Production of nuclei and anti-nuclei in pp and PbPb collisions with ALICE at the LHC

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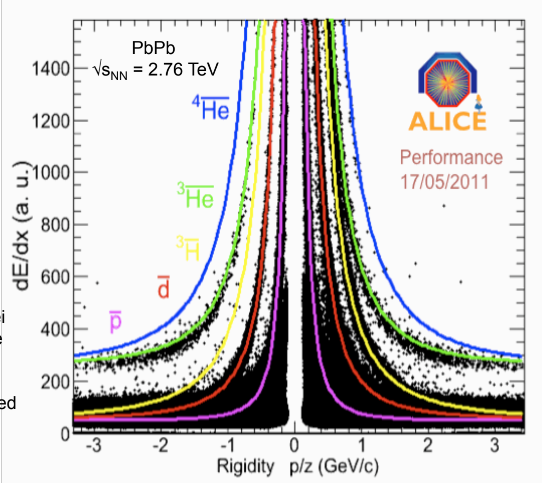
Particle Identification

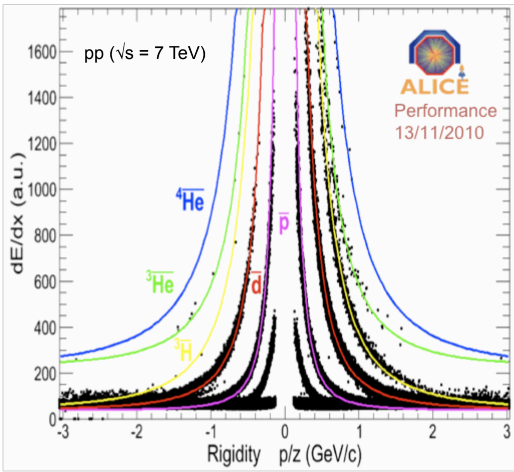
The Time Projection Chamber (TPC) is the main tracking device of ALICE. It identifies particles by measuring their specific energy loss.

These figures show the particle identification through their specific energy loss vs rigidity in the ALICE TPC. Solid lines are parameterized Bethe-Bloch function. Left figure is for PbPb ($\sqrt{s_{NN}}$ = 2.76 TeV) collisions and the right figure for pp ($\sqrt{s}$ = 7 TeV).

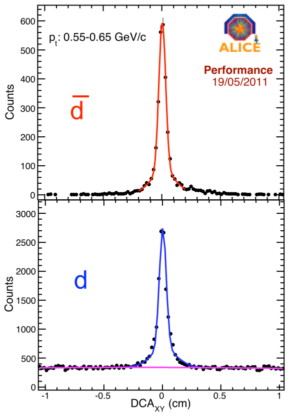
Various particles, nuclei and anti-nuclei are clearly identified over a wide range of momenta.

16 M minimum bias events are analyzed for PbPb collisions ($\sqrt{s_{NN}}$ = 2.76 TeV) and 360 M events are analyzed for pp collisions ($\sqrt{s}$ = 7 TeV).



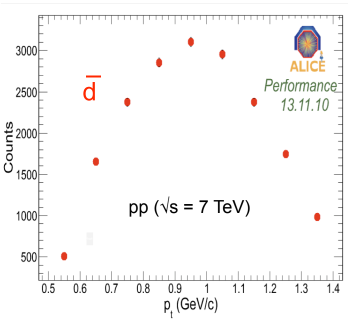


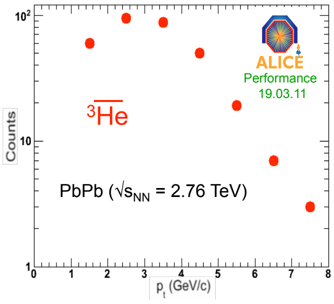
Extraction of yields



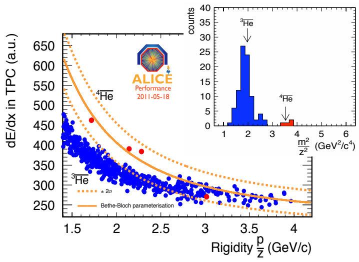
✧ The ALICE Inner Tracking System gives a precise determination of the event vertex, by which primary and secondary particles are separated.
✧ Nuclei and anti-nuclei produced in the collisions have Distance of Closest Approach (DCA) near to zero. Nuclei can also be produced by interaction with the material. Their yields are obtained after background subtraction in the DCA_{XY} distribution.
✧ Left figure is an example of the yield extraction in the p_t slice 0.55-0.65 GeV/c :
- Top panel shows the DCA_{XY} distribution for identified anti-d, red line is fitting with a 2-Gaussian function.
- Bottom panel shows the corresponding DCA_{XY} distribution for identified deuterons, blue line is fit function for Signal + Background.

Raw yields of various nuclei and anti-nuclei are determined by analyzing the DCA_{XY} distribution for different p_t bins.
Analyzed: d, anti-d, t, anti-t, ^{3}He and anti-^{3}He
Figures below show anti-d counts as a function of p_t for pp collisions ($\sqrt{s}$ = 7 TeV) and anti-^{3}He counts as a function of p_t for PbPb collisions ($\sqrt{s_{NN}}$ = 2.76 TeV)





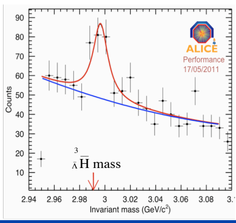
Anti-Alpha and Anti-HyperTriton Signal



✓ Four candidates of $^4\overline{He}$ are found in the PbPb collisions at $\sqrt{s_{NN}}$ = 2.76 TeV (red points).
✓ Out of these, two candidates are confirmed by Time of Flight (TOF) measurement.
✓the insert shows m^2/z^2 distribution combining TPC and TOF analyses.

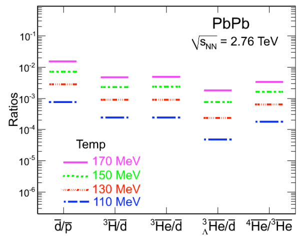
Anti-HyperTriton signal is obtained by calculating the invariant mass of displaced daughter tracks from the vertex.

$$^3_{\bar\Lambda}\overline{H} \rightarrow {}^3\overline{He} + \pi^+$$



Goals

• Comparison of spectra in pp and PbPb collisions (yields, slopes, radial flow).
• Comparison of particle ratios with thermal model predictions [1] using THERMUS [2].
• Comparison with coalescence expectations.



References :
[1] J. Cleymans, S. Kabana, I. Kraus, H. Oeschler, K. Redlich, and N. Sharma, arXiv:nucl-th/1105.3719.
[2] S. Wheaton J. Cleymans, and M. Hauer, Comput. Phys. Commun. **180**, 84 (2009), hep-ph/0407174.