KA-BAND CHIRPED-PULSE SPECTROSCOPY IN COLD SUPERSONIC FLOWS FOR THE DETERMINATION OF REACTION PRODUCT CHANNEL BRANCHING RATIOS FOR ASTROCHEMISTRY

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To understand the chemical processes taking place in the interstellar medium, it is necessary to recreate these interactions in the laboratory at similar conditions to their environment in space, which can be as cold as 10 K. A well-known way to study reaction kinetics and dynamics at cold temperatures is the CRESU (a French acronym for reaction kinetics in supersonic flow) technique. However, very few CRESU experiments exist that are able to determine reaction products. Recently, the combination of chirped-pulse Fourier transform microwave (CPFTMW) spectroscopy with the CRESU technique, termed CPUF (chirped pulse in uniform flows), was developed through collaboration with the Suits and Field groups.[a] CPUF has proven capable of detecting multiple reaction products, simultaneously, within a cold flow. The CRESUCHIRP project at the Institut de Physique de Rennes aims to discover more about cold reactions through a new CPUF experiment.

A novel CPFTMW spectrometer operating in the Ka-band (26.5 GHz – 40 GHz) has been built and tested on a number of benchmark systems, such as carbonyl sulfide, vinyl cyanide and benzonitrile. Rotational temperature and pressure-broadening data were able to be determined at room temperature in a flow cell, and within CRESU flows. Furthermore, some photodissociation and bimolecular reactions were able to be observed. However, the high collisional rates within CRESU flows greatly attenuate the detectable signal in CPFTMW spectroscopy, so, in order to observe heavy products with large pressure-broadening rates, we are developing two complementary additions to our experiment. The first to be implemented is skimmer which samples the CRESU flow into a secondary chamber differentially-pumped to low pressure. Preliminary results from this venture will be presented, as well as future plans for the CRESUCHIRP project.

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