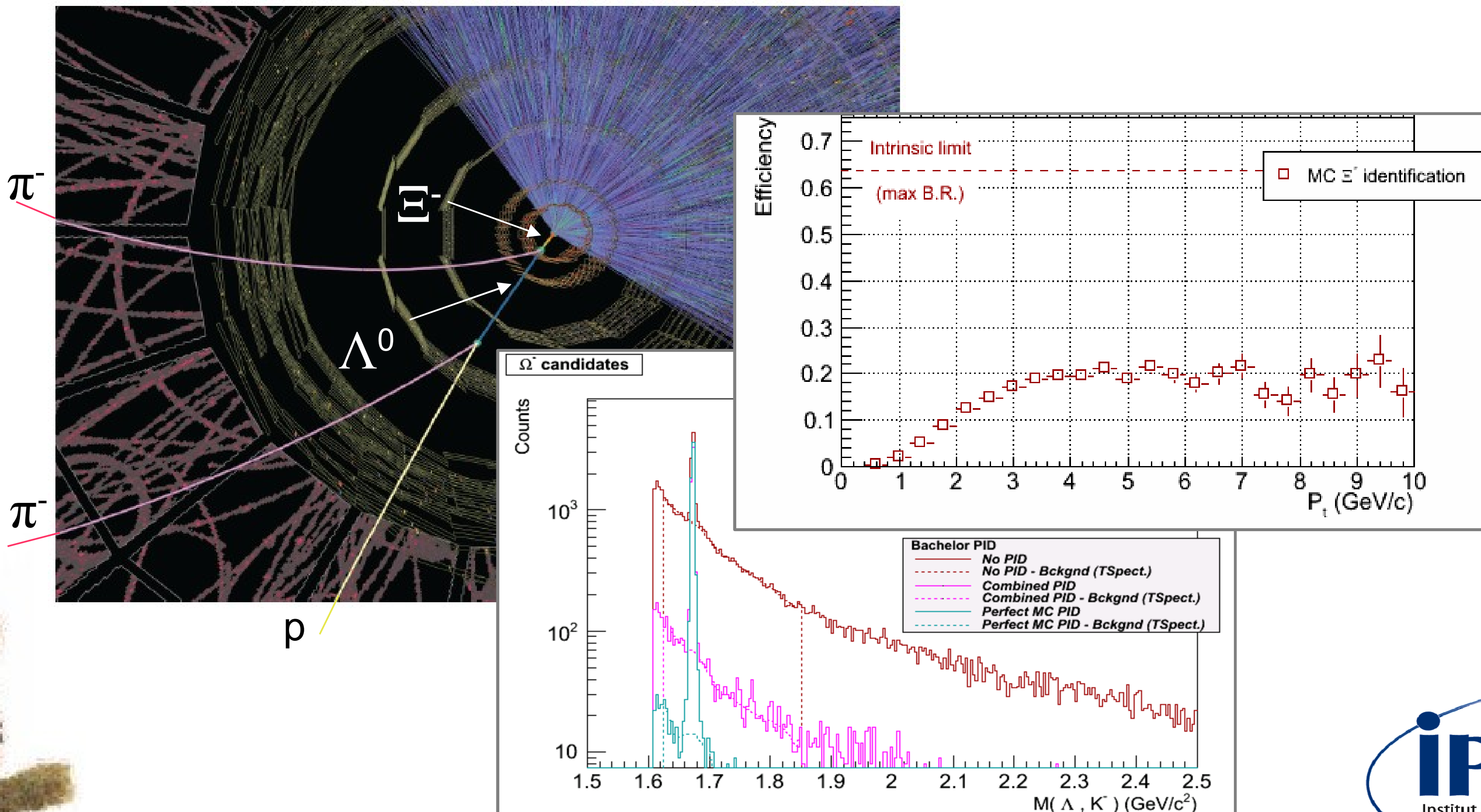
Antonin MAIRE – PhD student in Strasbourg
Friday, June 19th 2009 – Soft physics Workshop

Multi-strange particles : $\Xi^-(dss)$, $\Omega^-(sss)$ at LHC



Outline

I. Incentives for studying cascades
II. Topological identification
III. Situations: ESD/AOD + tasks
IV. Analysis environment
V. Latest output
VI. Conclusions

I.1 – Incentives : collective effects

- Radial flow :
  - → shape of the $d^2N/dp_t dy$ spectra
  - Flow seen in Au-Au at RHIC.
  - But radial flow in pp collision ?
  - at LHC ?

Example of Tsallis Blast-Wave

Exponential + Power law + blast ...

$$\frac{d^2N}{2\pi m_T dm_T dy} \propto (1+\frac{q-1}{T}m_T)^{-1/(q-1)}$$

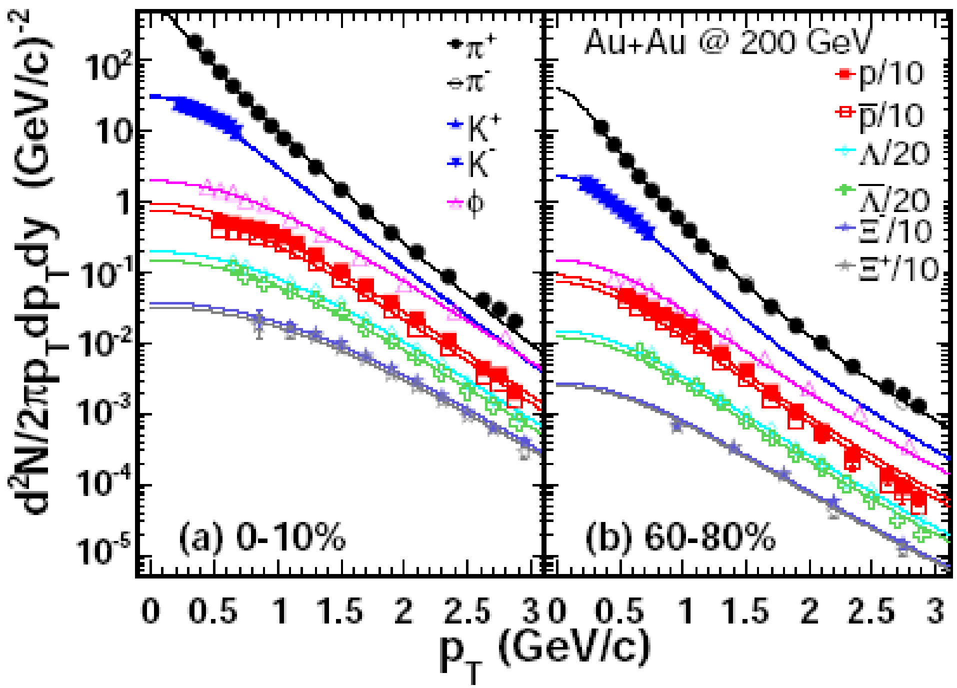
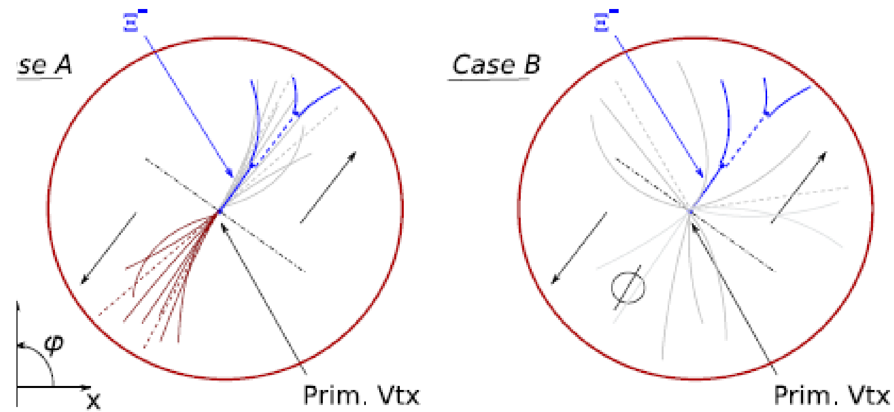


FIG. 1: (Color Online) Identified particle transverse momentum spectra in Au+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV in0-10% central (a) and in peripheral 60-80% collisions (b). The symbols represent experiment data points. The solid curves represent the TBW fit.

