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# The incredible shrinking proton and the proton radius puzzle

For nearly half a century the charge radius of the proton had been obtained from measurements of the energy levels of the hydrogen atom or by scattering electrons from hydrogen atoms. Until recently the proton charge radius obtained from these two methods, agreed with one another within experimental uncertainties. In 2010 the proton charge radius was obtained for the first time by precisely measuring the energy levels of an exotic kind of hydrogen atom called muonic hydrogen. The charge radius of the proton obtained from muonic hydrogen was found to be significantly smaller than those obtained from regular hydrogen atoms. This was called the proton charge radius puzzle" and led to a rush of experimental as well as theoretical efforts to understand why the size of the proton appears to be different when measured in regular hydrogen vs. muonic hydrogen. Many physicists were excited by the possibility that thepuzzle" was an indication of a possible new force that acted differently on electrons and muons.

The Proton Charge Radius (PRad) experiment at the Thomas Jefferson National Accelerator Facility (Jefferson Lab) was one such major new effort which used electron scattering from a regular hydrogen atom, but with several innovations that made it the highest precision electron scattering measurement. These innovative methods have allowed us to measure the size of the proton more precisely than it has been measured before using electron scattering. I will provide a brief review of the techniques used to measure the proton's size and introduce the proton radius puzzle", and the world-wide effort to resolve this puzzle. I will discuss the PRad experiment, the new results from this experiment, the current status of thepuzzle" and future prospects.

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