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Hydrodynamic models for the positive column with neutral gas depletion. JEAN-LUC RAIMBAULT, LAURENT LIARD, PASCAL CHABERT, LPTP CNRS Ecole Polytechnique — In the classical low-temperature plasma equilibrium, the ionization degree is sufficiently small that neutral density is considered constant. However, in many contemporary plasma reactors, such as helicons, the ionized fraction can be significant. This fraction may even reach 100% in plasma thrusters. In such circumstances, neutral dynamics has to be included in order to solve the plasma equilibrium. We have revisited the plasma equilibrium models, from low-pressure (Tonks-Langmuir) to high pressure (ambipolar diffusion) regime, including the neutral dynamics. The results show that neutrals are pushed towards the wall by the electronic pressure, creating a neutral depletion at the center of the discharge. The effect is significant when the electronic pressure becomes comparable to the neutral pressure. The electron temperature becomes a function of the electron density, so that particle and power balance are not decoupled. Finally, we derived a new expression for the edge-to-center electron density ratio which accounts for neutral density depletion.

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