Temperature Dependence of SF_6^- Auto-Detachment Rates

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The temperature dependences of the auto-detachment rates of SF_6^- ions are measured in an electrostatic ion beam trap [1]. The ions are produced in a pulsed Even-Lavie supersonic expansion source by attaching electrons supplied by the electron impact ionizer located ~ 1 mm after the nozzle [2]. The pre-expansion pressure of the carrier gas as well as other parameters of the source are varied to influence the initial temperature of the ions, and hence their internal energy distribution. The ions are accelerated to 4.2 keV and stored for up to ~ 1 second in the trap. Mass selection is achieved by applying the kick-out technique [3] during the first few milliseconds of storage.

After eliminating all other masses from the trap, the decay of the selected anions is monitored simultaneously using two independent techniques [4]. The trapped ions are bunched using a weak RF potential applied to one of the mirror electrodes of the trap. The neutralization rates due to the auto-detachment or other neutralization process such as residual gas scattering is monitored with an MCP detector, which detects the neutral products ejected from the trap. Simultaneously, the number of ions stored in the trap as a function of time is deduced by analysing the time signal induced by the oscillating ions in a ring electrode.

Auto-detachment rates of hot molecular or cluster anions result in a power law dependence $\propto t^{-d}$ when plotted as a function of storage time [5], where d depends beside others on the initial internal energy distribution. The dependence of the coefficient d is measured for different source conditions which correlate with different ion temperatures. Results are presented for SF_6^- ions [6,7] as a case study for upcoming experiments to be performed in the WIS-cryotrap [8] presently under construction.

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