An Acoustic/Microwave Determination of the Boltzmann Constant at LNE-INM/CNAM

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The international community in metrology has recently started to look after a new definition of the kelvin, based upon a fundamental constant, whose value would be fixed, as was done in 1983 for the meter. Such fundamental constant is the Boltzmann constant k, related to the quantum of energy kT, T being the thermodynamic temperature. We re-determine the Boltzmann constant k using the relation $c^2 = 5kT/(3m)$ that, in the limit of zero pressure, relates k to the speed of sound c in a noble gas, the thermodynamic temperature T, and the atomic mass m of a noble gas. We obtain the speed of sound c by measuring the acoustic resonance frequencies in a helium-filled, copper-walled, quasi-spherical cavity of known volume V. This volume V is determined by measuring the microwave resonance frequencies of the cavity, and/or by three-dimensional coordinated measurements. If the microwave method is satisfactory enough, the measurement of k can then be based on the ratio between the speed of sound in helium obtained by acoustic resonance measurements and the speed of the light, obtained by microwave resonance measurements. Here, we report on our first determination of the Boltzmann Constant at LNE-INM/CNAM and we present our uncertainty budget.