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A measurement of the Lamb shift in atomic hydrogen and its implication for the proton size puzzle

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We have measured the n=2 Lamb shift in atomic hydrogen. The measurement uses a direct microwave transition between the 2S and 2P states, and employs the new frequency-offset separated-oscillatory-fields (FOSOF) technique. The FOSOF technique is a variation of the Ramsey separated-oscillatory field technique in which the two separated fields have their frequencies slightly offset from each other. Our Lamb shift measurement, along with existing high-precision quantum-electrodynamics theory, leads to a precise measurement of the rms proton charge radius, and therefore helps to resolve the eight-year-old puzzle created by contradictory determinations of the proton size. In particular, this measurement is the direct analog of the very precise 2S-2P muonic-hydrogen determination of the proton size. Our recent work in determining the helium 2^3P fine structure and our new program to determine the electron electric dipole moment will also be discussed briefly.

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