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

Wioleta Rzęsa (on behalf of the ALICE Collaboration)
Warsaw University of Technology (wioleta.rzesa.dokt@pw.edu.pl)

Motivation

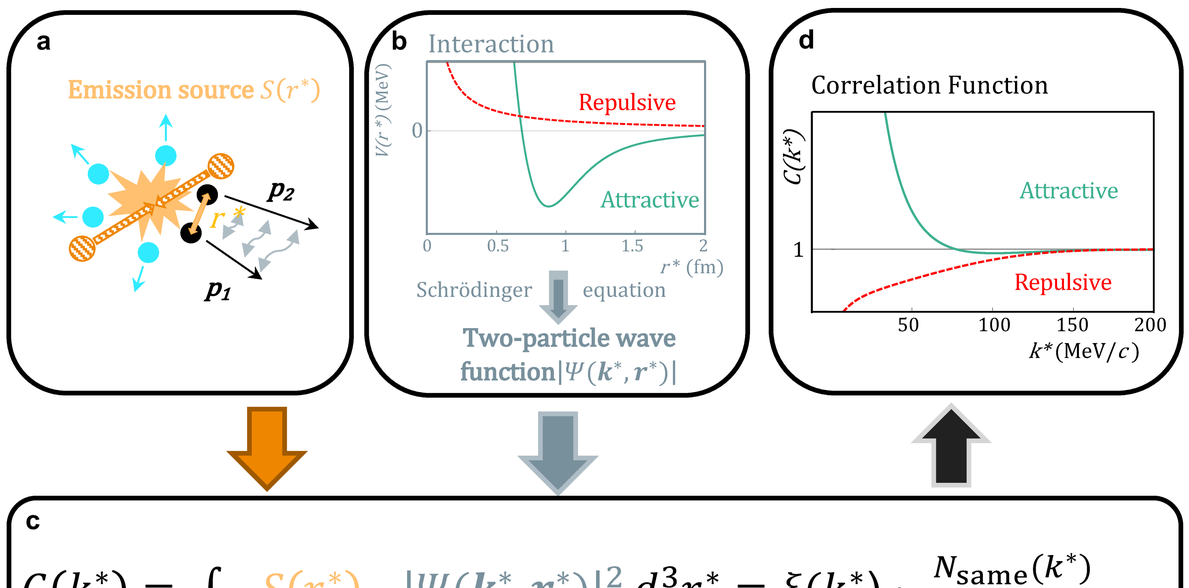
The (anti)deuteron creation in heavy-ion collisions (HIC) is not understood.
Two common scenarios:

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

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

Methodology

Femtoscopy makes it possible to measure the space-time characteristics of the source of particles by using particle correlation in momentum space. The correlation function (CF) can be understood as the convolution of the source function (which characterizes the source) and the wave function (which, if we consider non-identical particles, combines strong and/or Coulomb forces). Therefore, the shape of the correlation function can be used to draw conclusions about the source size of considered particles



