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Bifurcation to 3D Helical Magnetic Equilibrium in an Axisymmetric Toroidal Device[1] D.L. BROWER, W.F. BERGERSON, W.X. DING, L. LIN, UCLA, B.E. CHAPMAN, J.S. SARFF, University of Wisconsin-Madison, F. AURIEMMA, P. ZANCA, P. INNOCENTE, R. LORENZINI, E. MARTINES, M. MOMO, D. TERRANOVA, Consorzio RFX — We report the first direct measurement of the internal magnetic field structure associated with a 3D helical equilibrium generated spontaneously in the core of an axisymmetric, magnetically-confined, toroidal plasma. Magnetohydrodynamic equilibrium bifurcation occurs in MST RFP plasmas when the innermost resonant magnetic perturbation grows to large amplitude, reaching up to 8% of the mean field strength. Evolution of the magnetic topology is determined by measuring the Faraday effect, revealing that as the perturbation grows, toroidal symmetry is broken, and a helical equilibrium is established. Computational reconstruction of the magnetic field and electron density profiles based on a 3D topology agrees well with experimental data, providing a better fit than reconstructions based on a standard 2D cylindrical topology. These helical plasmas sometimes exhibit an improvement in electron particle confinement and increased temperature.

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