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Experimental Observation of Nonlocal Electron Thermal Transport in NSTX RF-Heated L-Mode Plasmas

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Understanding electron thermal transport is crucial for improving and predicting the confinement performance of future devices, e.g. FNSF and ITER. The observations of nonlocal electron thermal transport in tokamaks and stellarators challenge the standard local model of turbulence and transport. Here, we report the first observation of nonlocal electron thermal transport in a set of NSTX RF-heated L-mode plasmas with B_T=5.5 kG, I_p=300 kA 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. Thus linear stability is unlikely able to explain the observed reduction in electron-scale turbulence at the RF cessation.

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Author: Dr REN, Yang (Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543)

Co-authors: Dr LEBLANC, B. P. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543); Dr DOMIER, C. W. (University of California at Davis, Davis, CA 95616); Dr MAZZUCATO, E. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543); Dr YUH, H. (Nova Photonics, Inc., Princeton, NJ 08540); Dr LEE, Kwan Chul (Korea, Republic of); Dr BELL, R. E. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543); Dr KAYE, Stanley (Princeton Plasma Physics Laboratory, Princeton University, Princeton NJ, 08543 USA); Dr GUTTENFELDER, Walter (Princeton Plasma Physics Laboratory, Princeton University, Princeton, NJ 08543)

Presenter: Dr LEE, Kwan Chul (Korea, Republic of)

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