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Current Status of Precise Measurement of Muonium Hyperfine Structure in High Magnetic Field at J-PARC MUSE

Muonium is a pure leptonic binary system consisting of a positive muon and an electron, and its level structure can be calculated with high precision. The Muonium Spectroscopy Experiment Using Microwave (MuSEUM) experiment aims to verify the quantum electromagnetic dynamics theory and determine the positive muon magnetic moment and mass by precise measurements of the ground-state hyperfine structure of muonium. There are two methods to measure the hyperfine structure of muonium: Spectroscopy of the energy level differences at zero magnetic field and those between Zeeman splitting sublevels in high magnetic field [1]. We aim to improve the precision of the hyperfine structure of muonium by an order of magnitude using the high-intensity pulsed muon beam at Japan Proton Accelerator Research Complex (J-PARC) in 1 MW operation. The zero field experiment at J-PARC MLF MUSE D-Line was completed with a precision of 160 ppb in 2017 [2, 3], and the first high field measurement under 100 kW operation was performed at MUSE H-Line, the new high intensity beamline, from February to March this year. This talk will report on the current state of preparation including the latest results.

References

[1] W. Liu et al., Phys. Rev. Lett. 82, 711-714 (1999).
[2] S. Kanda et al., Phys. Lett. B 815, 136154 (2021).
[3] S. Nishimura et al., Phys. Rev. A 104, L020801 (2021).

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