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New ideas for the proton radius puzzle

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The radius of the proton has been studied using several techniques. Methods using electron scattering and the atomic spectrum of electronic hydrogen have both produced values compatible with r_E = 0.8751(51)fm. Note that the spectroscopy method relies on being able to measure the transition energies accurately enough that the influence of the finite size of the proton can be discerned. More recent results have used spectroscopic measurements of muonic hydrogen. Due to the muon's larger mass, its wave function is more spatially concentrated meaning that it is a better probe of the proton than electronic hydrogen and hence can provide more accurate proton radius determinations. Using this method, Pohl et al found that the radius from muonic hydrogen is around 4% smaller than the electronic hydrogen case. Since this represents 7 standard deviations, it is an unresolved puzzle. This paper introduces new ideas which may affect these proton radii measurements.

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