High precision measurement of muonium hyperfine structure

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Muonium is a bound state of a positive muon and an electron. The muonium hyperfine structure (MuHFS) is one of the physical property which is suitable for a stringent test of the bound state QED, because of the precise results derived from the theoretical calculation [1] and experiments[2][3].

Also as byproducts, muon-to-proton magnetic moment ratio (μ_μ/μ_p) and muon-to-electron mass ratio (m_μ/m_e) are derived from the MuHFS spectroscopy. μ_μ/μ_p is an important parameter to determine the muon anomalous magnetic moment (a_μ). a_μ is which the experimental result [4] has a 3.7σ deviation from the theoretical calculation [5] And the experimental value of m_μ/m_e is essential to determine the theoretical value of the MuHFS,.

MuSEUM (Muonium Spectroscopy Experiment Using Microwave) collaboration aims to improve the experimental precision of the MuHFS by a factor of 10. Previous measurements were constrained by statistical uncertainty. We will overcome by utilizing the intense pulsed muon beam at J-PARC MLF (Materials and Life Science Experimental Facility) MUSE (Muon Science Establishment). MuSEUM collaboration is currently measuring MuHFS with our upgraded experimental system, and in parallel we are also doing the R&D for the future MuHFS measurement with high magnetic field. In this poster presentation, I would like to introduce about the developments of MuSEUM experiment and report the experimental status.

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