Radiation transport, fluid dynamic and collisional-radiative model of radiative shock waves in H_2/He mixture for aerospace and astrophysical plasmas

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We have developed a comprehensive state-to-state (STS) kinetic model, coupling the master equations for internal distributions of heavy species with the Boltzmann equation for the free electrons and the radiative transfer equation (RTE). Local plasma emissivity and absorption coefficient are calculated using an accurate model [1] taking into account bound-bound, bound-free and free-free transitions. Solution of the RTE is performed to determine self-consistent values for the rate coefficients of photoinduced atomic transitions and photoionization [2]. Rate coefficients of electron-impact processes are self-consistently calculated integrating the local non-equilibrium electron energy distribution function over the relevant cross section [3]. A detailed collisional-radiative model (CMR) of a H_2, H_2^+, H, H^+, He, He^+ and e^- plasma, including the most significant radiative, electron impact and heavy particle impact processes, is applied to study the structure of a steady radiative shock created at the impact of an hypersonic vehicle (v=20−50 km/s) with high-temperature Jupiter's atmosphere. Preliminary reåsults concerning the application of this model to extremely low density conditions of relevance in astrophysical shocked flows [4] are also reported.

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References

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