ACCURATE DETERMINATION OF THE BOLTZMANN CONSTANT BY DOPPLER SPECTROSCOPY TOWARDS A NEW DEFINITION OF THE KELVIN

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Accurate molecular spectroscopy in the mid-infrared region allows precision measurements of fundamental constants. For instance, measuring the linewidth of an isolated Doppler-broadened absorption line of ammonia around 10 μm enables a determination of the Boltzmann constant k_{B}[a]. We report on our latest measurements. The main systematic effects, including the temperature control, will be discussed and an error budget will be presented in which the global uncertainty on systematic effects is at the level of a few ppm. This is valid provided that data is recorded under the optimized experimental conditions determined by the studies of systematic effects and provided that spectra are fitted to the speed-dependent Voigt profile, identified as the most suitable lineshape for our measurements [b]. A determination of k_{B} by Doppler spectroscopy with a combined uncertainty of a few ppm is within reach. 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).

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[b] M. Triki, C. Lemarchand, B. Darquié, P. L. T. Sow, V. Roncin, C. Chardonnet, and C. Daussy, Phys. Rev. A **85**, 062510 (2012).