

Experimental Observation of Nonlocal Electron Thermal Transport in NSTX RF-heated L-mode plasmas

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Abstract

Understanding electron thermal transport is crucial for improving the confinement performance of future devices, e.g. FNSF and ITER. Nonlocal thermal transport has been observed in both tokamaks and stellarators, where the response of heat flux and local turbulence to external perturbation is much faster than that of local equilibrium temperature/gradients. Here, we report the first observation of nonlocal electron thermal transport in a set of NSTX RF-heated L-mode plasmas with $I_p=300$ kA, $B_T=5.5$ kG and RF heating power of about 1 MW. We observed that electron-scale turbulence spectral power (measured with a high-k collective microwave scattering system) is reduced by almost an order of magnitude immediately after the RF heating terminates. The large drop in the turbulence spectral power and the cessation of the RF heating are not exactly synchronized, and the drop in the turbulence spectral power has a time delay of about 1 ms relative to the RF cessation. The correlation and time delay between the reduction of turbulence and RF cessation indicate a causal relation between the measured turbulence and heat flux. Local linear gyrokinetic stability analyses show that ion and electron-scale instabilities are robustly unstable in these plasmas and are far from marginal stability.