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Muonic X-ray measurmements 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 226Ra, 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 D2/H2 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 226Ra and 248Cm 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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