Abstract Submitted
for the DNP15 Meeting of
The American Physical Society

Few-Nucleon Charge Radii and a Precision Isotope Shift Measurement in Helium NIMA HASSAN REZAEIAN, University of North Texas, DAVID SHINER, University of North Texas (UNT) — Recent improvements in atomic theory and experiment provide a valuable method to precisely determine few nucleon charge radii, complementing the more direct scattering approaches, and providing sensitive tests of few-body nuclear theory. Some puzzles with respect to this method exist, particularly in the muonic and electronic measurements of the proton radius, known as the proton puzzle. Perhaps this puzzle will also exist in nuclear size measurements in helium. Muonic helium measurements are ongoing while our new electronic results will be discussed here. We measured precisely the isotope shift of the 2^3S - 2^3P transitions in ^3He and ^4He. The result is almost an order of magnitude more accurate than previous measured values. To achieve this accuracy, we implemented various experimental techniques. We used a tunable laser frequency discriminator and electro-optic modulation technique to precisely control the frequency and intensity. We select and stabilize the intensity of the required sideband and eliminate unused sidebands. The technique uses a MEMS fiber switch (t_s = 10 ms) and several temperature stabilized narrow band (3 GHz) fiber gratings. A beam with both species of helium is achieved using a custom fiber laser for simultaneous optical pumping. A servo-controlled retro-reflected laser beam eliminates Doppler effects. Careful detection design and software are essential for unbiased data collection. Our new results will be compared to previous measurements.

Nima Hassan Rezaeian
University of North Texas

Date submitted: 09 Jul 2015