Experimental studies of the Quasi- and the Weakly-Coherent-Modes in Alcator C-Mod*

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The edge regions of two high confinement regimes of Alcator C-Mod were studied using the fast (2 MHz) Gas-Puff-Imaging diagnostic. Both regimes exhibit a relatively high level of cross-field particle transport while maintaining a level of energy confinement characteristic of H- modes ($H_{ITER-98}$ up to 1.2). In one, the Enhanced D-Alpha H-mode, steady-state density profiles are achieved due to the particle transport through the edge pedestal provided by the Quasi-Coherent Mode (QCM). The other regime, the I-mode has a T_e pedestal, but the maximum gradient of the I-mode density profile is considerably lower than in any H-mode, often not different from that of the L-mode phase which precedes its onset. The key feature in the I-mode edge seems to be an edge fluctuation at 100–300 kHz, recently referenced as the Weakly Coherent Mode (WCM). The WCM has a spectral width significantly broader than the QCM of the EDA H-mode. Parallel to this, the maximum gradient of the I-mode density profile is considerably lower than in any H-mode, often not different from that of the L-mode phase which precedes the onset of the regime.

The paper will present the characteristics of the L-to-EDA and L-to-I-mode transitions in terms of their relation to the mode-like edge plasma responses with special attention to their time-histories in light of the characteristic time scales involved in the transitions. The connection of the WCM and QCM to the broadband edge turbulence will be discussed through bispectral estimators of nonlinear interactions inside the mode structures and between the modes and the rest of the turbulence. In particular, the strength of the forward QCM mode nonlinearity is shown to scale with the quality of global energy confinement – as measured by the values of H_{98}, stored energy and the height of the temperature pedestal; in the I-mode case, it is the poloidal propagation speed of the WCM which exhibits a dependence on H_{98}. The possible relation of both of these phenomena to the local radial electric field structure will be discussed, along with indications of a relatively stronger interaction of the WCM to the low frequency broadband turbulence, which may suggest a primarily broadband turbulence dominated transport.

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