Analysis of Combined Fast Wave Current Drive and Neutral Beam Injection in the DIII–D Tokamak

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In recent experiments with combined fast wave current drive (FWCD) and deuterium neutral beam injection on the DIII–D tokamak [Luxon *et al*., Fusion Technol. **8**, 441 (1985)], an enhanced fusion reactivity and fast ion energy content have been observed in the presence of FWCD, with a concomitant low FWCD efficiency [Petty *et al*., Radio Frequency Power in Plasmas (AIP, New York, 1997), p. 225]. In this paper, we investigate whether high-harmonic ion cyclotron damping could be responsible for the low FWCD efficiency in these experiments, since a number of high-harmonic hydrogen and deuterium cyclotron resonance layers existed in the plasma. The main analysis tool is the ion cyclotron range of frequencies (ICRF) code PION [Eriksson *et al*., Nucl. Fusion **33**, 1037 (1993)], modified to allow multiple frequencies simultaneously as was done in the DIII–D experiments. According to the PION modeling, high harmonic damping of fast wave power can give rise to enhanced fusion reactivity and fast ion energy content, which is consistent with the experimental observations.