Models of SOL Transport and Their Relation to Scaling of the Divertor Heat Flux Width in DIII-D*

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Using an improved high rep-rate and higher edge resolution Thomson scattering system on DIII-D, detailed comparisons are made between scrape-off-layer (SOL) profile characteristics and the between-ELM divertor heat flux width measured with a fast IR camera. We validate parallel heat transport models that relate the SOL profile gradient scale lengths of n_e and T_e to the heat flux width. In this case, a flux limited model is found to be in very good agreement with the measured heat flux widths over a wide range of collisionality, while a model based on Spitzer resistivity agrees with measurements only at high collisionality where it is expected to be more valid. Using a more extensive data set, scaling relations have been developed for the heat flux width. Results show that the heat flux width scales strongly with the outer midplane poloidal field, going as $B_{p,mp}^{e}$ with e ~ -1.0 (or equivalently, as I_p^{-1}). There are a number of models that predict a dependence near this. Among these is a heuristic model by Goldston, based on drift-induced transport [1]. We are also developing a model that extends the kinetic ballooning mode (KBM) pedestal paradigm to the separatrix and into the SOL. We have calculated the critical pressure gradient at the separatrix using the BALOO code and found that it scales proportionately with the measured pressure gradient derived from the Thomson profile measurements. Such a model will be dependent on B_p but will also be sensitive to other parameters, and thus requiring a more careful evaluation of the critical gradient.

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