Observation of q-profile dependence in noble gas injection radiative shutdown times in DIII-D

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Abstract

Massive injection of argon was used to terminate DIII-D discharges with different radial profiles of the safety factor q. An increasing delay before the onset of the central temperature collapse was observed as the overall (core and edge) q of the target plasma was increased. Additionally, an increase in the length of the current quench time was observed, consistent with reduced magnetohydrodynamic (MHD) mode amplitudes and reduced MHD mixing. These results are supported by measurements of heat and impurity mixing during the thermal collapse which observe that thermal transport and impurity mixing are not smooth functions of time but are accelerated when low-order $(n=1)$ MHD modes are destabilized. These results demonstrate that low-order MHD modes play a central role in gas jet shutdowns and density limit disruptions in tokamaks.