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The Role of MHD in 3D Aspects of Massive Gas Injection for Disruption Mitigation

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Massive gas injection (MGI) is a leading candidate technology for disruption mitigation in ITER, and recent modeling has suggested that MHD modes play a critical role in determining the distribution of radiated power during an MGI shutdown. NIMROD 3D MHD simulations of MGI in both ITER and DIII-D reveal how the distribution of gas jets and the n=1 mode interact to determine the localization of radiated power, and the likelihood of wall-melting on ITER. Various combinations of the four ports allocated for the ITER disruption mitigation system (DMS) are modeled, along with a range of gas quantities and species to determine the optimal scenario for ITER. The midplane port interacts with the plasma very differently than the upper ports due to the difference in minor radius. Use of the midplane port improves the radiated energy fraction with no detrimental effect on the radiation toroidal peaking. In DIII-D, dedicated experiments were performed to understand the effect of the n=1 mode phase on the distribution of radiated power. By varying the phase of applied n=1 fields, the radiation toroidal peaking during MGI was altered. Simulations of MGI in DIII-D with external n=1 fields are carried out and compared to the experiments to better understand this effect and its implications for optimizing radiation symmetry.

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