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Sympathetic and Direct Doppler Cooling of Boron Hydride in a Radio-Frequency Ion Trap[1] JUDD STAPLES, North Carolina School of Science and Mathematics, LU QI, EVAN REED, Department of Electrical and Computer Engineering, Duke University, NIKITA ZEMLEVSKIY, Department of Physics, Duke University, JYOTHI SARALADEVI, Department of Electrical and Computer Engineering, Duke University, KENNETH BROWN, Department of Electrical and Computer Engineering and Department of Physics, Duke University — The radio-frequency trapping of cold molecular ions has several potential applications including precision measurement of time variation in the electron/proton mass ratio, construction of two-qubit quantum gates, and the execution of cold chemistry experiments such as controlled reactions and charge exchange observation. However, the rovibrational degrees of freedom within molecular ions make direct Doppler cooling processes experimentally difficult, necessitating additional lasers to suppress state branching. Numerical analysis predicts nearly diagonal Franck-Condon factors within vibronic transitions of BH+, which signifies a nearly closed cooling cycle thereby making Doppler cooling feasible [1]. By first sympathetically cooling BH+ within a Ca+ Coulomb crystal to demonstrate BH+ synthesis then Doppler cooling on the $X^2\Sigma^+ \rightarrow A^2\Pi^+$ electronic transition, we aim to realize Doppler cooling of BH+. We report the current status of this experiment. [1] Nguyen, J. H. V., Viteri, C. R., Hohenstein, E. G., Sherrill, C. D., Brown, K. R., & Odom, B. (2011). Challenges of laser-cooling molecular ions. New Journal of Physics, 13(6), 063023. doi: 10.1088/1367-2630/13/6/063023

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