

JET-COOLED SPECTROSCOPY ON THE AILES INFRARED BEAMLINE OF THE SYNCHROTRON RADIATION FACILITY SOLEIL

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The Advanced Infrared Line Exploited for Spectroscopy (AILES) extracts the bright far infrared (FIR) synchrotron continuum of the third generation radiation facility SOLEIL. This beamline is equipped with a high resolution (10^{-3} cm^{-1}) Bruker IFS125 Fourier transform spectrometer which can be operated in the FIR but also in the mid and near infrared by using its internal conventional sources. The jet-AILES consortium (IPR, PhLAM, MONARIS, SOLEIL) has implemented a supersonic-jet apparatus on the beamline to record absorption spectra at very low temperature (5-50 K) and in highly supersaturated gaseous conditions. Heatable slit-nozzles of various lengths and widths are used to set properly the stagnation conditions. A mechanical pumping (roots pumps) was preferred for its ability to evacuate important mass flow rates and therefore to boost the experimental sensitivity of the set-up, the counterpart being a non-negligible consumption of both carrier (argon, helium or nitrogen) and spectroscopic gases. Various molecular systems were investigated up to now using the Jet-AILES apparatus. The very low temperature achieved in the gas expansion was either used to simplify the rotation-vibration structure of monomers, such as SF₆^a, CF₄ or naphthalene^b, or to stabilize the formation of weakly bonded molecular complexes such as the trimer of HF^c or the dimer of acetic acid^d. The nucleation of water vapor and the nuclear spin conversion of water were also investigated under free-jet conditions in the mid infrared.

^aHigh-resolution spectroscopy and analysis of the $\nu_2 + \nu_3$ combination band of SF₆ in a supersonic jet expansion. V. Boudon, P. Asselin, P. Soulard, M. Goubet, T. R. Huet, R. Georges, O. Pirali, P. Roy, *Mol. Phys.* 111, 2154–2162 (2013)

^bThe far infrared spectrum of naphthalene characterized by high resolution synchrotron FTIR spectroscopy and anharmonic DFT calculations. O. Pirali, M. Goubet, T.R. Huet, R. Georges, P. Soulard, P. Asselin, J. Courbe, P. Roy and M. Vervloet, *Phys. Chem. Chem. Phys.* 15, 10141-10150 (2013)

^cThe cyclic ground state structure of the HF trimer revealed by far-infrared jet-cooled Fourier transform spectroscopy. P. Asselin, P. Soulard, B. Madebène, M. Goubet, T. R. Huet, R. Georges, O. Pirali and P. Roy, *Phys. Chem. Chem. Phys.* 16(10), 4797-806 (2014)

^dStandard free energy of the equilibrium between the trans-monomer and the cyclic-dimer of acetic acid in the gas phase from infrared spectroscopy. M. Goubet, P. Soulard, O. Pirali, P. Asselin, F. Réal, S. Gruet, T. R. Huet, P. Roy and R. Georges, *Phys. Chem. Chem. Phys.* DOI: 10.1039/c4cp05684a