Universität Bielefeld **Fakultät für Physik**

Physikalisches Kolloquium

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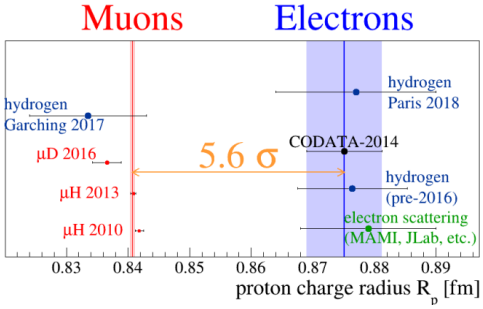
Laser spectroscopy of muonic atoms and the proton radius puzzle



The consistency of measurements of fundamental physical quantities is a crucial benchmark for testing both our understanding of the various measurement techniques and our fundamental theoretical framework of physics in general. Recently, laser spectroscopy of muonic hydrogen (μH) revealed a rather significant inconsistency for a very fundamental quantity, i.e., the proton rms charge radius retrieved from these measurements is 4 % (or 6 sigmas) smaller than the CODATA-2014 value [1,2]. Similar to this "proton radius puzzle" also the deuteron charge radius retrieved from muonic deuterium (μD) spectroscopy [3] is 6 sigmas smaller than the CODATA value, but consistent with the smaller proton inside the deuteron.

In this talk I will report about a new measurement of the Rydberg constant from the 2S-4P transition in regular hydrogen performed in Garching [4], which supports the smaller, "muonic" value. More recently, however, a new measurement of the 1S-3S transition in Paris confirmed the larger proton radius [5]. Several new measurements, such as hydrogen from Toronto, elastic electron scattering at lower Q2, and new results from electronic and muonic helium will help understand the proton radius puzzle. With most of the new results pointing towards the smaller "muonic" proton radius, also from measurements with electrons, we may have to revise the value of the Rydberg constant. The improved proton radius will then pave the way for tenfold improved tests of QED and the Standard Model.

[1] Pohl et al. (CREMA Coll.), Nature 466, 213 (2010)

[2] Antognini et al. (CREMA Coll.), Science 339, 417 (2013)

[3] Pohl et al. (CREMA Coll.), Science 353, 669 (2016)

[4] Beyer et al., Science 358, 79 (2017)

[5] Fleurbaey et al., PRL 120, 183001 (2018)

Montag, 12.11.2018, 16:15 Uhr
Ort: Hörsaal 6

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