“Non-perturbative nonlinear interplay of Alfvén modes and energetic ions.”

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Numerical simulation results of Alfvén modes driven unstable by supra-thermal ions in tokamaks are presented. The global nonlinear gyrokinetic particle-in-cell code NEMORB is used for such studies. The mode structure is analyzed in the linear and in the nonlinear phase; and, thereby, the self-consistent (nonlinear) interplay of mode structure and energetic particle transport is systematically investigated and explained. In particular, both wave-particle and wave-wave nonlinearities are considered and the regimes where either one is dominant are identified by varying the linear instability drive. Various aspects of the nonlinear dynamics are addressed separately, by artificially switching off other nonlinearities. Thus, also the effect of nonlinear modification of the mode frequency is investigated. Finite-Larmor-radius effects of energetic ions on mode structure, frequency and growth rate are also described. The insights into the isolated nonlinear dynamics are then used to interpret results of fully non-perturbative nonlinear simulations.

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