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Magnetic flux pumping mechanism prevents sawtoothing in 3D nonlinear MHD simulations of tokamak plasmas ISABEL KREBS, Max-Planck/Princeton Research Center for Plasma Physics, STEPHEN C. JARDIN, Princeton Plasma Physics Laboratory, SIBYLLE GUENTER, KARL LACKNER, MATTHIAS HOELZL, ERIKA STRUMBERGER, Max Planck Institute for Plasma Physics, Garching, Germany, NATE FERRARO, Princeton Plasma Physics Laboratory — 3D nonlinear MHD simulations of tokamak plasmas have been performed in toroidal geometry by means of the high-order finite element code M3D-C^1 [Jardin et al., Comput. Sci. Disc. 5 (2012)]. The simulations are set up such that the safety factor on axis (q_0) is driven towards values below unity. As reported in [Jardin et al., PRL 115 (2015)] and [Krebs et al., subm. to Phys. Plasmas] the resulting asymptotic states either exhibit sawtooth-like reconnection cycling or they are sawtooth-free. In the latter cases, a self-regulating magnetic flux pumping mechanism, mainly provided by a saturated quasi-interchange instability via a dynamo effect, redistributes the central current density so that the central safety factor profile is flat and $q_0 \approx 1$. Sawtoothing is prevented if β is sufficiently high to allow for the necessary amount of flux pumping to counterbalance the tendency of the current density profile to centrally peak. We present the results of 3D nonlinear simulations based on specific types of experimental discharges and analyze their asymptotic behavior. A set of cases is presented where aspects of the current ramp-up phase of Hybrid ASDEX Upgrade discharges are mimicked. Another set of simulations is based on low-q_{edge} discharges in DIII-D.

Isabel Krebs
Max-Planck/Princeton Research Center for Plasma Physics

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