

A study of the (anti)deuterons source in Pb–Pb collisions

Wioleta Rzęsa (on behalf of the ALICE Collaboration)

Warsaw University of Technology (wioleta.rzesa.dokt@pw.edu.pl)



Motivation

The (anti)deuteron's creation in heavy-ion collisions (HIC) is not understood.

Two common scenarios:

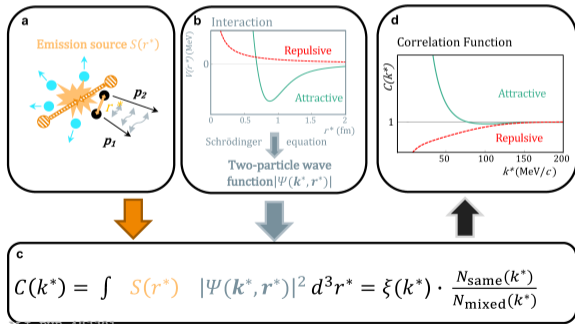
- Coalescence model: (anti)deuteron's creation from final-state interactions among nucleons after the chemical freeze-out
- Thermal model: (anti)deuteron's creation inside the fireball before the chemical freeze-out

Experimentally: (anti)deuteron's source size never studied in HIC!



Methodology

- Femtoscopy: determination of the space-time characteristics of the particle-emitting source using correlation function (CF) in momentum space
- CF: convolution of the source function and wave function (the latter for non-identical particles combines strong and/or Coulomb forces)



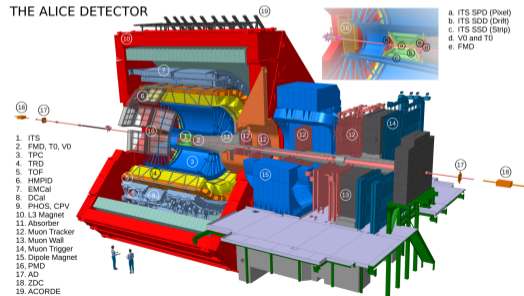
arXiv:1908.08339v1

Nature 588 (2020) 232-238

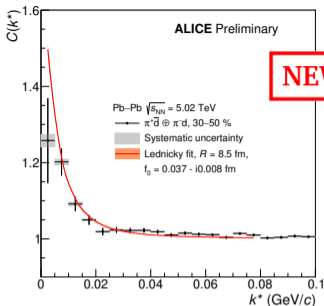
Data analysis

- Analysis of πd CFs in Pb–Pb at $\sqrt{s_{NN}} = 5.02$ TeV collisions
- 3 centrality intervals: 0–10%, 10–30%, 30–50%
- 2 m_T of particle pairs: 0.84, 1.03 GeV/c
- Momentum reconstruction via TPC detector
- Particle identification via TPC and TOF detectors

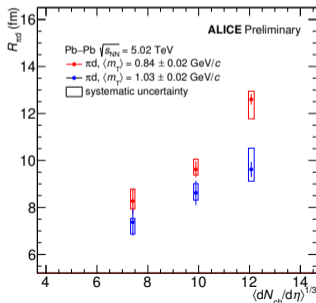
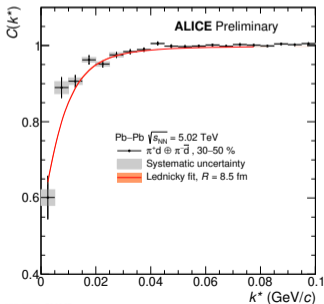
THE ALICE DETECTOR



πd correlation functions & radii



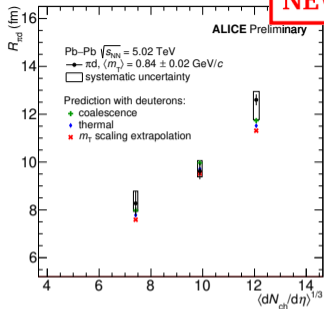
- Lednický-Lyuboshitz simultaneous fit to opposite (Coulomb & strong) and same (Coulomb) charges particle pairs
- Zero effective-range approximation ($d_0 = 0$)



- 6 πd radii: 3 centralities, 2 m_T of πd particle pairs
- πd radii depend on m_T and multiplicity

NEW

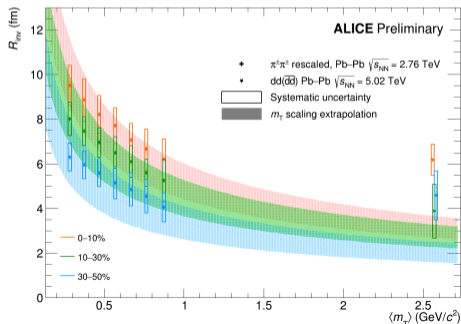
Comparisons with expectations



- πd source sizes obtained according to thermal and coalescence scenarios [1]. The πd source size does not depend on the employed production model.

- $d(\bar{d})$ source sizes estimated from measured πd radii and single pion radii (measured in Pb-Pb at 2.76 TeV [2] rescaled to 5.02 TeV) are larger than expected m_T scaling radii.

- [1] S. Mrówczyński, P. Słoń, Acta Physica Polonica B, 51 (2020)
 [2] ALICE Collaboration, Phys. Rev. C, 92, 5, (2015)



Summary and conclusions

- First measurement of πd CFs
- First measurement of CFs with deuterons in heavy-ion collisions
- πd CFs have low sensitivity on deuterons's source size and therefore differences related to its possible scenarios of creation.
- Deuteron's source size are slightly larger than the ones expected from a m_T scaling from other particles but compatible within uncertainties.