvDstar <	chi2PCA <	d0Prong0Normalised >	d0Prong1Normalised >
0.05	0.3	0.10	0.50	0.20	300	0.50	0.50
0.05	0.3	0.10	0.50	0.20	300	0.50	0.50
0.05	0.4	0.10	0.50	0.20	300	0.50	0.50
0.05	0.4	0.10	0.50	0.20	300	0.50	0.50
0.05	0.6	0.10	0.50	0.20	300	0.50	0.50
0.05	0.6	0.10	0.50	0.20	300	0.50	0.50
0.05	0.6	0.10	0.50	0.20	300	0.50	0.50
0.05	100	0.10	0.50	0.20	300	0.50	0.50
0.05	100	0.10	0.50	0.20	300	0.50	0.50

QA (D0)

DCAxy of Soft Pi

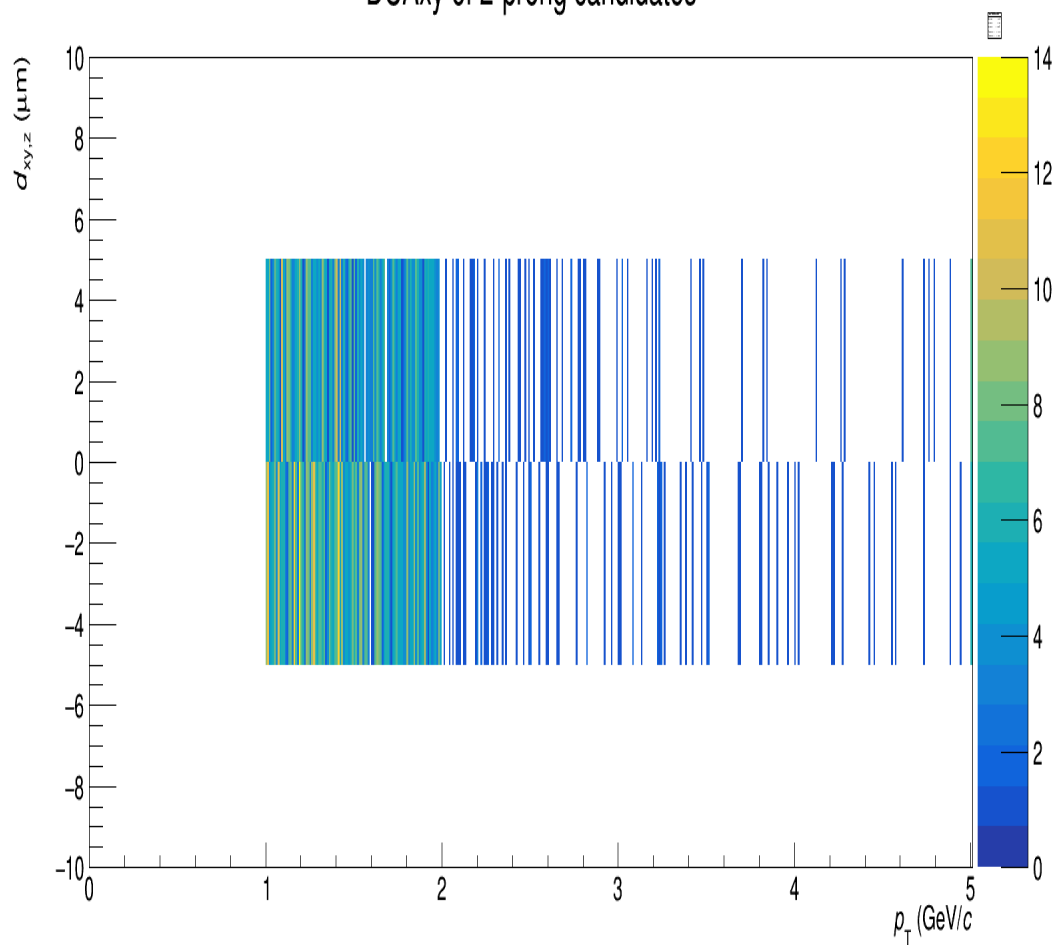


DCAz of Soft Pi

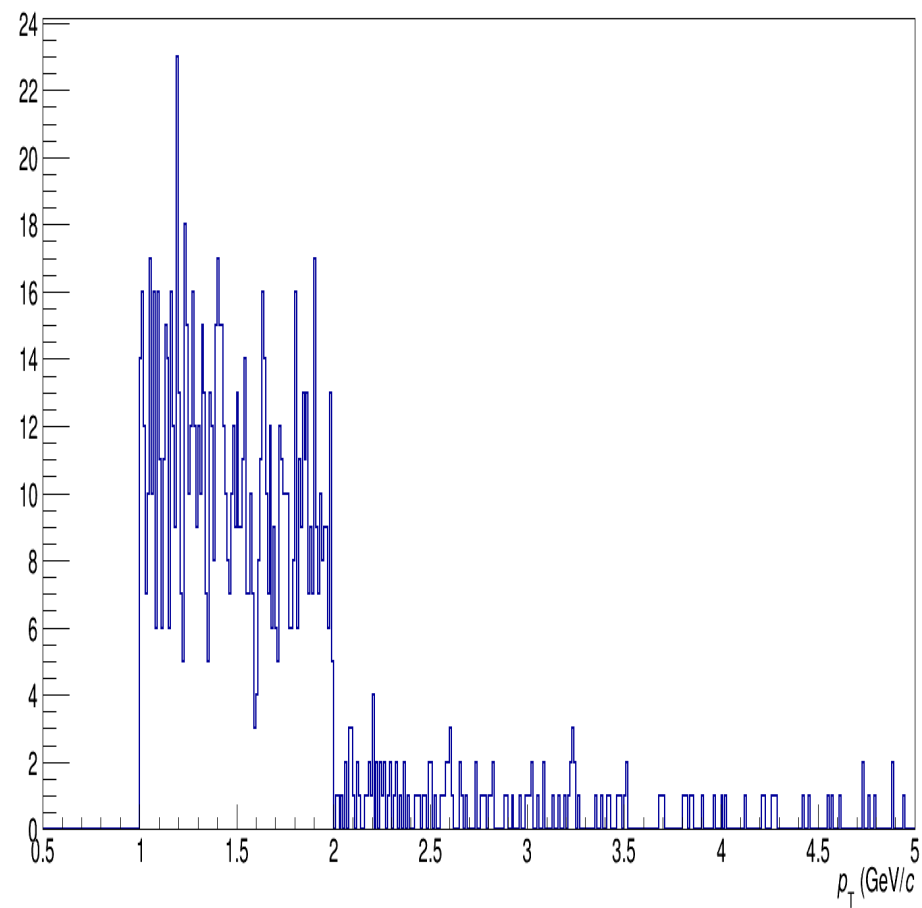


QA (D0)

