

MAR15-2014-020219

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

Quantum state preparation of polar molecular ions: Towards quantum logic and spectroscopy

MICHAEL DREWSSEN, Department of Physics and Astronomy, Aarhus University

For more than a decade, the translational degrees of freedom of trapped ensembles of molecular ions have efficiently been cooled to temperatures of a few millikelvin through Coulomb interaction with simultaneously trapped and laser Doppler cooled atomic ions [1]. More recently methods to produce rovibrational cold ensembles of translationally cold molecular ions have as well been demonstrated [2-8]. In my talk, I will present our recent progresses towards generating a single polar molecular ion in its absolute ground state with respect to both its rovibrational motion and its motion in the external trapping potential [6,8-11], as well as discuss future perspectives of applying fully quantum state prepared polar molecular ions for extremely high-resolution spectroscopy and as qubits for quantum information processing. [1] Mølhave, K. and Drewsen, M. Phys. Rev. A 62, 011401 (2000). [2] Staunum, P. F., Højbjerg, K., Skyt, P.S., Hansen, A. K., and Drewsen, M., Nat. Phys. 6, 271 (2010). [3] Schneider, T., Roth, B., Duncker, H., Ernsting, I., and Schiller, S., Nat. Phys. 6, 275 (2010). [4] Tong, X., Winney, A. H., and Willitsch, S., Phys. Rev. Lett. 105, 143001 (2010). [5] Rellergert, W. G., Sullivan, S. T., Schowalter, S. J., Kotochigova, S., Chen, K., and Hudson, E. R., Nature 495, 490 (2013) [6] Hansen A. K. et al., Nature 508, 76 (2014). [7] Lien, C.-Y., Seck, C. S., Lin, Y.-W., Nguyen, J. H. V., Tabor, D. A., and Odom, B.C., Nat. Commun. 5, 4783 (2014) [8] Kristensen S. B. et al., “Non-destructive high purity probabilistic rotational state preparation of a single molecular ion” Manuscript in preparation. [9] Poulsen G., Miroshychenko Y., and Drewsen M., Phys. Rev. A (Rapid Comm.) 86, 051402 (2012). [10] Poulsen G., and Drewsen M., arXiv:1210.4309v1. [11] Poulsen G., PhD thesis: “Sideband Cooling of Atomic and Molecular Ions” Department of Physics and Astronomy, Aarhus University.