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Electromagnetic properties of the Te isotopes: the path to collectivity and the nature of pre-collective nuclei

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The tellurium isotopes with 52 protons show a transition from vibrator-like structures near midshell (118Te) to seniority structures near N = 82 (134Te). We report measurements of excited-state g factors and E2-transition strengths following Coulomb excitation, as well as lifetimes from Doppler-broadened line shapes, for the stable isotopes from 124Te to 130Te. These measurements, performed at Australia's Heavy Ion Accelerator Facility, allow us to map the pathway from the π0g2 seniority structure in 134Te [1] toward 7/2 collective excitations near midshell as successive pairs of neutrons are removed. The experimental results, which give a novel perspective on the nature of pre-collective nuclei, will be presented. It is found that collectivity does not emerge suddenly, with the nucleus becoming collective as a whole, as might be inferred by examining energy patterns such as R4/2 = Ex(4+1)/Ex(2+1) ratios, alone. The E2 transition strengths and g factors show that collectivity develops in subsets of nuclear excitation: the 2+1 state becomes collective first while the 4+ and 6+ states retain a significant π0g2 component. The 11 7/2 4+1 state becomes collective next, while the seniority structure persists in the 6+1 states. For example, it appears that, despite approaching midshell, 124Te retains a seniority structure for the 6+ level, i.e. a significant π0g2 contribution. This persistence of the 1 7/2 shell structure at the 6+1 state is in contrast to the B(E2) values of the lower-excitation 2+1 and 4+1 states in 124Te, and neighboring 120Te and 122Te, for which the collectivity becomes enhanced. Large-basis shell-model calculations can describe the trends, although E2 strengths progressively fall short away from N = 82. It is evident that g-factor ratios such as g(4+1)/g(2+1) and g(6+1)/g(2+1) are an important indicator of emerging nuclear collectivity versus the persistence of seniority structure. This work is supported by Australian Research Council Grants DP170101673 and DP210101201. Support for the Heavy Ion Accelerator Facility operations through the Australian National Collaborative Research Infrastructure Strategy is acknowledged.

[1] A.E. Stuchbery, J.M. Allmond et al., Phys. Rev. C 88, 051304 (2013) .

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