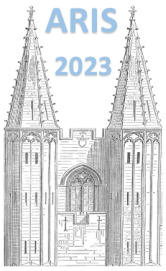

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Super-allowed alpha decay to doubly-magic ^{100}Sn

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The proton-rich doubly-magic self-conjugate nucleus ^{100}Sn and neighboring nuclei are a site of unique nuclear phenomena and a test bed for modern nuclear models. The ^{100}Sn nucleus is one of the fastest known Gamow-Teller β emitters. Due to close proximity of the proton drip line, nuclei with Z>50 and N>50 near ^{100}Sn form an island of α and proton emitters which decay towards ^{100}Sn. Alpha decays of proton-rich Te isotopes were proposed to terminate the astrophysical rp-process. Consequently, despite small production cross sections, this region of nuclear chart has been an aim of numerous experimental studies.
In an experiment with the Fragment Mass Analyzer at ATLAS, the super-allowed α-decay chain ^{108}Xe-^{104}Te to doubly-magic ^{100}Sn was observed [1] using the recoil-decay correlation technique. This was the first time that evidence was found for production of ^{100}Sn in a fusion-evaporation reaction. This observation is an important stepping-stone towards developing a microscopic model of α decay, since it is only the second case of α decay to a doubly-magic nucleus besides the benchmark ^{212}Po α decay to ^{208}Pb, and it triggered a flurry of theoretical activity. The decay properties of ^{108}Xe and ^{104}Te indicate that in at least one of them the reduced α-decay width is a factor of 5 larger than in ^{212}Po, which confirms their super-allowed character. This could be explained by an enhanced α-particle preformation probability due to a stronger interaction between protons and neutrons, which occupy the same orbitals in N=Z nuclei. The Q_α-values deduced for the very exotic ^{108}Xe and ^{104}Te nuclei are consistent with the doubly-magic nature of ^{100}Sn. Interestingly, a weak proton-decay branch in ^{108}I was found in the same experiment. The deduced ^{104}Sb Q_p value rules out the formation of the Sn-Sb-Te cycle at ^{103}Sn.
Further experiments to observe more ^{108}Xe-^{104}Te α-decay chains and to better characterize the properties of other α emitters in the ^{100}Sn region are planned. Tests with the recently constructed Argonne Gas-Filled Analyzer, which offers much higher efficiency, will be discussed.

[1] K.Auranen, D.Seweryniak, M.Albers, A.D.Ayangeakaa, S.Bottoni, M.P.Carpenter, C.J.Chiara, P.Copp, H.M.David, D.T.Doherty, J.Harker, C.R.Hoffman, R.V.F.Janssens, T.L.Khoo, S.A.Kuvin, T.Lauritsen, G.Lotay, A.M.Rogers, J.Sethi, C.Scholey, R.Talwar, W.B.Walters, P.J.Woods, and S.Zhu, Phys. Rev. Lett. 121, 182501 (2018)

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