Observations of pedestal impurity transport with 3D fields in ITER-baseline-shape DIII-D plasmas

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Recent results on DIII-D show that low-field-side RMPs improve the robustness of discharges to high-Z impurity injection. Experiments were performed in H-mode ITER-baseline-shape discharges for three cases: 1. ELMy – q_{95} = 4.1, 2. RMP ELM-suppressed – q_{95} = 4.1, and 3. RMP with ELMs – q_{95} = 3.5. For each case above, impurities were injected with either the laser blow off (W and Al) or gas valve (Ar) systems. W injection into ELMy discharges led to a rapid increase in impurity emission, halting of ELMs, and the radiative collapse of the plasma. W injection into discharges with RMPs—either ELMy or ELM-suppressed—did not lead to an increase in radiation or a decrease in plasma temperature. For Al and Ar impurity injection the charge exchange recombination (CER) diagnostic measured spatially (ΔR~8 mm) and temporally (Δt~2.5 ms) resolved emission in the pedestal region of the plasma. These measurements are used in conjunction with the STRAHL transport code to determine the particle convective velocity and diffusion coefficients. For the discharges with RMPs, after the initial Al density rise from the LBO injection, the Al density decreases at a steady rate in the pedestal. However, for the ELMy cases, the Al density continues to increase after the initial rise and only decreases during ELMs. This indicates a lack of outward diffusion of impurities in the inter-ELM period of the ELMy discharges that is maintained in the discharges with RMPs. The ELMy discharges, without RMPs to enhance radial transport, go ELM-free due to the increased impurity accumulation and radiation with the higher particle confinement and thus differ from the other discharges. *Supported by US DOE under DE-AC52-07NA27344, and DE-FC02-04ER54698.

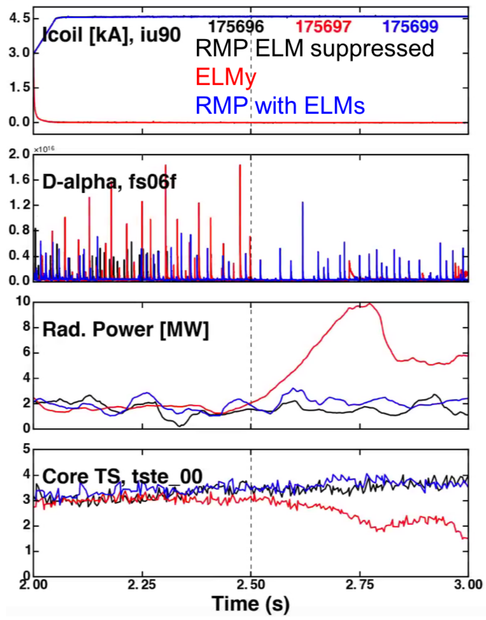

Figure 1: W is injected into three different plasmas at 2.5 s: RMP ELM suppressed, ELMy, and RMP with ELMs. Discharges with RMPs maintain similar core Te and radiated power after W injection. The ELMy plasma without RMPs goes ELM free, has an increase in radiated power, and a decrease in core Te after W injection.