

Plasma-wall transition in magnetized plasmas

Giovanni Manfredi

*Institut de Physique et Chimie des Matériaux de Strasbourg
CNRS – Université de Strasbourg, France*

The vast majority of plasmas produced in the laboratory are in contact with a material surface. In fusion devices, the surface can be either the material vessel that contains the plasma, or some *ad-hoc* device (limiter or divertor) specifically designed to optimize the interaction with the charged particles. These surfaces are eroded by ion and neutral bombardment and may thus see their lifetime considerably reduced. In addition, plasma-wall interactions also affect the outcome of probe measurements, as the probe's surface can disturb the plasma characteristics.

Perhaps the main feature of the physics of plasma-wall interactions is the formation of *sheaths*, i.e., boundary layers that form at the interface between the plasma and the surface. In a tokamak, the sheaths must support the main share of particles and heat fluxes directed towards the divertor.

In this talk, I will review the basic theoretical and computational aspects of plasma-wall interactions. Some fundamental results will be derived analytically using a simple fluid model, and subsequently tested with kinetic simulations. The various regions composing the plasma-wall transition will be discussed in detail.

The structure of the plasma-wall transition is considerably modified by the presence of a magnetic field, particularly when the latter has a grazing incidence with respect to the surface. Here, I will investigate the angular and energy distribution of the ions impinging on the surface, which is an important parameter to determine the level of wall erosion and sputtering.

In the final part of the talk, I will discuss some transient (i.e., time-dependent) phenomena such as edge localized modes (ELMs) in tokamaks and their modelling by means of kinetic equations.