Direct measurement of the $^3He^+$ magnetic moments

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Quantum-jump spectroscopy in Penning traps, which utilizes the continuous Stern-Gerlach effect, has been used to carry out the most precise g-factor measurements of charged particles, such as free [1] and bound [2] electrons, the positron [3], the proton [4] and the antiproton [5]. By applying similar techniques to hydrogen-like ^{3}He we measured the transition frequencies of four ground-state hyperfine transitions in a 5.7 T magnetic field. From the obtained transition frequencies the electron and the nuclear g-factor were determined with a precision of a few hundred ppt. Moreover, the value of the hyperfine structure constant of ^{3}He was improved by more than one order of magnitude.

This measurement is the first direct measurement of the nuclear g-factor of ^{3}He, which therefore contributes to establish ^{3}He magnetometers as an independent standard for high-precision magnetometry with unprecedentedly small systematic [6, 7]. The g-factor of the bound electron was calculated to high precision and was found to be consistent with the measured value. Furthermore, the low uncertainty of the hyperfine structure constant makes it sensitive to nuclear structure effects. This allows an independent determination of the Zemach radius. The current status of the hyperfine structure measurement as well as future plans for an improved nuclear magnetic moment measurement on $^3He^{2+}$ will be discussed [8].

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