The hyperfine-puzzle of strong-field bound-state QED

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A combined measurement of the ground-state hyperfine structure splitting in H-like and Li-like bismuth, the so-called specific difference

$$\Delta' E = \Delta E_{2s}^{\text{Li-like}} - \xi \Delta E_{1s}^{\text{H-like}},$$

was proposed to be ideally suited for a test of bound-state quantum electrodynamics (BS-QED) in strong fields, where a pertubative description of QED is no longer possible [1]. In this contribution, we report on our high-precision laser spectroscopy measurement in these few-electron systems, that has been carried out at the experimental storage ring (ESR) at the GSI Helmholtz-Center for Heavy Ion Research in Darmstadt [2]. The total accuracy of the hyperfine splitting determination was improved by more than an order of magnitude compared to previous measurements. Surprisingly, we found that the experimental value deviates by more than $7\,\sigma$ from the theoretical prediction, giving rise to the so-called *hyperfine puzzle* of BS-QED.

In addition to these results, we discuss possible explanations for the discrepancy and present the latest activities that have been carried out to provide a solution to this conundrum. In particular, we provide evidence that the observed discrepancy is caused by an inaccurate literature value of the nuclear magnetic moment μ_I of ^{209}Bi [3].

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[1] V. Shabaev *et al.*, Phys. Rev. Lett **86** (2001) 3959.
[2] J. Ullmann *et al.*, Nature Communications **8** (2017) 15484.
[3] L. Skripnikov *et al.*, accepted by Phys. Rev. Lett. (2018)