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Future Updates and Hypernuclei Production at the PUMA Experimental Setup

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Using low-energy antiprotons, the antiProton Unstable Matter Annihilation (PUMA) experiment [1] aims to probe the isospin composition in the density tail of radioactive nuclei. For this purpose, the isotopes of interest are trapped with antiprotons in a dedicated Penning trap. By measuring the charge of the reaction products of the antiproton-nucleon annihilation, the experiment will provide the neutron-to-proton annihilation ratio as a new observable for nuclear structure theory. The experiment allows to investigate neutron skin formation of neutron-rich nuclei as well as halo nuclei. In a first measurement campaign before CERN's long shutdown 3 (LS3), the PUMA collaboration plans to demonstrate this technique using hydrogen and helium isotopes. Furthermore, e.g. ^{16}O, ^{40}Ar and the Xe isotopic chain will serve as candidates to test the analysis with medium-mass nuclei.

This talk focuses on the future prospects of PUMA beyond LS3 and further. A currently planned future update is the implementation of a laser-ablation ion source, which enables the investigation of a broader range of stable nuclei. This modification will allow to study for example the proton-closed shell isotopic chains of $^{40-48}$Ca and $^{112-124}$Sn, as well as the closed shell nucleus ^{208}Pb. These nuclei are of particular interest because they are ideal candidates to study neutron skins which have a strong link to the slope parameter (L) of the nuclear equation of state. Thus, a systematic characterization of neutron skins, e.g., contributes to our understanding of neutron stars.

A possible future path of PUMA includes the study of hypernuclei. The extent to which the formation of antiproton atoms leads to the production of hypernuclei has been investigated in simulations [2]. Only using ^{16}O, ^{40}Ar, ^{84}Kr and ^{132}Xe as target nuclei, it was shown that the formation of antiprotonic atoms provides access to over 100 currently undiscovered hyperisotopes with production rates in the order of 10^{-5} to 10^{-4} per annihilation. Initial ideas have therefore been sketched out as to how the PUMA infrastructure can continue to be used for the investigation of hypernuclei after the measurement campaigns have been completed.

[1] PUMA Collaboration, PUMA, antiProton unstable matter annihilation. Eur. Phys. J. A **58**, 88 (2022)

[2] Schmidt, A., Gaitanos, T., Obertelli, A. et al. Production of hypernuclei from antiproton capture within a relativistic transport model. Eur. Phys. J. A **60**, 55 (2024)

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