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**Deeply Bound Pionic  $1s$  and  $2s$  States in Sn at RIBF** NATSUMI IKENO, Nara Womens University, JUNKO YAMAGATA-SEKIHARA, YITP, Kyoto, HIDEKO NAGAIRO, Nara Womens University, DAISUKE JIDO, YITP, Kyoto, SATORU HIRENZAKI, Nara Womens University — Deeply bound pionic states are interesting exotic systems since we can observe the properties of NG boson in nucleus and deduce clear information on the partial restoration of chiral symmetry around normal nuclear density. Recently it has been reported that the  $(d,^3\text{He})$  reaction at recoilless kinematics efficiently populates these states. New experiments will be performed at a new facility, RIKEN RIBF, in near future with significantly better energy resolution than those in the previous experiments. There, one expects to observe the  $2s$  atomic state, which has not been observed so far, in addition to the deepest  $1s$  state. In this contribution, we discuss physical implications of the new data obtained in simultaneous observation of the  $1s$  and  $2s$  states with high energy resolution. It is known that only information of pionic atom yrast levels hardly provides the pion properties at different nuclear densities. We expect that the pion in the  $2s$  state can probe different nuclear densities from the yrast levels. Thus, we perform a systematic evaluation of the effective nuclear densities which can be probed by pions in various atomic states. We explore the possibilities to deduce the pion properties at different nuclear densities by observing the different atomic states, and discuss the importance of the  $2s$  pionic states in Sn isotopes.

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