

# Impact of triangularity on edge plasma transport and detachment: a SOLPS-ITER study

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In magnetic confinement fusion, tokamak plasmas with negative triangularity (NT) have emerged as a promising alternative to H-mode operation scenarios, achieving high confinement while remaining in L-mode, thus inherently free of edge-localized modes [1]. Recent experiments in Tokamak a Configuration Variable (TCV) have shown that NT plasmas feature more challenging access to divertor detachment and reduced target cooling compared to positive triangularity (PT) cases [2, 3].

In this work, we numerically investigate two Ohmic L-mode, lower-single-null discharges at TCV, characterized by opposite upper triangularity and identical divertor geometry. The edge plasma is modeled with the state-of-the-art SOLPS-ITER mean-field boundary plasma code [4, 5], to examine the aforementioned experimental differences.

Simulations assuming identical cross-field transport coefficients show no appreciable differences between NT and PT, indicating that magnetic geometry alone cannot reproduce the experimentally observed behavior. Instead, agreement with upstream and divertor target measurements of the plasma density and temperature is achieved assuming reduced cross-field particle transport in NT, consistent with theoretical predictions of turbulence suppression. Those simulations reproduce the reduced target cooling in NT, indicating higher power fluxes and shorter power fall-off length  $\lambda_q$ . NT simulations also show more difficult access to detachment through higher target temperatures, a more attached ionization front for comparable upstream densities, and a narrower neutral pressure distribution. The simulations were repeated at different upstream densities for both NT and PT configurations and compared with the upstream and target profiles, and divertor neutral pressure measurements acquired during density ramp experiments. The analysis of the density ramp further confirms that reduced cross-field transport is required in NT simulations to reproduce the experimental observations.

These results, recently published in [6], highlight how variations in the underlying cross-field transport regimes can accurately account for the distinct behaviors observed in NT and PT, providing valuable insight into the edge physics of NT configurations and their implications for power exhaust in future reactors.

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