Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

Precision spectroscopy of the 2S-nP transitions in atomic hydrogen LOTHAR MAISENBACHER, VITALY ANDREEV, ARTHUR MATVEEV, AXEL BEYER, ALEXEY GRININ, Max Planck Institute of Quantum Optics (MPQ), RANDOLF POHL, MPQ; Johannes Gutenberg University Mainz, KSENIA KHABAROVA, NIKOLAI KOLACHEVSKY, MPQ; Lebedev Physical Institute, THEODOR W. HÄNSCH, MPQ; Ludwig Maximilian University of Munich, THOMAS UDEM, MPQ — Precision measurements of atomic hydrogen (H) have long been used to extract fundamental constants and to test bound-state quantum electrodynamics. Both Rydberg constant R_∞ and proton RMS charge radius r_p are determined significantly by H spectroscopy, requiring the measurement of at least two transitions. With the very precisely known 1S-2S transition frequency (C. G. Parthey et al., PRL 107, 203001 (2011)) as a corner stone, the limitation of this extraction is the measurement precision of other H transitions. Moreover, r_p extracted from the H spectroscopy disagrees by 4 standard deviations with the value extracted from muonic hydrogen (μp) spectroscopy (A. Antognini et al., Science 339, 417 (2013)). Using a cryogenic beam of H atoms optically excited to the 2S state, we measured the 2S-4P transition with a relative uncertainty of 4 parts in 10^{12} (A. Beyer et al., Science 358, 79 (2017)). Combining our result with the 1S-2S result yields $R_\infty = 10973731.568076(96)\,\mathrm{m}^{-1}$ and $r_p = 0.8335(95)\,\mathrm{fm}$. 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. To further improve on this result, we are working on a measurement of the 2S-6P transition in H and deuterium.

Lothar Maisenbacher
Max Planck Institute of Quantum Optics (MPQ)

Date submitted: 26 Jan 2018 Electronic form version 1.4