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Suppressed Electric Quadrupole Collectivity in 49Ti Relative to Semi-Magic 50Ti

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Single-step Coulomb excitation of 46,48,49,50Ti is presented. A complete set of E2 matrix elements for the quintuplet of states in 49Ti, centered on the 2+ core excitation, was measured for the first time, using the CLARION2-TRINITY arrays [1]. A total of nine E2 matrix elements are reported, four of which were previously unknown. 49Ti shows a 20% quenching in electric quadrupole transition strength as compared to its semi-magic 50Ti neighbour. This 20% quenching is empirically unprecedented, and contrary to the enhancement recently observed in 129Sb relative to a 128Sn core [2]. Both cases are near double-magic nuclei and have small core B(E2) values. The quenching in 49Ti can be explained with a remarkably simple two-state mixing model, which is also consistent with other ground-state properties such as the magnetic dipole moment and electric quadrupole moment. The simplicity of the 49Ti-50Ti pair (i.e., approximate single-j 0f7/2 valence space and isolation of yrast states from non-yrast states) provides a unique opportunity to disentangle otherwise competing effects in the ground-state properties of atomic nuclei, the emergence of collectivity, and the role of proton-neutron interactions.

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[1] T.J. Gray, J.M. Allmond et al., Nucl. Instrum. Methods A 1041, 167392 (2022)
[2] T.J. Gray, J.M. Allmond et al., Phys. Rev. Lett. 124, 032502 (2020)

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