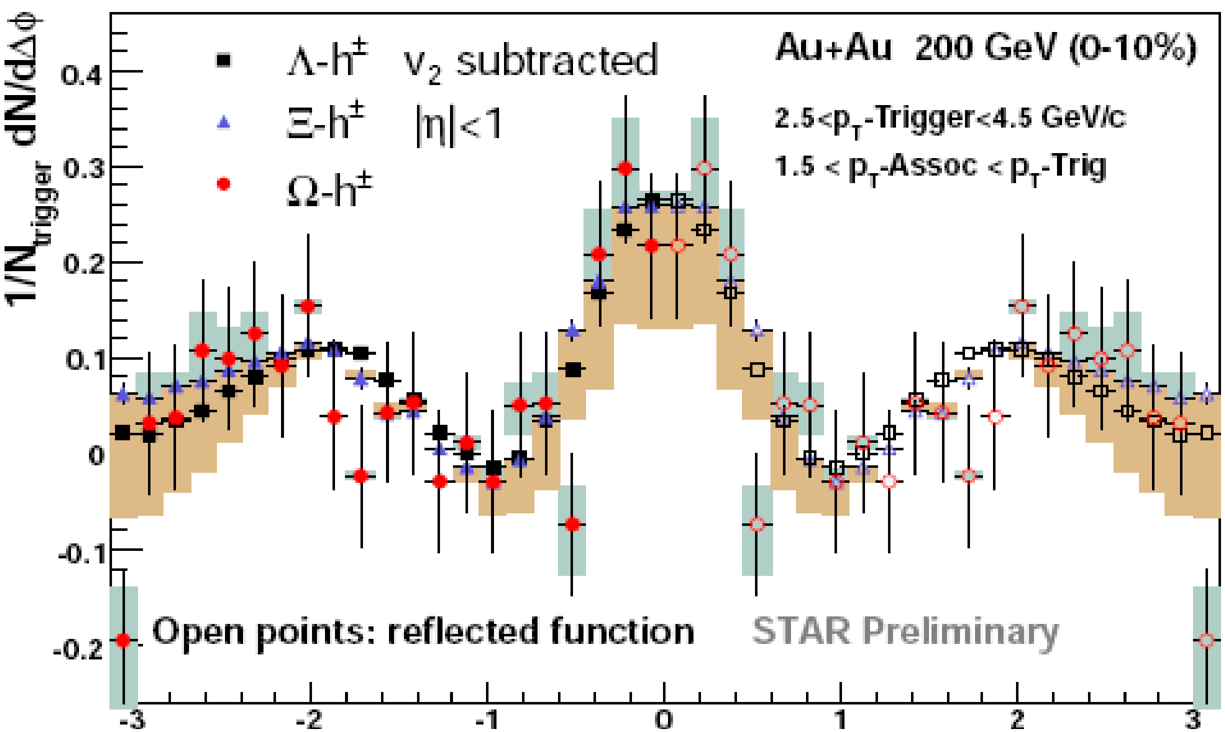
Tang et al. / arxiv:0812.1609

I.2 – Incentives : hadronisation mechan.

- Coalescence or fragmentation ?
  - Tool : azimuthal correlation studies



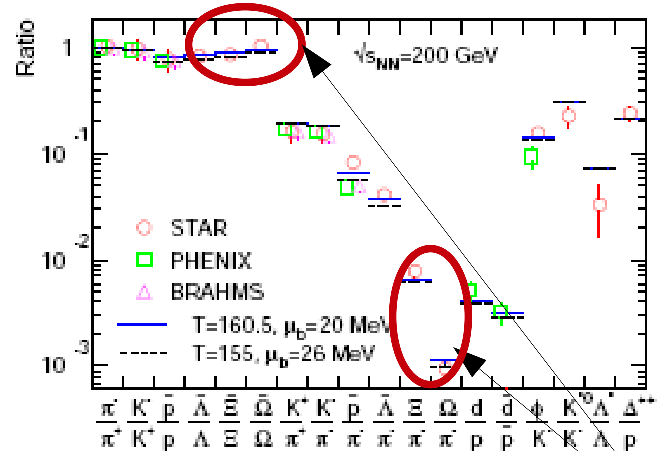
B.Abelev (STAR) / arXiv:0705.3371



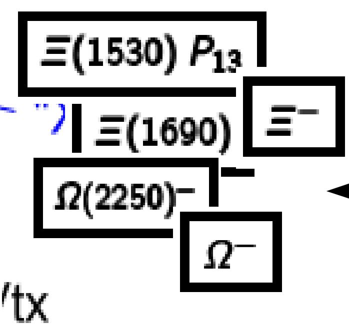
- Correlation seen in Au-Au at RHIC
- Again, in pp ? At LHC ?

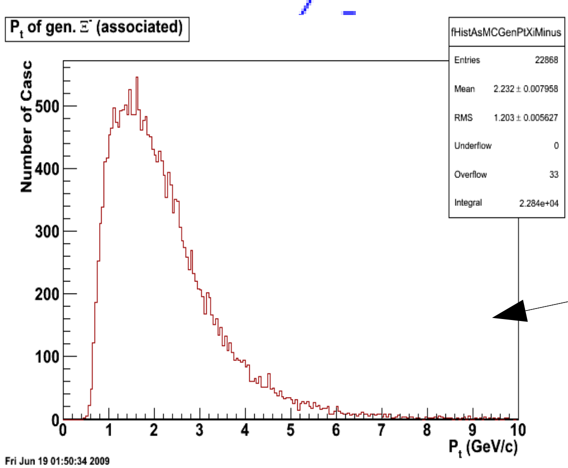
II – With topological identification

Andronic et al. / arXiv:nucl-th/0511071



Bachelor : π^-





- A general question :

  hadronisation issue for quarks coming out of QGP

  → Charged multi-strange baryons :

  Ξ^- (dss) Ξ^+ ($\bar{d}\bar{s}\bar{s}$)

  Ω^- (sss) Ω^+ ($\bar{s}\bar{s}\bar{s}$)

Advantages coming along :

1. *s* quarks, ~ genuine + ~ relatively abundant products of the collision
2. small cross section in the hadronic phase
3. decay mode in *cascade*
   → possible identification over a large energy range (*soft* to *hard* phenomena)

III.1 – **Situation** : vertexers; ESD, AOD.

ESD :

* *STEER/AliV0vertexer* + *STEER/AliCascadeVertexer :*
- Use of AliESDEvent::GetPrimaryVertex()
  = best available Vtx between Trackg, SPD, TPC, Default Prim. Vtx

* *STEER/AliESDv0* + *STEER/AliESDcascade :*
- inheritance from AliVParticle
- Constrain on the charge sign according to the sign of the bachelor

Filter ESD to AOD : (for V0 : B.Hippolyte)

for Cascades : *AliAnalysisTaskESDfilter* + *AliAODEvent,*
updated to properly include Cascades at AOD level.

