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Plasma-Based Electrical Transformers and Electrostatic Current Drive in Tokamaks RICHARD NEBEL, W. GIBSON, K. MOSER, D.C. BARNES, L.L. GLASCOCK, Tibbar Technologies, J.M. FINN, J. DUNN, Los Alamos National Laboratory — Recent nonlinear simulations shown that it is possible to drive current in tokamaks with app-lied helical electrostatic fields. These electrostatic studies have uncovered a new nonlinear MHD relaxation principle. This new principle states that if helical electrostatic fields are applied to a plasma, it tries to relax to a state where the magnetic field aligns parallel with the electrodes. If an m=1, n=1 driving electrostatic field is applied at the boundary, the plasma tries to relax to a state where q $\sim$ 1 everywhere even if no loop voltage is applied to the plasma. It is possible to operate a tokamak steady-state without applying a loop voltage. At Tibbar Technologies we are primarily interested in using this new MHD relaxation principle to build DC-DC electrical transformers. This technology is important for High Voltage DC electrical transmission. We have now demonstrated this new physics in a linear device in the laboratory. The plasma tries to align the magnetic fields parallel to the electrodes, as the theory predicts. It also doesn't matter which electrode is positive and which is negative, which is also consistent with the theory. Finally, changing the direction of the magnetic field in the solenoid also changes the direction of the current flow in the secondary of the transformer. Efficiencies of 50%-60% are regularly observed.

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