

Prize Talk PV X Wed 15:30 V53.01
The size of the proton from laser spectroscopy of an exotic hydrogen atom — ●RANDOLF POHL^{1,3} and ALDO ANTIGNINI^{2,3} —
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The proton has a finite size because it is a composite system of quarks and gluons. The charge radius R_p of the proton has so far been known only with a low precision of about 1% from both electron scattering and precision spectroscopy of hydrogen.

We have recently determined R_p by means of laser spectroscopy of

the exotic "muonic hydrogen" atom [1]. Here, the muon, which is the 200 times heavier cousin of the electron, orbits the proton with a 200 times smaller Bohr radius. This enhances the sensitivity of the muonic atom energy levels to the proton's finite size tremendously. Our new value $R_p = 0.84184(67)$ fm is ten times more precise than the generally accepted CODATA value, but it differs by 5 standard deviations from it.

A lively discussion about this discrepancy has started, considering bound-state QED, proton shape and structure, the value of the Rydberg constant and even new physics.

[1] R. Pohl, A. Antognini et al., Nature 466, 213 (2010)