Fundamental aspects of magnetized plasma sheath associated with secondary electron emission

By nature, a plasma is composed of charged particles which, in response to electromagnetic fields they generate or which are applied to them, exhibit collective behaviors from which quasi-neutrality results on spatial scales larger than the Debye lengths. This property break-down when the plasma encounters a solid frontiers where non-neutral sheath forms at Debye length scales and, potentially, deeply impact on the bulk dynamics, *i.e.* far from the frontiers. Ions and electrons dynamics, due to their mass difference, evolve with different temporal scales. In particular, when approaching an external object , which can be device boundaries in experiments or bodies in astrophyscal contexts, multi-scale physics phenomena emerge especially where the sheath is formed. Surfaces immersed in a plasma could emit secondary electrons which change the physics of the sheath. Even more, some numerical theories predict an "inverse sheath" [1].

The physics of plasma sheath is of major interest in the fields of, both, laboratory, astrophysics and fusion by magnetic confinement (tokamaks,...). Many studies have been devoted to the understanding of plasma sheath [2]. However, comparisons of theoretical models to experiment can sometimes show disagreements, in particular in sheath where secondary electrons are emitted [1, 3, 4]. In that context, the first goal of this internship is to improve comparison between models (already existing) and experiments of electrostatic plasma sheath. Models developed during this internship will be compared with experimental results on emissive sheath obtained by the experimental group of the PIIM laboratory. The second goal of the internship is to improve the model adding the impact of an oblique magnetic field on the sheath properties. Here, it is expected to improve the fundamental knowledge of the physical mechanisms at play in a magnetized plasma sheath that is crucial for fusion plasmas.

The student must have master's level knowledge in mathematics, numerical calculation and plasma physics to carry out theoretical calculations and participate in numerical code development. He will have available fluid [5] and kinetic codes developed at the PIIM.

The master's internship will be supervised at the PIIM laboratory by M. Muraglia. This subject is associated to a thesis subject funded by AMIDEX which will be directed by M. Muraglia and co-directed by G. Fubiani (Lalpace laboratory at Toulouse) and supervised by N. Claire(PIIM).

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