New Development in Non-locality in Transport

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The extremely rapid (~1 msec) response of core temperature to edge cooling perturbation experiments (i.e. cold pulse and related) has long presented a stiff challenge to the conventional wisdom of quasi-local dynamics of turbulence and transport in tokamaks. Here we report on results from recent non-locality experiments in HL-2A and KSTAR. In particular:

i. Sequential SMBI (Supersonic molecular beam injection) on HL-2A appears to prolong the duration of increased core temperatures produced in response to the edge perturbation. This supports the notion that the perturbation-driven state is a de facto electron thermal ITB. Repetitive modulated SMBI yields a temperature perturbation which may be fourier analyzed to obtain detailed information about pulse propagation.

ii. Off-axis ECRH switch-off experiments have been performed on HL-2A, which indicate that the non-local response is sensitive to the spatial location of the perturbation and the plasma properties there. The results are somewhat suggestive of a type of hysteresis in non-locality.

iii. ELMy H-mode experiments on KSTAR indicate that ELMs can trigger extremely fast, non-local response in the core. In this case, the response time $T_{resp} \sim 10\mu\sec$, in contrast to the usual $T_{resp} \sim 1m\sec$ for such studies. This disparity suggests a possible dependence of the non-local response time on the edge temperature gradient scale.

These results will be discussed in the context of theoretically based models of fast transient response.

References:

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