INTERPLAY OF PROMPT TWO-PROTON AND SEQUENTIAL DECAY MECHANISMS IN PROTON-UNBOUND EXOTIC NUCLEI

Ivan Mukha, GSI Helmholtzzentrum für Schwerionenforschung, Darmstadt, Germany

Nuclei beyond the proton drip line have been intensively investigated in recent years, because they exhibit exotic new phenomena that cannot be found in stable nuclei. For instance, two-proton (*2p*) radioactivity of ^{45}Fe was discovered in 2002. This phenomenon manifests a complicated few-body dynamics of "true *2p*" (or "true three-body") decays. Because of the pairing effect in nuclei, the sequential emission of protons from the true-2p precursors is not possible, which forces simultaneous (i.e., prompt) emission. As a result, three-body effects lead to extremely long half-lives of true-*2p* precursors and specific correlations of their fragments. Besides making further observations of *2p* radioactivity in ^{54}Zn and ^{48}Ni, a study of *p-p* correlations for the *p-f* shell *2p* precursor ^{45}Fe has been performed. The three-body decay mechanisms of short-living "democratic" *2p* emitters ^{6}Be and ^{16}Ne were studied in broad energy ranges. The first case of *2p* radioactivity in an *s-d* shell was found in the ^{19}Mg isotope by measuring its decay in flight with a novel tracking technique.

In spite of the experimental advances, most *2p*-decay precursors remain unexploited. In this talk, the discovery and spectroscopic study of the *2p* emitter ^{30}Ar and its neighbor ^{29}Cl will be reported. The corresponding experiment is based on in-flight decay of the 2p emitters and the tracking of the decay-product trajectories by microstrip silicon detectors [1].

The lowest states in ^{30}Ar and ^{29}Cl point to a violation of isobaric symmetry in the structure of these unbound nuclei. The *2p* decay has been identified in a transition region between simultaneous two-proton and sequential proton emissions from the ^{30}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. The spotted dramatic change of odd-even mass staggering in *2p*-unbound nuclei calls for further systematic investigation.

REFERENCES

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