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Predator-Prey Time Dynamics and Locking Control of Spontaneous Helical States in the RFP

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Reversed Field Pinch (RFP) plasmas tend toward self-organized behavior depending on the nonlinear coupling between mutually interacting tearing modes. In multiple helicity plasmas one or more linearly unstable tearing modes may drive energy into stable modes through this coupling. In contrast, at high current and low density plasmas tend towards a state with a single dominant core mode. Although secondary modes are present, their amplitudes are reduced in this Quasi-Single Helicity (QSH) state. Recent work on modeling the shear-suppression mechanism has produced a predator-prey model of the QSH dynamics that reproduces the observed time dynamic behavior, in particular the increased persistence of the QSH state with increased plasma current. To diagnose these plasmas, we have established an error field control mechanism that locks the structure to a particular helical phase, to the advantage of the advanced diagnostic set on MST. With this diagnostic set, we have obtained evidence of helical structure in electron temperature, density, and impurity temperature.

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