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The PUMA Experiment: Investigating Short-lived Nuclei with Antiprotons

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The antiProton Unstable Matter Annihilation (PUMA) experiment is a nuclear physics experiment at CERN which will provide the ratio of protons to neutrons in the tail of the nucleon density distributions to constrain nuclear structure theories [1]. To determine this ratio, the interaction of antiprotons and nuclei at low relative energies is used [2]. Following the captures of the antiproton by the nucleus (formation of antiprotonic atom), the antiproton cascades towards the nucleus and eventually annihilates with a nucleon. This annihilation conserves the total charge, so that the annihilated nucleon can be identified by detecting all charged pions produced in the annihilation. The process takes place at larger radii than usual nuclear reactions (e.g. nucleon removal reactions) [1,3], making this method unique for nuclei with a high neutron-to-proton asymmetry, i.e. short-lived nuclei close to the driplines, halo nuclei and nuclei with a thick neutron skin [3]. As there is no joint facility for antiprotons and short-lived nuclei available, a transportable experimental setup is needed to bring antiprotons from ELENA/CERN to the nuclei at ISOLDE/CERN.
This talk will give an overview over the fundamental physics, the experimental setup and technique as well as the current status of the experiment.

[1] PUMA Collaboration, "PUMA: antiprotons and radioactive nuclei", Proposal SPSC P 361, CERN (2019)
[2] A. Trzcińska et. al., "Neutron Density Distributions Deduced from Antiprotonic Atoms", Phys. Rev. Lett. 87, 082501 (2001)
[3] J. Eades and F.J. Hartmann, "Forty years of antiprotons", Rev. Mod. Phys. 71, 373 (1999)

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