ALI-PUB-483391

πd source sizes

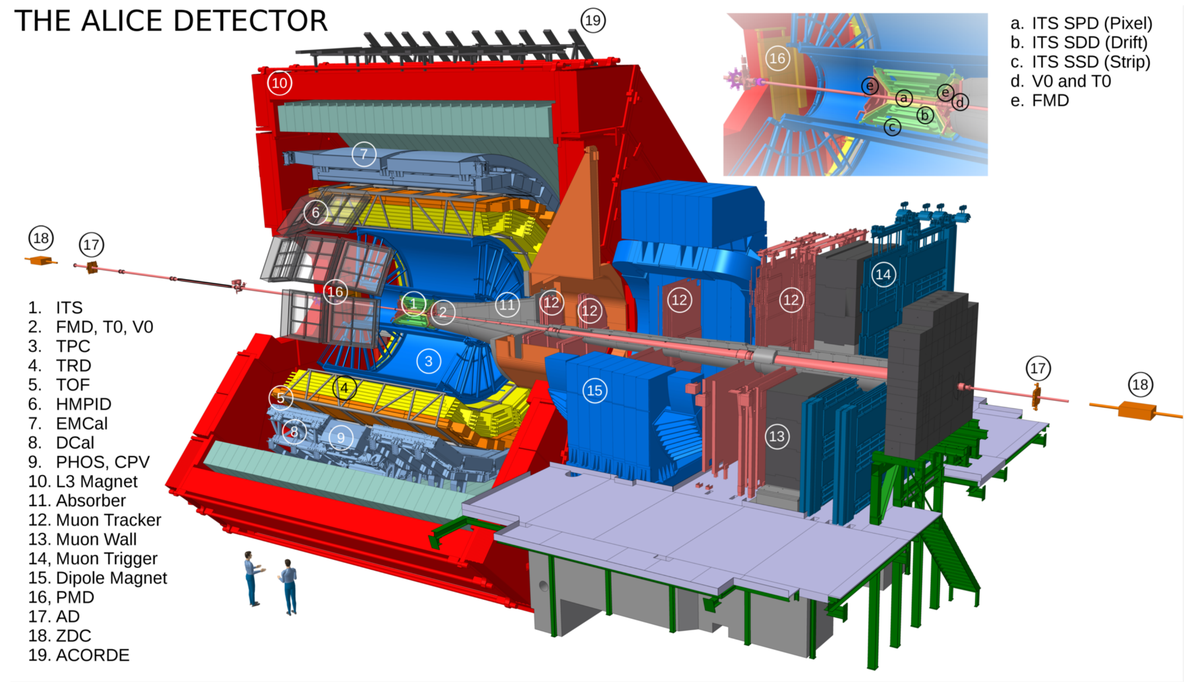
πd radii depend on m_{T} and multiplicity

ALI-PREL-504112

Data analysis

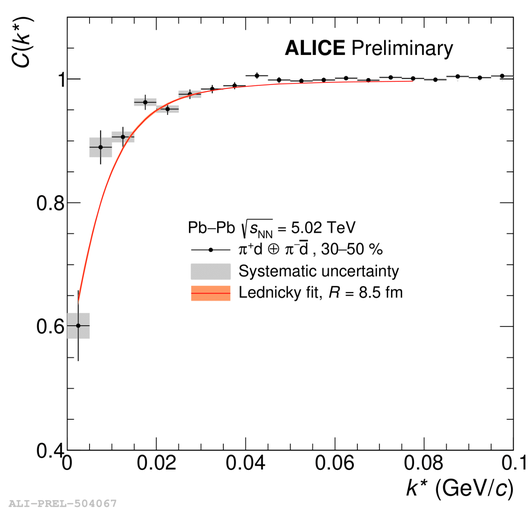
Analysis of πd CFs in Pb–Pb at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV collisions

- 3 centrality intervals: 0–10%, 10–30%, 30–50%
- $2 < m_{\mathrm{T}} >$ of particle pairs: 0.84, 1.03 GeV/c
- Momentum reconstruction via TPC detector
- Particle identification via TPC and TOF detectors

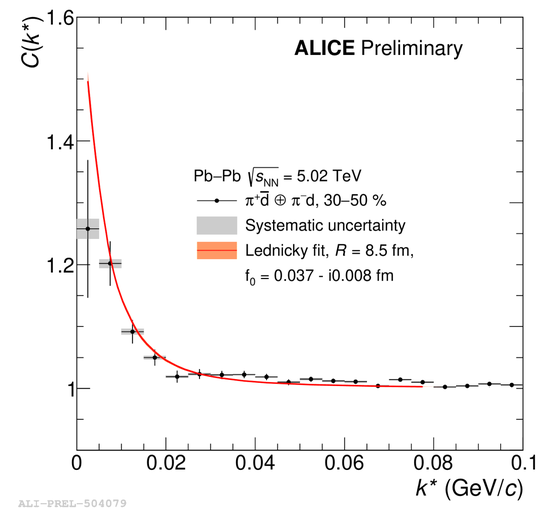


Fitting

Simultaneous fit to opposite charge (Coulomb & strong) and same charge (Coulomb) particle pairs with Lednický–Lyuboshitz [1] model



