Elementary Reactions and the Interpretation of Measurements of Chemically Reacting Non L.T.E. Plasmas

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The "thermodynamic state" and the spatial-temporal evolution of the composition of chemically reacting plasmas are generally described by the Boltzmann or Pauli kinetic equations (balance equations for the transfer of the particle densities, of momentum, and of energy for the different chemical species). Due to the numerous difficulties encountered when solving these coupled differential equations simplifying assumptions are often introduced. The results therefore depend on the one hand on the cross sections. Vice versa, the interpretation of the thermodynamic state and of diagnostic measurements is dependent on the kind of elementary reactions introduced in the model.

The dependency on the different atomic and molecular elementary reactions of the atomic (molecular) models adopted is demonstrated for some cases such as hydrogen, helium, highly ionized atoms, nitrogen, on the basis of a Maxwellian velocity distribution. As a refined step, deviations from a Maxwellian distribution are taken into account. Especially are treated:

a) Excited state populations
b) Calculation of recombination and ionization coefficients
c) Influence of deviations from a Maxwell distribution of the electrons
d) Influence of diffusion on temperature and excited state populations
e) Influence of Collisions between chemically excited particles.

The laser is often used for plasma diagnostic purposes. The influence of the plasma state by a superposed laser radiation field is briefly treated including photoionization

and recombination stimulated by one and two laser photons. Omission of these reactions can lead to erroneous interpretation of measurements. Some of the model calculations are compared with experimental results.

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