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Non-twist map bifurcation of drift-lines and drift-island formation in saturated 3D MHD equilibria DAVID PFEFFERLE, PPPL, WILFRED A. COOPER, JONATHAN P. GRAVES, CRPP-EPFL — Based on non-canonical perturbation theory, guiding-centre drift equations are identified as perturbed magnetic field-line equations. The topology of passing-particle orbits, called drift-lines, is completely determined by the magnetic configuration. In axisymmetric tokamak fields, drift-lines lie on shifted flux-surfaces, called drift-surfaces. Field-lines and drift-lines are subject to island structures at rational surfaces only when a non-axisymmetric component is added. The picture is different in the case of 3D saturated MHD equilibrium like the helical core associated with a non-resonant internal kink mode. In assuming nested flux-surfaces, these bifurcated states, expected for a reversed q-profile with q_{min} close yet above unity and conveniently obtained in VMEC, feature integrable field-lines. The helical drift-lines however become resonant with the axisymmetric component in the region of q_{min} and spontaneously generate drift-islands. Due to the locally reversed sheared q-profile, the drift-island structure follows the bifurcation/reconnection mechanism of non-twist maps. This result provides a theoretical interpretation of NBI fast ion helical hot-spots in Long-Lived Modes as well as snake-like impurity density accumulation in internal MHD activity.

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