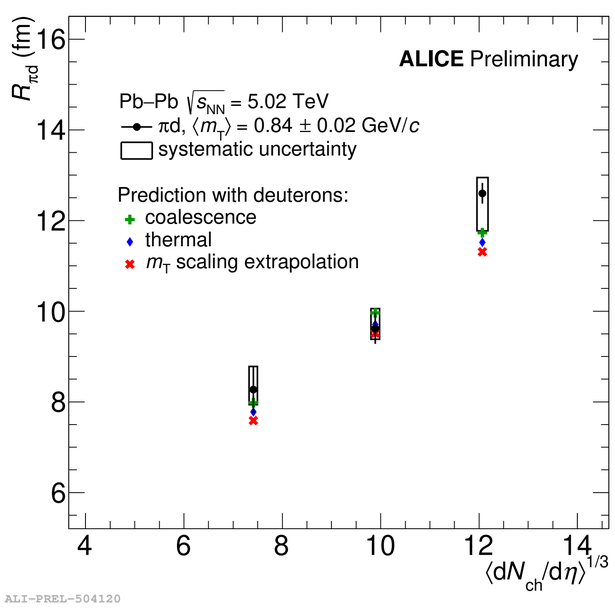
ALI-PREL-504067



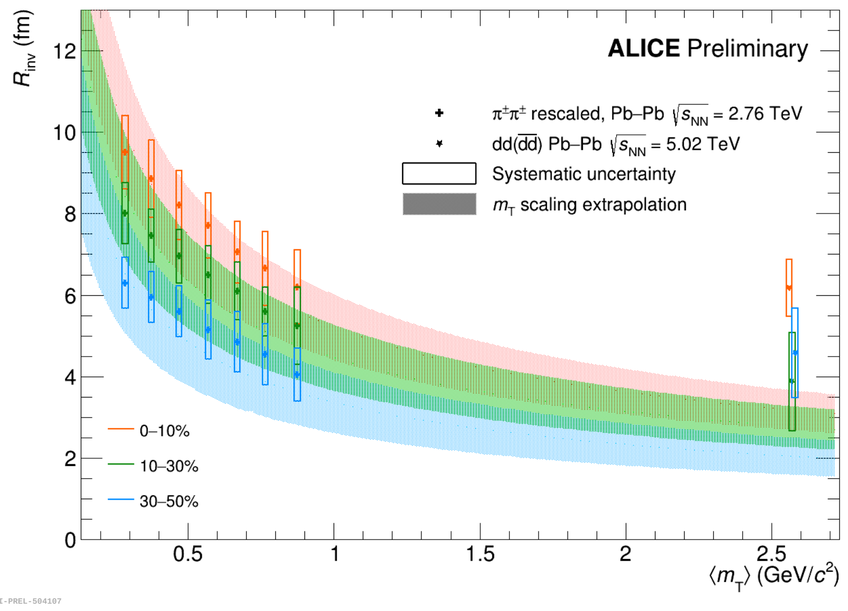
ALI-PREL-504079

Comparisons with expectations

- (Left) πd-source sizes determined according to thermal and coalescence scenarios [2]. The size of the πd-source does not depend on the production model used
- (Right) $d(\bar{d})$ source sizes estimated from measured πd radii and single pion radii (measured in Pb–Pb at 2.76 TeV [3] rescaled to 5.02 TeV) are larger than expected m_{T} scaling radii



ALI-PREL-504120



ALI-PREL-504107

References

[1] R. Lednický, Phys. Atom. Nucl. 67 (2004) 72
[2] S. Mrówczyński, P. Słoń, Acta Physica Polonica B 51 (2020) 1739
[3] ALICE Collaboration, Phys. Rev. C 92 (2015) 054908

This project has received funding from the Helmholtz Institute Mainz and the European Union's Horizon 2020 research and innovation programme under grant agreement No 824093