Topic E	Requested: ☐ Oral ☒ Poster	Panel suggestion: ☐ Oral ☐ Poster

Scaling and Profiles of Heat Flux During Partial Detachment in DIII–D[*]

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We examine the scaling of the peak divertor heat flux and total divertor plate power in partially detached divertor (PDD) discharges in DIII–D, as a function of input power and radiated power. The peak heat flux ($\hat{q}$) is the highest concern in tokamak divertor design. It is expected that operation in the PDD regime will allow a reduction in $\hat{q}$ for a given input power, for instance the reference operating point for ITER anticipates a factor of 5 reduction in $\hat{q}$. However, little is known about how the peak heat flux and radial profile shape q(R) vary with either input power or radiation fraction in these conditions. Since electron conduction can not be the dominant energy transport mechanism[1] in low-temperature PDD as it is in the attached state, we might expect the $\hat{q}$ scaling with input power to differ from the dependence[2,3] in the attached case.

We measure the divertor heat flux profiles in DIII–D using infrared thermography. The most striking feature of q(R) in PDD plasmas is that the peak near the separatrix is reduced first, so that $\hat{q}$ decreases faster than the total radiative losses increase. In the DIII–D open divertor, deuterium gas puffing can reduce $\hat{q}$ by a factor of 5, while radition losses increase by only a factor of 1.7 The PDD condition is produced by deuterium gas puffing from either the private flux region or the plasma midplane. We examine possible explanations for the shape of the remaining heat flux profile, including direct radiative heating and recombination.

We compare the total measured plate power with the total radiative heating power absorbed at the plate, calculated from bolometers. In the private flux region, radiated power on the target plate is comparable to the measured plate heating. Using q(R) and subtracting the calculated profile of radiated heating on the plate, we determine the remaining heat flux profile due to charged particle flux. We compare this profile with the heat flux profile calculated from particle flux measured using divertor Langmuir probes. The residual heat flux after subtracting radiation and charged particle contributions is attributed to charge exchange neutrals. Utilizing fast line scan IR measurements, we attempt to separate the effect of heat flux deposited by ELMS in the PDD state from the interaction of plasma with the plate between ELMs.

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[1]A.W. Leonard, *et al*., Phys. Rev. Lett. **78** 4769 (1997).

[2]D.N. Hill, *et al*., J. Nucl. Mater. **196-198** 204-209 (1992).

[3]C.J. Lasnier *et. al.*, "Target plate heat flux in diverted DIII-D discharges," submitted to Nuclear Fusion.