Pionic atoms spectroscopy at RCNP with the (p,^{2}He) reaction

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A spectroscopy of pionic atoms is one of the most established ways to investigate quantitatively partial restoration of chiral symmetry in medium. From experimental information on binding energies of pionic states, we can deduce in-medium parameters of the pion-nucleus optical potential, such as the b_1 parameter, which is connected to the quark condensate [1]. The quark condensate is an order parameter of chiral symmetry and its reduction corresponds to the partial restoration of chiral symmetry. Experiments at GSI verified that the quark condensate is reduced by about 33 % at the normal nuclear density by deducing an enhancement of the b_1 parameter [2]. For a better understanding of the in-medium QCD, it is essential to extract the experimental information about the density dependence of the quark condensate. This may be realized by a systematic study of pionic states in nuclei along isotope or isotone chains. Currently, a systematic study is ongoing at RIBF, focusing on the Sn isotopes. We are going to perform an experiment at RCNP with a ^{136}Xe gas target, which is difficult to use as a target at GSI and RIBF. The study with ^{136}Xe target will be a starting point of a systematic investigation along N=82 isotones and Z=54 isotopes.

In order to establish the experimental methods of the pionic atom spectroscopy at RCNP, we performed the E483 experiment using the ^{124}Sn(p,^{2}He) reaction in 2017. We could observe peak structures corresponding to pionic states [3]. As a next step, we performed a test experiment with a natural Xe gas target for a study of the background as well as a part of R&D of the gas target system. The result of the E483 experiment and the current status for the next experiment will be reported in the presentation.

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