DCAxy of 2-prong candidates

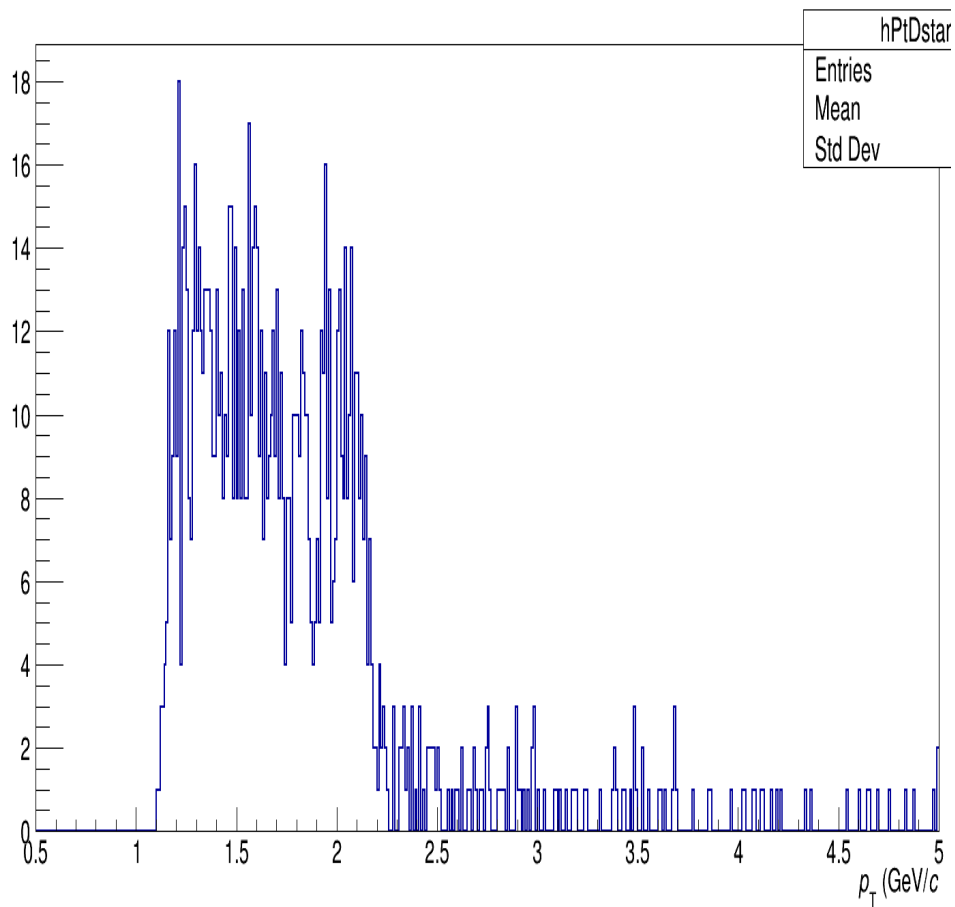


D^0 candidates

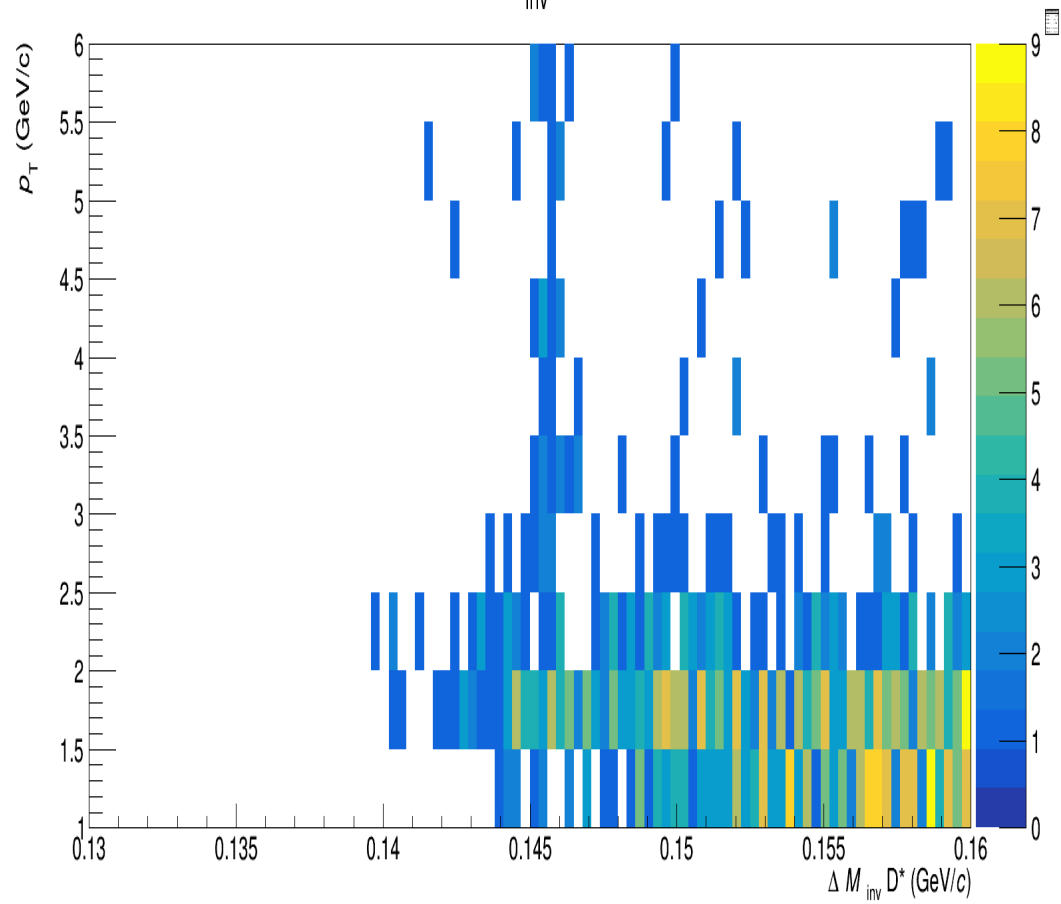


QA (D*)

