Frequency measurements of the ^{3}He 2^3P hyperfine structure

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Frequency measurements of the energy splittings of the Helium triplet P levels are used to test the QED theory of the simplest bounded three-body system at an accuracy level of few parts in 10^8. In particular, the 2^3P level fine structure (FS) of ^{4}He has been measured for many years by different groups using different experimental approaches (cf. [1]), in order to determine the FS constant, α, by comparison with at least equally accurate theoretical calculation of these splittings (cf. [2]). On the contrary, measurements of the hyperfine structure (HFS) of the ^{3}He 2^3P level have been published more than twenty years ago (cf. [3]) with an accuracy that can be improved by more than three orders of magnitude with present day precision spectroscopy techniques. The three ^{3}He hyperfine interaction constants can be improved with these measurements and the strong hyperfine contribution to the 2^3P energies can be experimentally determined in order to get the ^{3}He-^{4}He isotope shift (IS) measurements of the 2^3S→2^3P transition. Accurate information about the different nuclear volume of the two isotopes can be determined by comparison between IS measurements and theoretical determinations. Moreover, the extracted FS ^{3}He 2^3P energies, corrected for the hyperfine interaction, can be used to test the mass dependent QED terms of the already developed theory for ^{4}He.

In this meeting, we will show new HFS measurements for the ^{3}He 2^3P level. Our experimental approach is to measure these splittings by frequency difference of absolute frequency measurements of the 2^3S→2^3P transitions at 1083 nm as demonstrated for ^{4}He (cf. [4]). Optical-frequency-comb (OFCS)assisted precision spectroscopy is performed on these transitions by using two OFCS-phase locked 1083 nm laser sources simultaneously resonant with different He transitions. In this way, absolute and relative frequency measurements of these transitions are simultaneously performed, cancelling some time-dependent systematic effects in the relative measurements.

[1] G. Giusfredi *et al.*, Can. J. Phy. **83** (2005) 301 and references there in.

[2] G.W.F. Drake, Can. J. Phys. **80** (2002) 1195.

[3] J.D. Prestage *et al.*, Phys. Rev. A **32** (1985) 2712.

[4] P. Cancio *et al.*, Phys. Rev. Lett. **92** (2004) 023001 and Phys. Rev. Lett. **97** (2006) 139903