LIFETIME MEASUREMENTS WITH ELECTROSTATICALLY TRAPPED COLD MOLECULES

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With a Stark decelerator, bunches of state-selected molecules with a controlled velocity and with longitudinal temperatures as low as a few mK can be produced. These slow bunches of molecules can subsequently be trapped in an electrostatic trap. We will report on the deceleration and trapping of ground state OH, and metastable CO and NH molecules. The OH radicals are trapped at a density of $10^7 - 10^8$ cm^{-3} and at a temperature of around 50 mK, and their trap lifetime is measured to be 2.8 s. The long interaction time afforded by the trap can be exploited to measure lifetimes of vibrationally excited states or electronically excited metastable states. Such lifetimes can be used as an accurate test of theoretical models. We will present experiments on the lifetime of OH ($X^2\Pi_{3/2}$), $v = 1$ and of metastable CO ($a^3\Pi, v = 0$). The different loss processes that play a role in the trap, like optical pumping by blackbody radiation, were studied in detail.

[1] S.Hoekstra *et al.*, Optical pumping of trapped neutral molecules by blackbody radiation, Phys. Rev. Lett. **98** 13301 (2007)
[2] J. J. Gilijamse *et al.*, The radiative lifetime of metastable CO ($a^3\Pi, v = 0$), J. Chem. Phys. **127** 221102 (2007)