# HIGHEST RESOLUTION FOURIER TRANSFORM INFRARED SPECTROSCOPY WITH AN ELEVEN CHAMBER BRUKER INTERFEROMETER AT THE SWISS SYNCHROTRON

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We have interfaced a newly constructed eleven chamber interferometer, the ETH-SLS Bruker IFS 125 HR prototype 2009, to the infrared port available at the Swiss Light Source (SLS), located at the Paul-Scherrer-Institute. The Maximum Optical Path Difference (MOPD) of this spectrometer is 11.70 m allowing for a best theoretical unapodized resolution of 0.00053 $cm^{-1}$ (18 MHz). The ETH-SLS Bruker spectrometer is a further development of our nine chamber interferometer Bruker IFS 120/125 Zurich prototype 2001[a,b] which has an MOPD of 9.4 m and unapodized resolution of 0.00068 $cm^{-1}$ (23 MHz). We present spectra of CO and pyrimidine ($C_4H_4N_2$) as examples to illustrate the improved resolution. Due to the high brightness of the synchrotron source the signal-to-noise ratio is effectively 5 to 20 times better than that of conventional thermal sources in the spectral region between 180 and 900 $cm^{-1}$ (6-28 THz). We present examples of pyrimidine ($C_4H_4N_2$) and CDBrClF spectra in the region 600 to 900 $cm^{-1}$ and of phenol ($C_6H_5OH$) and aniline ($C_6H_5NH_2$) spectra in the region 180 to 350 $cm^{-1}$. Due to the excellent resolution and the bright synchrotron source we were able to detect the spin statistical weights in the pyrimidine[c] spectra and found new combination bands in the CDBrClF spectra. We were able to rotationally resolve the torsional $c$-type band of phenol with $\nu_{0a} = 309.1141$ $cm^{-1}$ and $\nu_{0b} = 309.5517$ $cm^{-1}$ and detect a torsional splitting of 0.4376 $cm^{-1}$ in the $v = 1$ torsional level. In addition, we were able to rotationally resolve and assign the very weak two torsional $b$-type subbands of aniline with $\nu_{0a} = 234.8$ $cm^{-1}$ and $\nu_{0b} = 304.3$ $cm^{-1}$ showing the mode selective inversion splitting[d].

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[b] S. Albert and M. Quack, *ChemPhysChem*, **2007**, *8*, 1271.
[c] S. Albert and M. Quack, *J. Mol. Spectrosc.*, **2007**, *243*, 280.
[d] B. Fehrensen, M. Hippler and M. Quack, *Chem. Phys. Lett.*, **1998**, *298*, 320.