

Microwave spectroscopy of the hyperfine structure in muonium: zero-field results and high-field preparation

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A hydrogen-like atom consisting of a positive muon and an electron is known as muonium. It is an ideal two-body system to test bound-state theory and fundamental symmetries. The MuSEUM collaboration aims to obtain the hyperfine structure (HFS) in muonium and the muon-to-electron mass ratio, which is necessary to determine the muon's anomalous magnetic moment. Our goal is to exceed the precision of the previous experiment at Los Alamos National Laboratory [1] by a factor of ten. Since most of the uncertainty was a statistical error, we expect a significant improvement in the precision by using the high-intensity pulsed muon beam at J-PARC MLF MUSE. The project is divided into two phases: proof of principle at zero field and measurements at high-field for the highest precision. We have reported the first physics results for the former [2], showing that our new method is working properly. For the latter, construction of a new beamline and R&D of high-precision magnetic field probes are in progress. In this contribution, we will present an overview of the project, the analysis results of the zero-field measurement, and the preparations for the high-field experiment.

[1] : W. Liu et al., Phys. Rev. Lett. 82 (1999) 711-714.

[2] : S. Kanda et al., Phys. Lett. B 815 (2021) 136154.

Working group

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