D* candidates



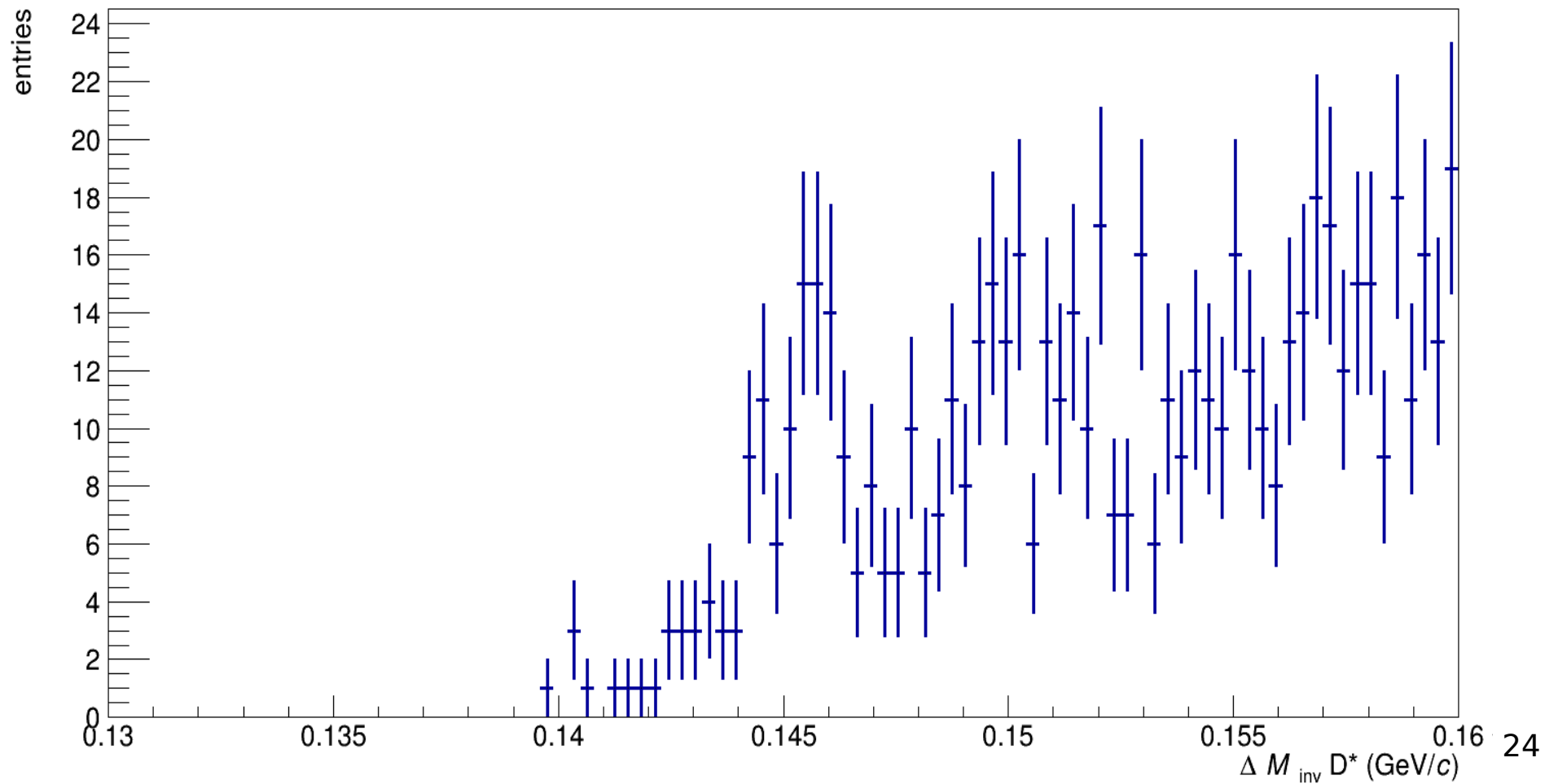
$\Delta M_{inv} D^*$



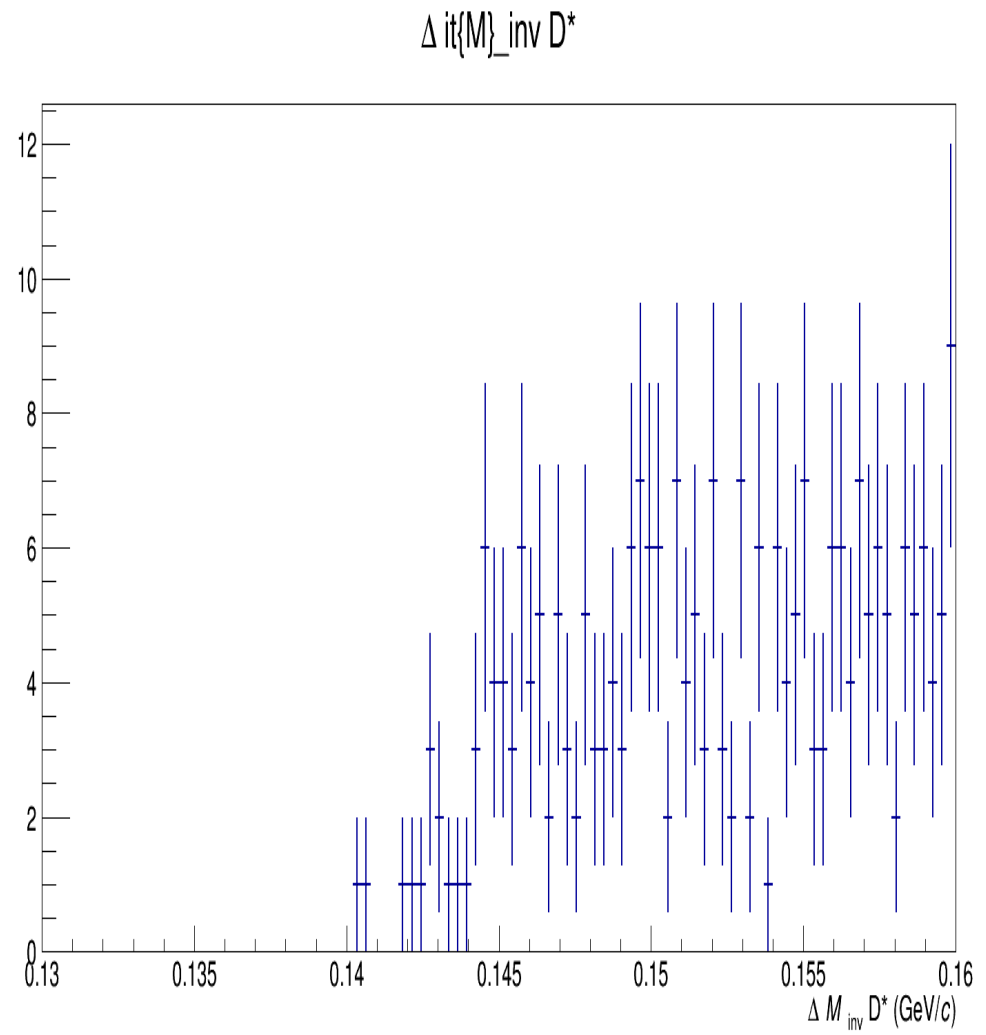
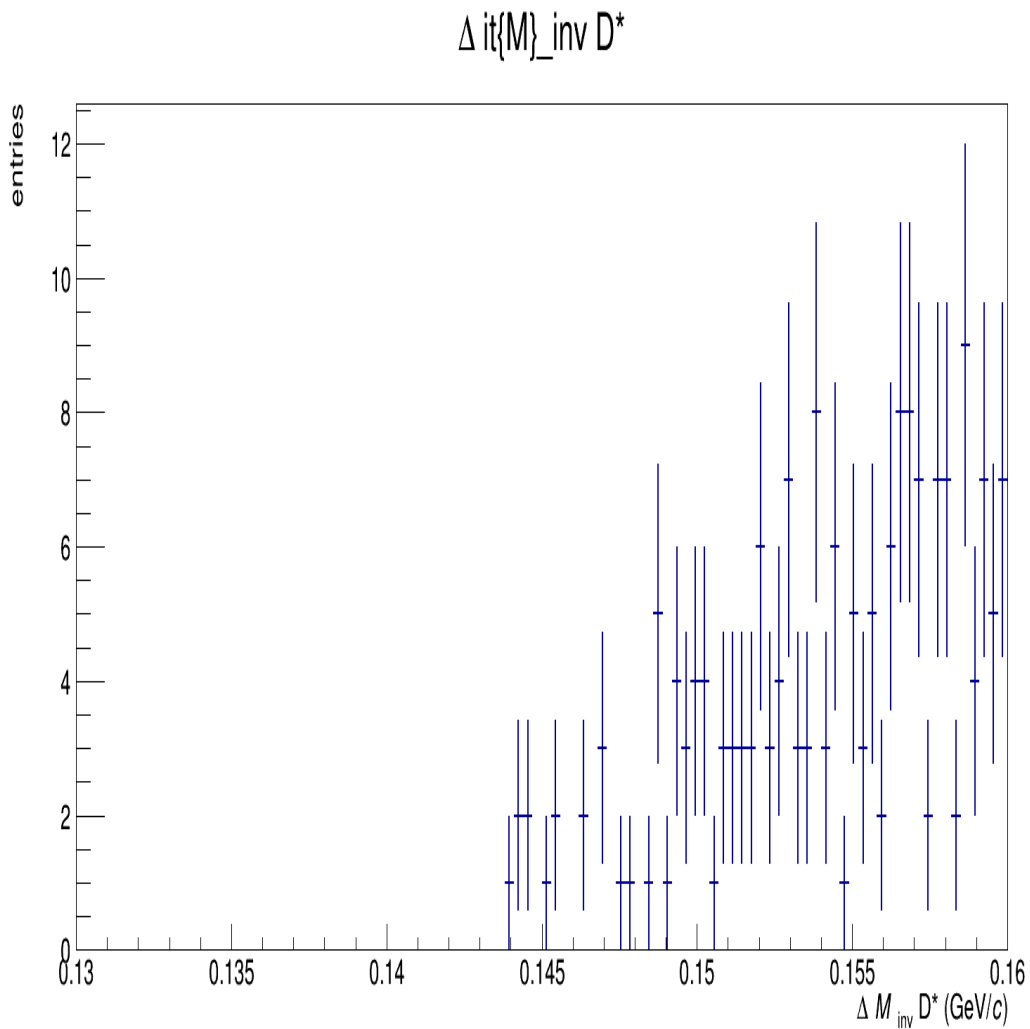
Result D^* (integrated pT bin)

