

Progress Towards a Determination of the Molar Gas Constant at INRIM

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In the framework of the international research effort aiming at a possible new definition of the Kelvin, INRIM is developing an experiment for the determination of the molar gas constant R and the Boltzmann constant k with ppm uncertainty. The experiment is based on the same scheme, involving an accurate measurement of the microwave and acoustic resonance frequencies of a gas-filled spherical cavity, which recently allowed us to determine differences between the thermodynamic temperature and ITS-90 with high accuracy [1].

For the purpose of the achievement of the present task, several experimental and conceptual improvements are required. Particularly, it is necessary to reduce the uncertainty associated with an absolute determination of the volume of the resonator. Two different strategies, involving different perturbations of ideal spherical geometry, have been pursued. Namely: i) disalignment of the two hemispheres comprising the resonator; ii) the realization of an ellipsoidal cavity [2]. In both cases, the geometrical perturbations are intended to increase the precision achievable in measuring multiple degenerate microwave modes, while maintaining the corresponding perturbation of the acoustic field within a few ppm. We report and discuss the recent results of measurements performed at the triple point of water with the cavities filled with He or Ar.

[1] G. Benedetto, R.M. Gavioso, R. Spagnolo, A. Merlone, and P. Marcarino, *Metrologia* **41**, 74 (2004).

[2] J.B. Mehl, M.R. Moldover, and L. Pitre, *Metrologia* **41**, 295 (2004).