Role of neoclassical mechanisms in the formation of a tokamak scrape-off layer

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Understanding of the mechanisms responsible for the formation of tokamak scrape-off layer (SOL) is crucial for ITER as well as for future tokamak reactors. In particular it is necessary to understand inverse dependence of the SOL width on the plasma current observed on present day tokamaks. Grad B drift could be a candidate for a leading mechanism of SOL formation as was suggested by Goldston [1]. However, the radial ion flux caused by grad B drift should be considered together with the radial ion ExB drift as it was done in standard neoclassical theory for closed flux surfaces, and the resulting flux is determined by ion viscosity [2].

In the present paper role of neoclassical mechanisms in the formation of density and electron temperature fall-off lengths is analyzed. It is shown that neoclassical mechanisms can give SOL width of the order of ion Larmor radius multiplied by safety factor in accordance with the observed inverse current dependence. Radial transport is followed by flow of radial current which is short-circuited through the divertor plates. The analytics is supported by numerical modeling of edge plasma by SOLPS5.2 code [2] with the reduced anomalous transport coefficients in the SOL. These results are in agreement with the earlier modeling with reduced anomalous diffusion coefficient [3].

A possibility of contribution from blob (filament) transport to the SOL formation is also considered. It is shown that blob transport can also give inverse current dependence of the SOL with.

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[2] Rozhansky V, Kaveeva E, Senichenkov I, Vekshina E 2018 *Plasma Phys. Control. Fusion* **60** 035001
[3] Meier E T, Goldston R J, Kaveeva E G, Makowski M A, Mordijck S, RozhanskyV A, Senichenkov I Yu, Voskoboynikov S P 2016 *Plasma Phys. Control. Fusion* **58** 125012