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A spectroscopic study of 10ΞLi hypernucleus via the 10B(Kˆ-,Kˆ+)X reaction

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The Ξparticle-nucleon interaction is the last piece of the nuclear force study that has been extended to the strange quark, and the Ξ hypernuclear spectroscopy experiment will provide us the rich information. We are planning a series of Ξ hypernuclear spectroscopy experiments using (K^-, K^+) reactions at the Japan Proton Accelerator Re-search Complex (J-PARC), K1.8 beamline.

The K^- beam with a momentum of 1.8 GeV/c is transported to the target by the K1.8 beamline spectrometer. The scattered K^+ associated with the Ξ hypernuclei production is detected with the newly constructed magnetic spectrometer S-2S at the forward scattering angle. S-2S consists of two quadrupole magnets and one dipole magnet with the acceptance of 60 msr, and measure the momentum of the scattered K^+, which momentum is around 1.3 GeV/c, with a resolution of $\Delta p/p \tilde{} 5.0 \times 10^{-4}$. The Ξ hypernuclei are identified in the missing mass spectrum, and their binding energies are determined with an accuracy of a few MeV (FWHM). As the first experiment, a ${}^{12}_{\Xi}\mathrm{Be}$ hypernucleus spectroscopy experiment using a CH_2 active target is planned. The usage of an active target enables us to compensate for the event-by-event energy loss of the K^- beam and scattered K^+ inside the target.
In order to further investigate the Ξ-nucleon interaction precisely, it is necessary to systematically measure the binding energies of various Ξ hypernuclei using different targets. We are particularly interested in spectroscopic experiments on ${}^{10}_{\Xi}\mathrm{Li}$ hypernucleus. ${}^{10}_{\Xi}\mathrm{Li}$ hypernucleus consists of two α particles, one neutron, and one Ξ particle, and are very unique because the interaction between α and Ξ can be obtained. To produce the ${}^{10}_{\Xi}\mathrm{Li}$ hypernucleus, it is necessary to use the ${}^{10}\mathrm{B}(\mathrm{K}^-, \mathrm{K}^+)\mathrm{X}$ reaction with a ${}^{10}\mathrm{B}$ target. It is not possible to fabricate an active target to compensate for the energy loss in case of the boron target. Therefore, the parameters of the experiment, such as target thickness, must be carefully set to achieve high statistics and high resolution at the same time.

In this presentation, we will discuss the physical motivation for the study of the ${}^{10}_{\Xi}\mathrm{Li}$ hypernucleus, and the validity of the experiment based on simulations.

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