Precision measurement of the radii of light nuclei with high-resolution x-ray spectroscopy

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Our knowledge of the nuclear charge radius is often the limitation to the precision with which we can confront theory with experiment. Such comparisons allow us to determine the fundamental constants [1] and search for new physics [2]. The most accurate charge radius determinations are through its effect on the energy levels of muonic atoms—compact exotic bound systems where a negative muon orbits a nucleus. Although the radii of nearly 300 nuclei have been measured in this way, those of light nuclei that extend from lithium to neon are poorly known [3].

The QUARTET experiment aims to improve the radii of light nuclei by an order of magnitude [3]. To do so we employ a novel quantum sensing technology for photon energies—metallic magnetic calorimeters [4]. In October 2024, we have taken data with enriched targets of ^{6}Li, ^{7}Li, ^{9}Be, ^{10}B and ^{11}B with enough statistical accuracy to significantly improve their radii. In this talk I will show preliminary results from the ongoing analysis and discuss the interplay with other precision measurements such as the laser spectroscopy of helium-like ions.

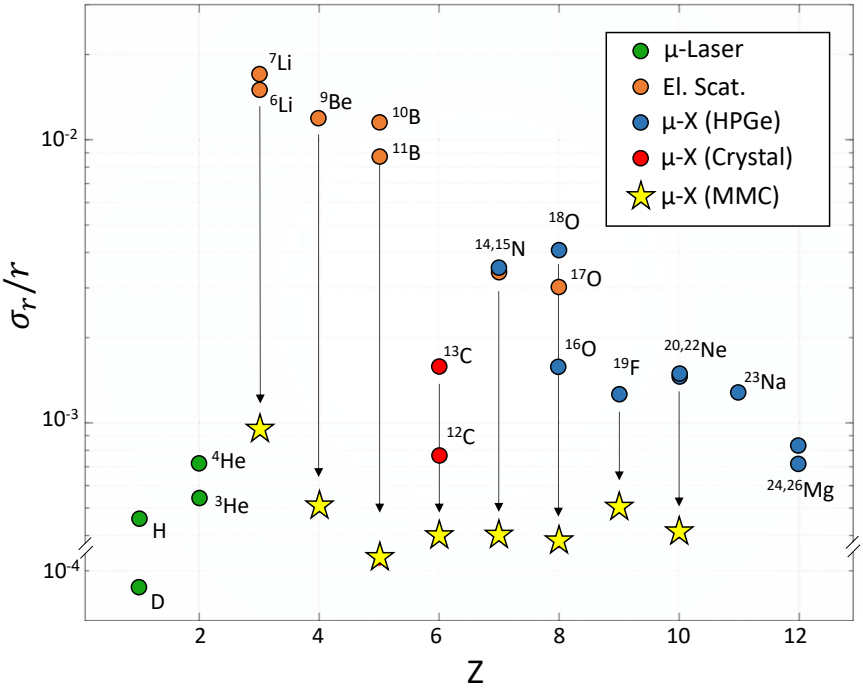

Figure 1: Current status [5, 6] and our accuracy goals for the radii of light nuclei

References

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