Reduced model prediction of electron temperature profiles in microtearing-dominated NSTX plasmas

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Abstract

A representative H-mode discharge from the National Spherical Torus Experiment (NSTX) is studied in detail to utilize it as a basis for a time-evolving prediction of the electron temperature profile using an appropriate reduced transport model. The time evolution of characteristic plasma variables such as β_e, ν_e^*, the MHD α parameter and the gradient scale lengths of T_e, T_i and n_e were examined as a prelude to performing linear gyrokinetic calculations to determine the fastest growing micro instability at various times and locations throughout the discharge. The inferences from the parameter evolutions and the linear stability calculations were consistent. Early in the discharge, when β_e and ν_e^* were relatively low, ballooning parity modes were dominant. As time progressed and both β_e and ν_e^* increased, microtearing became the dominant low-k_θ mode, especially in the outer half of the plasma. There are instances in time and radius, however, where other modes, at higher-k_θ, may, in addition to microtearing, be important for driving electron transport. Given these results, the Rebut-Lallia-Watkins (RLW) electron thermal diffusivity model, which is based on microtearing-induced transport, was used to predict the time-evolving electron temperature across most of the profile. The results indicate that RLW does a good job of predicting T_e for times and locations where microtearing was determined to be important, but not as well when microtearing was predicted to be stable or subdominant.

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