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Precise spectroscopy of muonium hyperfine structure at J-PARC

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Our experimental group, MuSEUM (Muonium Spectroscopy Experiment Using Microwave), has been doing a precise spectroscopy of muonium ground state hyperfine splitting (MuHFS) with high-intensity pulsed muon beam supplied from J-PARC. We aim ten-fold improvement of the preceding measurement of the experimental value of MuHFS both at zero magnetic field and in high magnetic field (1.7 T). Muonium is the bound state of a positive muon and an electron, both of which are leptons. This means that muonium is free from the finite-size effect of nucleons and thus the theoretical value of MuHFS can be determined precisely. Also we can measure the experimental value of it precisely compared with other exotic atoms such as positronium. Therefore we can compare the two values precisely and accordingly say that muonium is one of the most preferable systems for the rigorous test of bound-state quantum electrodynamics (QED) theory. In addition, we can also obtain the value of the muon-proton magnetic moment ratio (μ_μ/μ_p) in the high-field measurement. Precise determinations of it can contribute to solving the muon anomalous magnetic moment (muon $g-2$) puzzle because it is used to determine the experimental value of muon $g-2$. In this presentation, we report the result of the measurements in zero magnetic field and also the R&D of the high field measurement.

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