→ *Code in SVN : trunk/ANALYSIS*
+ branches/v4-16-Release/ANALYSIS/ *(See Savannah - #47433)*

AOD :

Class *STEER/AliAODcascade* + *STEER/AliAODv0* available

III.2 – CheckCascade : QA for $\Xi^{-/+}$, $\Omega^{-/+}$

Description of the task : *AliAnalysisTaskCheckCascade*

→ performs **basic cross-checks** prior to full Cascade analysis (QA task)

= Validation of the cascade vertexer selections

= Inv Mass distribution of the candidates under different mass hypotheses (Ξ-/+, Ω-/+)

= Info for extra selections (Armenteros, Λ mass Vs Ξ- mass…)

→ profits from **combined PID**,

→ provides TH2F **Inv Mass Vs Pt** = traw material for yield extraction ...

Output : TList of (44) TH1F, (14) TH2F

Readiness of the code :

- code is in SVN ($ALICE_ROOT/PWG2/SPECTRA),
- class in compliance with ALICE Analysis Framework,
- tested on **local**, **CAF**, **GRID** with latest aliroot trunk,
- able to process **ESD ... or AOD, pp or PbPb**.

III.3 – Efficiency task : perf. for $\Xi^{-/+}$, $\Omega^{-/+}$

Description of the task :

→ Performs study of performance with MC info

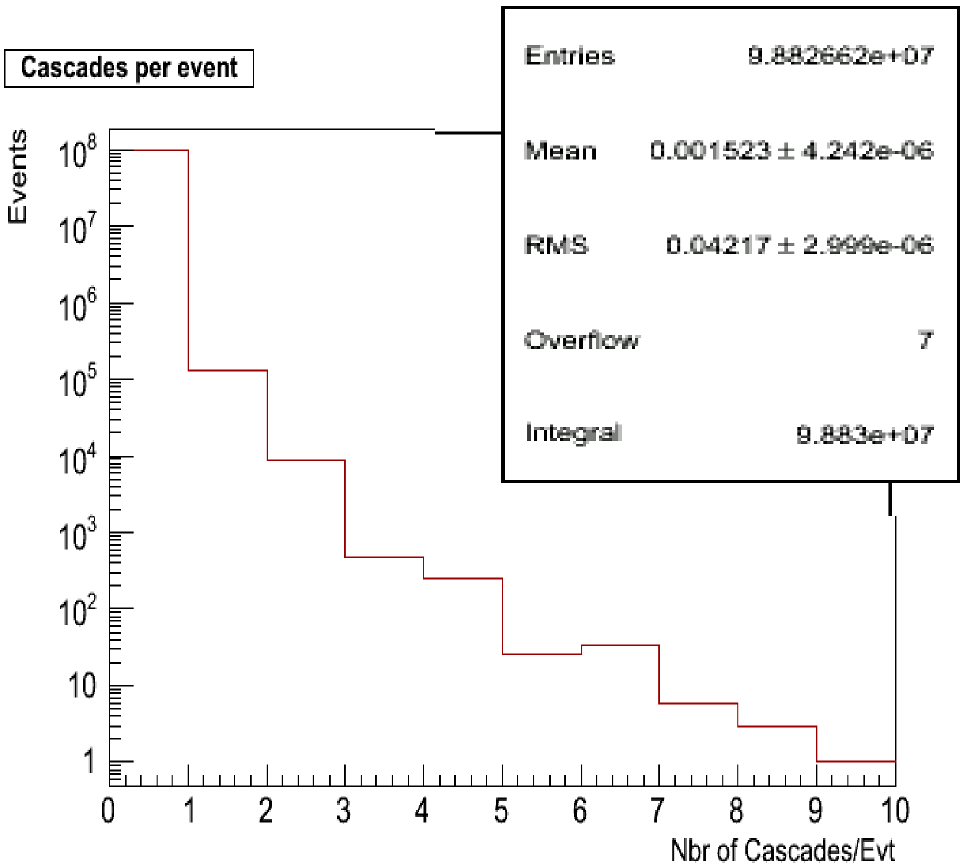
= look for any primary **generated** cascades,
= look for generated cascades which are **findable**,
= Inv Mass distribution of the candidates under different mass hypotheses (Ξ-/+, Ω-/+),
= **Association** of reconstructed cascade candidate to MC cascade,
= tap **MC PID** info,

Output : TList of (88) TH1Fand (13) TH2F

Readiness of the code :

- code is in SVN ($ALICE_ROOT/PWG2/SPECTRA),
- class in compliance with ALICE Analysis Framework,
- tested on **local**, **CAF**, **GRID** with latest aliroot trunk,
- able to process **ESD ... + ~AOD, pp or PbPb**.

IV – Analysis Env. : around LHC09a4



- Production LHC09a4:
  - Root : *v5-23-02,*
  - *Geant3 : v1-10*
  - AliRoot : *v4-16-Rev08,*
  - Runs : 81 007 to 81 656

  → *110 Mevts p+p collisions at 10 TeV,*
  = Pythia + enhancement (!)
  (0.25% of events = with 1 Ω^-; same for Ω^+)

- Analysis environment :
  - AliRoot v4-17-03,
  - Task : trunk/PWG2/SPECTRA/

- Analysed stat :
  - Standalone Cascade train on GRID,
  - AliEn plugin,
  - 98.8 Mevts

V.1 – Latest output : efficiencies

Hypotheses :

1. LHC09a4,
   Here, 98.8 Mevts analysed with MC

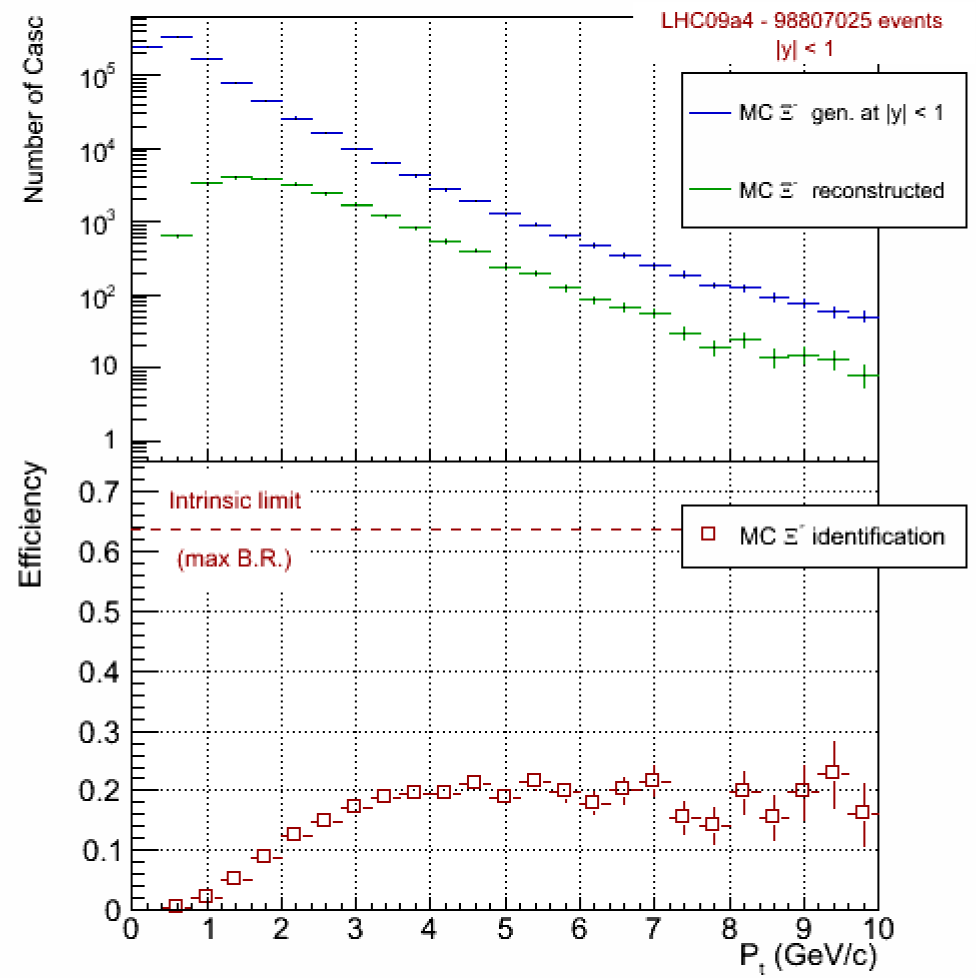
2. Considered channel =
   $\Xi^- \rightarrow \Lambda^0 + \pi^- \rightarrow (p+\pi^-) + \pi^-$
   (B.R. = 99,88% * 63,9% = 63,8 %)

