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A search for the K^-pp bound state in the ^{3}He(*inflight*-K^-,n) reaction at J-PARC

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Kaonic nuclei are extremely valuable systems to understand the $\bar{K}$N interaction and the possible nuclear shrinkage caused by $\bar{K}$ meson. Especially, the simplest kaonic nuclear state, K^-pp, is recently attracting great interest in both experimental and theoretical fields. Many theoretical calculations have been progressed for the K^-pp system, resulting in various binding energy and width predictions. Experimentally, however, only a small amount of information is available, which is not sufficient to discriminate between a variety of conflicting interpretations.

In this situation, we are carrying out an experimental search of the K^-pp bound state at J-PARC K1.8BR beam-line [1]. The most important key of our experiment is the inflight (K^-,n) reaction at 1 GeV/c. At this reaction, neutron backgrounds from non-mesonic two-nucleon absorptions or hyperon decays are expected to be substantially suppressed and kinematically separated. In addition, by using a liquid ^{3}He target and a large acceptance detector surrounding it, we can detect decay particles from "K^-pp" to fully reconstruct the reaction kinematics. For this purpose, we have constructed a new spectrometer system (fig. 1) [2], which has a quite unique feature of having large-acceptance high-resolution neutron detector system in the forward direction. A cylindrical detector system (CDS) is also developed for the detection of decay particles from the liquid ^{3}He target.

A commissioning of the brand-new beam line and the spectrometer system has been completed. Figure 2 is a semi-inclusive (requiring 1 charged track in CDS) neutron 1/β spectrum of the ^{3}He(K^-, n) reaction obtained in the engineering run in June, 2012. The clear gap between the γ-ray peak and the broad neutron distribution shows a well suppressed background. Both the missing-mass resolution of this reaction and the invariant-mass resolution for the "K^-pp" $\rightarrow \Lambda p$ decay mode were revealed to be $\sim$10 MeV/c^2 as designed. Further engineering run with a forward proton detection system for the "K^-pn" study was carried out in January, 2013. In the first-stage physics run planned in March, 2013, a neutron spectrum of more than 50 times statistics will be accumulated, which will enable us a coincidence study with the decay particles detected in the CDS.

In this contribution, an overview of the experiment and a preliminary result of the first-stage physics run will be presented.

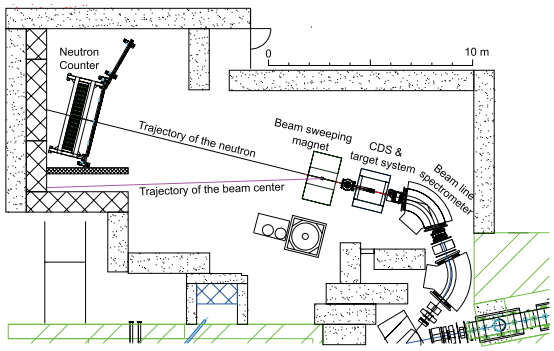

Figure 1: J-PARC K1.8BR spectrometer [2].

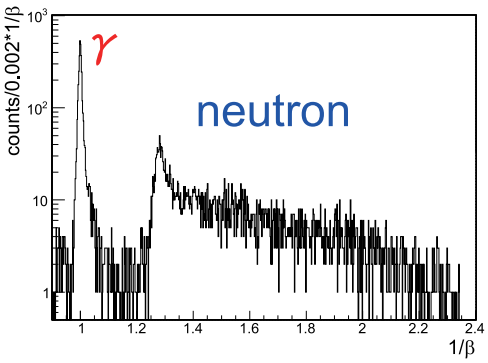

Figure 2: Semi-inclusive neutron 1/β spectrum [2].

[1] M. Iwasaki et al., J-PARC E15 proposal, http://j-parc.jp/NuclPart/pac_0606/pdf/p15-Iwasaki.pdf.
[2] K. Agari et al., [J-PARC E15 collaboration], Prog. Theor. Exp. Phys. (2012) 02B011.