$$\Delta M_{inv} = M_{inv}(\pi\pi k) - M_{inv}(\pi k)$$

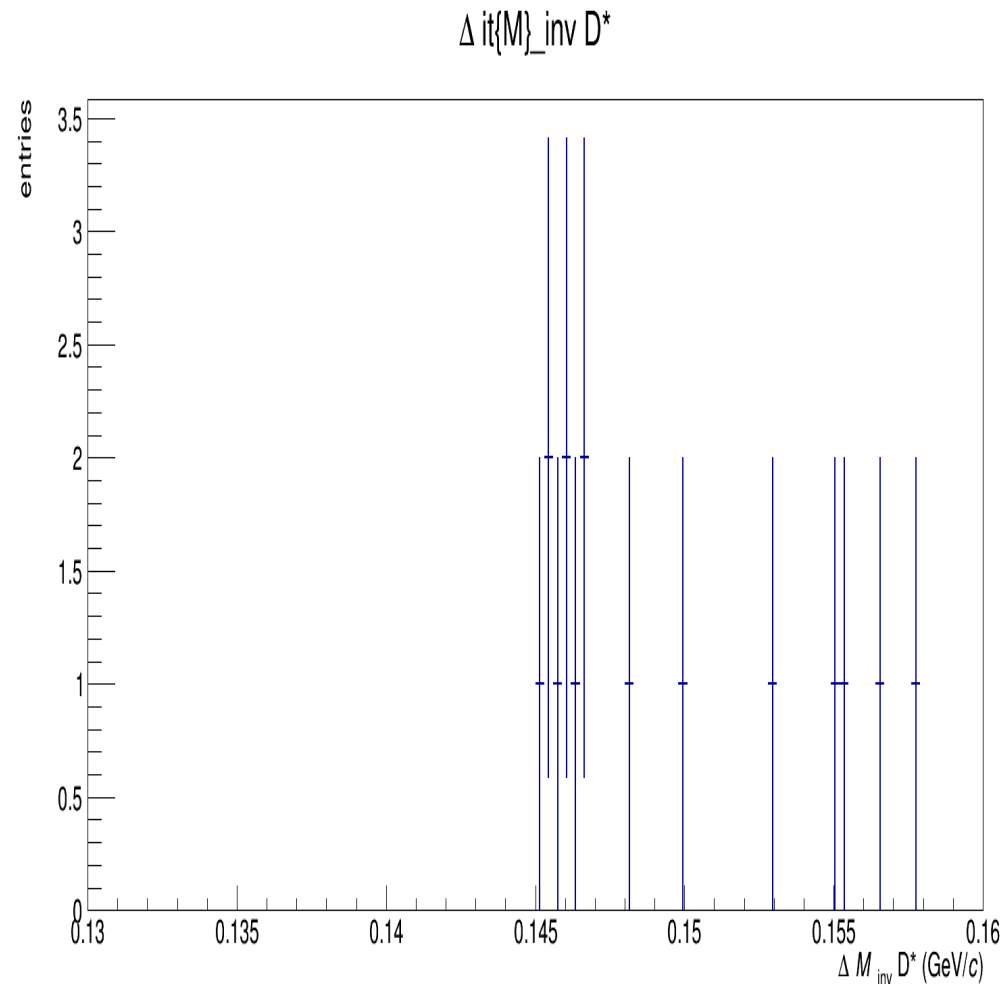
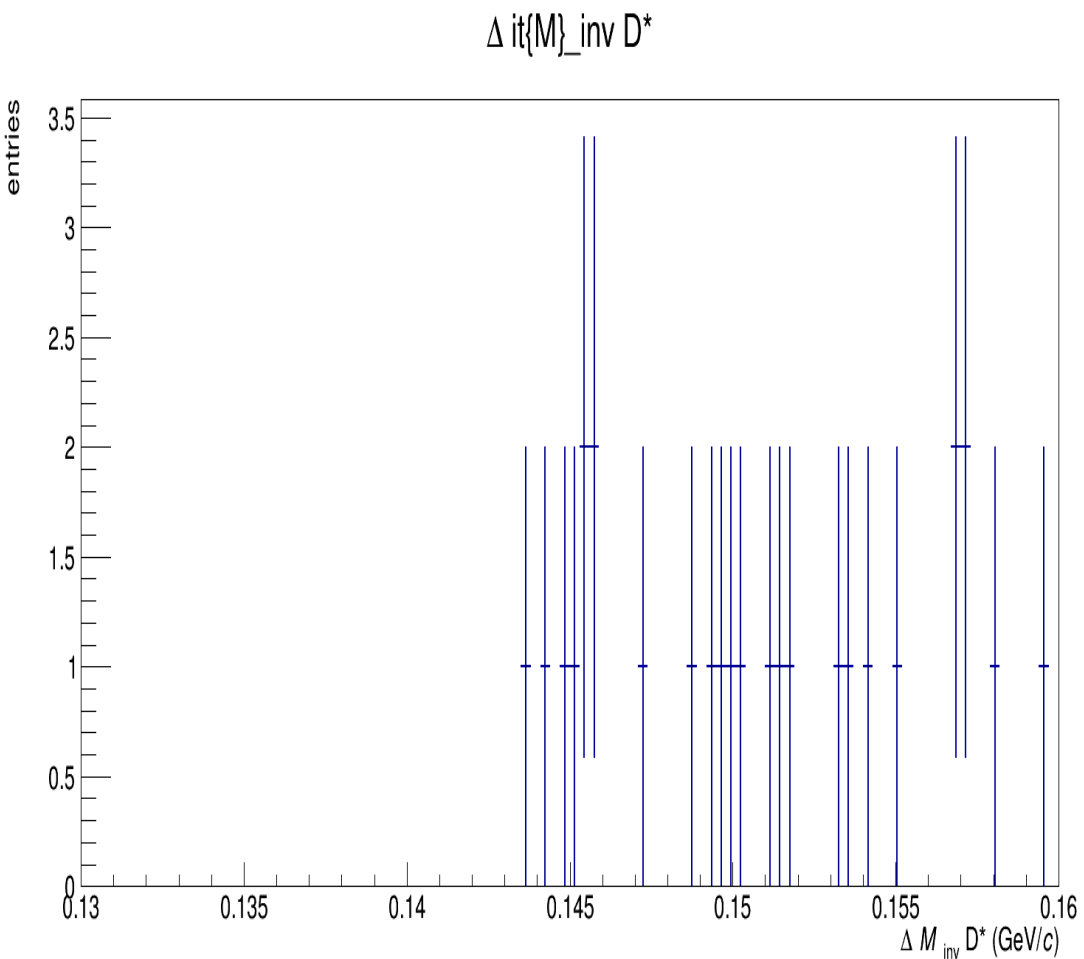
$\Delta M_{inv} D^*$ candidate