Used definition

$$\text{Eff.} = \frac{\text{Nb of MC part. effectively reco.}}{\text{Nb of gen. at } |y| < 1}$$

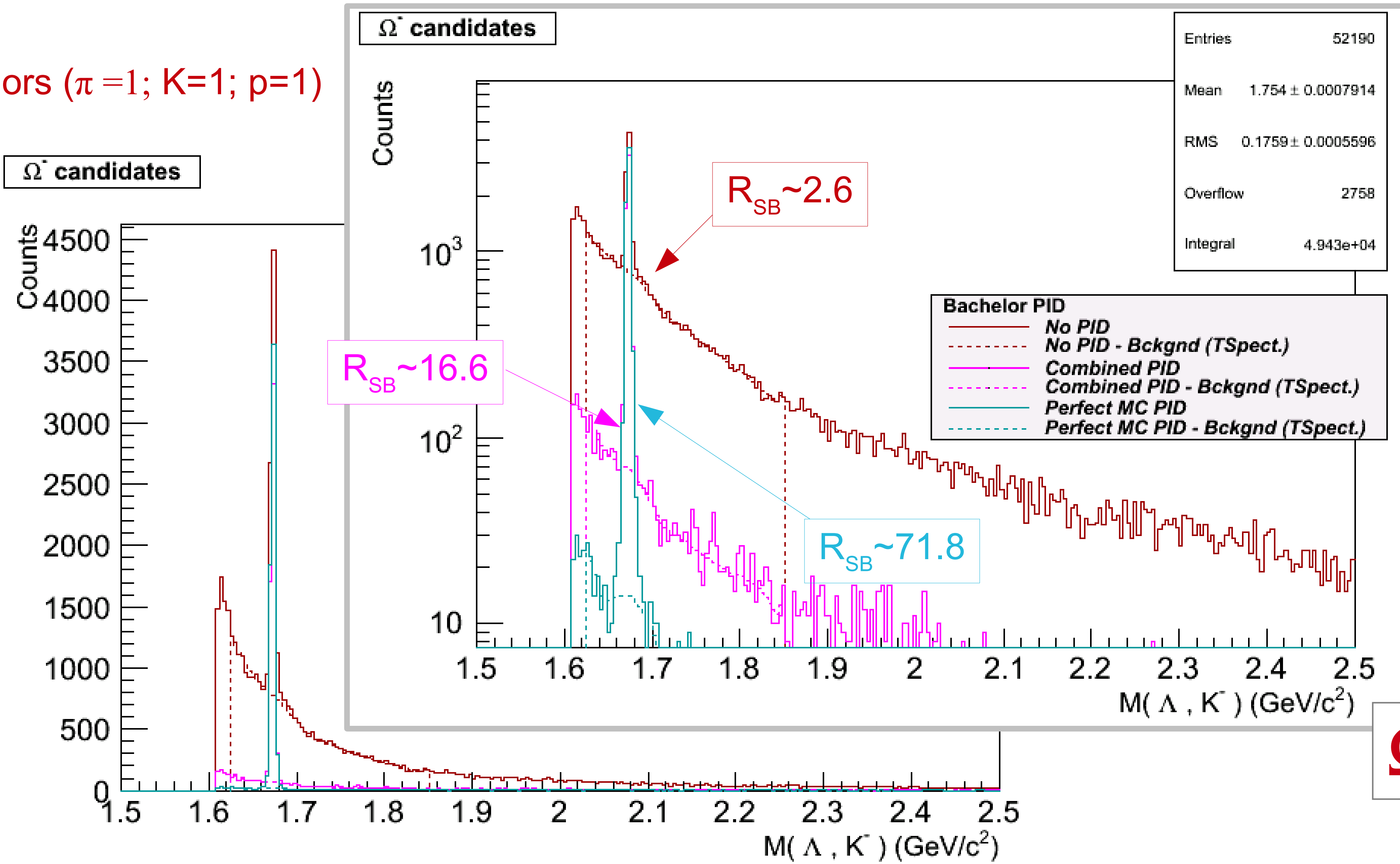
Reconstructed Ξ^- : 22 868
Ξ^- generated. at mid-rapidity : 932 995

