Power Distribution in the Snowflake Divertor in TCV

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The "snowflake" divertor [1], pioneered by the TCV tokamak [2], is now a well-established configuration. As the primary motivation driving this development was the alleviation of the power flux to the first wall, TCV has now moved on to a detailed study of the edge physics of the snowflake, especially in relation to ELMs, and to a characterization of the experimental conditions under which the power flux is appreciably reduced. Power exhaust is deemed to be a major challenge for a DEMO fusion reactor with conventional divertor configurations extrapolating to intolerable power flux densities. Alternative divertor configurations such as the snowflake divertor are therefore currently evaluated. The snowflake configuration is characterised by a second-order null point where not only the poloidal field but also its spatial derivatives vanish. This leads to two additional divertor legs and a reduced poloidal field in the vicinity of the null point. Since the snowflake proper is only a point in the operating space any experimental snowflake configuration possesses two neighbouring x-points. The distance between the x-points normalized to the minor radius, σ, provides a convenient parameterisation of the continuum between the snowflake and a conventional single null configuration. TCV experiments show that during ELMs a significant redistribution of particles and power into the private flux region and onto the additional strike points occurs for σ as large as 0.6. This redistribution contributes to an observed reduction of the peak heat fluxes at the primary strike points during ELMs by up to a factor of four compared to conventional configurations with similar ELMs. In L-mode the separation of the x-points compatible with significant power redistribution into the private flux region is much smaller, which supports the hypothesis of poloidal beta driven convection being the main cross-field transport mechanism in the null point region [3]. Such a mechanism could alleviate the requirements on the magnetic configuration and decrease constraints on divertor coil positions and currents in a snowflake divertor facilitating the access to this configuration in a reactor.

[1] D.D. Ryutov, *Phys. Plasmas* **14** (2007) 064502.

[2] F. Piras, et al., *Plasma Phys. Control. Fusion* **51** (2007) 055009.

[3] D.D. Ryutov, et al, *Contrib. Plasma Phys.* **52** (2012) 539.