Effect of poloidal asymmetry on impurity transport

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Poloidally asymmetric impurity distribution has been observed in the various experiments. In the plasma core, where the collisionality is low, in-out asymmetries can arise due to toroidal rotation or the presence of radio frequency heating. In the plasma edge neoclassical theory predicts an up-down asymmetry, which is caused by the ion-impurity friction. In this work the role of poloidal asymmetry on impurity transport in tokamak plasmas is analyzed. Since impurity transport is usually dominated by driftwave turbulence, special focus is given to the effect of the impurity poloidal asymmetry on impurity transport driven by electrostatic microinstabilities. Our results show that in the presence of an in-out asymmetry for both ion temperature gradient (ITG) and trapped electron (TE) mode dominant cases, the zero-flux impurity density gradient is significantly modified and even a sign change (negative peaking factor) can be obtained if the asymmetry is large enough. Also an up-down asymmetry can lead to a negative impurity peaking factor in the TE mode dominant case. The reason for the sign change of the impurity peaking factor in the presence of a poloidal asymmetry is attributed to the interaction between the poloidal variation of the related electrostatic potential, magnetic drift and the poloidal dependence of the impurity density. This effect may be a contributing factor to the observed outward convection of impurities in the presence of radio frequency heating.