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Thermal shift of atomic levels in hydrogen: influence on the determination of the proton radius

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The Quantum Electrodynamics theory for bound states at finite temperatures is discussed. The details of theory can be found in [1] where the derivation of thermal photon propagator in different forms and gauges is presented. The constructed theory is used to find the "thermal Coulomb interaction" and its asymptotic at large distances. Finally, the thermal effects of the lowest order in the fine structure constant and temperature are discussed in detail. Such effects are represented by the thermal one-photon exchange between a bound electron and the nucleus, thermal one-loop self-energy, thermal vacuum polarization, and recoil corrections and that for the finite size of the nucleus. As a result, the influence of thermal effects on the finding the proton radius and Rydberg constant from the hydrogen spectroscopy experiments is discussed.

References:
[1] D. Solovyev, Ann. Phys. **415**, 168128 (2020)

Primary author: SOLOVYEV, Dmitry (Saint-Petersburg State University)

Presenter: SOLOVYEV, Dmitry (Saint-Petersburg State University)

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