



**11<sup>th</sup> December 2014 - 10:00**  
Building 99, Seminar Room I+II (EG)

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### **Precision spectroscopic measurements and tests of fundamental physics with molecules**

Accurate molecular spectroscopy in the mid-infrared region allows precision measurements with applications in metrology or fundamental physics. We will report on some of our latest results on the determination of the Boltzmann constant  $k_B$  by Doppler spectroscopy and on the search for a parity violation (PV) effect in chiral molecules. Measuring the line-width of a Doppler-broadened absorption line of  $\text{NH}_3$  around  $10 \mu\text{m}$  enables a determination of  $k_B$ . The main systematic effects will be discussed and an error budget will be presented showing that a determination of  $k_B$  by Doppler spectroscopy with an uncertainty of a few ppm is within reach [1]. This is comparable to the best current uncertainty obtained using acoustic methods and would make a significant contribution to any new value of  $k_B$  determined by the CODATA. Furthermore, having multiple independent measurements at these accuracies opens the possibility of defining the Kelvin by fixing  $k_B$ , an exciting prospect considering the upcoming redefinition of the International System of Units (SI).

The weak nuclear force should cause parity violating frequency shifts between the rovibrational spectra of two enantiomers of a chiral molecule. However, these small effects have never been observed. The measurement of PV in molecules is interesting for a range of subjects across the board from biomolecular homochirality to tests of the standard model. We will present our on-going work towards developing the technologies needed for this precision spectroscopic measurement and will report on the high-resolution spectroscopy, in cells and in beams, of methyltrioxorhenium (MTO) [2, 3], an achiral test molecule from which promising chiral derivatives have recently been synthesized [4].

Host: Melanie Schnell - CFEL Molecular Physics seminar