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Stringent test of QED in hydrogenlike 118Sn49

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Quantum electrodynamics (QED) is one of the most successful fundamental theories to date. With the *g*-2 measurement of the free electron, QED interaction has been tested rigorously [1]. Using a highly charged ion (HCI), one can similarly test bound-state QED effects. This allows to test the interaction of the electron with the strong electric field present in the vicinity of the nucleus. So far the regime of the heaviest ions has been explored exclusively via Lamb shift measurements of 1<i>s</i>- and 2<i>s</i>-shell electrons [2, 3]. Similar the bound-electron *g* factor can be measured and compared to theory to perform tests of QED in heavy HCI [4, 5]. Until now, *g*-factor measurements were limited to low-<i>Z</i> ions, as the production of heavy HCI requires large experimental setups.
Here we present a QED test using a hydrogenlike ¹¹⁸Sn⁴⁹⁺ ion. From an external electron beam ion
trap (HD-EBIT) [6], we inject the HCIs into our Penning-trap setup [7]. A single ion is isolated, and its bound-electron *g* factor is measured with a relative precision of 4.6×10^{−9}, limited solely by the
mass uncertainty of the ¹¹⁸Sn isotope. The comparison with our ab-initio theory calculation allows a
stringent test, matching the stringency of the previous Lamb-shift measurements.

This result marks a key step for *g*-factor QED tests into the high-<i>Z</i> region. Furthermore, our experimental result surpasses the current theory precision by far and thus establishes the basis for order of magnitude improved sensitivity, once currently ongoing theory calculations succeed.

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