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EX/P4-07: Characterization of Temperature Fluctuations during Type-I and Type-II Edge Localized Modes at ASDEX Upgrade

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The application of a 2D temperature diagnostic, ECE-Imaging, at ASDEX Upgrade revealed a variety of temperature fluctuations associated with type-I and type-II edge localized modes (ELMs). The characteristics and dynamics of the various modes, and their role in the ELM cycle, are presented.
During type-I ELMs, different phases of distinct mode activity have been identified. Prior to the onset of the ELM crash, a short lived mode is observed in the pedestal region that rotates in the electron diamagnetic drift direction. The poloidal mode number, estimated around m = 75, is seen to increase towards the ELM crash, simultaneously with a poloidal velocity increase. This speeding up of the mode is followed by the actual ELM crash phase. As the crash develops, multiple filamentary structures are observed just outside the separatrix. Most of these filaments are observed to rotate in the electron diamagnetic drift direction, although often the first few filaments move in the opposite direction. A third type of fluctuation is often observed in between ELM crashes. This mode shows a pronounced poloidal amplitude asymmetry. On the plasma mid-plane the mode amplitude has a minimum. The occurrence of this mode tends to lengthen the ELM period, suggesting it regulates the stability of the pedestal.
In type-II ELMs (large) temperature crashes are absent and a continuous broadband fluctuation in the 20-60 kHz range is observed, flattening the Te profile at the top of the pedestal. This mode rotates in the electron diamagnetic direction and has a poloidal mode number m ˜ 100. As with the mode observed between type-I ELM crashes, also the time averaged 2D mode amplitude of the type-II ELM mode shows a pronounced minimum at the plasma mid-plane. The similarities between the characteristics of these two modes suggest that it is the same instability. In type-I ELMs it delays the next crash, in type-II ELMs it might be responsible for the complete absence of crash events. A more detailed investigation of this mode shows beat-wave-like behavior in both space and time, indicating that it actually consists of multiple simultaneous modes that are alternately interfering destructively and constructively.

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