Cold Polyatomic Molecules: The Beginning of a New Era?

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Dipolar molecules cooled to low velocities and high densities offer new perspectives for the exploration of fundamental physics and the implementation of novel ideas. Examples include measurement of the electron electric dipole moment and the simulation of quantum-many body systems, respectively. Reaching such goals requires the development of generally applicable and sufficiently simple deceleration, trapping and cooling techniques for molecules. The talk will highlight some recent achievements in this direction, including the deceleration of polyatomic molecules with the large inertial force in the rapidly rotating frame of a centrifuge, their accumulation and trapping in tailor-made electrostatic fields [1], as well as their cooling by means of an opto-electrical Sisyphus effect which employs microwave transitions between rotational states to remove the energy and spontaneous transitions between vibrational states to decrease the entropy of the molecules [2].

[1] B.G.U. Englert, M. Mielenz, C. Sommer, J. Bayerl, M. Motsch, P.W.H. Pinkse, G. Rempe, and M. Zeppenfeld, *Physical Review Letters* **2011**, *107*, 263003.

[2] M. Zeppenfeld, B.G.U. Englert, R. Glöckner, A. Prehn, M. Mielenz, C. Sommer, L.D. van Buuren, M. Motsch, and G. Rempe, *Nature* **2012**, *491*, 570.