

## A model of plasma-wall interaction : the dynamical plasma sheath

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In this talk, we study a dynamical model of plasma sheath. When an isolated metallic material is immersed in a plasma, quasineutrality is broken inside a thin layer around it. The length scale of this layer is the well-known Debye length. The electric potential of the material drops to balance the fluxes of incoming ions and electrons. As electrons are more mobile than ions, this mechanism tends to repel electrons (only the most energetic electrons reach the surface) and accelerate the ions toward the interface [3]. Considering this phenomenon is important when designing probes to perform measures on a plasma. In [1], plasma sheaths have been described by a Vlasov-Poisson system with thermalized electrons, and their linear stability around steady states was investigated. We offer to study a slightly more complex model, which takes into account the potential of the material. The latter admits an expression in term of the electric current crossing the plasma and is called the floating potential. The first result concerning existence and uniqueness of solutions have been established in a recent work by the authors [2].

The model is the following : a bi-species plasma fills the domain  $[0, 1]$ . Particles are injected from the plasma core at  $x = 0$  toward the metallic wall at  $x = 1$ . The problem is described by the Vlasov-Poisson system. In a first part, we will explicit the potential at the wall by expressing the compatibility of the Poisson and Ampère equations. This will give us the so-called floating potential condition. In a second part, we will show briefly arguments of existence of solutions. In a third part, we will show simulations. The simulations motivate the study of steady states (stationary plasma sheaths) and the search of an entropy functional in a last part.

- [1] M. Badsì. *Linear and nonlinear stability for the kinetic plasma sheath on a bounded interval*. SIAM Journal on Mathematical Analysis., 2025.
- [2] M. Badsì, B. Grosse. *The plasma-wall dynamic : wellposedness*, 2025. Working paper or preprint.
- [3] P. Stangeby. *The Plasma Boundary of Magnetic Fusion Devices*. Institute of Physics Publishing, 2000.