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Investigation of a sudden change in collectivity at $170, 172\text{W}$

The rare-earth region of the nuclear chart is one of the most thoroughly explored in terms of quadrupole deformation, providing a valuable benchmark for studying nuclear structure and collectivity. Two key observables in this context are the energy ratio $R_{4/2}$ and the reduced transition probability $B(E2; 2_1^+ \rightarrow 0_1^+)$, which serve as indicators for nuclear structure. Notably, nuclei around neutron number $N = 90$ [1, 2] display a rapid change in structure, transitioning between spherical and axially deformed configurations. A prime example for a shape-phase transitional nucleus is ^{152}Sm , in which also the $E2$ transition strength of the 1^+ scissors mode reflects a phase transitional behavior [3]. Another new method to investigate nuclear shapes which was recently developed is the measurement of the γ -decay of the giant dipole resonance [4]. However, also other regions with a P factor of ~ 5 can exhibit phase transitions. In the tungsten isotopic chain the $R_{4/2}$ values change gradually with neutron number and do not suggest a phase transition, while existing $B(E2; 2_1^+ \rightarrow 0_1^+)$ data suggest a sudden change in nuclear deformation around $N = 96, 98$. To investigate this anomaly, we performed a lifetime measurement of excited states of ^{170}W to determine absolute yrast $E2$ transition strengths [5]. The extracted $B(E2)$ values exhibit a behavior consistent with the critical-point symmetry known as $X(5)$ [6], reflected in an $R_{4/2}$ ratio of 2.95 close to the theoretical $X(5)$ limit of 2.90. To extend the study to $N = 98$, we measured lifetimes of low-lying states in ^{172}W using the 10 MV FN-tandem accelerator at the University of Cologne. This experiment used the newly developed Cologne CATHEDRAL (Cologne Coincidence detector Array at the Tandem accelerator for High Efficiency Doppler shift and LaBr fast-timing measurements) spectrometer, together with the Cologne plunger setup [7], enabling simultaneous application of fast-timing and recoil distance Doppler-shift (RDDS) techniques for a broad lifetime range.

Lifetimes of the 2_1^+ and 4_1^+ states of ^{172}W were measured using the fast-timing approach, while the RDDS method was used for higher-lying yrast states. Results from ^{170}W and ^{172}W were analyzed in the framework of the confined β -soft rotor model [8].

- [1] R. F. Casten, Nat. Phys. **2** (2006) 811.
- [2] R. F. Casten, Prog. Part. Nucl. Phys. **62** (2009) 183.
- [3] K. E. Ide *et al.*, Phys. Rev. C **103** (2021) 054302.
- [4] J. Kleemann, Ph.D. thesis Technische Universität Darmstadt (2024).
- [5] K. E. Ide *et al.*, LNL report 2019 (2020).
- [6] F. Iachello, Phys. Rev. Lett. **87** (2001) 052502.
- [7] A. Dewald, O. Möller, and P. Petkov, Prog. Part. Nucl. Phys. **67** (2012) 786.
- [8] N. Pietralla and O. M. Gorbachenko, Phys. Rev. C **70** (2004) 011304.

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