→ Overall efficiency for Ξ^- = **2,45 %**



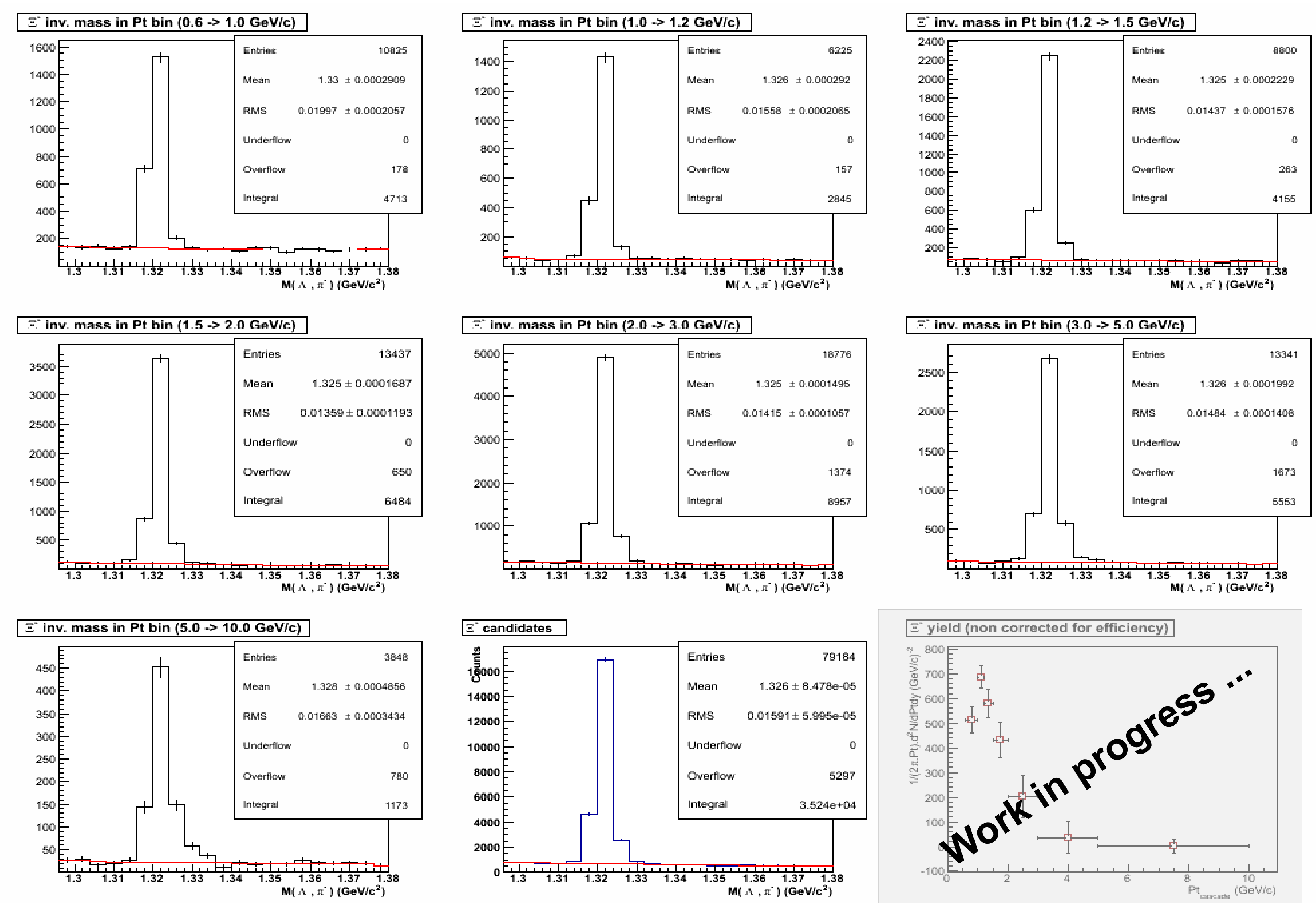
V.2 – Latest output : Bachelor PID

Priors (π =1; K=1; p=1)



Ω-

V.3 – Latest output : towards Yields

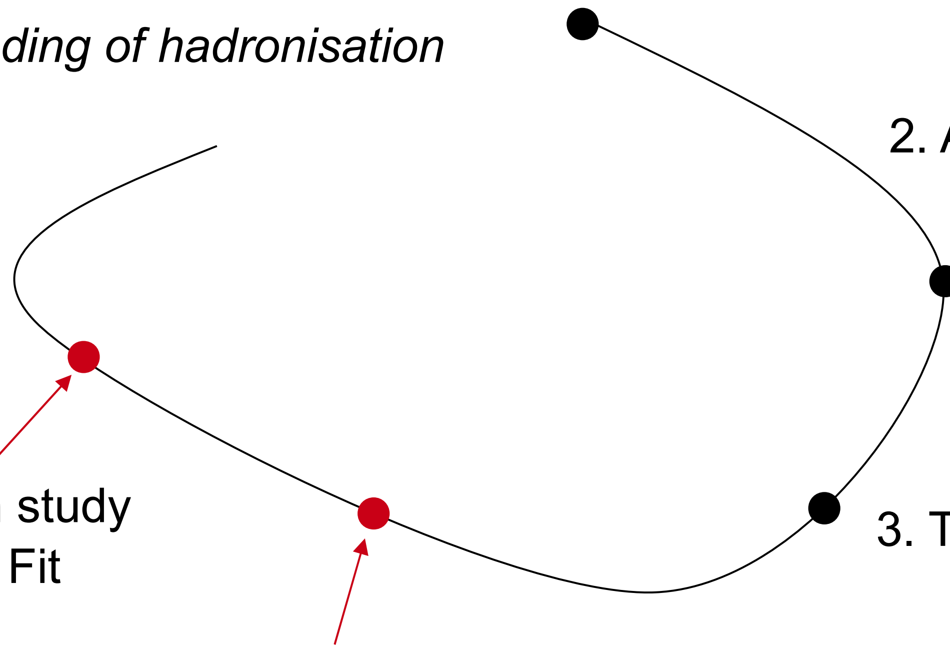


Conclusion

1. Issues : collective effects + hadronisation of quarks

Understanding of hadronisation Mechanisms ...

2. Adapted probe :
   Multi-strange baryons
   (over large pt range)



3. Topological reconstruction

5.1 Angular correlation study
5.2 Yields extraction + Fit

4. Control + assessment tools for reconstruction

- QA task (ESD/AOD) → needs extensive tests over AOD
- AliEVE visualisation → done.

- Performance tasks → profit from CORRFW

Conclusions and Prospects

- Conclusions :
  - Conclusion 1 sur cet **aspect**
  -

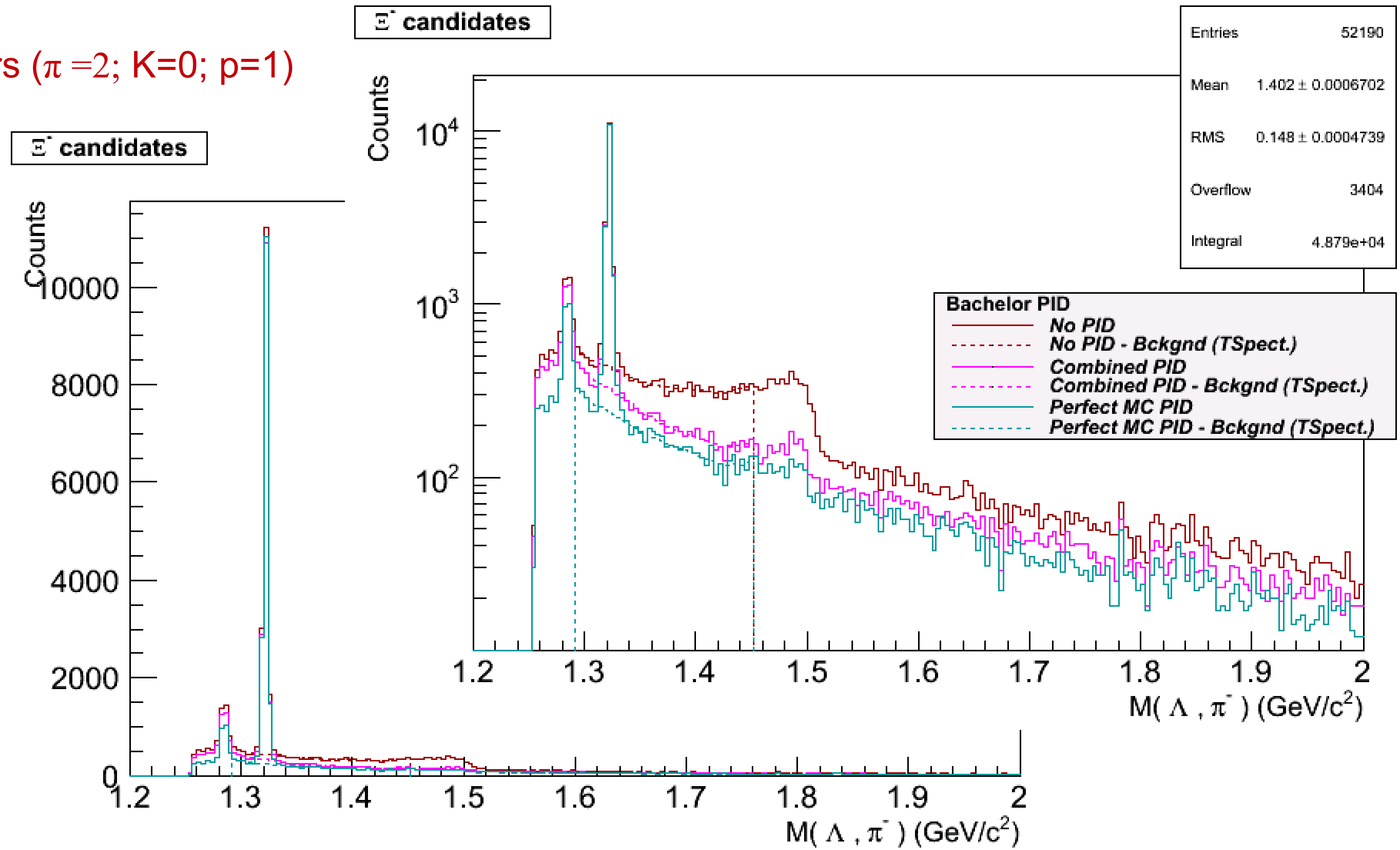
- Prospects :
  - perspective 1 sur cet **aspect**
  -

