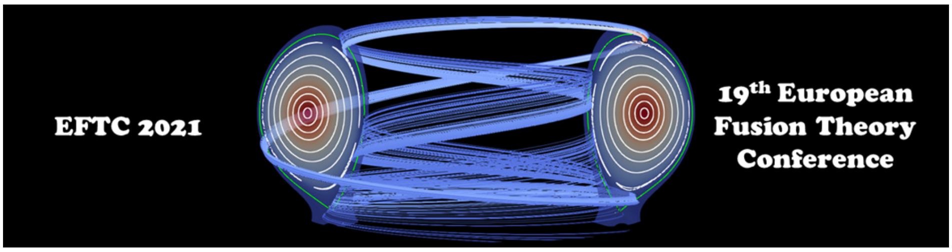


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# Kinetic analysis of the collisional layer

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To understand plasma behaviour in the scrape-off layer (SOL), we need to know the boundary conditions for the plasma and electromagnetic fields near a divertor. At the boundary, in the direction perpendicular to the wall, there are four length scales of interest. These are the Debye length $\lambda_D$, the ion gyroradius $\rho_i$, the projection of the collisional mean free path in the direction normal to the wall $\lambda_\perp$ and the device size $L$. Assuming that the plasma near the divertor satisfies the scale separation $\lambda_D \ll \rho_i \ll \lambda_\perp \ll L$, we can split the plasma-wall boundary into three separate layers, the layer closest to the wall is the Debye sheath of width $\lambda_D$, then follows magnetic presheath of width $\rho_i$ and then the collisional layer of width $\lambda_\perp$. Plasma dynamics in the first two layers are well understood. In the SOL at distances much greater than $\lambda_\perp$ from the wall collisionality is high and Braginskii fluid equations are used to model the plasma behaviour, the ion and electron distribution functions are assumed to be approximately Maxwellian. The collisional layer connects this region of high collisionality with the collisionless magnetic presheath, where the ion distribution function is far from Maxwellian. The distribution function must satisfy the Chodura condition at the entrance to the magnetic presheath. We have also found that at the entrance of the collisional layer the flow of ions has to be supersonic. The numerical analysis should recover these results. To analyse the collisional layer we use the Galerkin method to solve the drift kinetic equation in one spatial dimension with the full Fokker-Planck collision operator, together with the quasineutrality equation and the assumption of adiabatic electrons. For our boundaries we assume that all ions that reach the wall are absorbed and we set the distribution function far away from the wall to be approximately Maxwellian.

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