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Reaction product determination using photoionization/mass spectrometry techniques down to very low temperatures: applications to combustion and molecular astrophysics

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Understanding the mechanism of elementary gas phase reactions leading to the formation of molecules and clusters in various conditions, especially at very low temperatures (i.e. low collision energies), is of fundamental interest and yields crucial information for modelling gaseous environments encountered in the fields of atmospheric chemistry (of the Earth and other planets) and astrophysics.
We present a new instrument, CRESUSOL, developed by the Laboratory Astrophysics group at the Institute of Physics of Rennes in collaboration with the DESIRS beamline group at SOLEIL. The main scientific aim of this project is to identify the product of reactions at substantially lower temperatures than has been attempted before (< 100 K) and estimate their branching ratios. Associated aims include the measurement of rate coefficients for a selection of reactions, including dimerization, down to low temperatures.
To achieve this feat, a CRESU (Cinetique de Réaction en Ecoulement Supersonique Uniforme or Reaction Kinetics in Uniform Supersonic Flow) reactor is associated with a photoelectron-photoion coincidence (PEPICO) mass spectrometer to probe reactants and products of reaction after threshold photoionisation by the VUV beamline of the SOLEIL synchrotron. The original experimental set up will be presented and preliminary results will be shown for (i) the kinetics of dimerization of formic acid HCOOH observed at 50 and 70 K, (ii) the detection of C_4H_2 resulting from the reaction of C_2H with C_2H_2 at 50 K.

Summary

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