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## Experimental study of the KbarNNN state and beyond at J-PARC

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Kaonic nuclear states have been one of the hottest topics in hadron physics for these decades. After many experimental efforts, we finally found strong evidence of the KbarNN state in the Apn final state via in-flight K- reaction on helium-3 in J-PARC E15. We are now constructing an upgraded solenoid spectrometer system to investigate kaonic nuclear systems further. One direction is systematically investigating heavier systems, such as KbarNNN, Kbar-alpha, etc., which would lead to a more solid establishment of the kaonic nuclear states and to study the interplay between the KbarN attraction, the NN repulsion, and other involving effects.

As for the KbarNNN state, we can study it with a quite similar method in E15 by replacing the target with helium-4. We already had a chance to collect data with a helium-4 target as a feasibility test of a lifetime measurement of light hypernuclei (J-PARC T77). In a preliminary analysis, we successfully reconstructed hundreds of  $\Lambda$ dn events and observed a structure below the KbarNNN binding threshold in the  $\Lambda$ d invariant mass spectrum. The same reaction will be measured in more detail with the new spectrometer as J-PARC E80.

In this contribution, we would like to present the latest results of the  $\Lambda$ dn analysis described above and discuss future prospects for a more comprehensive investigation of the heavier kaonic nuclear systems.

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