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Confinement transitions in predator-prey models for tokamak plasmas RICHARD DENDY, Culham Centre for Fusion Energy, HAO ZHU, SANDRA CHAPMAN, Warwick University — Energy transport in tokamak plasmas is mainly determined by small-scale turbulence and larger coherent nonlinear structures, and their interactions. Zero-dimensional models of this offer a simple direct way of capturing the physical origins of enhanced energy confinement and transitions between regimes. The prime zero-dimensional paradigm is predator-prey. We have extended a three-variable (temperature gradient; microturbulence level; one class of coherent structure) model [M A Malkov and P H Diamond, Phys Plasmas 16, 012504 (2009)], by adding a fourth variable representing a second class of coherent structure. We investigate [H Zhu, S C Chapman and R O Dendy, Phys Plasmas 20, 042302 (2013)] the degree of invariance of the phenomenology generated by the two models given this change. We compare the long-time behavior of the systems, their evolution to the final state, and their attractive fixed points and limit cycles. We explore the sensitivity of paths to attractors. Having thus confirmed that the model approach is robust, we investigate transitions to enhanced confinement regimes triggered by sharp changes in external heating, and relate this aspect of model phenomenology to tokamaks.

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