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Precision spectroscopy of pionic 121, 116Sn atoms at RI Beam Factory

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We report the precision spectroscopy of the pionic 121, 116Sn atom using the 122, 117Sn(d, 3He) reaction near the charged pion emission threshold.

An established approach for quantitative evaluation of the chiral symmetry breaking in finite density is study of pion-nucleus interaction through the experimental measurement of pionic atoms. So far the 1s pionic states in 205Pb and 115, 119, 123Sn have been discovered at GSI. The deduced chiral order parameter was compared with that of the vacuum, which was deduced from the pionic hydrogen, and partial chiral restoration was suggested. However, the evaluation still had large systematic and statistical errors.

For the further study of the symmetry breaking in medium, we measured the excitation energy of the 122, 117Sn(d, 3He) reaction at RIKEN, RI Beam Factory. The experiments were performed in 2010, as a pilot experiment, and 2014, for the precision measurement. In these experiments, we observed the distinct structures corresponding to the pionic bound states in 1s, 2p and other shallower states. At the pilot experiment, we succeed in measurement of the angular dependence of the pionic atom production reaction for the first time. In 2014, we improved the missing mass resolution and succeed in the precise determination of the binding energy of 1s and 2p pionic states simultaneously, which contribute to reduce the systematic errors dramatically. In the report, we will give the current status of the analysis.

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