IMPACT PRESSURE MEASUREMENTS OF MODIFIED LAVAL NOZZLE GEOMETRIES

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Over 270 distinct molecules have been detected in the interstellar medium (ISM). Chemical kinetics models are used to elucidate the formation mechanisms of these species under astrophysical conditions, and these models require accurate temperature-dependent rate coefficients for gas-phase reactions. The combination of laser-induced fluorescence (LIF) with uniform supersonic molecular beams (i.e., CRESU) has proven to be a powerful method for measuring total rate constants. In recent years, there has been considerable interest in coupling chirped-pulse Fourier transform microwave (CP-FTMW) spectroscopy with the CRESU method, but the high density environment of the uniform flow causes rapid rotational dephasing, dramatically limiting its sensitivity. The Suits group at the University of Missouri-Columbia has proposed the design of an extended nozzle which contains the uniform flow, followed by a free-jet expansion where CP-FTMW spectroscopy may be employed. However the use of a nozzle extension prevents optical access to the uniform flow, complicating LIF measurements. Here, we discuss the incorporation of a fiber optic access port within the nozzle extension to provide in situ LIF measurements. Pitot tube impact pressure measurements were recorded to assess flow uniformity for solid extended nozzles, an extended nozzle with a hole, and a nozzle outfitted with a fiber optic collimator, for He and Ar nozzles spanning a range of temperatures. The effects of flow perturbation and the prospects for in situ fluorescence measurements will be discussed.