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Sawtooth relaxation oscillations, nonlinear helical flows and steady-state m/n=1 magnetic islands in low-viscosity tokamak plasma simulations. ZHANG WEI, ZHIWEI MA, HAOWEI ZHANG, Institute for Fusion Theory and Simulation — A numerical study on the influence of plasma viscosity and of the plasma β (=kinetic pressure/magnetic pressure) parameter on the nonlinear evolution of resistive internal kink modes in tokamak plasmas is presented. A new regime with relatively low viscosity is found, such that sawtooth oscillations spontaneously evolve towards states with stationary m/n =1 magnetic islands. It is suggested that the mechanism at work in the limit of small viscosity is related to magnetic flux pumping, which, allied with the nonlinear resistive internal kink dynamics, leads to a stationary helical flow, only weakly dissipated by viscosity and entirely self-consistent with the presence of saturated m/n =1 stationary magnetic islands. It is also found that the threshold viscosity value for the onset of the steady state regime increases with increasing β values. The newly found regime for a steady-state m/n =1 magnetic island may be relevant for the understanding of tokamak experiments, where saturated helical structures such as the density snake and steady-state magnetic islands are sometimes observed in the core plasma region where the safety factor is close to or below unity

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