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## Excursion Far Beyond the Proton Dripline Along Ar and Cl Isotopes

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Nuclei beyond the proton drip line have been intensively investigated in recent years, and their structure exhibited exotic features that cannot be found in particle-stable nuclei. For instance, two-proton (2p) radioactivity of elements was discovered on  $^{45}\text{Fe}$ . In spite of the experimental advances, most 2p-decay precursors remain unexploited though their low-excitation spectrum is expected to be discrete. This naturally causes the question: How far beyond the driplines the nuclear structure phenomena fade and are completely replaced by continuum dynamics?

In this talk, the first spectroscopic studies of the chains of 2p emitters  $^{31,30,29}\text{Ar}$  and their 1p-unbound subsystems  $^{30,29,28}\text{Cl}$  will be reported. The corresponding experiment is based on measurements of in-flight decays of the 2p emitters and tracking trajectories of their decay products by microstrip silicon detectors [1]. The lowest states in  $^{30}\text{Ar}$  and  $^{29}\text{Cl}$  point to a violation of isobaric symmetry in the structure of these unbound nuclei (i.e., the Thomas-Ehrmann shift). The 2p decay has been identified in a transition region between simultaneous 2p and sequential proton emissions from the  $^{30}\text{Ar}$  ground state, which is characterized by interplay of three-body and two-body decay mechanisms. Such a phenomenon, never observed before, is argued to be common in 2p-unbound nuclei and could be of interest for other disciplines dealing with few-body systems [2]. The spotted dramatic change of odd-even mass staggering in 2p-unbound nuclei calls for further systematic investigation.

Systematic studies of the ground and excited states of unbound Ar and Cl isotopes have revealed that the Thomas-Ehrmann shifts are even larger for the  $^{29}\text{Ar}$  and  $^{28}\text{Cl}$  isotopes in comparison with  $^{30}\text{Ar}$  and  $^{29}\text{Cl}$ , respectively. Predictions for even more remote isotopes  $^{28}\text{Ar}$  and  $^{27}\text{Cl}$  are provided by using the elaborated models. For these isotopes, the Thomas-Ehrmann effect is expected to be less important, as their isobaric mirror partners are located near the neutron drip line.

References:

[1] I. Mukha et. al., Phys. Rev. Lett. 115 (2015) 202501.

[2] T.A. Golubkova, X.-D. Xu, L.V. Grigorenko, I.G. Mukha, C. Scheidenberger and M.V. Zhukov, Phys. Lett. B 762, 263 (2016).

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