Appendix

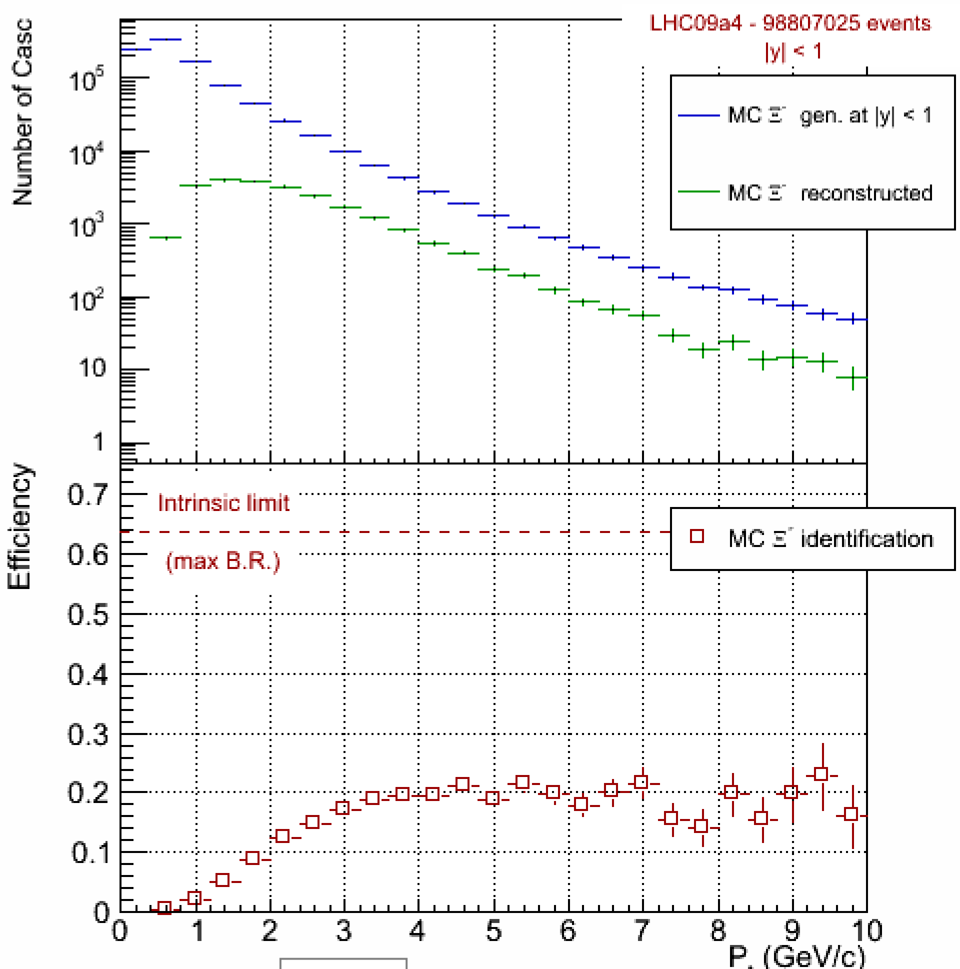
A. Annexe 1
B. Annexe 2

A.1 – Appendix : *Bachelor PID for $\Xi^{-/+}$*

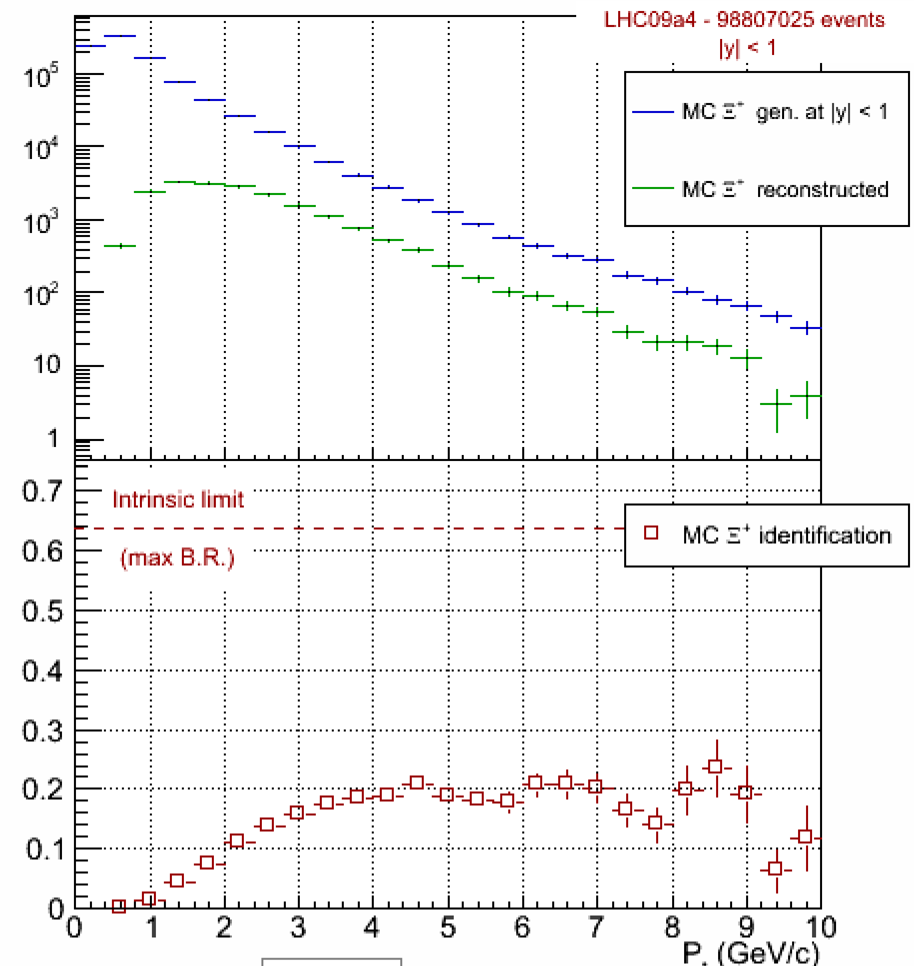
Priors (π =2; K=0; p=1)



