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Rotation Instability of Neoclassical Plasma Near Magnetic Separatrix

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The plasma rotation plays a central role in magnetic confinement of toroidal plasmas, as it can reduce turbulence and enhance transport. In turn rotation can be generated both intrinsically by microturbulence via Reynolds stress, and by external momentum sources, such as, for example, neutral beam injection (NBI). By assuming a collisional plasma with steep gradients at the edge region of an axisymmetric tokamak with large aspect ratio, we investigated the rotation of the plasma and its stability criteria through a numerical analysis in the context of neoclassical transport theory. The governing equations of temperature, density and poloidal and toroidal velocities were obtained previously by reducing the Braginskii equations with Mikhailowskii-Tsypin corrections. This system of equations can be cast into a generic reaction-diffusion form. Under various types of BCs to be found in the medium, and inputs like NBI, Pellet Injection or Loop Voltage, we studied the selection of wave trains, the symmetry-breaking bifurcations, responsible for the emergence of spatiotemporal patterns, that are stationary or oscillatory in space and time. In our simulations the interaction of wave and Turing instabilities were also considered, as the rise of Turing type of patterns requires the diffusivities in the individual equations to be of different order, as is the case in our equations.

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