Experiments on gas puffing to enhance ICRF antenna coupling*

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Plasma heating using compressional Alfvén waves [“fast waves” (FWs)] in the ion cyclotron range of frequencies is a well-established technique in magnetic confinement devices and is part of the ITER day-one heating systems. The large plasma/FW antenna distance foreseen for ITER implies a light antenna load resistance, which will necessitate an antenna rf voltage standoff near the upper end of what has been demonstrated in experiments. Active methods to increase the loading resistance are under study in several tokamak experiments. One promising method is to puff neutral gas into the far scrape-off layer (SOL) during the FW pulse. Loading resistance may be enhanced by increasing the SOL density (narrowing the evanescent zone) or by decreasing the density gradient within the propagating region (reducing the reflections). In this paper, results on loading enhancement by gas puffing will be reported from JET [1], DIII-D, AUG and Tore Supra. In all cases, increasing the density adjacent to the antenna increases the loading. Up to a factor of 6 enhancement in loading is obtained in JET with gas puffing, and up to a factor of 4 in DIII-D. The effect of puffing on the density profile in the SOL is measured with X-mode reflectometers in these experiments. The trade-off between the positive effects of gas puffing on antenna loading and possible deleterious effects on confinement is studied. Both JET and DIII-D clearly observe very strong dependence of the effects obtained with gas puffing in ELMy H-mode on ELM character, pumping, and recycling properties which are sensitive to plasma shape. AUG and Tore Supra (the latter in limiter L-mode discharges) have so far observed smaller loading enhancements with local puffing; the possible role of different antenna enclosure/limiter geometries will be discussed. No strong dependence of the loading enhancement on the power level applied to the antenna is found. The core FW heating efficiency with gas puffing will be evaluated, to determine where the wave energy is deposited.

[1] M.-L. Mayoral, *et al.*, in *RF Power in Plasmas (Proc. 17th Top. Conf., FL, 2007)* (AIP, NY, 2007) 55

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