Recent developments in hydrogen Lamb shift and Rydberg constant

Vladimir A. Yerokhin

Max-Planck Institute for Nuclear Physics, Saupfercheckweg 1, 69117 Heidelberg, Germany

I discuss recent progress achieved in theoretical calculations of the Lamb shift in hydrogen and the implications for the determination of the Rydberg constant. Particular attention is paid to one of the most problematic effects, the two-loop electron self-energy. The corresponding correction in hydrogen is obtained by combining numerical all-order (in $Z\alpha$) and $Z\alpha$-expansion calculations [1-3]. Recently, we were able to achieve a breakthrough in all-order calculations of the electron self-energy [4], basing on the method for improving convergence of the partial-wave expansion suggested in [5]. Extrapolation of our all-order results to hydrogen yields a result twice as precise as the previously accepted value [6], differing from it by 2.8 standard deviations. The resulting shift in the theoretical prediction for the 1S-2S transition frequency in hydrogen decreases the value of the Rydberg constant by one standard deviation.

References

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