Experiments on Minimizing ELM-induced Fast Wave Antenna Breakdown in DIII-D*

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All present-day Fast Wave (FW) antennas operating into H-mode plasmas encounter a limit in coupled power set by antenna breakdown. This limit is due to low antenna/plasma coupling leading to high antenna rf electric fields which exceed the dielectric strength of the antenna parts immersed in the far SOL plasma. As previously observed by the ASDEX-U [1] and DIII-D [2] groups, this problem is aggravated by large edge localized modes (ELMs): the arrival of an ELM at the antenna can substantially reduce the voltage at which breakdown occurs. This issue has been addressed experimentally in three ways at DIII-D. A prototype data acquisition system capable of sampling rates up to 1 GHz has been developed and will be used in 2008 experiments to study the electrical signatures of breakdown in the DIII-D FW antenna systems at extremely high time resolution. This work may lead to new antenna arc prevention and mitigation measures. Another approach to the problem, suggested by work on ASDEX-U and DIII-D, is to reconsider the use of a nearly optically-opaque Faraday screen (FS) to reduce the ELM-induced plasma density around the antenna elements. A double-layer FS has been installed on one of the three DIII-D antenna arrays, while the other two retain the open, single-layer configuration. The first results of operating the array with the double-layer FS in ELMing H-modes with large antenna/plasma distance are encouraging. Arc-free operation of this array has been documented at up to 28 kV peak antenna voltage (vacuum conditioned up to 30 kV) with an ELMing H-mode plasma at antenna/plasma gap of 12.5 cm. Comparisons of array operation between the open and closed FS configurations will be shown. Finally, another strategy is to stabilize the ELMs with resonant magnetic perturbations (RMP)[3], since it may be that large ELMs are intolerable in ITER for other reasons. For the first time, FW antenna operation has been investigated in RMP-stabilized discharges, free of antenna breakdown as long as the ELMs are suppressed. Central heating is observed with FW power levels up to 1.7 MW coupled with the two arrays with open Faraday screens.

[1] J.-M. Noterdaeme, *et al.*, in Radio Frequency Power in Plasmas (Proc. 15th Top. Conf., Moran, WY, 2003) (AIP, NY, 2003) p. 154.
[2] R.I. Pinsker, *et al.*, Proc. of 31st Euro. Conf. on Controlled Fusion and Plasma Phys., London, 2004 (European Physical Society) Vol. **28G**, p.-2.175.
[3] T.E. Evans, R.A. Moyer, K.H. Burrell, *et al.*, Nature Physics **2** (2006) 419.

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