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Plasma driven by helical electrodes CIHAN AKCAY, JOHN FINN, RICHARD NEBEL, DANIEL BARNES, Tibbar Plasma Technologies — A novel plasma state, obtained by applying a helical voltage at the wall with a uniform axial magnetic field, is studied by means of zero-pressure resistive MHD simulations in a periodic cylinder. The radial magnetic field at the wall is taken to be zero. For a small helical electrode voltage, the helical perturbation in the plasma is small and localized to the edge. Beyond a critical electrode voltage, there is a bifurcation to the newly discovered state, which is a single-helicity Ohmic equilibrium with the same helicity as the electrodes, *i.e.*, the fields depend only on radius and $m\theta - n\varphi$, where θ and $\varphi = z/R$ are the poloidal and toroidal angles. For electrostatic driving with $m = 1$, the mean magnetic field ($m = n = 0$) has field line safety factor $q(r)$ equal to the pitch of the electrodes $m/n = 1/n$ except near the edge, where it monotonically increases an amount of order unity. The plasma is force-free in the interior. Near the edge, however, the current crosses the field lines to enter and exit through the helical electrodes. A large helical plasma flow related Pfirsch-Schlüter-like currents exist in this edge vicinity. Applications to current drive in tokamaks, as well as to straight plasmas with endcap electrodes are discussed.

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