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Energetic particle confinement and effects in 3D RFP plasmas[1]
J.K. ANDERSON, W. CAPECCHI, S. EILERMAN, J.J. KOLINER, M.D. NORNBERG, J.A. REUSCH, University of Wisconsin, L. LIN, University of California-Los Angeles — Fast ions are well confined in the stochastic magnetic field of the multiple-helicity (MH) RFP, with fast ion confinement of neutral-beam-injected ions routinely a factor of 5 to 10 higher than thermal confinement time. As the plasma current is increased in discharges with a weakly reversed edge toroidal magnetic field, the equilibrium tends to transition from nearly axisymmetric to a strongly helical three-dimensional state. In lower current discharges, where the onset of the helical state is uncertain, high power NBI tends to suppress the transition to the single helicity state. In high current discharges ($\sim$ 0.5MA), where the onset of n=5 single helicity is quite robust, a short blip of NBI is used to probe the confinement of fast ions with minimal perturbation to the 3D equilibrium. The fast ion confinement time is measured to be substantially lower than fast ions in comparable MH RFP states, and there is a strong dependence on the spectral index. Full ion orbit calculations through the 3D equilibrium field reveal a substantial deviation of the ion trajectory from the helical flux surfaces and degraded confinement. The helical mode is stationary in the laboratory frame but locks at variable phase with respect to the MST vessel. Hence, experiments where the tangential neutral beam injector is effectively moved relative to the helical structure are performed. The total fast particle content and confinement time with respect to this angle are explored.

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