

# Institutsseminar Kern- und Hadronenphysik

Dec. 9, 2019 at 2 p.m. c.t.  
HS Kernphysik, Becherweg 45

Ethan Cline  
MIT

## The Proton Radius Puzzle and MUSE

In 2010 when the CREMA Collaboration released their measurement of the proton radius (Pohl et. al (2010)) from muonic hydrogen spectroscopy:  $r_p = 0.84184(67)$  fm. This was seven standard deviations smaller than the accepted 2010 CODATA value (0.8768(69) fm). This discrepancy lies at the heart of the proton radius puzzle. The MUon-Proton Scattering Experiment (MUSE) was first proposed in 2012 to be the first muon-proton elastic scattering experiment with sufficient precision to address the proton radius puzzle. MUSE has the capacity to simultaneously measure elastic muon-proton, and electron-proton scattering, and switch polarities to measure with opposite charge states. As such, MUSE can directly measure the two-photon effect by comparing charge-states, and compare muon and electron scattering with minimal systematic error. By comparing the two measured scattering cross sections, the experiment will provide more data for the proton radius puzzle and determine if the radius is the same in electron and muon-proton scattering. We will review the motivation for and status of MUSE, which is due to begin production running in 2020. Initial analysis results will be shown from the summer 2019 beam time.