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High confinement/high radiated power H-mode experiments in Alcator C-Mod and consequences for ITER Q_{DT}=10 operation

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Understanding the mechanisms that influence plasma confinement and drive its degradation for high density/radiation conditions in H-mode is of critical importance to ITER, since the expected edge power flow for Q_{-DT} =10 operation is very close to that required to maintain H-mode confinement and the level of radiated power required for acceptable divertor power fluxes is $\sim$ 80%. Experiments have been carried out in Alcator C-Mod to study the role of edge power flux and plasma radiation in determining the quality of H-mode plasma confinement by varying injected ICRF power up to $\sim$ 5MW, and by injecting extrinsic impurities of various Z (Ar, Ne, N) in both EDA and ELMy H-modes. Analysis of the experimental results shows that plasma energy confinement (and edge pedestal pressure) are primarily determined by the absolute level of edge power flux $P_{edge} = P_{in}$-$P_{rad,core}$, independently of the way this edge power flow is achieved and thus not directly correlated with core nor total radiated power fractions. In this respect, high Z impurity seeding (Ar) is found to cause lower plasma confinement for a given level of total plasma radiation because of the larger core plasma radiation and reduced edge power flow in these experiments. With lower Z impurity seeding, EDA H-modes with high plasma confinement (H_{98} = 1) have been maintained at high density with edge power flows only marginally exceeding (20-30%) the required power for H-mode access, as expected in ITER Q_{DT} =10 plasmas, and with a considerable reduction of the divertor power flux (by a factor of 2 or more) relative to attached plasma conditions, also as required in ITER. Detailed analysis of the experiments in C-Mod and consequences for ITER plasma performance will be discussed. Work supported by US DoE Agreement DE-FC02-99ER54512.