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Simulations of L and H confinement regimes in the simple magnetized plasma TORPEX and comparisons with experiments

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The basic plasma experiment TORPEX contributes to bridging the gap between experimental observations and simulations in the field of plasma turbulence and related transport. TORPEX is a toroidal device, in which a vertical and a toroidal magnetic field create open helical field lines. Similarly to the Scrape-Off Layer (SOL) of magnetic fusion devices, the turbulence driven by magnetic curvature and plasma gradients causes the plasma to be transported in the radial direction, while it is lost due to flows along the field lines. TORPEX facilitates the experimental study of low frequency instabilities and related turbulence, as it allows more detailed diagnostics and wider parameter scans than usually possible in magnetic fusion devices. The relative simplicity of TORPEX provides a useful testbed in which to explore transport physics in the SOL of more complex geometries. Recently, a fluid model has been developed to follow the TORPEX plasma dynamics. The model takes into account plasma sources, parallel losses, and perpendicular transport due to plasma turbulence. Simulations show that, by increasing the plasma source strength, reducing the vertical magnetic field, or increasing the ion mass, a transition from a low (L) to a high (H) confinement mode occurs. In the H-mode, a strong ExB shear limits the perpendicular transport, leading to steeper gradients and larger peak values of electron density and temperature. The TORPEX device is used to explore the accessibility of the H-mode by varying the vertical magnetic field, ion mass and microwave source power. By using the same data analysis techniques for experimental and simulation results, we discuss how the trends predicted by the theory compare with the measured quantities.