Atomphysik-Seminar

Wednesday, January 10, 13.15, KBW Lecture Hall - Side Room

Precision spectroscopy of the 2S-4P transition in atomic hydrogen

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Precision measurements of atomic hydrogen (H) have long been successfully used to extract fundamental constants and to test bound-state quantum electrodynamics. Both the Rydberg constant R_∞ and the proton root mean square charge radius r_p are determined to a large degree by H spectroscopy, requiring the measurement of at least two transition frequencies. With the very precisely measured 1S-2S transition frequency [1] serving as a corner stone, the current limitation of this extraction is the measurement precision of other H transition frequencies. Moreover, r_p extracted from the H spectroscopy world data disagrees by 4 standard deviations with the much more precise value extracted from spectroscopy of muonic hydrogen (μp).
Using a cryogenic beam of H atoms optically excited to the initial 2S state, we measured the 2S-4P transition in H with a relative uncertainty of 4 parts in 10^{12} [2]. Combining this result with the 1S-2S transition frequency yields the values of the Rydberg constant R_∞ = 10973731.568076(96) m^{-1} and r_p = 0.8335(95) fm. Our r_p value is 3.3 combined standard deviations smaller than the previous H world data, but in good agreement with the μp value.

[1] C. G. Parthey, A. Matveev et al., Phys. Rev. Lett. 107, 203001 (2011).
[2] A. Beyer, L. Maisenbacher, A. Matveev et al., Science 358 (2017).

Find it on Indico: http://indico.gsi.de/e/AP_Seminar_Maisenbacher