CRESU studies of the reactivity of atomic nitrogen at low temperature.

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At the present time, the reactivity of ground state atomic nitrogen (N(4S)) at low temperature is poorly understood despite its importance for the chemistry of the interstellar medium and planetary atmospheres. This contribution will describe our recent experimental results on the kinetics of the reactions of atomic nitrogen with other small radical species such as OH, CN, CH, C₂ and C₂N to temperatures as low as 50 K. The experimental results will be compared with the results of quantum mechanical calculations and the future prospects for extending this method to investigate the reactions of other atomic radicals (O(³P), H(²S)) will be discussed.



Fig. 1: (A) Exemplary temporal profiles at 147 K obtained for the N + OH \rightarrow H + NO reaction with estimated [N] = 1.1×10^{14} atom cm⁻³. \square NO($^{2}\Pi_{1/2}$) LIF signal. OOH($^{2}\Pi_{3/2}$) LIF signal. (B) As in (A) but with estimated [N] = 4.1×10^{14} atom cm⁻³.

References

[1] J. Daranlot, M. Jorfi, C. Xie, A. Bergeat, M. Costes, P. Caubet, D. Xie, H. Guo, P. Honvault and K. M. Hickson, "Revealing atom – radical reactivity at low temperature through the N + OH reaction", Science, 334, 1538 (2011).

[2] J. Daranlot, U. Hincelin, A. Bergeat, M. Costes, J.-C.Loison, V. Wakelam and K. M. Hickson, "Elemental nitrogen partitioning in dense interstellar clouds", Proc. Natl. Acad. Sci. USA, 109, 10233 (2012).

[3] J. Daranot, X. Hu, C. Xie, J.-C.Loison, P. Caubet, M. Costes, V. Wakelam, D. Xie, H. Guo and K. M. Hickson, "Low temperature rate constants for the $N(^{4}S) + CH(X^{2}\Pi_{r})$ reaction. Implications for N_{2} formation cycles in dense interstellar clouds", Phys. Chem. Chem. Phys., 15, 13888 (2013).

[4] J.-C. Loison, X. Hu, S. Han, K. M. Hickson, H. Guo and D. Xie, "An experimental and theoretical investigation of the $N(^{4}S) + C_{2}(^{1}\Sigma_{g}^{*})$ reaction at low temperature", Phys. Chem. Chem. Phys., 16, 14212 (2014).