Understanding the “Proton Radius Puzzle”: Nuclear Polarizability Correction in $^{2}$H

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The accuracy of the proton radius was improved ten-fold by new spectroscopic measurements in muonic hydrogen [1] but it differs by $7\sigma$ from hydrogen determinations. This discrepancy, has been coined the “proton radius puzzle”. The results of new high-precision experiments on muonic deuterium indicate a new deuterium radius puzzle [2]. The accuracy of the nuclear charge radius determination from these measurements is limited by the uncertainty in the nuclear structure effects. We have calculated this correction in Ref. [3] including the first estimate of the nuclear-model dependence. Due to the importance of constraining the uncertainty, we will determine the statistical and systematic uncertainties of the $\chi$EFT potentials by determining the co-variance matrices of our predictions. I will also discuss an alternate method that may reduce the theoretical uncertainty.


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