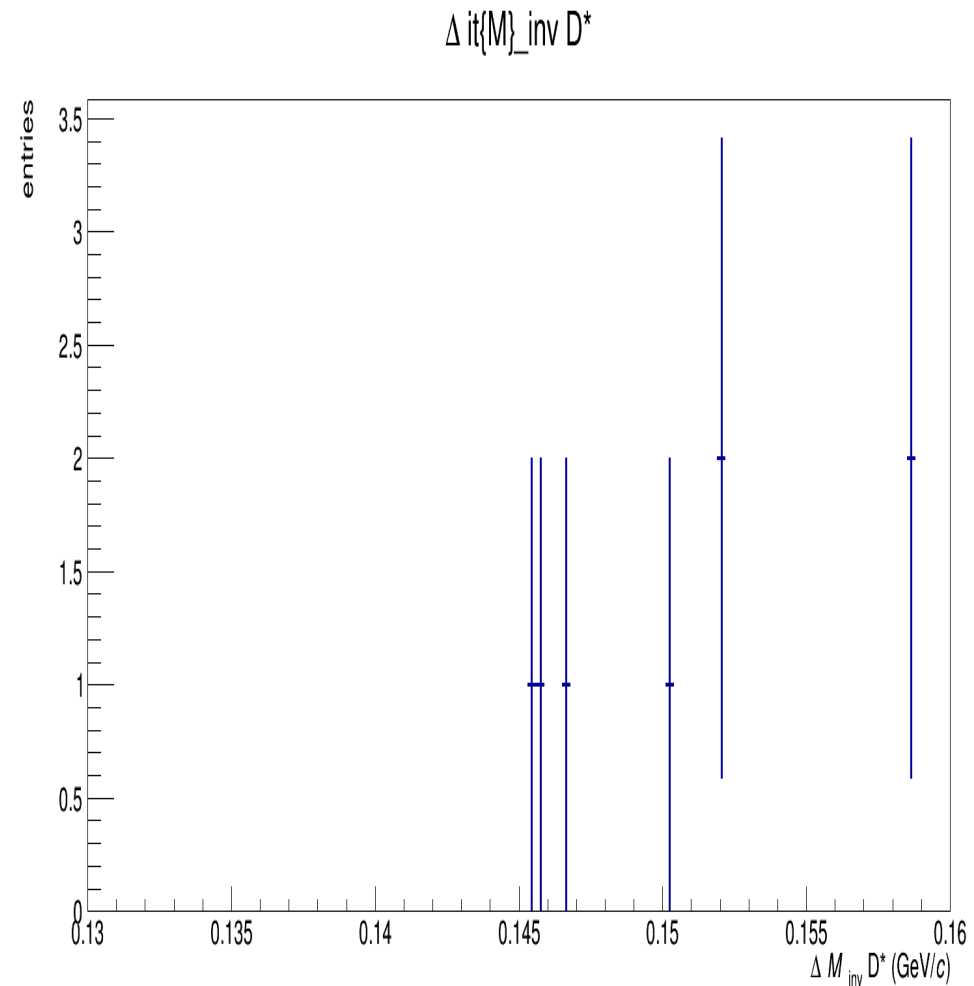
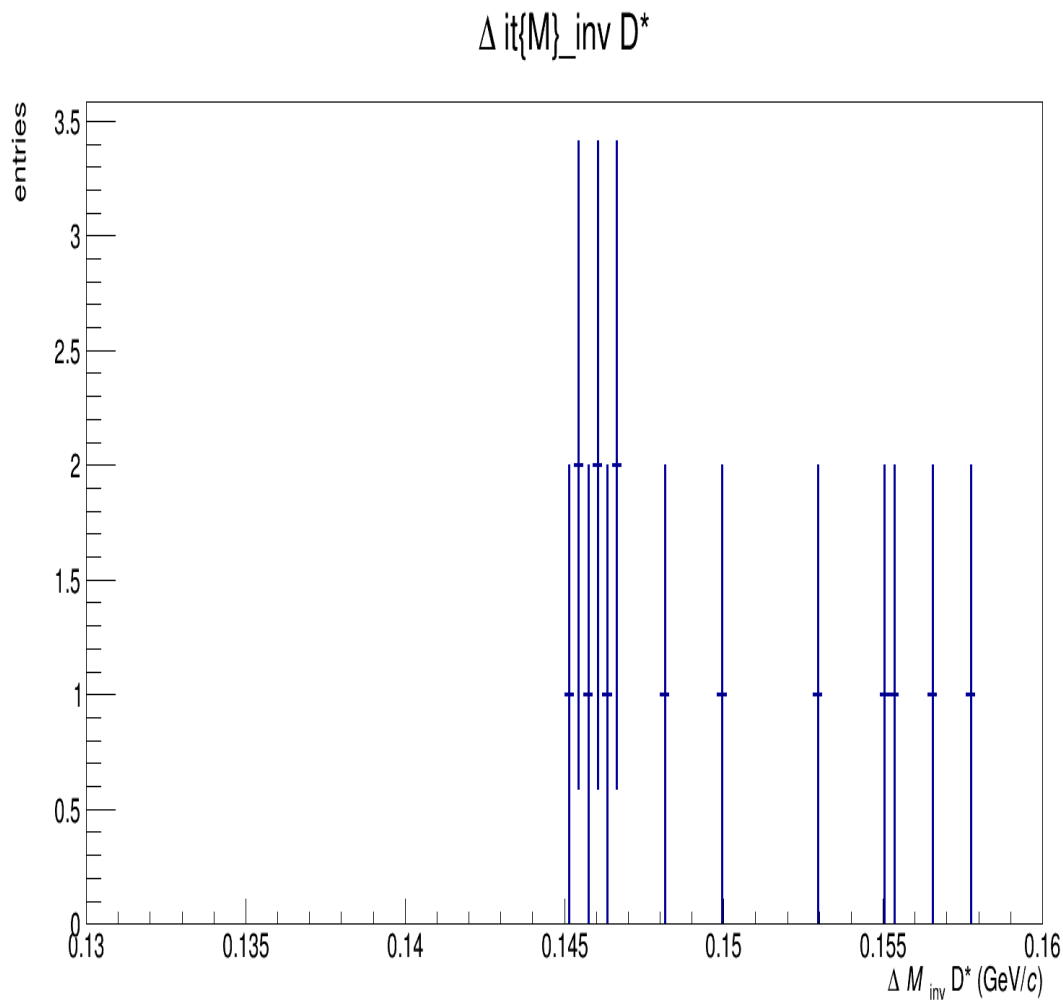
Result D^* (Left: 1st pT Bin, Right: 2nd pT Bin)



