Downstream Heat Flux Profile *vs*. Midplane *T* Profile in Tokamaks*

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The relationship between the midplane scrape-off-layer (SOL) electron temperature profile and the parallel heat flux profile at the divertor in tokamaks is investigated. A model is applied which takes into account anisotropic thermal diffusion in rectilinear geometry with constant density. Eigenmode analysis is applied to the simplified problem with rectangular geometry and constant, but highly anisotropic, thermal diffusivities. A nonlinear solution is also found for the more realistic problem with anisotropically temperature-dependent thermal diffusivities. Numerical solutions are developed for both cases, with spatially dependent heat flux emerging from the plasma, and geometry that includes a model for the divertor leg. For both constant and temperature-dependent thermal diffusivities it is found that, below about one-half of its peak, the heat flux profile shape at the divertor, compared with the midplane temperature profile shape, is robustly described by the scaling of the simplest two-point model. However the physical processes are not those assumed in the simplest two-point model, nor is the numerical coefficient relating $q_{||div}$ to $T_{mp}\ \chi_{||mp}/L_{||}$ as predicted in that model. For realistic parameters the peak in the heat flux, moreover, can be reduced by a factor of two or more relative to the two-point model scaling that fits the remaining profile. For temperature profiles in the SOL region above the x-point set by marginal stability, the heat flux profile to the divertor can be largely decoupled from the prediction of the two-point model. These results suggest opportunities and caveats for data interpretation, and possibly favorable outcomes for divertor configurations with extended field lines.

These techniques can also be applied to model heat flux profiles at non-axisymmetric boundaries.

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