Σ^0 and $\bar{\Sigma}^0$ Baryon Production in pp Collisions at $\sqrt{s} = 7$ TeV at the LHC with ALICE

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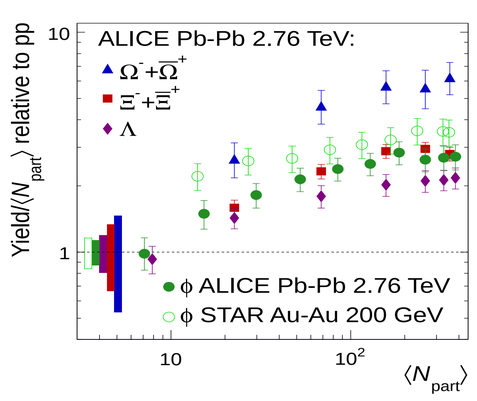
First observation of $\Sigma^0 \to \Lambda + \gamma$ and $\bar{\Sigma}^0 \to \bar{\Lambda} + \gamma$ decays in pp collisions at $\sqrt{s} = 7$ TeV

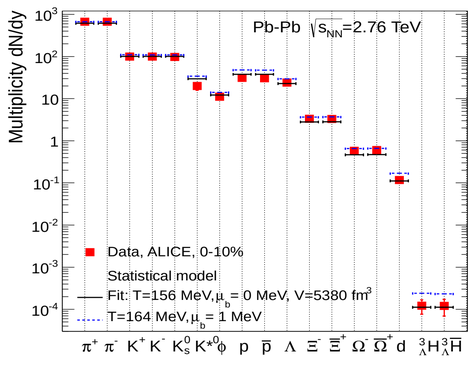
$\Sigma^0(1192)$, **branching ratio** $\approx 100\%$, **quark content:** *uds*, $c\tau = 2.22 \times 10^{-11}$ **m**

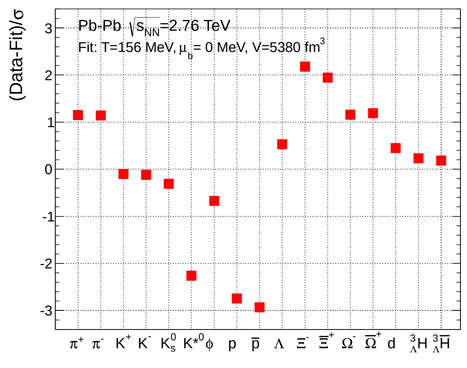
$\Lambda \to p + \pi^-$ **and** $\bar{\Lambda} \to \bar{p} + \pi^+$ **is detected through secondary vertex (V0) in the central barrel detectors**

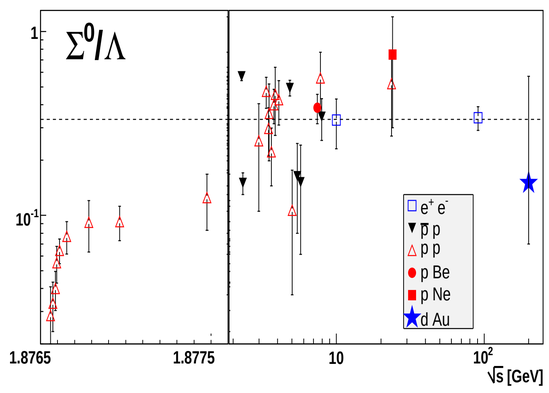
$\gamma \to e^+ + e^-$ **with Photon Conversion Method (PCM) in the central barrel detectors and in PHOS calorimeter,** $< E_\gamma > \approx 100$ **MeV**

Motivations: strangeness enhancement, contribution to thermal fits, discrimination of prompt and contaminated by Σ^0 decay Λ





