Abstract Submitted
for the DAMOP15 Meeting of
The American Physical Society

Towards an improved measurement of the proton size from precision spectroscopy of atomic hydrogen LOTHAR MAISENBACHER, AXEL BEYER, Max Planck Institute of Quantum Optics Garching, KSENIA KHABAROVA, Lebedev Physical Institute Moscow, ARTHUR MATVEEV, RANDOLF POHL, THOMAS UDEM, THEODOR W. HÄNSCH, Max Planck Institute of Quantum Optics Garching, NIKOLAI KOLACHEVSKY, Max Planck Institute of Quantum Optics Garching, Lebedev Physical Institute Moscow — Precision spectroscopy of atomic hydrogen has long been successfully used to provide stringent tests on fundamental theories and precisely determine physical constants. The current limit originates from the uncertainty in the value of the proton r.m.s. charge radius r_p. Moreover, the value of r_p extracted from laser spectroscopy of muonic hydrogen[1] is ten times more accurate than any other determination, but disagrees by 7σ with the recommended CODATA 2010 value. Here, we report on our progress towards an improved absolute frequency measurement of the 2S-4P (one-photon) transition in atomic hydrogen, which combined with the much more precisely known 1S-2S transition frequency[2] allows a more precise extraction of r_p from electronic hydrogen. To suppress the first order Doppler shift, we use a cryogenic beam of atoms optically excited to the 2S state and actively stabilized counter-propagating laser beams. Interference effects due to spontaneous emission[3] were studied and we show how to experimentally suppress the corresponding line center shifts.

[1]R. Pohl et al., Nature 466, 213 (2010)
[2]C. G. Parthey et al., PRL 107, 203001 (2011)
[3]M. Horbatsch and E. A. Hessels, PRA 82, 052519 (2010)

Lothar Maisenbacher
Max Planck Institute of Quantum Optics Garching

Date submitted: 30 Jan 2015 Electronic form version 1.4