High resolution gas phase spectroscopy in the far infrared with a synchrotron radiation source

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The far infrared spectrum contains information on the energetics of molecular deformations such as torsions around single bonds and large scale vibrations of ring compounds. The intermolecular motions of molecular clusters fall in the far infrared spectrum. Far infrared data is therefore important as input to molecular mechanics programs for simulations of macromolecular conformations and of macromolecular solvation dynamics.

High resolution gas phase measurements can give data which are unpolluted by solvation effects. Compared to the mid infrared very few high resolution gas phase studies have been published. The reason seems to be that the achievable signal to noise ratio in the far infrared region is determined by the intensity and stability of the source. The generally available source is a black body radiator, where the intensity is determined by the source temperature. It has been known for a long time that the synchrotron radiation from a storage ring can be a high resolution source with an order of magnitude higher intensity. However Fourier spectroscopy requires a very stable source. This puts very stringent requirements on the position stability of the electron beam of the storage ring. Max-I in Lund has proven to be a good source for high resolution spectroscopy. Examples of successful measurements will be given, and the limitations of Max-I will be discussed.