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Multi-dimensional fluid simulations of gas discharges GERJAN HAGELAAR, LAPLACE, CNRS and University of Toulouse — Numerical simulations based on fluid models are widely used in low-temperature plasma research to gain insight in physical mechanisms and aid the development of gas discharge devices. The computational methodology of these simulations is at present quite mature, and many tools and software products are available to carry them out in 2D or even 3D. However, fluid simulations involve numerous physical approximations which are valid only under certain conditions and limit their accuracy and predictive capabilities. Many of these approximations are specific to low-temperature plasmas, or even to certain discharge types or conditions, and there exists a whole variety of fluid approaches, addressing a variety of discharge conditions. It takes specific expertise to pick the optimal approach and apply it in a meaningful way. In this talk, we present a brief overview of the main fluid modeling approaches with their capabilities and limitations, and we discuss some key approximations (e.g. regarding transport coefficients or plasma sheaths). We also attempt to identify areas where fluid simulations are problematic or not yet mature, so that not even experts know exactly which equations to use, how to efficiently solve them and for what benefit (e.g. magnetized plasma discharges).

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