# PRad II: An Upgraded Electron-Proton Scattering Experiment for High Precision Measurement of the Charge Radius of the Proton at Jefferson Lab[1]

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The PRad experiment at Jefferson Lab has performed an electron $e-p$ scattering experiment in 2016 by utilizing a magnetic-spectrometer-free approach with a hybrid electromagnetic calorimeter, gas electron multipliers and a windowless hydrogen gas target to measure the proton root-mean-square charge radius, $r_p$, with a good accuracy. Although the PRad result, within its experimental uncertainties, was a critical input in the recent revision of the CODATA recommendation for $r_p$, the experiment did not reach the highest precision allowed by the calorimetric technique. Besides, the PRad $r_p$ value is 5.8% smaller than that extracted from the most precise electron scattering experiment to date. In order to resolve such a tension with modern $e-p$ scattering results, the PRad collaboration proposed PRad-II (PR12-20-004), an upgraded experiment that was approved by the JLab program advisory committee with the highest scientific rating "A". PRad-II has its goal to reach an ultra-high precision in the radius measurement with $\sim 4$ times smaller total uncertainty than what PRad has reported. Furthermore, PRad-II will reach a $Q^2$ range of $\sim 10^{-5}\,(\mathrm{GeV/c})^2$, enabling a more accurate and robust extraction of $r_p$. In this talk, we will present how PRad-II will open up a new precision frontier in electron scattering, by discussing a number of critical upgrades to the PRad sub-detectors and DAQ along with improved radiative correction calculations, as well as by discussing how PRad-II will measure $r_p$ in general.

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