Contribution ID: **17** Type: **not specified**

Theory of the bound-electron g-factor

Thursday, 15 October 2015 11:30 (30 minutes)

Quantum electrodynamic (QED) effects in strong fields can be scrutinized to high precision in Penning trap experiments: a recent measurement yielded a value
for the g-factor of hydrogenlike silicon with a 5×10^{-10} fractional uncertainty, allowing to test certain higher-order QED corrections for the
first time [1]. The measured g-factor is in excellent agreement with the state-of-the-art theoretical value, which includes QED contributions up to the two-loop level of the order of $(Z\alpha)^2$ and $(Z\alpha)^4$. At the above experimental accuracy, also nuclear structural effects start to be visible. We determined the nuclear root-mean-square radius of ^{28}Si from the comparison of experimental and theoretical g-factors and found agreement to tabulated values within our limits of error [1]. As a further nuclear contribution, we investigated the influence of nuclear
deformation, and found the leading correction to become significant for mid-Z ions and for very heavy elements to even reach the 10^{-6}
level [2].

Furthermore, we present theoretical results of a recent determination of the electron mass via measurement of the Larmor and cyclotron frequencies in a $^{12}\mathrm{C}^{5+}$ ion confined in a Penning trap [3]. The electron mass was determined with a relative uncertainty more than an order of magnitude better than the established literature value by means of comparison of the theoretical prediction for $g\left(^{12}\mathrm{C}^{5+}\right)$ and the experimental frequencies. In order to reduce the uncertainty on the theory's side, the unknown two-loop higher-order correction to $g\left(^{12}\mathrm{C}^{5+}\right)$ was estimated. The electron mass is closely linked to other fundamental constants, such as the Rydberg constant R_∞ and the fine-structure constant α. Thus the current improvement of its value paves the way for future fundamental physics experiments and further precision tests of the Standard Model.

[1] S. Sturm, A. Wagner, B. Schabinger, J. Zatorski, Z. Harman, W. Quint, G. Werth, C. H. Keitel, K. Blaum, Phys. Rev. Lett. 107, 023002 (2011).

[2] J. Zatorski, N. Oreshkina, C. H. Keitel, Z. Harman, Phys. Rev. Lett. 108, 063005 (2012).

[3] S. Sturm, F. Köhler, J. Zatorski, A. Wagner, Z. Harman, G. Werth, W. Quint, C. H. Keitel, K. Blaum, Nature 506, 467 (2014).

Primary author: Dr HARMAN, Zoltán (Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany)

Co-authors: Prof. KEITEL, Christoph H. (Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany); Dr ZATORSKI, Jacek (Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany)

Presenter: Dr HARMAN, Zoltán (Max Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany)

Session Classification: Theory