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A New Experiment for the Measurement of the g-factors of 3He2+ and 3He+

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We construct a new experiment aiming at the first direct high-precision measurement of the 3He2+ nuclear magnetic moment μHe with a relative precision of 10−9 or better as well as an improved value for the ground state hyperfine splitting of 3 He+ with a relative precision of 10−10 [1,2]. The direct measurement of μHe will complement hyper-polarized 3He as an independent
magnetometer, which exhibits smaller systematic corrections concerning sample shape, impurities and environmental dependencies compared to water NMR probes. In our experiment we will apply methods similar to those used in proton and antiproton magnetic moment measurements [3,4].

Those techniques rely on the challenging detection of single spin flips. However, the spin-flip detection fidelity is limited by the ions'energy and if applied to μHe the methods would lead to an insufficient detection fidelity. Thus, we rely on sympathetic laser-cooling to deterministically decrease the ions'energy and a novel Penning trap design optimized for nuclear spin-flip detection.

The status of the experiment will be presented.

[1] Mooser et al., J. Phys.: Conf. Ser. 1138, 012004 (2018)
[2] Schneider et al., Annalen der Physik 531, 1800485 (2019)
[3] Schneider et al., Science 358, 1081 (2014)
[4] Smorra et al., Nature 550, 371 (2017)

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