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Modeling of toroidal torques exerted by internal kink instability in a tokamak plasma

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Toroidal modeling efforts are initiated to systematically compute and compare various toroidal torques, exerted by an unstable internal kink in a tokamak plasma, using the MARS-F/K/Q suite of codes. The torques considered here include the resonant electromagnetic torque due to the Maxwell stress (the EM or JXB torque), the neoclassical toroidal viscous (NTV) torque, and the torque associated with the Reynolds stress. Numerical results show that the relative magnitude of the net resonant electromagnetic and the Reynolds stress torques increase with the equilibrium flow speed of the plasma, whilst the net NTV torque follows the opposite trend. The global flow shear sensitively affects the Reynolds stress torque, but not on the electromagnetic and the NTV torques. Detailed examinations reveal dominant contributions to the Maxwell and Reynolds stress torques, in terms of the poloidal harmonic numbers of various perturbation fields, as well as their relative toroidal phasing.

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