Contribution ID: **194** Contribution code: **O-43** Type: **Oral**

Status of the New Muonic Helium Atom HFS Measurements at J-PARC MUSE

Thursday, 1 September 2022 17:00 (20 minutes)

We recently proposed new precision microwave spectroscopy measurements of the ground-state hyperfine structure (HFS) of muonic helium atom [1]. Muonic helium is a hydrogen-like atom composed of a helium atom with one of its electrons replaced by a negative muon. The ground-state HFS, resulting from the interaction of the remaining electron and the negative muon magnetic moment, is very similar to that of muonium but inverted, and the same technique can be used to precisely measure muonic helium HFS. It is a sensitive tool to test three-body atomic system, bound-state quantum electrodynamics theory, and determine fundamental constants of the negative muon magnetic moment and mass. The world most intense pulsed negative muon beam at J-PARC MUSE gives an opportunity to improve previous measurements, and to test further CPT invariance through comparison of the magnetic moments and masses of positive and negative muons.
Test measurements at D-line are in progress utilizing MuSEUM apparatus at zero field. Muonic helium HFS were measured at different helium pressures to determine the pressure shift using methane as an electron donor. The obtained results have already better accuracy than previous measurements [2,3]. Muonium HFS was also measured to investigate the isotopic effect on the pressure shift.
We also started investigating a new experimental approach to improve HFS measurements by repolarizing muonic helium atoms using a spin exchange optical pumping (SEOP) technique [4]. If successful, this would drastically improve the measurement accuracy.
An overview of the different aspects of these new muonic helium HFS measurements and the latest results will be presented.

[1] P. Strasser, et al., JPS Conf. Proc. 21 (2018) 011045.
[2] H. Orth, et al., Phys. Rev. Lett. 45 (1980) 1483.
[3] C.J. Gardner, et al., Phys. Rev. Lett. 48 (1982) 1168.
[4] A.S. Barton, et al., Phys. Rev. Lett. 70 (1993) 758.

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Session Classification: Oral contributions

Track Classification: New techniques