Neoclassical Plateau Regime Transport in a Tokamak Pedestal

I. Pusztai\textsuperscript{1}, P. J. Catto\textsuperscript{2}

\textsuperscript{1} Chalmers University of Technology, Applied Physics, Göteborg, Sweden

\textsuperscript{2} Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, MA, USA

In tokamak pedestals with subsonic flows the radial scale of plasma profiles can be comparable to the ion poloidal Larmor radius \cite{1}, thereby making the radial electrostatic field so strong (\(\sim 100 \text{ kV/m}\)) that the \(\mathbf{E} \times \mathbf{B}\) drift has to be retained in the ion kinetic equation in the same order as the parallel streaming. By adopting the approach of Ref. \cite{2}, the modifications of neoclassical plateau regime transport – such as the ion heat flux, and the poloidal ion and impurity flows – are evaluated in the presence of a strong radial electric field \cite{3}, allowing for

\[ U = v_{E \times B} B / (v_i B_p) = \mathcal{O}(1), \]

where \(v_{E \times B}\) is the \(\mathbf{E} \times \mathbf{B}\) velocity, \(v_i = (2T_i / M)^{1/2}\) is the ion thermal speed, and \(B\) and \(B_p (\ll B)\) are the magnitudes of the total and poloidal magnetic fields. The altered poloidal ion flow is most pronounced in the region of the strongest radial electric field where it modifies the friction of the electrons with the ions and can lead to an increase in the bootstrap current, by enhancing the coefficient of the ion temperature gradient term. Unlike the banana regime, orbit squeezing does not affect the plateau regime results.

References

