Recent results in rational extended thermodynamics: macroscopic approach and maximum entropy principle for dense and rarefied polyatomic gases

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After a brief survey on the principles of Rational Extended Thermodynamics of monatomic gas (entropy principle, constitutive equations of local type, symmetric hyperbolic systems, main field, principal sub-system) we present in this talk a recent new approach to deduce hyperbolic system for dense gases not necessarily monatomic.
In the first part of the talk we study extended thermodynamics of dense gases by adopting the system of field equations with a different hierarchy structure to that adopted in the previous works. It is the theory of 14 fields of mass density, velocity, temperature, viscous stress, dynamic pressure and heat flux. As a result, all the constitutive equations can be determined explicitly by the caloric and thermal equations of state as in the case of monatomic gases. It is shown that the rarefied-gas limit of the theory is consistent with the kinetic theory of gases.
In the second part, we limit the result to the physically interesting case of rarefied polyatomic gases and we show a perfect coincidence between ET and the procedure of Maximum Entropy Principle. The main difference with respect to usual procedure is the existence of two hierarchies of macroscopic equations for moments of suitable distribution function, in which the internal energy of a molecule is taken into account.

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