Contribution ID: **417** Type: **Invited Speaker**

Review of Proton Radius Puzzle

Thursday 25 May 2017 13:25 (25 minutes)

Our ability to completely understand the size of the proton has come into question. This puzzle is presently unsolved. It has been building up since 2010 when a measurement of the Lamb shift in muonic hydrogen yielded a very precise value[1] for the electric charge radius of the proton equal to $\langle r^2{}_E \rangle^{1/2}$ = 0.84087(39) fm with an amazing 0.1% uncertainty. This precision measurement, however, is 4% smaller than the accepted value[2] of the radius of the proton of $\langle r^2{}_E \rangle^{1/2}$ = 0 .8751(61) fm. This latter measurement has been the standard and determined from a combination of electron data either by scattering from protons or by analyzing the fine structure splitting in hydrogen energy spectra using the Lamb shift. This disagreement is significant and very important to reconcile, not only for our understanding of the structure of the proton, but also for understanding of the predictions of quantum electrodynamics. A short review of these measurements, recently published re-analysis[3] of old data, possible corrections, and selected new experiments will be presented to help solve the puzzle.

1. R. Pohl et al. Nature 466, 213–216 (2010), A. Antognini et al., Science 339, 417 (2013)
2. P.J. Mohr et al., Rev. Mod. Phys 84, 1527-1603(2012), CODATA 2010
3. D.B Higinbotham et al., Phys Rev C93, 055207(2016)

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Session Classification: A12: High Energy Physics

Track Classification: High Energy and Particle Physics