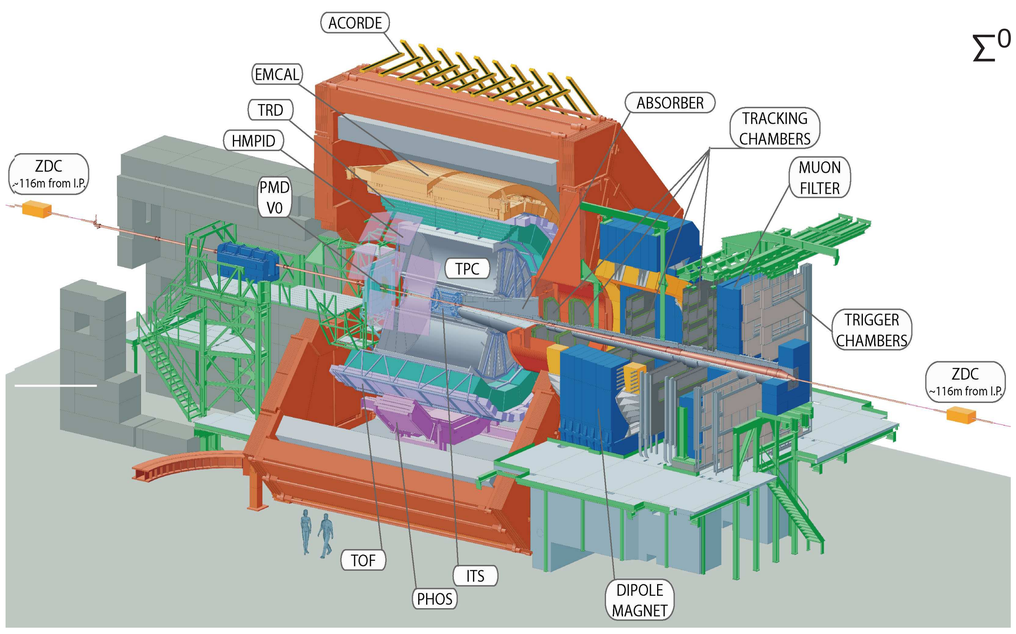




Yield of Σ^0 to be compared with Λ
(B.Abelev et al. (ALICE Collaboration), arXiv:1404.0495v1 [nucl-ex])

Σ^0 will be between p, Λ and Ξ
(J.Stachel,A.Andronic,P.Braun-Munzinger,K.Redlich,J.Phys.: Conf. Series 509 (2014) 012019)

Is cross section ratio $\Sigma^0/\Lambda \approx 0.33$ at LHC?
(G.Van Buren for the STAR Collaboration, arXiv:nucl-ex/0512018v1)

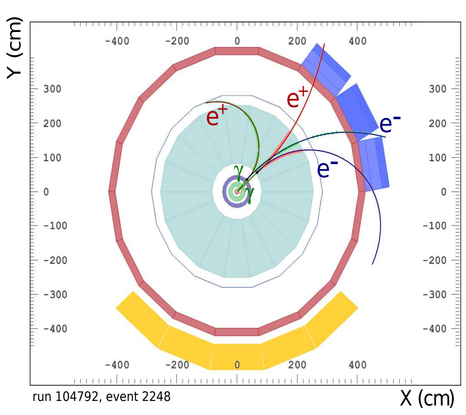


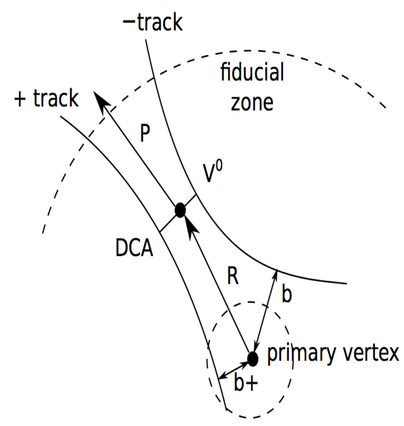
$\Sigma^0(\bar{\Sigma}^0)$ detection and reconstruction in TPC, ITS and PHOS

