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P5.1016 Guiding centre simulation of neoclassical impurity transport in the pedestal region

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The neoclassical impurity transport in the pedestal region of a tokamak plasma is studied with non-local guiding center particle simulations, employing the code HAGIS with a Monte Carlo collisions model. The simulations are done in two steps, assuming the trace limit for the impurity ions. First the parallel velocity of the main ions (D) is obtained for given density and temperature profiles from a simulation with D-D collisions neglecting the collisions with impurities. Then the simulation for the impurity ions is made, where only the collisions between impurities and main ions are included, since the particle transport is caused by these collisions. HAGIS is a δf code, the evolution of δf = f - f_0 is calculated from the change of f_0 along the orbits (with full radial motion) and the contribution from the collisions. For the main ions f_0 is chosen as a Maxwellian centred at v = 0, while for the impurity ions f_0 is a shifted Maxwellian centred at the parallel velocity of the main ions. Thus in both steps f_0 is invariant to the collisions. In the simulations the radial interval 0.8 <= ρ_pol <= 0.999 is covered, where ρ_pol is defined by ρ_pol^2 = ψ/ψ_edge with ψ_axis = 0. The poloidal and radial variations of density, temperature, and parallel velocity and the radial particle flux are obtained. We determine the deviation of the parallel impurity velocity from that of the main ions and we find an in-out density asymmetry as seen in the experiments. We also find an up-down density asymmetry, which is caused by the friction between impurity and main ions and which is necessary for radial transport. The radial transport in the pedestal is found to be reduced compared to the usual neoclassical expression. No poloidal electric field is included, so the poloidal variation of the radial flux is equal to that of the magnetic particle drift: the flux is inwards above the midplane and outwards below the midplane (for ion drift directed downwards). For trace impurities this is generally true, since the poloidal electric field is small, except for the field caused by the centrifugal force, which does not produce a net radial transport.

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