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## Preliminary Conceptual Design of Proton Charge Radius Experiment using Future Muon Beam at CiADS

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Accurate knowledge about proton charge radius is essential to high-precision QED calculations of atomic energy levels, and to test the Standard Model. It also has a strong impact on the Rydberg constant. Typically, one can measure the proton charge radius using ordinary hydrogen spectroscopy or elastic e-p scattering. However, in 2010, the first muonic hydrogen spectroscopy experiment, with an unprecedented precision (0.1%), yielded a proton charge radius result that was 7 smaller than previous measurements. This unexpected discrepancy is often referred to as the “proton charge radius puzzle”. In the past decade, significant progress has been made in both theory and experiment, yet many problems remain. For example, the form factor results are inconsistent between PRad and Mainz experiments, and the cause of this discrepancy is still unknown. Furthermore, there has been no result published from  $\mu$ -p elastic scattering experiments until now. Therefore, we propose a high-precision measurement of proton charge radius using the  $\mu$ -p scattering technique, based on the future muon beam of CiADS at HIAF. It aims to collect  $\mu$ -p, e-p, as well as e-e elastic scattering simultaneously, which will offer a unique opportunity for a direct test of the lepton universality, and help resolve the “proton charge radius puzzle”. In this poster, we will present a potential conceptual design of this experiment, including projected results for the main physics observables.

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