Abstract Submitted
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Proposal for Two-Photon Doppler-Free Extreme Ultraviolet Direct Frequency Comb Spectroscopy of the Helium Ground State[1] GIL PORAT, CHRISTOPH M. HEYL, STEPHEN B. SCHOUN, JUN YE, JILA, NIST and the University of Colorado — Tests of quantum electrodynamics (QED) are part of the search for physics beyond the standard model. QED calculations are most precise in simple systems, e.g., few-electron atoms. Hydrogen spectroscopy yielded the most stringent test so far, however QED effects are stronger in helium ground state transitions. Furthermore, experimental results disagree on the $^3He -^4 He$ nuclear charge radius difference, measured using excited state transitions. This discrepancy might be related to the proton radius puzzle, and could potentially be resolved by measuring a helium ground state transition, where the effect of the nucleus is greatest. However, such transitions are in the extreme ultraviolet (XUV), where the only available stabilized laser is a frequency comb, which has so far lacked sufficient power for direct spectroscopy. We propose to perform direct two-photon frequency comb spectroscopy of the 20.6eV $1^1S - 2^1S$ transition in helium, using a cell of cryogenic helium. This approach just became available, due to our success in scaling the power of our XUV frequency comb. The use of cold (∼4K) helium gas significantly reduces transit-time broadening and also allows for high gas densities. We expect to achieve the first spectroscopic measurement in the XUV with sub-MHz precision.

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