FAST WAVE HEATING AND CURRENT DRIVE IN ELMING H-MODE PLASMAS IN DIII–D*

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Recent improvements in the DIII–D Fast Wave Current Drive (FWCD) systems have enabled the coupling of more than 3 MW of rf power to vigorously ELMing H–mode plasmas despite rapidly fluctuating antenna loading in these discharges. These improvements include: (1) simplification of the transmission line configuration used for the 60 MHz system so that only one adjustable tuning element remains, yet the standing wave ratio seen by the transmitter is less than 1.25 at all times during the discharge despite rapid fluctuations in the antenna loading resistance of more than a factor of four in ELMing H–mode, (2) reworking the arc protection systems on all three FWCD systems so that the loading transients due to ELMs are distinguished from those due to single-point arcs,[1] while also introducing a new type of fault detector sensitive to "balanced faults" that in some aspects closely mimic ELMs, and (3) implementing a fast voltage limiting circuit so that the peak voltage in the antenna and transmission lines is always kept below a preset value.

The use of these techniques has allowed the extension of previous DIII–D FWCD studies in L–mode discharges to new regimes, such as ELMing H–mode. A series of experiments has begun in which ELMing H–modes were established with the combination of neutral beam injection (NBI) and 2–3 MW of FWCD power. FW power modulation studies have shown cases in which the same fraction of the coupled FW power (~ 50%) is absorbed on electrons in the plasma core in the L–mode and ELMing H–mode portions of the same discharge. However, in other cases the central absorption of the FWCD power in the ELMing H–mode was much less efficient than in L–mode. Comparing these cases has shown a correlation between the effectiveness of the central FW heating and the character of the ELMs. Conversely, a dependence of the character of the ELMs on the type of auxiliary heating (NBI or FW) has been reported from JET.[2] In this paper, results of DIII–D experiments on high power FW coupling to ELMing H–mode plasmas are presented, including dependence of the central heating effectiveness on the ELM characteristics and comparisons of the ELM behavior observed with NBI versus those obtained with FW heating.

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[1] R.H. Goulding, *et al*., *Proc. AIP 11th Top. RF Conf. (Palm Springs, 1995)*, (New York: AIP) 397.

[2] V.P. Bhatnagar, *et al*., 24th EPS, Berchtesgaden (1997), Europhys. Conf. Abs. **21A**, I, 77.