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High order fluid model for streamer discharges[1] ARAM MARKOSYAN, SASA DUJKO, Centrum Wiskunde and Informatica, Amsterdam, RONALD WHITE, ARC Centre for Antimatter-Matter Studies, Australia, JANNIS TEUNISSEN, UTE EBERT, Centrum Wiskunde and Informatica, Amsterdam
— We present a high order fluid model for streamer discharges. Using momentum transfer theory, the fluid equations are obtained as velocity moments of the Boltzmann equation. We solve Poisson equation to obtain space charge electric field. The high order tensors from the energy flux equation are specified in terms of low order moments to close the system. The average collision frequencies for momentum and energy transfer in elastic and inelastic collisions required as an input in high order fluid model of streamers in molecular nitrogen are calculated using a multi term Boltzmann equation solution. The results of simulations are compared with those obtained by a PIC/MC method and by the classical first order fluid model based on the drift-diffusion and local field approximation. The comparison clearly validates the high order fluid model, while the first order fluid model underestimates many aspects of streamer dynamics. Two important issues are discussed on the basis of fundamental kinetic theory developed in the past decade: (1) the correct implementation of transport data in fluid models of streamer discharges; (2) the accuracy of two term approximation for solving Boltzmann's equation in the context of streamer studies.

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