EVOLUTION OF 2D VISIBLE AND VUV DIVERTOR EMISSION PROFILES DURING DIII–D H–MODE DETACHMENT TRANSITIONS*

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A key element in the physics model of Partially Detached Divertor (PDD) operation in DIII–D is that carbon radiation near the X–point dissipates the energy flowing in the scrape-off-layer (SOL) before it enters the divertor [1]. This allows the divertor temperature to be low, density to be high and thereby reduces the heat and ion particle fluxes to the targets both by reduced recycling and increased recombination. Previous line integrated SPRED measurements [2] and computer simulations indicated that the 155 nm $\Delta n=0$ transition of C^{3+} was the main power radiator from carbon during PDD operation.

The first 2D profiles of 155 nm CIV emission from a tokamak divertor were obtained recently on DIII–D with a new tangentially viewing VUV camera [3] and image reconstruction techniques which were developed originally for visible emission images [4]. Comparison of the CIV VUV profiles with CIII visible profiles shows that the CIII emission is located very near the high radiated power CIV emission especially during PDD operation. This supports previous conclusions that visible CIII images give a good indication of the spatial profile of carbon radiation in the divertor [1]. These techniques are now also used to analyze visible emission data (including CIII) from TCV [5] and ASDEX-Upgrade [6].

The profile of the VUV carbon emission evolves during the transition to PDD operation induced by continuous deuterium gas injection, starting from 1) localized emission in the inner SOL at the X–point height moving to 2) the outer SOL above the X–point and then 3) into the closed flux surfaces above the X–point at the H→L density limit. Animations of the CIV emission profiles from the entire discharge will be compared with animations of visible CIII and D_α profiles and with reconstructions of total radiated power from bolometers and divertor target heat flux profiles from IRTV. Animations of the 2D profiles of D_α emission due to recombination and that due to ionization show separated regions of recombination and ionization in the inner leg during the pre-injection phase and in the outer leg during PDD. Substantial emission is observed in the private flux (PF) region during the transition to PDD for H–mode discharges with high ELM frequency; reduced emission is observed at lower power and ELM frequency. Status of work underway with the time dependent B2-Eirene code (developed at IPP-Garching) to understand the differences between the PF emission profiles in these two regimes will also be presented.

[1] M.E. Fenstermacher, *et al.*, Phys. Plasmas **4** (1997) 1761, M.E. Fenstermacher, *et al.*, Proc. 25th EPS, Prague, 1998 (to be published in Plasma Phys. and Control. Fus., 1999).
[2] R.D. Wood, *et al.*, Proc. 23rd EPS, Kiev (1996) in PPCF Vol. **20C** Part II 763–766.
[3] D.G. Nilson, *et al.*, Rev. Sci. Instrum. **70** (1999) 738–741.
[4] M.E. Fenstermacher, Rev. Sci. Instrum. **68** (1997) 974.
[5] R.A. Pitts, *et al.*, abstract this conference.
[6] J. Gafert, *et al.*, abstract this conference.

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