# Kinetic Simulations of the Formation and Stability of the Field-Reversed Configuration

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**Abstract** — The Field-Reversed Configuration (FRC) is an elongated compact toroidal plasma confined primarily by poloidal fields. In the FRC the external field is reversed on axis by the diamagnetic current carried by thermal plasma particles. A 3-D, hybrid, Particle-in-Cell (PIC) code (zero-inertia fluid electrons and kinetic ions), FLAME [1] previously used to study ion rings is applied to investigate FRC formation and tilt instability. Axisymmetric FRC equilibria are obtained by simulating the standard experimental reversed theta-pinch technique. These are used to study the nonlinear tilt mode in the "kinetic" and "fluid-like" cases characterized by "small" ($\sim 3$) and "large" ($\sim 12$) ratios of the characteristic radial plasma size to the mean ion gyro-radius, respectively. The formation simulations have revealed presence of a substantial toroidal (azimuthal) magnetic field inside the separatrix, generated due to the stretching of the poloidal field by a sheared toroidal electron flow. This is shown to be an important tilt-stabilizing effect in both cases. On the other hand, the tilt mode stabilization by finite Larmor radius effects has been found relatively

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insignificant for the chosen equilibria.

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