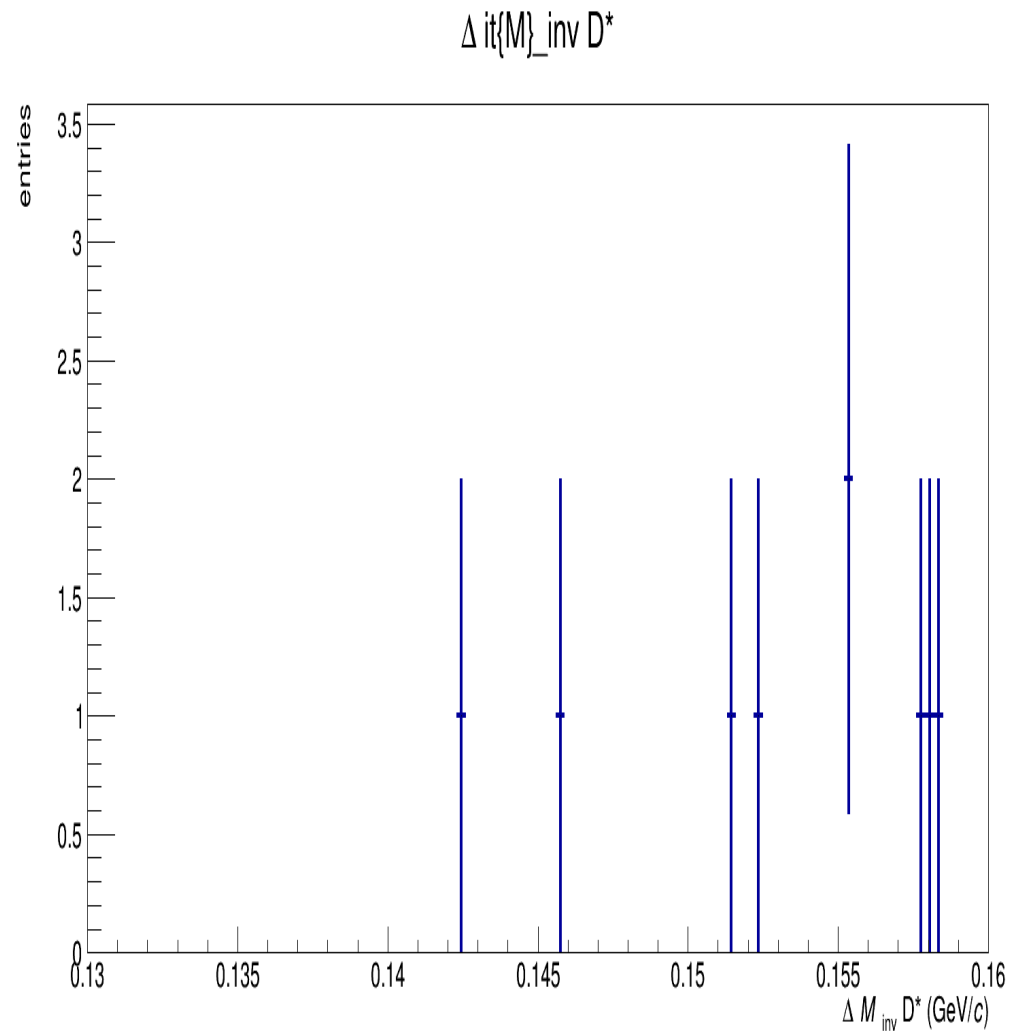
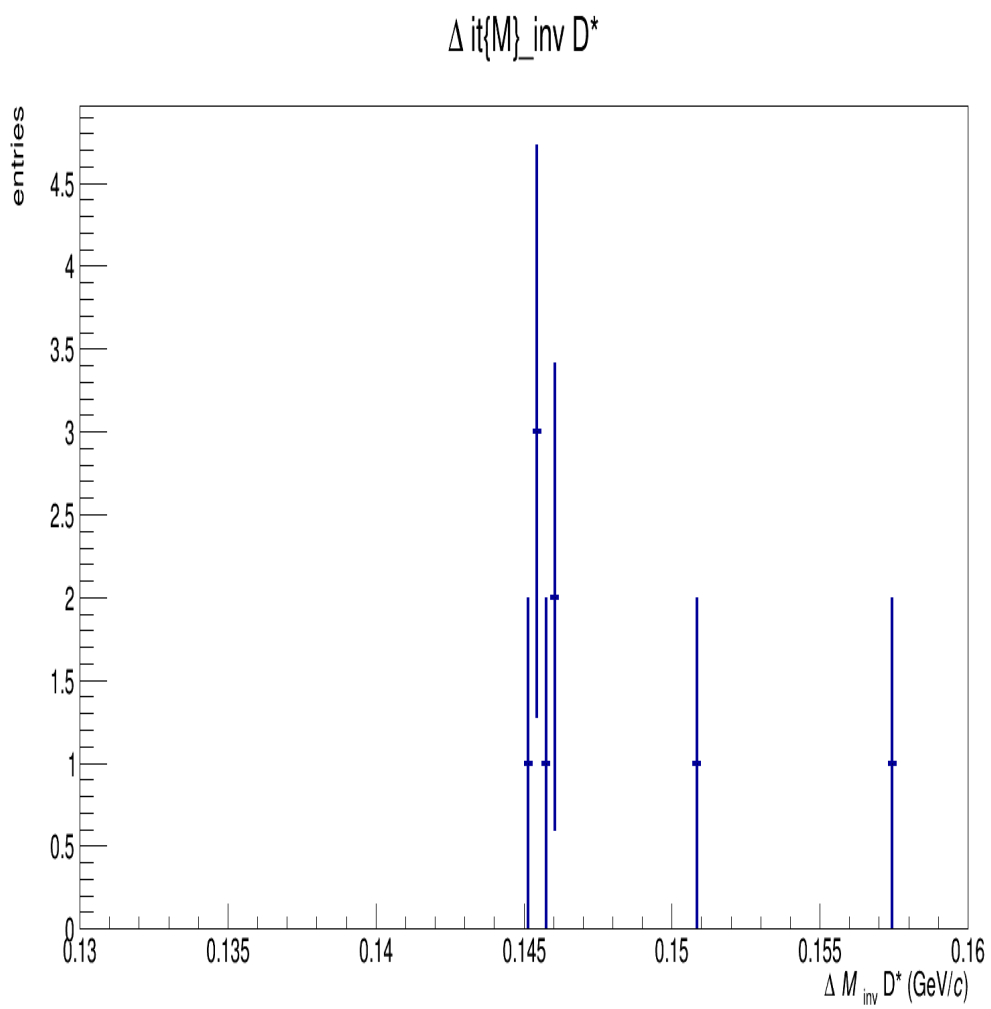
Result D^* (Left: 3rd pT Bin, Right: 4th pT Bin)



