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Investigating shape transition in neutron-rich nuclei in the region of A = 100 through conversion electron spectroscopy at ALTO

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The region of neutron-rich nuclei around $N = 60$ has attracted interest in the late eighties, and even until now, its unique features continue to be of great importance in our understanding of shape evolution far from stability. First indirect evidence of shape coexistence in the region comes from a substantial increase in the two-neutron separation energy together with the difference in mean-square charge radius in nuclei from rubidium to zirconium at $N = 60$ [1], [2]. The observation of low-lying 0^+ states in even-even strontium and zirconium isotopes and the inversion between the spherical and intruder configuration at $N = 60$ and above supports the shape transition hypothesis. Such an inversion can be explained by a polarization mechanism introduced by P. Federman and S. Pittel [3], in which the addition of neutrons to the $g_{7/2}$ orbital can cause the promotion of protons in its spin-orbit partner orbital, $g_{9/2}$, which in turn can cause the promotion of more neutrons to $g_{9/2}$. Correlations between neutrons in $g_{9/2}$ and protons in $g_{7/2}$ lead to deformation and the mutual polarization causes the $Z = 40$ gap to be reduced, and the lowering of the energy of the 0^+ intruder configurations towards $N = 60$. The most direct way to study these low-lying 0^+ states in even-even nuclei is via conversion electron spectroscopy, to observe electric monopole transition to the ground state.

An experiment was conducted in October 2022 at ALTO, to investigate neutron-rich strontium and zirconium isotopes up to mass 100 through β decay of a rubidium ISOL beam. The beam was then collected in the newly developed COeCO [4] decay station to measure the E0 decay strength in ^{98}Sr and both ^{98}Zr and ^{100}Zr but also to look for a low-lying 0^+ state, predicted but not yet discovered, in ^{100}Sr. I will present the results of this experiment, which led to several re-measurements of half-lives of states in ^{96,97,100}Zr, ^{97}Sr as well as a new value for the half-life of the first 0^+ excited state in ^{98}Zr. This new half-life value allows to determine the strength of the E0 transition, which in turn gives a value of the difference in mean-square charge radius between the ground state and the first excited 0^+ state. These results expand on our knowledge of shape transition in the region and open up new perspectives for conversion electron studies in neutron-rich nuclei produced at ALTO.

[1] U. Hager et al., Phys. Rev. Lett. 96, 042504 (2006)
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[3] P. Federman and S. Pittel, Phys. Rev. C 20, (1979)
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