ELM particle and energy transport in the SOL and divertor of DIII-D

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ABSTRACT

Results from a series of dedicated experiments measuring the effect of particle and energy pulses from Type-I Edge Localized Modes (ELMs) in the DIII-D scrape-off layer (SOL) and divertor are compared with a simple model of ELM propagation in the boundary plasma. The simple model asserts that the propagation of ELM particle and energy perturbations is dominated by ion parallel convection along SOL field lines and the recovery from the ELM perturbation is determined by recycling physics. Time scales associated with the initial changes of boundary plasma parameters are expected to be on the order of the ion transit time from the outer midplane, where the ELM instability is initiated, to the divertor targets. To test the model, the ion convection velocity is changed in the experiment by varying the plasma density. At moderate to high density, n_e/n_{Gr} = 0.5-0.8, the delays in the response of the boundary plasma to the midplane ELM pulses, the density dependence of those delays and other observations are consistent with the model. However, at the lowest densities, $n_e/n_{Gr} \sim 0.35$, small delays between the

responses in the two divertors, and changes in the response of the pedestal thermal energy to ELM events, indicate that additional factors including electron conduction in the SOL, the pre-ELM condition of the divertor plasma, and the ratio of ELM instability duration to SOL transit time, may be playing a role. The results show that understanding the response of the SOL and divertor plasmas to ELMs, for various pre-ELM conditions, is just as important to predicting the effect of ELM pulses on the target surfaces of future devices as is predicting the characteristics of the ELM perturbation of the core plasma.