Result D^* (Left: 5th pT Bin, Right: 6th pT Bin)

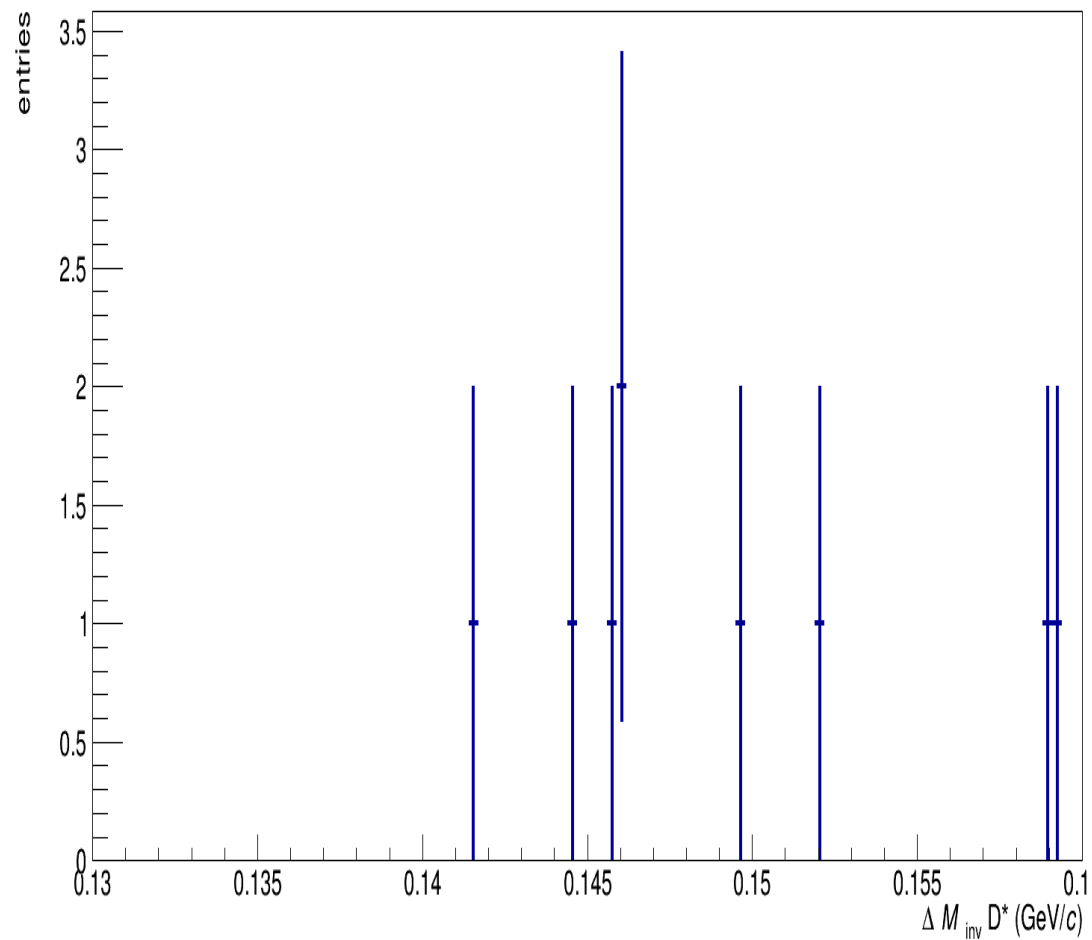


Result D^* (Left: 7th pT Bin, Right: 8th pT Bin)

