GEC06-2006-000308

Abstract for an Invited Paper
for the GEC06 Meeting of
the American Physical Society

Detailed Studies of Cold and Ultracold Ions in RF Traps

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The physics and chemistry determining the composition of the interstellar medium is quite different from other chemical systems since low densities ($< 10^7$ cm^3) and low temperatures prevail. For example, modeling the early stages of protostellar collapse requires a detailed understanding of ultracold hydrogen plasmas. This contribution concentrates on recent results in the field of cold gas phase ion chemistry, producing, modifying or destroying $C_mH_n^+$ ions and their deuterated variants (m≥0, n≥0). All experimental activities with charged particles are based on *inhomogeneous, time dependent electric fields*, created with suitable electrode arrangements. Rather complex machines have been constructed by combining for example temperature variable multi-electrode ion traps (e.g. a 22-pole trap) with atomic or molecular beams. In addition analytical tools such as laser induced reactions are used in order to understand the low energy dynamics on a state specific level. It is emphasized that reactions (in the trap or in space) often do not reach thermodynamical equilibrium, especially if traces of ortho-hydrogen are present.