Divertor heat flux control research on DIII-D

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Abstract. Divertor heat flux characterization and control results from DIII-D are summarized. The peak divertor heat flux is found to scale with a simple conduction model having perpendicular transport scaling with plasma current and heating power. In a double null configuration the heat flux sharing between divertors is very sensitive to the magnetic balance. Heat flux control in ELMing H-mode is obtained with deuterium gas puffing resulting in a partially detached divertor (PDD) regime. Important physical processes in the PDD regime include; radiation from the intrinsic carbon impurity and deuterium, loss of electron pressure near the separatrix, parallel energy transport in the divertor dominated by convection and particle flux reduction from deuterium recombination. Divertor neutral pressure is found to be an important control parameter to maintain the PDD regime. Divertor heat flux reduction is also obtained with impurity injection. In one approach divertor radiation is enhanced using induced scrape-off-layer flow to enrich divertor impurity concentration. Another approach uses seeded impurities to produce radiation inside the separatrix in a radiating mantle configuration. Observations of heat flux transients from ELMs and disruptions are summarized. Finally, the implications of these results for next generation tokamaks are discussed.