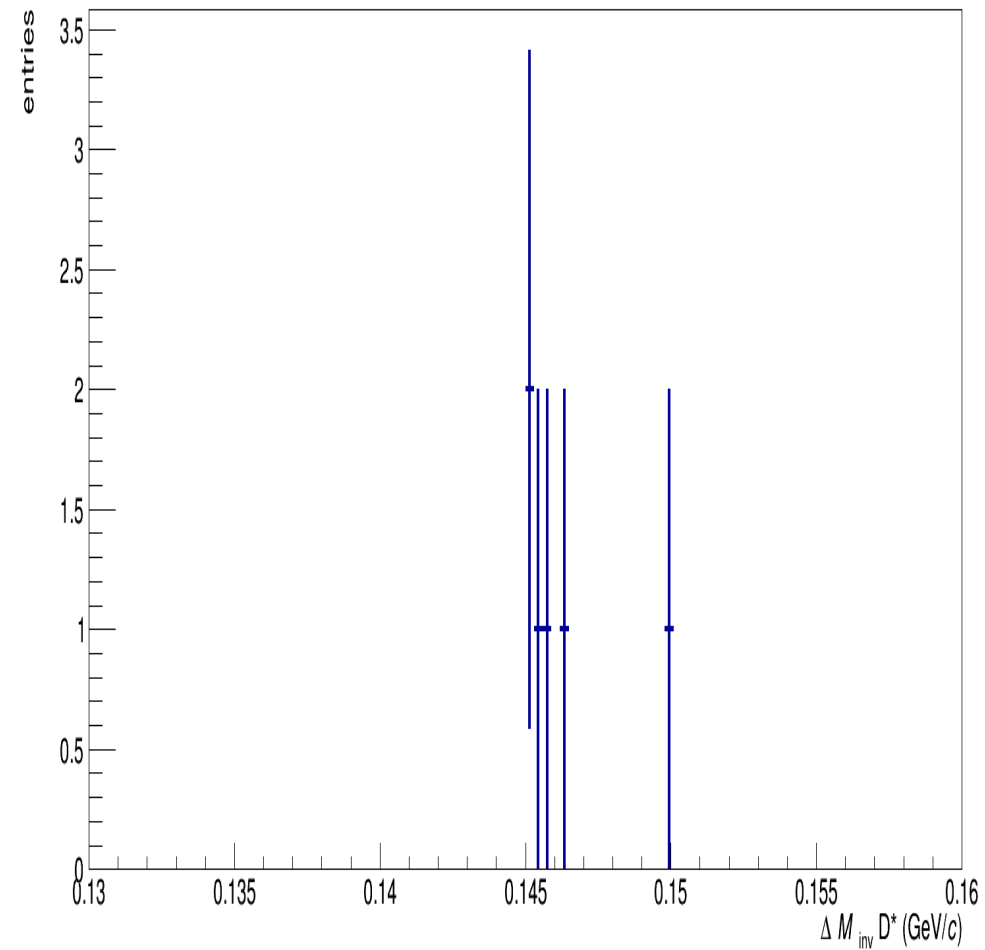


Result D^* (Left: 9th pT Bin, Right: 10th pT Bin)

$\Delta M_{\text{inv}} D^*$



$\Delta M_{\text{inv}} D^*$

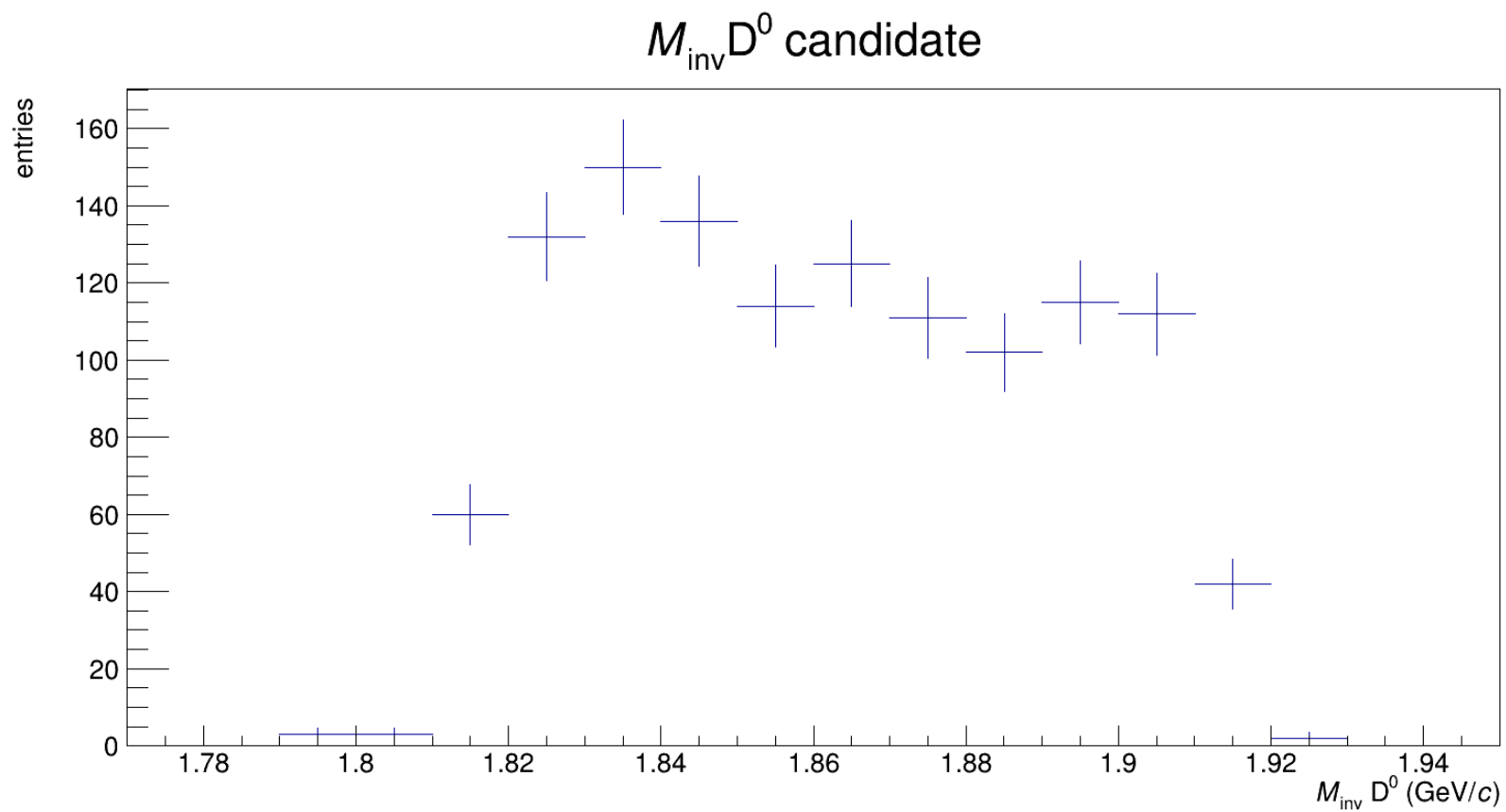




Remaining to be done...

- Merging of the “two Tasks” to Git repository and Run over hyperloop
- Validation of QA plots with Run2 QA plots.
- The will go for signal extraction.

BackUp



Non prompt D*

