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Non-equilibrium JOREK simulation of ITER L-mode SPI process

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Simulation of Ne/H Shattered Pellet Injection (SPI) into an ITER L-mode plasma is carried out by JOREK non-equilibrium impurity model with separate electron and ion temperature. The focus of this report is on the MHD dynamics, the density transport, the temperature profile evolution and relaxation during the loss of the core confinement, as well as the impact from the non-equilibrium impurity, the neon mixture ratio, the nonlocal effect on ablation and the numerical toroidal elongation of the density source.

The non-equilibrium result is first compared against the Coronal Equilibrium (CE) result. The non-equilibrium treatment is shown to capture the early phase cooling due to the lowly charged impurities which is missed by the CE model, although in the late phase radiation is comparable between the models and the characteristic MHD dynamics are similar.

Meanwhile, SPIs with neon mixture ratio ranging from 0% to 20% exhibit only a slight difference in the characteristic MHD dynamics despite the difference in the radiative power. The relationship between this behavior and the lack of radiative collapse is discussed.

Further, "T_e hole" is found to develop along the field line with Braginskii thermal conduction due to the competition between local thermal sink and parallel conduction, resulting in a lower ablation rate. Considering the mean-free-path of the electrons, flux-averaged electron temperature is used in ablation rate calculation, results in slightly enhanced ablation, broader MHD spectrum and stronger stochasticity.

Last, the numerical toroidal elongation of the ablation source is found to artificially lower the radiation power, the extent of such effect and its implication to numerical result is discussed.

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