

First measurement of properties of strong interaction between deuterons and light hadrons in Pb–Pb collisions with ALICE

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Motivation

The interaction between charged kaons and (anti-)deuterons has been a missing piece of information in the field of the low-energy (anti-)kaon-nucleon interactions for more than 40 years. So far, the only experimental studies of the strong interaction have come from scattering experiments that provided the scattering cross sections at intermediate momenta. Specific information on the strong interaction can be accessed also via kaonic deuterium X-ray spectroscopy but such measurements are challenging due to the available detection efficiency. Moreover, a theoretical description of the strong interaction of the system is also not well understood. Therefore, predictions of f_0 value for K⁻d have been made based on an input from kaonic hydrogen measurements and there are no published predictions for K⁺d.

The subject of the presented poster is the first measurement of the scattering lengths of the strong interaction of K^-d and K^+d through the study of femtoscopic correlation functions.



Methodology

Femtoscopy is a technique that describes particle correlations in momentum space. The correlation function (CF) can be understood as the convolution of the source function and the two-particle 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 two components.



Fitting

Simultaneous fit to 6 correlation functions with Lednický–Lyuboshitz model [1]. The fit provides 3 radii (1 radius for given centrality interval is shared between same and opposite sign pairs) and 2 scattering lengths (1 value is shared between 3 centralities of same or opposite sign pairs).



Data

This poster presents the analysis of $K^{\pm}d/\overline{d}$ CFs in 3 centrality intervals (0–10%, 10–30%, 30–50%) of Pb–Pb at $\sqrt{s_{NN}} = 5.02$ TeV collisions registered by the ALICE Experiment.



$K^{\pm}d/d$ femtoscopic radii

First measurements of Kd femtoscopic source

$\mathrm{K}^{-}\mathrm{d}$ and $\mathrm{K}^{+}\mathrm{d}$ scattering lengths

Right: f₀ for K⁻d ⊕ K⁺d̄ pairs together with the theoretical predictions available in the literature. The experimental value can be used to discriminate between the different theoretical approaches and can have significant impact on understanding of hadron-hadron interaction in strangeness sector.
 Bottom: f₀ for K⁺d ⊕ K⁻ d̄ pairs together with theoretical predictions (private communication).

 $K^+d \oplus K^-d$

ALICE Preliminary

ALICE $(d_{a} = 0 \text{ fm})$



sizes in heavy-ion collisions as a function of multiplicity density.





Haidenbauer (priv. comm., d = -1.75 fm)

This project has received funding from the IDUB YOUNG WUT programme under grant agreement No 1820/96/Z01/2013



-2 -1.5 -1 -0.5-PREL-541577 $\Re f_0$ (fm)

References

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