Nonlinear interplay of Alfvén instabilities and energetic particles in tokamaks.

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The problem of the confinement of energetic particles (EP) is crucial for an efficient heating of tokamak plasmas. Plasma instabilities such as Alfvén Eigenmodes (AE) can redistribute the EP population making the plasma heating less effective, and leading to additional loads on the walls. The nonlinear dynamics of Alfvén instabilities is investigated by means of the global gyrokinetic particle-in-cell code ORB5, within the NEMORB project [1, 2, 3]. Both wave-particle and wave-wave interaction are considered, and the nonperturbative nonlinear interplay of Alfvén instabilities and EP is studied in different regimes of interest. In particular, we focus on the nonlinear modification of the radial structure and on the competition of the different saturation mechanisms. Regarding the spatial structure, its dependence on the equilibrium parameters and on the EP distribution function is discussed. Regarding the saturation mechanisms, both wave-particle saturation mechanisms and mode-mode coupling, such as the generation of zonal structures, are discussed in details.

References

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