S2-13: Perspective on Metrology of Thermophysical Quantities Based on Quantum Electrodynamic Calculations

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Abstract: In classical metrology, thermophysical quantities are generally scaled in macroscope on the base of thermodynamic laws and thermal properties of practical materials. On the other hand, the advanced quantum electrodynamics calculations result in the thermophysical and electromagnetic properties, and the virial coefficients of helium in high accuracy in temperatures from 1 K to $10^4$ K. The thermodynamic relations of helium are well characterized over such wide temperatures. The accurate calculations are transferring to the heavier monoatomic gases, such as argon, xenon, and krypton. The new primary procedures are emerging according to the state of the art of the calculations. For instance, the temperature is calculated out by knowing the Boltzmann constant and the measure of refractivity or kinetic energy of helium or a reference monoatomic gas; the pressure by knowing the relative electric permittivity of such a monoatomic gases; the flowrate by knowing the pressure difference, the calculable viscosity and the pvt relation of such a monoatomic gas. The new procedures exploit the exceeding stability of the properties of helium and other monoatomic gases. Relative primary procedures are perspective to be developed accordingly, which will be of the advantages of operational convenience with high stability of measurements in wide temperatures and pressures. The trains for the SI traceability of thermophysical quantities may be largely squeezed and the ranges largely extended.