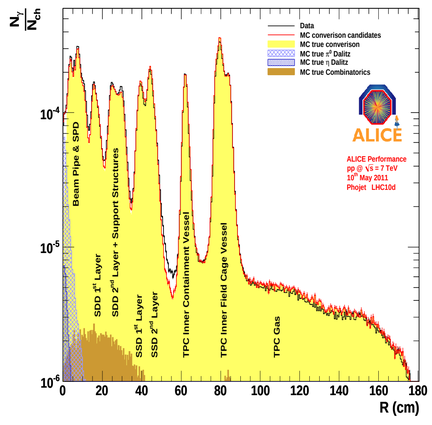
Σ^0 decays in the interaction point, two secondary vertices (V0) are from Λ and γ

Several topological cuts are applied for Λ and γ vertices

The ALICE material is well reproduced with PCM





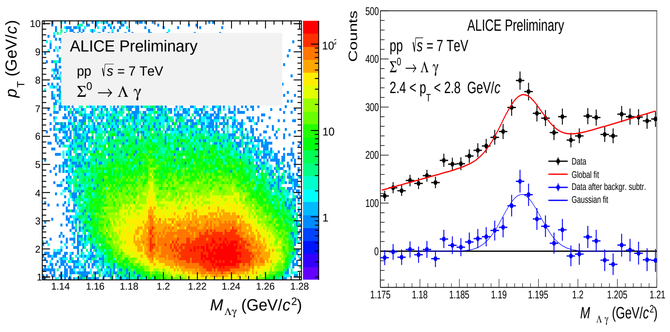


Examples of Σ^0 and $\bar{\Sigma}^0$ data at $2.4 < p_T < 2.8$ GeV/*c*

$M_{\Sigma^0} = 1192.64 \pm 0.13$ MeV

$\sigma_{M_{\Sigma^0}} = 2.14 \pm 0.13$ MeV

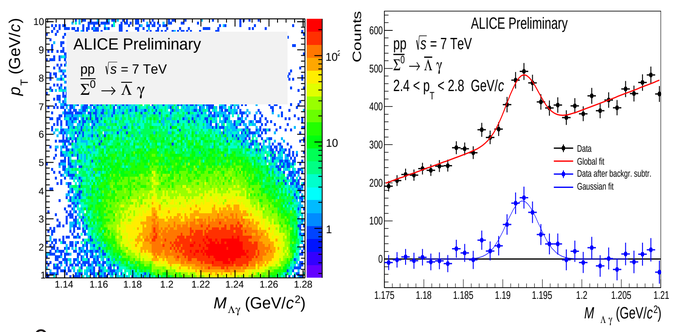
Significance $\Sigma^0 = 21.8 \pm 2.6$



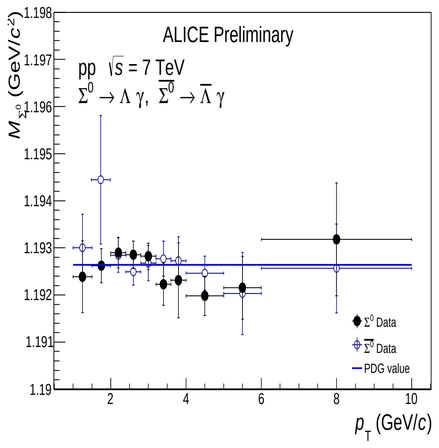
$M_{\bar{\Sigma}^0} = 1192.66 \pm 0.14$ MeV

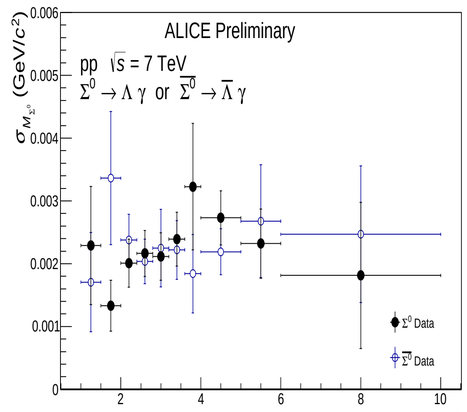
$\sigma_{M_{\bar{\Sigma}^0}} = 2.20 \pm 0.17$ MeV

