A Critical Reappraisal of Low-Temperature Kinetics in Uniform Supersonic Flows

Olivier Durif

Max Planck Institute for Solid State Research (MPI-FKF) — o.durif@fkf.mpg.de

For decades, uniform supersonic flow (CRESU) experiments have provided the vast majority of gas-phase reaction rate coefficients at temperatures below 100 K. These measurements have long been presented as foundational to astrochemistry [1]. However, they have proven difficult to reconcile with detailed astrophysical modelling in at least one key case [2].

In this presentation, I critically re-examine these foundational experiments. I demonstrate that the apparent strong negative temperature dependence is largely an experimental artefact: the observed signals are dominated by the sharp decrease in gas density occurring during reactant mixing in the adiabatic expansion, rather than by intrinsic temperature-dependent rate constants [3].

This reappraisal supports the view that astronomical observations can be used to constrain important chemical reactions, as recently illustrated in the methoxy radical case [2]. It calls for a significant revision in the interpretation and use of low-temperature kinetic data in astrochemical models.

References

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