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First spectroscopy of ^{62}Ti: Shell evolution towards ^{60}Ca

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Shell evolution for the N=40 isotones has recently attracted considerable attention. In a single-particle shell model N=40, which corresponds to the filling of the fp neutron shells, is predicted to be a sub-shell closure. However, measurements of the first 2^+ states in ^{64}Cr and ^{66}Fe give evidence of a rapid weakening of the N=40 gap when removing protons from the $f_{7/2}$ shell. Conversely, the 2^+ energies of ^{58,60}Ti show only a slight decrease towards N = 40. To further understand the shell evolution towards the supposedly doubly-magic ^{60}Ca, we report on the measurement of the first excited 2^+ state of ^{62}Ti.
Excited states in ^{62}Ti were populated via the ^{63}V(p,p2)^{62}Ti reaction and studied using γ-ray spectroscopy. The energies of the $2^+ \rightarrow 0^+$ and $4^+ \rightarrow 2^+$ transitions, observed here for the first time, indicate a deformed ^{62}Ti ground state. These energies are increased compared to the neighboring Cr and Fe isotones, suggesting a small decrease of quadrupole collectivity. This result is well reproduced by large-scale shell-model calculations based on effective interactions, while ab initio and beyond mean-field calculations do not yet reproduce them. The shell-model calculations for ^{62}Ti show a dominant configuration with four neutrons excited across the N=40 gap. Likewise, they indicate that the island of inversion extends down to Z=20, disfavoring a possible doubly magic character of ^{60}Ca.

Primary author: CORTES, Martha Liliana (RIKEN)

Presenter: CORTES, Martha Liliana (RIKEN)

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