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Multichannel Transport in L-mode and I-mode Plasmas at Alcator C-Mod and Comparison with Gyrokinetic Simulations¹
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New experiments at Alcator C-Mod are challenging and expanding our understanding of electron, impurity particle, and momentum transport. Understanding these coupled transport channels is important, since alpha particles will slow down mostly on electrons in ITER intrinsically rotating, alpha-heated plasmas. Core density fluctuations are reduced in high performance (H98~1) I-mode plasmas by up to 30% compared to L-mode. At the L-I transition, the core turbulence changes lead the edge turbulence changes. This is in contrast to observations at L-H transitions, where the edge turbulence changes lead the core turbulence changes. It is also found that L-mode and I-mode plasmas are both ITG dominant, with lower linear ITG growth rates in I-mode. TRANSP analysis indicates that core electron heat transport is reduced in I-mode compared to L-mode, with little change in ion heat transport. This indicates that significant electron heat transport is driven by ITG turbulence in L-mode. However, impurity particle transport is similar in L-mode and I-mode, suggesting that tracking changes in ITG drive alone does not describe as well the transport in this channel. Additionally, in L-mode plasmas, small < 20% changes in line averaged density lead to dramatic differences in the on-axis rotation, due to a hollowing of the radial profile at marginally lower density. This change in the shape of the rotation profile in L-mode plasmas does not appear to occur at the ITG/TEM boundary, contrary to similar phenomena seen in Ohmic plasmas. For the first time, local, long-wavelength density and electron temperature fluctuations in the core plasma ($0.4 < r/a < 0.9$) at C-Mod have been measured with reflectometry and correlation ECE. These new fluctuation measurements at C-Mod will allow for better testing and validation of transport models. Gyrokinetic simulations are in progress to interpret the new multichannel and multifield turbulence/transport results from C-Mod.

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