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Status of the muX project at PSI

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Negative muons at rest quickly get captured by nearby atoms and subsequently de-exite via radiative and Auger transitions until the muon ends up in the 1s orbital. At the lower orbits, there is substantial overlap between the muon wave function and the nucleus, making this system an excellent laboratory to study the interaction between the muon and atomic nucleus. With a physics program focusing on Atomic Parity Violation (APV), the muX collaboration is exploiting the coverage and high multiplicity of germanium detector array in a series of muonic X-ray measurements at PSI.
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 on electronic radium. To overcome the restrictions on the amount of radioactive target material, we have developed a novel D2/H2 gaseous target, where a sequence of transfer reaction enables us to stop a standard muon beam in a few micrograms of target material. During the 2017 and 2018 runs, we have achieved a stopping efficiency of a few percent in a 3˜nm thick gold layer. The measurement with 226Ra is planned for the fall of 2019.
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. First measurements of the transition were made in 2017 and 2018. In 2019, we aim to improve the signal to background significantly.
In addition, we have measured the muonic X-ray spectrum of rhenium, deriving its quadrupole moment, and the muonic cascade of different noble gases after transfer. In this talk, we will give an overview of the muX program, and the status of the 2019 experimental campaign, where we will bring over and deploy the high-resolution Miniball germanium detector array from the ISOLDE/CERN facility.

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