Edge power balance and TGLF/TGYRO-predicted quasilinear thermal fluxes in ITER-Similar-Shape DIII-D Plasmas near the L-H Transition

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Recent experiments in ITER Similar Shape (ISS), low collisionality and low torque hydrogen plasmas in the DIII-D tokamak have enabled a systematic study of edge ion and electron thermal fluxes near sawtooth-triggered L-H transitions. Power balance analysis of these mainly NBI-heated plasmas with the transport code TRANSP has shown that the edge ion heat flux is increased by a factor of ~3 compared to reference deuterium ISS plasmas, while edge electron heat is largely unchanged. This observation strengthens previous claims that the ion heat flux plays a dominant role in L-H transition physics [1].

Validation of L-mode edge thermal fluxes predicted by TGLF/TGYRO quasilinear gyrofluid simulations has been undertaken, based on power balance analysis of experimental data. Sensitivity scans have identified critical normalized electron temperature and density gradients, a/L_{Te}, and a/L_{ne} in both the deuterium and hydrogen plasmas of interest at similar inverse length scales. Additionally, TGLF has been found to reproduce the experimental isotopic dependence in edge ion heat flux. TGYRO simulations of the plasma edge indicate that a simultaneous solution to experimental profiles and heat fluxes is present (within error margins for measured normalized gradients) for both H and D plasmas using TGLF saturation rule 1 (a saturation model based on a Zonal flow mixing [2]). The role of electromagnetic corrections (including $B_\perp$ and $B_\parallel$) to the predicted TGLF/TGYRO quasilinear fluxes will be discussed.

[1] F. Ryter et al., Nucl. Fusion 58 014007 (2016).
[2] G. Staebler et al., Physics of Plasmas 23, 062518 (2016).

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