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Nuclear moments of isomeric states around 132Sn

The nuclear electromagnetic moments provide an essential information about the structure of the state of interest. They are very stringent tests to the nuclear theory. The magnetic dipole moments are especially sensitive towards the single-particle properties of the nuclear wave functions while the electric quadrupole moments give an insight to the nuclear deformation and collectivity.

Experimental nuclear moments studies of microsecond isomeric states constitute a special challenge for the neutron-rich nuclei far from stability. Often those isomeric states are populated in projectile fragmentation reactions and specific techniques are applied in order to obtain spin-oriented ensembles of nuclei. The peculiarities of those techniques will be touched upon.

From nuclear structure perspective the region around ^{132}Sn represents a special interest and is often considered in a conjunction with the ^{208}Pb region. The nuclear wave functions are expected to demonstrate clear single-particle properties thus the nuclear magnetic moments are expected to be well in agreement with the extreme single-particle shell model. Indeed, this has been observed experimentally for the case of ^{131}In [1], a single proton hole in ^{132}Sn, for which the experimental ground-state magnetic moment has been reproduced by the theory using free-nucleon g factors.

A campaign of two experiments, aiming at magnetic moment studies in ^{132}Sn and ^{130}Sn has been performed at the RIKEN Nishina Center in December 2024. The 10^+ isomeric state in ^{130}Sn (E_x = 2435 keV, $t_{1/2}$ = 1.6 µs) has been populated in a two-step projectile fragmentation reaction following the two-neutron removal from the 132Sn secondary beam. The Time Dependent Perturbed Angular Distribution (TDPAD) technique has been applied. In the second experiment the 6^+ (E_x = 4715 keV, $t_{1/2}$ = 20 ns) isomeric state in ^{132}Sn has been populated following the γ-ray decay of the 8^+ ($t_{1/2}$ = 2.1 µs) isomeric state in the same nucleus. The Time Dependent Perturbed Angular Correlations (TDPAC) technique has been used for the moment study of the short-lived isomeric state.

The experimental details and the status of the data analysis for the two experiments will be presented and the results will be compared to theoretical models. The experimental challenges and the future perspectives will be discussed as well.

[1] A. Vernon et al., Nature 607 (2022) 260

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