

Muonic X-ray measurements at PSI with medium and high-Z nuclei.

Due to the large overlap between the muon and nuclear wave function, muonic atoms are an exceptionally sensitive system to study short range muon-nuclear/nucleon interactions and probe various nuclear moments. With a physics program focusing on Atomic Parity Violation (APV), the muX collaboration is performing a series of muonic X-ray measurements in medium- and high-Z nuclei, exploiting the coverage and high multiplicity of a germanium detector array and the high-quality negative muon beams at the Paul Scherrer Institute.

A measurement of the charge radius of ^{226}Ra , derived from the $2p-1s$ transition energy, will serve as crucial input for an upcoming APV experiment with electronic radium. To overcome the restrictions on the allowed amount of radioactive target material, we have developed a novel D_2/H_2 gaseous target, where a sequence of transfer reactions enable us to stop a standard muon beam in a few micrograms of target material. After developing the technique in 2018 and 2019, the muonic X-ray spectrum of ^{226}Ra and ^{248}Cm was measured. A second measurement program explores the possibility of observing APV directly in muonic atoms. APV arises from the mixing of the opposite parity $2p$ and $2s$ atomic states, leading to parity violation in the $2s-1s$ transition. We focus on $Z=30$ nuclei, where a measurable branching ratio of the single photon $2s-1s$ transition is expected. The high granularity of a large solid angle germanium detector array is exploited to suppress background from more intense transitions in the cascade.

In this talk, I will discuss the status of the project, focusing on the 2019 experimental campaign where we deployed the high-resolution Miniball germanium detector array from the ISOLDE/CERN facility, and discuss future measurements.

Working group

WG4

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