In a future fusion reactor based on magnetic confinement a very thin region of cold plasma exists in the vicinity of material walls. It extends over only a few centimeters while the size of the device is of several meters. This is the plasma boundary. It is situated between the hot central plasma with temperatures of several $10^8$ K and the plasma facing components, PFCs. The fusion reactions and auxiliary heating sources in the central region give origin to a heat flux of several GW/m$^2$ in the plasma boundary. Impurities are seeded into the plasma boundary for reducing this power flux by line radiation losses. They cool the plasma to temperatures at which even molecules exist. Simultaneously the plasma boundary must limit the level of impurities that contaminate the fuel in the central region. The interaction of the plasma with the PFCs as a result of magnetic geometry, the temperature and density gradients, the nature of plasma transport as well as the simultaneous presence of neutral species together with several charge states of impurities leads to a rich and complex physical system. This system needs to be described, interpreted and understood in existing devices to allow a reliable design of a nuclear fusion reactor.

This contribution describes how the improved quality of experimental data together with numerical simulations containing a comprehensive set of physical models has allowed us to significantly improve our understanding of the relative importance of individual physics processes. To this end experiments on devices of different size and PFC materials using various seeding impurities have been analyzed. Example cases are shown in which the discrepancies between numerical results and experimental data could be significantly reduced. Analytical and numerical tools of various levels of complexity and sophistication will be introduced and it will be shown how their application could lead to forecast the performance of the plasma boundary in future devices.