Appendix B : $\Xi^{-/+}$ in Pt

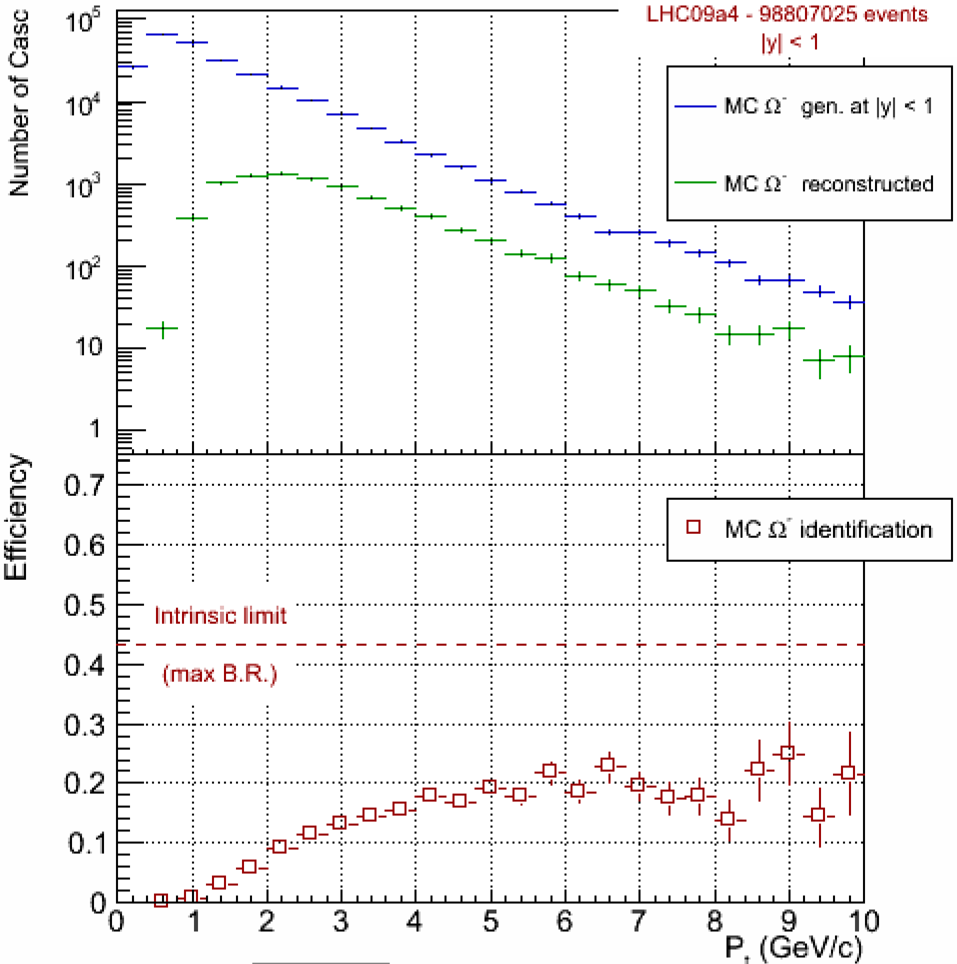


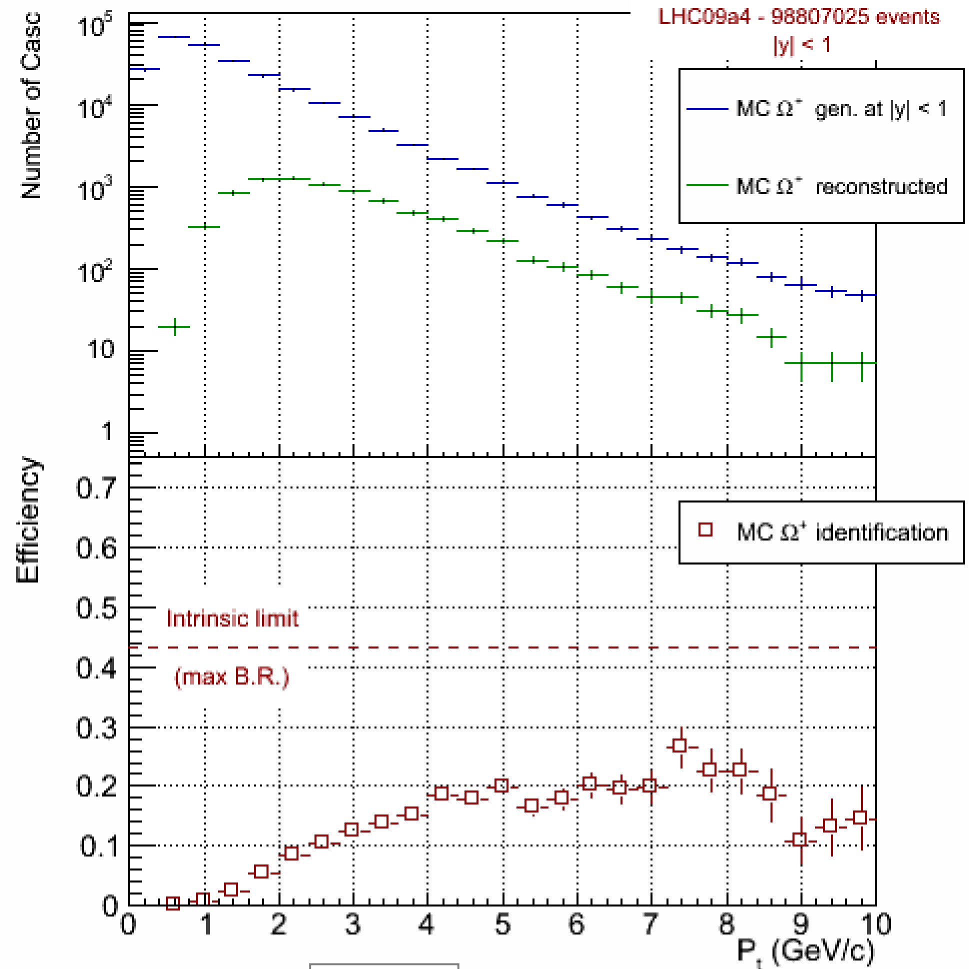
Ξ^-



Ξ^+

Appendix C : $\Omega^{-/+}$ *in Pt*



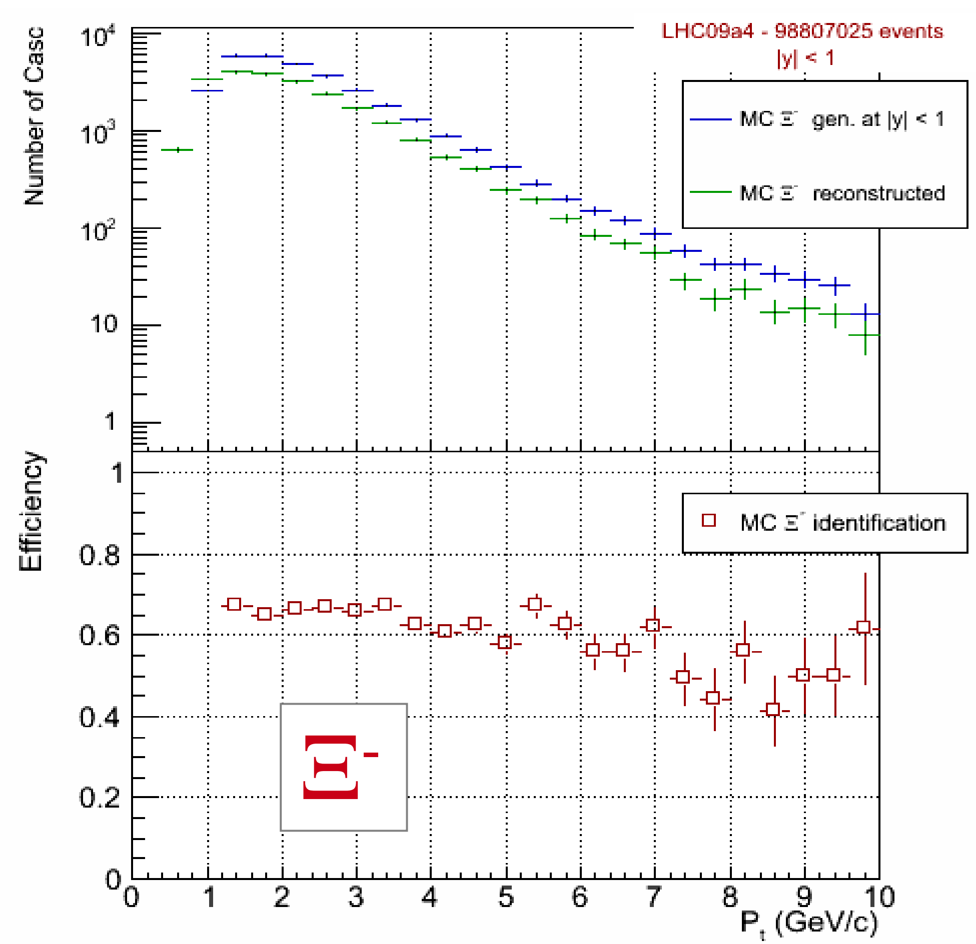


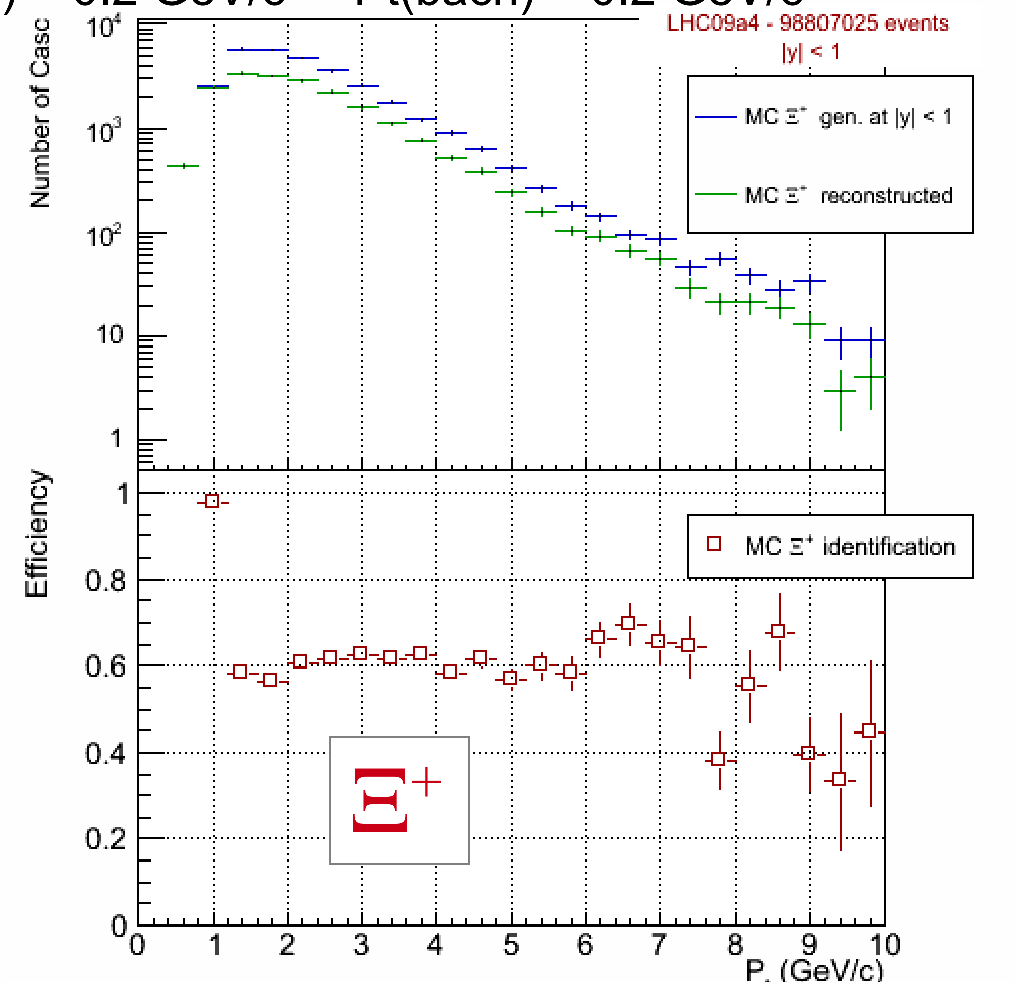
Ω^-

Ω^+

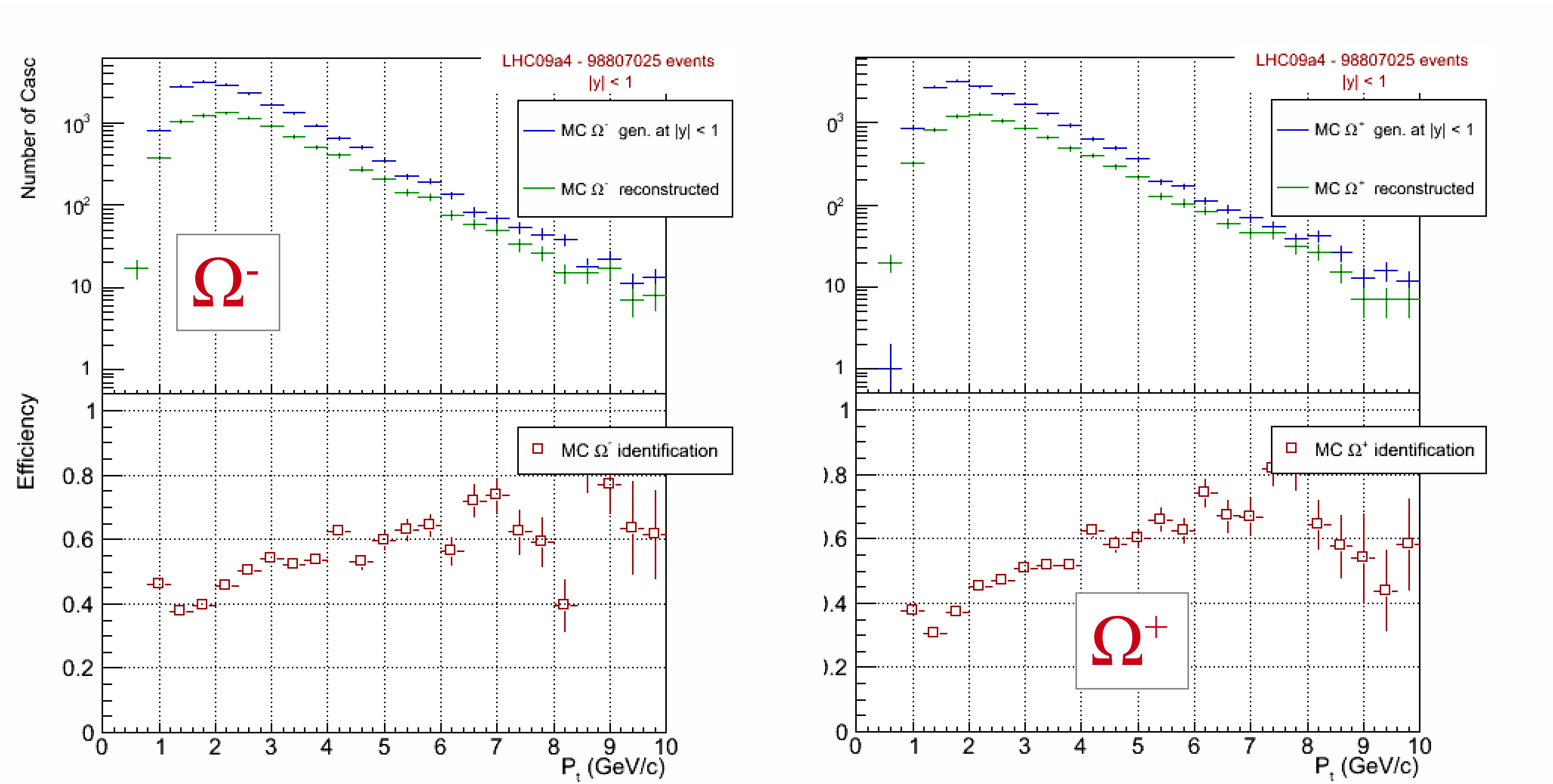
Appendix D : $\Xi^{-/+}$ *associated over« findable »*

For Ξ particle decaying into the proper channel :
45° < Θ < 135° for all the daughters,
Pt(p) > 0.5 GeV/c + Pt(π) > 0.2 GeV/c + Pt(bach) > 0.2 GeV/c





Appendix E: $\Omega^{-/+}$ associated over « findable »



Appendix F : Ξ^- *in Y or in η (examples)*