Recent progress in theoretical aspects of impurity transport

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Impurity accumulation in the plasma core should be kept at minimum to avoid radiation losses and plasma dilution. Here we review recent progress in theoretical aspects of impurity transport, with special emphasis given to the effect of poloidal asymmetries on the cross-field transport of high-Z impurities and the dependence of the zero-flux impurity density gradient (peaking factor) on local plasma parameters.

Poloidal asymmetries in the impurity density can be generated due to plasma rotation or by off-axis radio frequency (RF) heating in the central regions and by neoclassical effects in the edge of tokamak plasmas. We will show results of neoclassical and gyrokinetic simulations of impurity transport in an RF-heated Alcator C-Mod discharge, together with comparison with experimental observations.

In a pedestal case study, using global neoclassical simulations we find that finite orbit width effects can generate significant poloidal variation in the electrostatic potential, which varies on a small radial scale. Gyrokinetic modelling shows that these poloidal asymmetries can be strong enough to significantly modify turbulent impurity peaking. In the pedestal the ExB drift due to the radial electric field can give a larger contribution to the poloidal motion of impurities than that of their parallel streaming. Under such circumstances we find that up-down asymmetries can also affect impurity peaking.