Significance $\bar{\Sigma}^0 = 19.6 \pm 2.1$



p_T dependecies of $M_{\Sigma^0}, M_{\bar{\Sigma}^0}$ and $\sigma_{M_{\Sigma^0}}, \sigma_{M_{\bar{\Sigma}^0}}$





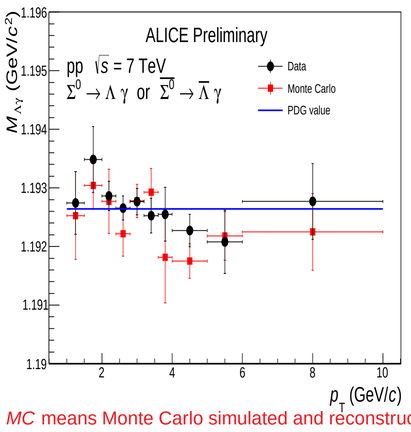
Armenteros-Podolanski cuts are applied for Σ^0, Λ decays and γ conversion. Only statistical uncertainties are presented on the plots.

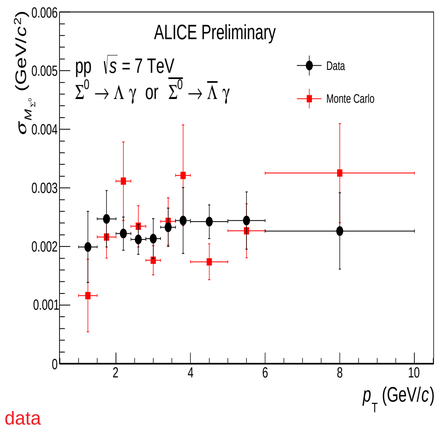
Combined $\Sigma^0, \bar{\Sigma}^0$ data

$M = 1192.65 \pm 0.099$ MeV, $\sigma_M = 2.27 \pm 0.12$ MeV

$M^{MC} = 1192.43 \pm 0.13$ MeV, $\sigma_M^{MC} = 2.08 \pm 0.13$MeV

$M_{\Sigma^0}^{PDG} = 1192.642 \pm 0.024$ MeV





MC means Monte Carlo simulated and reconstructed data

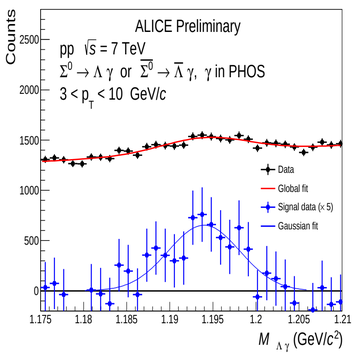
Proof-of-principle: γ in PHOS

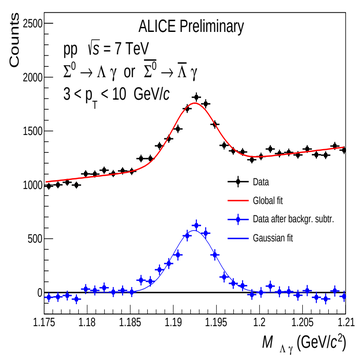
γ_{PHOS} :

$M = 1194.1 \pm 0.6$ MeV, $\sigma_M = 5.1 \pm 0.5$ MeV

γ_{PCM} :

$M = 1192.38 \pm 0.12$ MeV, $\sigma_M = 2.5 \pm 0.14$ MeV





Summary

- Σ^0 invariant mass agrees with PDG, its width with the simulations.
- Extraction of the yields and Σ^0/Λ cross section ratio is going on for pp data. Analysis of pPb and PbPb data is started.
- Σ^0 is an independent cross-check of alignment, calibration and search of the vertex of the converted low-p_T photon.

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