Spectroscopy of hydrogen 1S-3S transition with a cw-laser at 205 nm

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High resolution spectroscopy of simplest atomic systems provides access to fundamental quantities of physics such as the Rydberg constant and the proton charge radius (r_p) as these systems are calculable. In 2010, the spectroscopy of muonic hydrogen (made of a proton and a muon) yielded a value of r_p an order of magnitude more precise, but about 4% smaller, than the CODATA-recommended value [2]. This discrepancy has become known as the proton radius puzzle [3].

A recent measurement of the hydrogen $2S-4P$ [4] transition frequency in Garching has brought a new dimension to this conundrum, as it agrees with the smaller muonic value of the proton charge radius, in disagreement with other spectroscopic measurements in electronic hydrogen.

Recently we have improved the spectroscopy of hydrogen $1S-3S$ transition [5] [6] with a cw-laser at 205 nm [7]. It is now realized with a relative uncertainty of 9×10^{-13} [8]. It yields a value of the proton charge radius that appears to support the CODATA-recommended value (see Fig. 1). We will present our experiment and our current efforts to improve it.

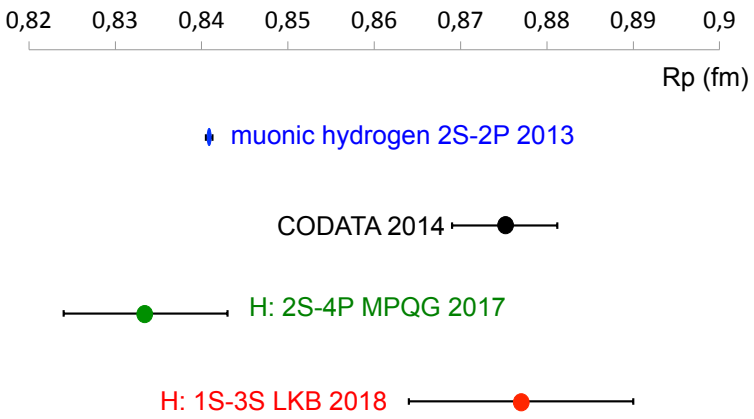

Fig. 1: Recent determinations of the proton charge radius.

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