A study of K^-d and K^+d interactions via femtoscopy technique

Wioleta Rzęsa (Warsaw University of Technology) on behalf of the ALICE Collaboration

EISIOIN

ALICE

ALICE/WUT

 \bigcirc

- Study of kaon-deuteron scattering parameters of the strong interaction (not measured before).
- \blacksquare K^-d enables access to the antikaon-neutron system.

- Study of kaon-deuteron scattering parameters of the strong interaction (not measured before).
- \blacksquare K^-d enables access to the antikaon-neutron system.

June 24, 2023

2/10



- Study of kaon-deuteron scattering parameters of the strong interaction (not measured before).
- \blacksquare K^-d enables access to the antikaon-neutron system.



- Study of kaon-deuteron scattering parameters of the strong interaction (not measured before).
- $\blacksquare \ K^-d$ enables access to the antikaon-neutron system.



Femtoscopy



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).

Data

- Pb-Pb collisions at \sqrt{s_NN} = 5.02 TeV.
 \$\mathcal{K}^{\pm}d/\mathcal{K}^{\pm}d}\$ correlation functions.
- 3 centrality intervals: 0–10%, 10–30%, 30–50%.
- Momentum reconstruction via TPC detector.
- Particle identification via TPC and TOF detectors.





Modeling correlation functions

■ Theoretical CFs modeled with Lednický-Lyuboshitz approach [1] with the assumptions: □ gaussian source,

Examples of modeled CFs for different values of fit parameters

June 24, 2023

5/10

 \Box zero effective-range approximation of the interaction, $d_0=0.0~{\rm fm}.$

Numerical calculation of theoretical CFs for different fit parameters.



[1] Lednický, R. and Lyuboshits, V. L., Final state interaction effect on pairing correlations between particles with small relative momenta, Yad. Fiz. 35 (1981).

Kd in Pb–Pb with L-L fit

- Simultaneous fit to 6 CFs.
 Source radii from likeand unlike-sign pairs:
 one R_{Kd} per centrality.
- Scattering lengths from three centralites:
 □ one f₀(𝔅,𝔅) for unlike-sign pairs,

□ one $f_0(\mathfrak{N})$ for like-sign pairs.



Kd radii



- 3 radii for 3 centralities (the same radius for all particle pairs).
- Source size increases with multiplicity.

$K^{-}d$ scattering length

 \blacksquare $\Re f_0$ and $\Im f_0$ are in agreement with most of the available calculations.



K^+d scattering length





		Ee 1	(m)	T.A.	
	121210101				
	C3011		-	<u>.</u>	1
IVI	eson		U	2	

< ロト < 同ト < ヨト < ヨ

Summary

- First measurement of Kd correlation functions and 1D radii in heavy-ion collisions.
 First measurements of K⁻d and K⁺d scattering lengths:
 - $\implies \text{In agreement (within uncertainties) with many K^-d predictions and with the two currently available K^+d calculations.}$
 - \Longrightarrow Obtained values play a crucial role in constraining the scattering parameters for future theoretical studies.

Thank you for your attention!