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Kinetic modeling of gas discharges

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Numerical modeling of gas discharge plasmas has gained growing importance for the basic understanding of plasma processes and dynamics as well as for the optimization of discharge parameters in plasma applications and the design of plasma reactors. Different modeling approaches are commonly utilized to describe theoretically the behavior of gas discharges. The present contribution focuses on modeling and analysis of non-isothermal plasmas by means of time- and space-dependent hybrid methods combining a hydrodynamic description of the plasma species with the solution of the inhomogeneous Boltzmann equation of the electrons. Recent progress in such hybrid modeling is reported and illustrated by means of results of the analysis of the spatiotemporal behavior of spatially one-dimensional glow discharge plasmas. The results make the pronounced nonlocal characteristics of the electrons understandable. The analysis demonstrates as well the applicability and the limits of current models. Perspectives of kinetic modeling are discussed.