## Abstract Submitted for the DAMOP19 Meeting of The American Physical Society

Towards Continuous-wave Laser Cooling for Anti-hydrogen<sup>1</sup> WAYNE HUANG, Department of Physics and Astronomy, Center for Fundamental Physics, Northwestern University, THARON MORRISON, Department of Physics, Harvard University, NATHANIEL MCDONOUGH, GERALD GABRIELSE, Department of Physics and Astronomy, Center for Fundamental Physics, Northwestern University — Anti-hydrogen synthesis opens new avenues for precision measurements for investigating the antimatter-matter asymmetry. The narrow line of the 1S-2S transition in hydrogen and anti-hydrogen provides an excellent test for this asymmetry. Precision hydrogen spectroscopy is typically performed in a beam configuration. This is not applicable for anti-hydrogen due to constraints in the ability to produce and contain it. Laser cooling is thus a prerequisite for precise antihydrogen spectroscopy in a neutral particle trap. However, the required cooling laser wavelength, Lyman-alpha (121.56 nm for 1S-2P transition), is difficult to produce coherently. A pulsed source can be used to achieve few microwatts of average power [1], but the broad linewidth limits the cooling performance. Based on [2] where 20 nanowatts of Lyman-alpha was demonstrated, we are working towards improvements to microwatt coherent Lyman-alpha generation. Some important improvements are: (1) efficient collection schemes for Lymen-alpha, and (2) implementation of a buildup cavity for 254 nm. With these improvements, we expect to achieve cooling in all three axes on the time scale of minutes. [1] G. Gabrielse et al., Opt. Lett. 43, 2905 (2018). [2] K. S. E. Eikema, J. Walz, and T. W. Hnsch, Phys. Rev. Lett. 86, 5679.

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Wayne Cheng-Wei Huang Northwestern University

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