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Higher partial waves and resonance contributions in femtoscopy

Koichi Murase[1,2], Presenter/Tetsuo Hyodo[1,2]*,

[1] *Department of Physics, Tokyo Metropolitan University,, Hachioji, 192-0397, Japan,*

[2] *RIKEN Interdisciplinary Theoretical and Mathematical Science Program (iTHEMS), Wako, 351-0198, Japan*

Content

In recent years, the advancement of femtoscopy techniques in high-energy collision experiments has opened a new frontier in the study of hadron-hadron interactions. Femtoscopy enables us to probe the low-energy region of hadronic interactions, which is often inaccessible in conventional scattering experiments, by measuring the momentum correlation functions of hadron pairs. With both experimental and theoretical progress, new insights have been obtained into two-body systems involving multi-strangeness and charmed hadrons, as well as three-hadron systems.

Many hadrons are, however, observed as unstable resonances due to their strong decay modes. In fact, measurements by the ALICE Collaboration have revealed resonance contributions such as $\Xi(1620)$, Ω^-, $\Xi(1690)$, and $\Xi(1820)$ in the $K^-\Lambda$ correlation function [1]. These resonances can appear not only in s-wave interactions but also in higher partial waves. At present, such resonance peaks are typically fitted using Breit-Wigner functions; however, it remains theoretically unclear whether this approach accurately describes the resonance peaks observed in the correlation functions. Moreover, the formation mechanism of these peaks is still not fully understood.

In this talk, we extend the formalism of femtoscopy to include the effects of higher partial waves [2]. This allows us to quantitatively evaluate the contributions from the higher partial waves in correlation functions, which have not been considered in the frequently used formulae. We then analyze the contributions of resonance states to correlation functions using a potential model approach. We demonstrate how the localization of the scattering wave functions in the interaction region leads to the appearance of resonance peaks in the momentum correlation functions.

Reference

[1] S. Acharya et al. [ALICE], Phys. Lett. B 845, 138145 (2023).
[2] K. Murase, T. Hyodo, J. Subatomic Part. Cosmol. 3, 100017 (2025)

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