

§5. Observation of Hollow Radiation Profiles and Highly Asymmetric Radiative Decay of NBI Heated Plasma in LHD

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Radiation profiles were measured during NBI heated discharges of the 2nd cycle on LHD using a 32 channel array of metal foil bolometers[1]. An SVD technique[2] was used to invert the data to give the evolution (temporal resolution is 5 ms) of the radial profile of the radiated power as shown in Figure 1. Profiles were typically very hollow with 40 – 50% of the radiation coming from the ergodic region ($\rho > 1$).

LHD discharges commonly ended with a highly radiative thermal collapse/decay (occurring before/after the NBI turn off) in which the radiation source is concentrated on the inboard side ($\rho < 1$). In Figure 2 the evolution of various plasma parameters is shown during a highly asymmetric radiative decay. Electron temperature (Fig. 2a) shows no appreciable asymmetry to within the time resolution of the Thomson scattering diagnostic (20 ms). The FIR interferometer in Fig. 2b shows a strong inboard asymmetry starting at 1.25 sec which continues until the signal at $\rho = -0.7$ disappears due to excessively strong density gradients. In Fig. 2d we see the spectroscopy signals increasing, first OV, then CIII and finally H α in accordance with the temperature drop. In Fig. 2e the peak in the bolometer brightness profile moves in from the inboard side to the center in 30 ms. In the same figure the timing of the interferometer perturbation is also shown and is very well correlated in time and space with the movement in the peak of the bolometer brightness profile. This correlation of bolometer and interferometer signals during an asymmetric radiative phenomenon is similar to that seen during MARFE in tokamaks[3].

References

- [1] K.F. Mast, *et al.*, Rev. Sci. Instrum., **62**, 744 (1991).
- [2] W. H. Press, *et al.*, Numerical Recipes, the Art of Scientific Computing, (Cambridge University Press, Cambridge, 1986), pp. 52-58.
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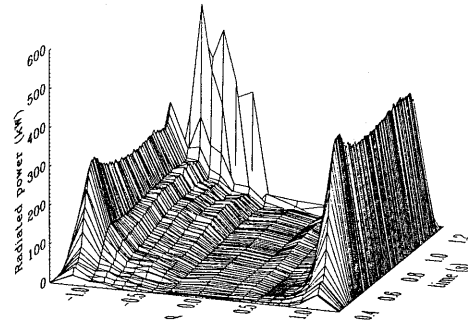


Figure 1 Evolution of radiated power profile for Shot 3700.

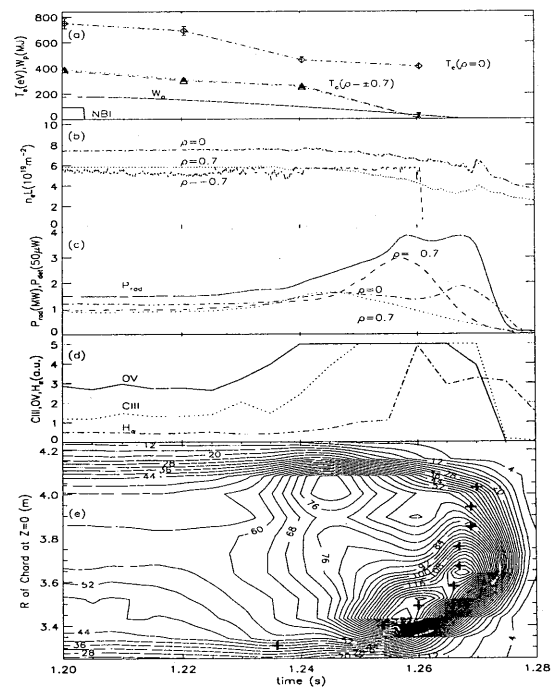


Figure 2 Evolution of plasma parameters during radiative decay for Shot 3700; (a) electron temperature, (b) line density, (c) bolometer brightness, (d) spectroscopy signals and (e) bolometer brightness profiles (μW), (+) indicates the timing of the interferometer signal perturbation.